cenovus ENERGY

PROJECT APPLICATION
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PROJECT APPLICATION APPENDICES
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Appendices

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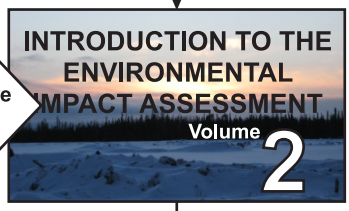

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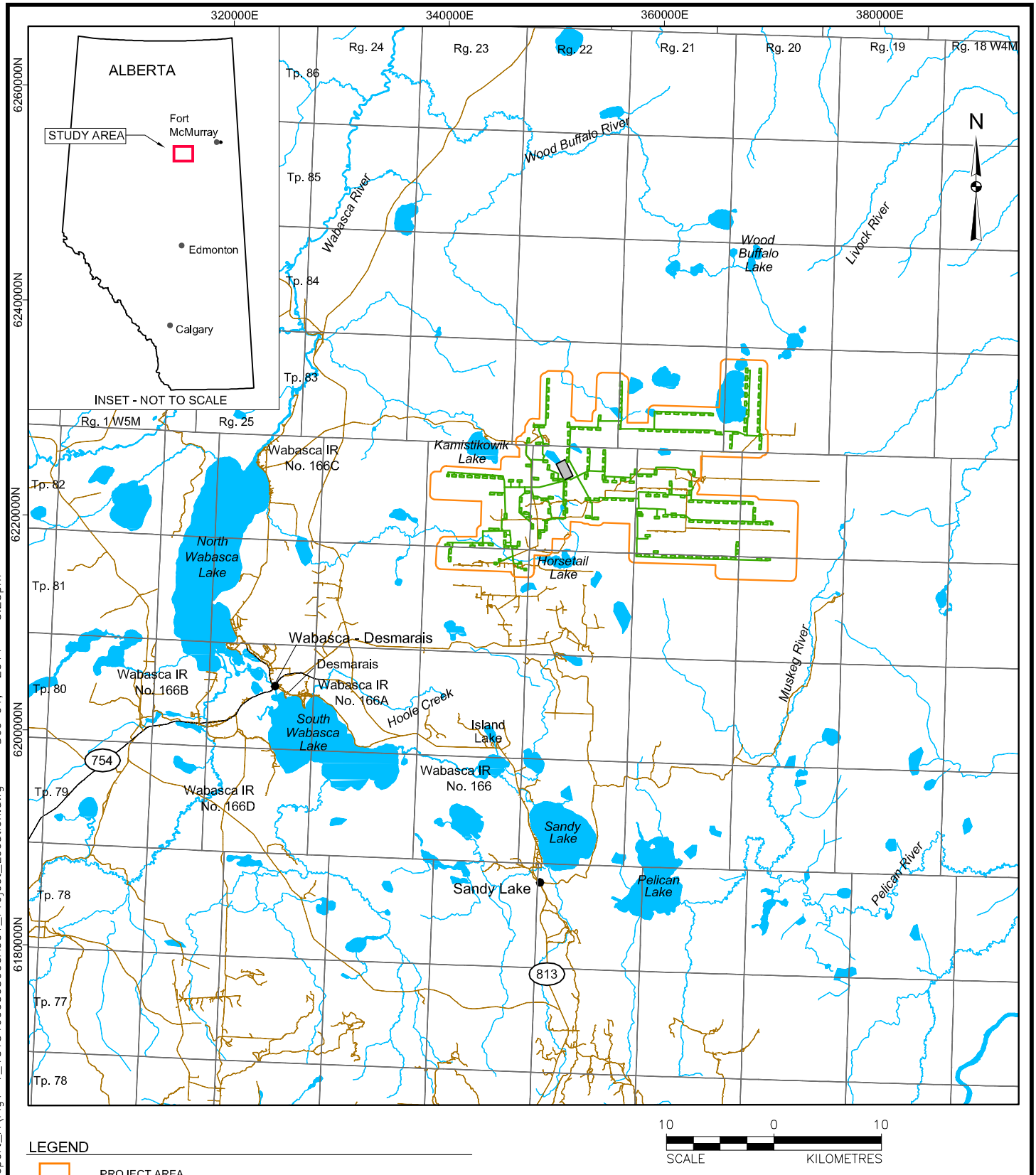
1 INTRODUCTION

Cenovus Energy Inc. (Cenovus) is seeking approval for the proposed Pelican Lake Grand Rapids Project (the Project). The Project is located in northeast Alberta, about 300 km north of Edmonton, primarily in Townships 81 to 83, Ranges 20 to 23, West of the Fourth Meridian. The closest populated areas are the hamlet of Wabasca-Desmarais (Wabasca) and the Bigstone Cree Nation (Figure 1-1).

The Project will use Steam-Assisted Gravity Drainage (SAGD) technology for enhanced oil recovery. Once the SAGD operation is established, Cenovus may incorporate co-injection of light hydrocarbons, referred to as Solvent Aided Process (SAP), where economically feasible. The Project is expected to have a maximum production capacity of approximately 180,000 barrels of oil per day and will be constructed in three phases over the estimated 40-year life of the Project. The central processing site will cover about 1.5 km^2. The proposed development is expected to include up to 200 well pads over the life of the Project, supporting up to 3,700 well pairs. Wherever reasonably possible, the Project will use existing clearings and infrastructure.

The Project is expected to require other related infrastructure projects including electrical power lines, fuel gas pipelines, produced oil pipelines, and diluent/condensate supply pipelines. These related infrastructure projects will be applied for separately, as appropriate.



LEGEND

- PROJECT AREA
- PLANT SITE
- PROJECT FOOTPRINT
- INDIAN RESERVE
- OPEN WATER
- PAVED ROAD
- UNPAVED ROAD
- WATERCOURSE

REFERENCE

ALBERTA DIGITAL DATA OBTAINED FROM ALTALIS LTD. (SEPTEMBER 2008.) USED UNDER LICENSE. DATUM: NAD83 PROJECTION: UTM ZONE 12

PROJECT

cenovus ENERGY

PELICAN LAKE
GRAND RAPIDS PROJECT

TITLE

PROJECT LOCATION

Golder Associates
Calgary, Alberta

PROJECT	10.1346.0006.5000		FILE No.	1_10134600065000A0
DESIGN	KM	22 Nov. 2011	SCALE AS SHOWN	REV. 0
CADD	KJM	24 Nov. 2011		
CHECK	KM	01 DEC. 2011		
REVIEW	DB	01 DEC. 2011		

FIGURE: 1-1

L:\2010\1346\10-1346-0006\5000\Report_A\Fig1-1_10134600065000A001_Project_Location.dwg Dec 01, 2011 - 3:23pm

2 TERMS OF REFERENCE

This assessment was completed to meet the relevant Terms of Reference (TOR) (AENV 2011) for the Project. The draft TOR was submitted to Alberta Environment (AENV) in May 2011. Alberta Environment issued the final TOR in August 2011 (AENV 2011). A copy of the final TOR is provided in Volume 2, Appendix 2-I.

The TOR also includes the requirement that the EIA be prepared in accordance with the environmental information requirements prescribed under the *Alberta Environmental Protection and Enhancement Act* (EPEA; Government of Alberta 2006) and the *Canadian Environmental Assessment Act* (Government of Canada 1994) and other applicable federal legislation. Volume 1 provides additional detailed EPEA information requirements. Concordance tables are provided in Volume 2, Appendix 2-II.

3 ASSESSMENT APPROACH

To gain approval for the Project, Cenovus has developed an integrated application to the Energy Resources Conservation Board (ERCB) and AENV for the Project. This integrated application provides details on the Project and provides supporting information for additional approvals for the Project. The integrated application and Environmental Impact Assessment (EIA) have also been completed to conform to the requirements of applicable legislation.

3.1 ENVIRONMENTAL IMPACT ASSESSMENT OVERVIEW

As required in the TOR for the Project (AENV 2011), the EIA examines the environmental and socio-economic effects of the Project. The EIA identifies Project development activities and describes the potential effects, mitigation options and residual effects of the Project.

Information on Cenovus's operations as well as the development details for the Project are provided in Volume 1. Details on the EIA completed for the Project are provided in Volumes 2 to 6. This section details the purpose and approach for the EIA. The EIA methods used to assess the effects of the Project are described in Volume 2, Section 4. The developments included in the assessment are listed in Volume 2, Section 5. A complete list of common and scientific names used throughout the assessment sections is in Volume 2, Appendix 2-III.

This EIA builds on a variety of environmental information collected in the area, other regional EIAs and specific Project information. All relevant provincial and federal regulatory requirements were considered in the development of the Project application and completion of the EIA.

Data sources for the EIA include:

- data collected during baseline studies for the Project as well as other developments in the region;
- digital elevation data for the region (from National Topographic Database [NTDB]);
- government resource agencies, such as Alberta Sustainable Resource Development (ASRD) and AENV;
- government statistics;
- Light Detection and Ranging (LIDAR);

- literature (published and unpublished) on environmental parameters relevant to the Project;
- previously submitted EIAs for projects in the region and the associated public supporting data;
- Project design details;
- published literature on EIA methods;
- socio-economic information collected specifically for the Project;
- socio-economics interviews;
- traditional land use information; and
- Alberta Vegetation Inventory (AVI) data supplied by Alberta-Pacific Forest Industries Inc.

Existing regional data were also used for the initial Project design work. Cenovus will continue to incorporate findings and recommendations from regional efforts as part of the adaptive management of the Project.

The Quality Assurance and Quality Control (QA/QC) program for the Project EIA is detailed in Volume 2, Appendix 2-IV.

3.2 REPORT ORGANIZATION

The Project application and EIA have been organized into six volumes as follows:

- Volume 1 includes:
  - the application for the Project including ERCB and EPEA applications;
  - a corporate overview of Cenovus;
  - a summary of public consultation activities;
  - a geological description;
  - a description of the reservoir recovery process;
  - a description of the Project;
  - a summary of environmental management and controls;
  - waste management and contingency plans;
  - an evaluation of alternatives considered;
  - a summary of the EIA; and

  - the Conservation and Reclamation (C&R) Plan.
- Volume 2 includes:
  - an introduction to the EIA;
  - the EIA assessment methods;
  - proposed monitoring programs;
  - the TOR for the Project; and
  - concordance tables.
- Volumes 3 includes assessments of:
  - Air Quality;
  - Noise;
  - Human and Wildlife Health (including human and wildlife health risk assessments); and
  - Air Emissions Effects.
- Volume 4 is an integrated volume consisting of the following assessments:
  - Hydrogeology;
  - Hydrology;
  - Water Quality; and
  - Fish and Fish Habitat.
- Volume 5 is an integrated volume consisting of the following assessments:
  - Terrain and Soils;
  - Terrestrial Vegetation, Wetlands and Forest Resources;
  - Wildlife; and
  - Biodiversity.
- Volume 6 includes assessments of:
  - Traditional Land Use;
  - Resource Use;
  - Visual Resources;
  - Historical Resources; and
  - Socio-Economics.
- Each volume also includes:

- a list of references, a list of abbreviations and a glossary;
- discipline-specific baseline reports, where applicable; and
- appendices containing relevant supporting information and additional information.

4 ENVIRONMENTAL IMPACT ASSESSMENT METHODS

4.1 OVERVIEW

The Project EIA was completed employing accepted techniques and is in compliance with the regulatory requirements. The EIA addresses the requirements of the Project TOR (AENV 2011) as well as additional information to address federal regulations. The Cumulative Effects Assessment (CEA) has been completed as an integral component of the EIA to meet any applicable requirements of Section 16 of the *Canadian Environmental Assessment Act* (Government of Canada 1994).

4.1.1 Information Used

The Project EIA used the following information:

- quantitative and qualitative information on the environmental and ecological processes in the study areas, including Traditional Land Use (TLU) where available, and relevant information presented in previous EIAs;
- current, publicly available information about the past, existing and planned human activities in the study areas and the nature, size, location and duration of their potential interactions with the environment;
- information about ecological processes and natural forces that are expected to produce changes in environmental conditions;
- existing and proposed industrial projects, as well as activities associated with land use and infrastructure, to the extent information is known and available to the public six months prior to the submission of the assessment; and
- information about regional monitoring, research and other strategies or plans to minimize, mitigate and manage potential adverse effects.

4.1.2 Assessments Conducted

The information was used to analyze and address potential environmental effects of the Project. The assessments include:

- quantitative and qualitative descriptions of effects, with consideration of trends and uncertainties for the available information used in the EIA;

- descriptions of any deficiencies or limitations in existing environmental databases including:
  - how identified deficiencies and/or limitations were addressed, considering their potential effect on the analysis and discussion on any appropriate follow-up.
- the use of appropriate predictive tools and methods, to enable quantitative estimates of future conditions with the highest possible degree of certainty;
- an evaluation of the effects, employing a system that is in compliance with the provincial and federal guidelines:
  - the ranking of the consequences of effects measured quantitatively against management objectives or baseline conditions and described qualitatively with respect to the views of the proponent and stakeholders.
- a description of management plans to prevent, or mitigate adverse effects and to monitor and respond to expected or unexpected conditions;
- a description of follow-up plans to verify the accuracy of predictions or determine the effectiveness of mitigation plans;
- a discussion of the assumptions and confidence in data to support conclusions regarding reclamation and mitigation success; and
- a description of residual effects and their environmental consequences.

4.1.3 Content of Reports

The EIA and baseline reports include the following information for each discipline:

- a description of the existing conditions;
- the identification of environmental disturbances from previous activities that are considered part of baseline conditions;
- a description of the nature of environmental effects associated with Project development activities;
- comments on whether available data are sufficient to assess effects and mitigative measures;
- the presentation of plans to minimize, mitigate or eliminate adverse effects, together with a discussion of the key elements of such plans;

- the identification of residual effects and the environmental consequence of those effects;
- the presentation of a plan to monitor environmental effects and manage environmental change to demonstrate that the Project will be operated in an environmentally sound manner;
- the presentation of a plan that addresses the adverse effects associated with the Project that may require joint resolution by government, industry and the community; and
- a summation of the mitigative measures that will be implemented for the Project.

4.1.4 Cenovus's Climate Action Plan

Cenovus has a corporate strategy for management of greenhouse gas emissions, as described in Volume 1, Section 8.4.

The Project is "Carbon Capture and Storage-ready" in that plot space has been reserved for potential future Carbon Capture and Storage implementation (Volume 1, Section 9.0). The Project plot plan (PLGR1-44-SK-00-001-04 in Volume 1, Appendix 1-VII) shows the plot space, adjacent to the steam generators, that has been reserved.

In determining the approach to carbon capture for the Project, consideration was given to: provincial regulations; current and proposed federal framework; current carbon capture technology; current carbon transportation and storage infrastructure; and emerging United States regulatory approaches.

The alternatives selected include:

- to meet emerging federal and United States emission reduction expectations, proactive monitoring of evolving regulations, assessment of internal emission reduction opportunities, monitoring of the availability and cost of external offset options and other compliance pathways, and continued evaluation of the cost of carbon capture in the face of technology advancement and incentives; and
- to meet provincial greenhouse gas reduction requirements, Cenovus focuses on the following:
  - energy efficiency;
  - technology development; and
  - if necessary, purchasing provincial emission reduction credits.

4.1.5 Assessment Cases

The three development scenarios addressed in the EIA are the Baseline Case, the Application Case and the Planned Development Case (PDC).

The Baseline Case establishes the conditions that would exist if the Project were not developed. It describes environmental conditions that include the effects resulting from existing and approved projects or activities within the study areas.

The Application Case describes the Baseline Case with the effects of the Project added. The Application Case includes both existing oil sands and other regional resource development activities and is a CEA for the Project.

The PDC includes the Application Case developments plus other regionally planned projects. The methodology for completing this case is the same as for the Application Case.

A PDC assessment is only completed for a component when the Application Case assessment results in a rating for predicted residual effects greater than negligible. The PDC is considered a conservative assessment of social and environmental conditions, since the projects included in the assessment may or may not proceed. In addition, the scope and size of the planned developments may change once designs are finalized and approved.

For the purposes of the Project, the information used for “Planned Projects” is based on what was publicly available in June 2011. Projects disclosed after June 2011, or projects where approvals were issued or plans were modified after June 2011 were considered in the Project EIA based on the relevant information available as of this date.

The Application Case and PDC are both CEAs, as they consider the effects of existing and approved developments in combination with the Project and in combination with other planned projects. The CEA aspect of the Project has been completed to comply with the provincial and federal requirements, as detailed in the document *Cumulative Effects Assessment in Environmental Impact Assessment Reports under the Alberta Environmental Protection and Enhancement Act* (AENV, EUB and NRCB 2000) and to meet the requirements of Section 16 of the *Canadian Environmental Assessment Act* (Government of Canada 1994). The process for completing the CEA as part of the Project EIA included consideration of guideline information as provided in the *Athabasca Oil*

Sands Cumulative Effects Framework Report (Golder 1999a), and the *Cumulative Effects Practitioners Guide* (Hegmann et al. 1999).

The assessment cases for the Project include consideration of the following, as required by the TOR (AENV 2011):

- Cenovus will conduct a cumulative environmental effects assessment of the Project based on the AENV/Alberta Energy and Utilities Board (EUB; predecessor to the ERCB)/Natural Resources Conservation Board (NRCB) Information Letter *Cumulative Effects Assessment in Environmental Impact Assessment Reports under the Alberta Environmental Protection and Enhancement Act* June 2000 (AENV, EUB and NRCB 2000). Cenovus will include a summary of all proposed monitoring, research and other strategies or plans to minimize, mitigate and manage potential adverse effects.
- The identification and assessment of the likely cumulative effects of the Project will:
  - define the spatial and temporal study area boundaries, and provide the rationale for assumptions used to define those boundaries for each environmental component examined;
  - describe the current (baseline) state of the environment in the Regional Study Area (RSA) (used for the cumulative effects assessment) and the activities that have created the current conditions;
  - assess the incremental consequences that are likely to result from the Project in combination with other existing, approved and planned projects in the region;
  - discuss how relevant information or data used from previous oil sands and other development projects is appropriate for use in this EIA report;
  - consider and describe deficiencies or limitations in the existing database for relevant components of the environment; and
  - explain the approach and methods used to identify and assess cumulative effects, including co-operative opportunities and initiatives undertaken to further the collective understanding. Cenovus participates in co-operative efforts to address industry issues where it determines that such endeavours are effective. Cenovus re-visits its participation in such co-operative efforts regularly.

4.2 KEY ISSUES AND KEY QUESTIONS

The EIA identifies the key issues for the Project and addresses them through key questions. These key questions frame the relationships between the Project and the potential environmental effects. This transparency allows reviewers to understand the rationale and assumptions used to make conclusions.

4.2.1 Key Issues

A key component of the EIA process is to identify and focus on the issues that are of greatest concern to stakeholders and regulators. This process was initiated through evaluation of the issues and responses in recent regional EIAs, recent regional regulatory hearings, the *Regional Sustainable Development Strategy* (RSDS) *for the Athabasca Oil Sands Area* (AENV 1999), other relevant documents and through information received during consultation with stakeholders for the Project.

Some of the key issues associated with oil sands projects identified through regional initiatives such as RSDS and through consultation sessions include:

- sustainable ecosystems and end land use;
- air emissions and their effects on human health, wildlife and vegetation;
- groundwater supply effects and drawdown effects on surface aquatic and terrestrial ecosystems;
- aquatic effects related to watercourse crossings for roads and infrastructure;
- effects on unique soils, vegetation and wetlands communities;
- rare and traditional use plant effects;
- wildlife and wildlife habitat with particular emphasis on Species at Risk Act (SARA) listed species (Species at Risk Public Registry 2011); and
- traditional land use.

Some of the issues considered in association with the Project include:

- facilities location;
- air quality and noise;
- aquatic resources;
- terrestrial resources;

- traditional land use;
- resource use; and
- socio-economics.

Several of the key issues applicable to the Project are presented below. Additional issues relevant to the Project are provided within the EIA (Volumes 3 to 6).

4.2.1.1 Facilities Location

The location of facilities and infrastructure relative to the existing Cenovus Pelican Lake Wabiskaw Operations has been identified as a key issue for the Project.

4.2.1.2 Greenhouse Gas Emissions and Climate Change Considerations

Cenovus's corporate strategy for greenhouse gas management is discussed in Volume 1, Section 8.4. The strategy is to continuously reduce greenhouse gas emissions from its operating facilities through the following:

- Cenovus targets measureable improvements in Greenhouse Gas (GHG) emissions. Cenovus has reduced the GHG intensity of its oil sands projects by 26% since 2004. Cenovus has also met or exceeded the emission reduction targets established under Alberta's Specified Gas Emitters Regulation (AENV 2007).
- Minimizing Steam Oil-Ratio (SOR) in design – A lower SOR means lower fuel consumption, which results in lower GHG emissions, in addition to lower water use and reduced infrastructure. Cenovus already leads the industry in minimizing SOR in its existing operations.
- Continuous energy efficiency improvements in operations – Cenovus continuously seeks to fine tune its operations to increase energy efficiency and lower the amount of resources consumed and reduce GHG and air emissions.
- Technology development activities through the Energy Efficiency Fund and the Environment Opportunities Fund explore and pilot technology that can demonstrate significant environmental improvements, including GHG emissions reductions.

The predicted GHG emissions associated with the construction and operation of the Project are assessed in the Key Questions for Air Quality Application Case (AQAC)-6 in Volume 3, Section 1.8.7.

The Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment (FPTCCCEA) issued a general guidance document in November 2003 for practitioners to use when incorporating climate change issues into environmental assessments (FPTCCCEA 2003). Approaches for climate change considerations include Greenhouse Gas (GHG) considerations where the proposed project may contribute to GHG emissions; and effects consideration where changing climates may have an effect on the proposed project (FPTCCCEA 2003).

The design, operations and reclamation planning for the Project considers relatively extreme climate variables as an expectation for occurrence during the life of the Project. This includes design for operations under possible operating temperatures ranging from -40 to +35°C. Potential predicted changes in key climate variables over the life of the Project are not predicted to adversely affect the planned construction, operation, decommissioning and reclamation of the Project.

4.2.1.3 Air Quality and Noise

Key issues include the following:

- emissions of oxides of sulphur dioxide (SO_2), oxides of nitrogen (NO_x), GHGs and Particulate Matter (PM), as well as other industrial emissions;
- effects of emissions on ecological receptors; and
- effects of sound levels on people, wildlife and local traditional land uses.

4.2.1.4 Aquatic Resources

Key issues include the following:

- groundwater withdrawals and potential effects on groundwater quality and quantity, as well as surface water flows and water levels;
- watercourse crossings and associated effects of suspended sediment entrainment and deposition;
- natural drainage and flow patterns;

- wastewater management;
- runoff management;
- spill management;
- acid deposition from air emissions;
- effects on fish and fish habitat, including benthic invertebrate communities; and
- effects of fishing pressure.

4.2.1.5 Terrestrial Resources

Key issues include the following:

- caribou habitat and movement (e.g., West Side Athabasca River Caribou Range);
- old growth forest;
- rare plants;
- habitat fragmentation; and
- reclamation.

4.2.1.6 Traditional Land Use

Key issues include the following:

- medicinal plants;
- traplines; and
- trail access.

4.2.1.7 Resource Use

Key issues include the following:

- aggregate resources;
- berry picking;
- environmentally important areas;
- fishing;
- forestry;

- hunting and trapping; and
- recreation.

4.2.1.8 Socio-Economic

Key issues include the following:

- traditional use;
- job creation;
- regional infrastructure and services; and
- community, regional and provincial benefits.

4.2.2 Key Questions

Key questions have been identified for each EIA component to address the specific issues identified by the communities, stakeholders, regulators or technical experts. The key questions also address issues detailed in the TOR as that document is designed to focus on the key issues associated with the Project. Although key questions are used to focus the EIA, issues over and above those captured in the key questions are also addressed.

Key questions are provided for both the Application Case and PDC. The PDC key questions are intended to focus the EIA on the primary cumulative effects issues associated with the Project in relation to other existing, approved and planned projects. Therefore, if the Application Case resulted in the determination that the Project had a negligible residual effect, the assessment under the PDC may not be completed as the effects of the Project are not expected to overlap with those of planned projects.

Key questions for the Project are summarized in Table 4.2-1 and 4.2-2.

Table 4.2-1 Summary of Key Questions for the Project: Application Case

Number	Key Question
Air Quality	
AQAC-1	What effects could existing and approved developments and the Project have on ambient air quality in the region?
AQAC-2	What effects could existing and approved developments and the Project have on the deposition of acid-forming compounds in the region?
AQAC-3	What effects could existing and approved developments and the Project have on concentrations of ground-level ozone in the region?
AQAC-4	Will emissions from the Project be in compliance with relevant provincial and federal emission guidelines?
AQAC-5	What effects could existing and approved developments and the Project have on odours at the selected receptors?
AQAC-6	What is the contribution of the Project to greenhouse gas emissions?
Noise	
NAC-1	What effects could existing and approved developments and the Project have on noise levels?
Human Health	
HHAC-1	What effects could emissions from existing and approved developments and the Project have on long-term (chronic) exposure and human health?
HHAC-2	What effects could emissions from existing and approved developments and the Project have on short-term (acute) exposure and human health?
HHAC-3	What effects could emissions from existing and approved developments and the Project have on $PM_{2.5}$ emissions and human health?
Wildlife Health	
WHAC-1	What effects could emissions from existing and approved developments and the Project have on long-term (chronic) wildlife health?
Air Emissions Effects	
AEEAC-1	What effects could air emissions from existing and approved developments and the Project have on waterbodies and the aquatic resources therein?
AEEAC-2	What effects could air emissions from existing and approved developments and the Project have on soils?
AEEAC-3	What effects could air emissions from existing and approved developments and the Project have on terrestrial vegetation and wetlands?
AEEAC-4	What effects could air emissions from existing and approved developments and the Project have on wildlife habitat?
Hydrogeology	
HGAC-1	What effects could existing and approved developments and the Project have on groundwater quantities, levels and flow patterns?
HGAC-2	What effects could existing and approved developments and the Project have on groundwater quality?
Hydrology	
HAC-1	What effects could existing and approved developments and the Project have on open-water areas, flows and water levels in receiving and nearby waterbodies?
HAC-2	What effects could existing and approved developments and the Project have on the geomorphic conditions of watercourses and the concentration of suspended sediments in the watersheds and drainage systems?

Table 4.2-1 Summary of Key Questions for the Project: Application Case (continued)

Number	Key Question
Water Quality	
WQAC-1	What effects could existing and approved developments and the Project have on water quality?
Fish and Fish Habitat	
FAC-1	What effects could existing and approved developments and the Project have on fish habitat and fish habitat fragmentation?
FAC-2	What effects could existing and approved developments and the Project have on fish health?
FAC-3	What effects could existing and approved developments and the Project have on fish abundance?
FAC-4	What effects could existing and approved developments and the Project have on fish and fish habitat diversity?
Terrestrial Resources	
TRAC-1	What effects could existing and approved developments and the Project have on the quantity of terrain and soils, and soil quality/capability?
TRAC-2	What effects could existing and approved developments and the Project have on terrestrial vegetation, wetlands and forest resources?
TRAC-3	What effects could existing and approved developments and the Project have on wildlife abundance and habitat?
TRAC-4	What effects could existing and approved developments and the Project have on biodiversity?
Traditional Land Use	
TLUAC-1	What effects could existing and approved developments and the Project have on traditional land uses?
Resource Use	
RUAC-1	What effects could existing and approved developments and the Project have on environmentally important areas?
RUAC-2	What effects could existing and approved developments and the Project have on natural resources and non-traditional resource users?
Visual Resources	
VRAC-1	What effects could existing and approved developments and the Project have on visual resources?
Historical Resources	
HRAC-1	What effects could existing and approved developments and the Project have on historical resources?
Socio-Economic	
SEAC-1	What effects could existing and approved developments and the Project have on the local and provincial economies?
SEAC-2	What effects could existing and approved developments and the Project have on population, housing, services, traffic and infrastructure?

Table 4.2-2 Summary of Key Questions for the Project: Planned Development Case

Number	Key Question
Air Quality	
AQPDC-1	What effects could existing and approved developments, the Project and planned developments have on ambient air quality in the region?
AQPDC-2	What effects could existing and approved developments, the Project and planned developments have on the deposition of acid-forming compounds in the region?
Noise	
NPDC-1	What effects could existing and approved developments, the Project and planned developments have on noise levels?
Human Health	
HHPDC-1	What effects could emissions from existing and approved developments, the Project and planned developments have on long-term exposure and human health?
HHPDC-2	What effects could emissions from existing and approved developments, the Project and planned developments have on short-term exposure and human health?
HHPDC-3	What effects could emissions from existing and approved developments, the Project and planned developments have on exposure to $PM_{2.5}$ and human health?
Wildlife Health	
WHPDC-1	What effects could emissions from existing and approved developments, the Project and planned developments have on long-term (chronic) wildlife health?
Air Emissions Effects	
AEEPDC-1	What effects could air emissions from existing and approved developments, the Project and planned developments have on waterbodies and the aquatic resources therein?
AEEPDC-2	What effects could air emissions from existing and approved developments, the Project and planned developments have on soils?
AEEPDC-3	What effects could air emissions from existing and approved developments, the Project and planned developments have on terrestrial vegetation and wetlands?
AEEPDC-4	What effects could air emissions from existing and approved developments, the Project and planned developments have on wildlife habitat?
Hydrogeology	
HGPDC-1	What effects could existing and approved developments, the Project and planned developments have on groundwater quantities, levels and flow patterns?
HGPDC-2	What effects could existing and approved developments, the Project and planned developments have on groundwater quality?
Hydrology	
HPDC-1	What effects could existing and approved developments, the Project and planned developments have on open-water areas, flows and water levels in receiving and nearby waterbodies?
HPDC-2	What effects could existing and approved developments, the Project and planned developments have on the geomorphic conditions of watercourses and the concentration of suspended sediments in the watersheds and drainage systems?
Water Quality	
WQPDC-1	What effects could existing and approved developments, the Project and planned developments have on water quality?
Fish and Fish Habitat	
FPDC-1	What effects could existing and approved developments, the Project and planned developments have on fish habitat and fish habitat fragmentation?
FPDC-2	What effects could existing and approved developments, the Project and planned developments have on fish health?
FPDC-3	What effects could existing and approved developments, the Project and planned developments have on fish abundance?
FPDC-4	What effects could existing and approved developments, the Project and planned developments have on fish and fish habitat diversity?

Table 4.2-2 Summary of Key Questions for the Project: Planned Development Case (continued)

Number	Key Question
Terrestrial	
TRPDC-1	What effects could existing and approved developments, the Project and planned developments have on the quantity of terrain and soils, and soil quality/capability?
TRPDC-2	What effects could existing and approved developments, the Project and planned developments have on terrestrial vegetation, wetlands and forest resources?
TRPDC-3	What effects could existing and approved developments, the Project and planned developments have on wildlife abundance and habitat?
TRPDC-4	What effects could existing and approved developments, the Project and planned developments have on biodiversity?
Traditional Land Use	
TLUPDC-1	What effects could existing and approved developments, the Project and planned developments have on traditional land uses?
Resource Use	
RUPDC-1	What effects could existing and approved developments, the Project, and planned developments have on environmentally important areas?
RUPDC-2	What effects could existing and approved developments, the Project, and planned developments have on natural resources and non-traditional resource users?
Visual Resources	
VRPDC-1	What effects could existing and approved developments, the Project and planned developments have on visual resources?
Historical Resources	
HRPDC-1	What effects could existing and approved developments, the Project and planned developments have on historical resources?
Socio-Economic	
SEPDC-1	What effects could existing and approved developments, the Project and planned developments have on socio-economics in the study areas?

4.3 SPATIAL CONSIDERATIONS

The disturbance footprint for the Project is shown in Figure 1-1.

The total area for all the components of the Project, including plant site, well pads, camp, borrow pits, access roads, utility corridors and pipelines is estimated to be 3,291 ha, which includes 207 ha of existing disturbance.

Study areas for the Project EIA were determined with consideration of the specific component of the EIA. The spatial approach defined for a component generally includes a Local Study Area (LSA) and a Regional Study Area (RSA). The LSA is used to focus on and evaluate areas that may be directly affected by the Project. The RSA is generally used to evaluate the effects of the Project in the larger geographic and ecological contexts. The study areas for the EIA components are described below, with additional details in the relevant EIA sections.

4.3.1 Air Quality

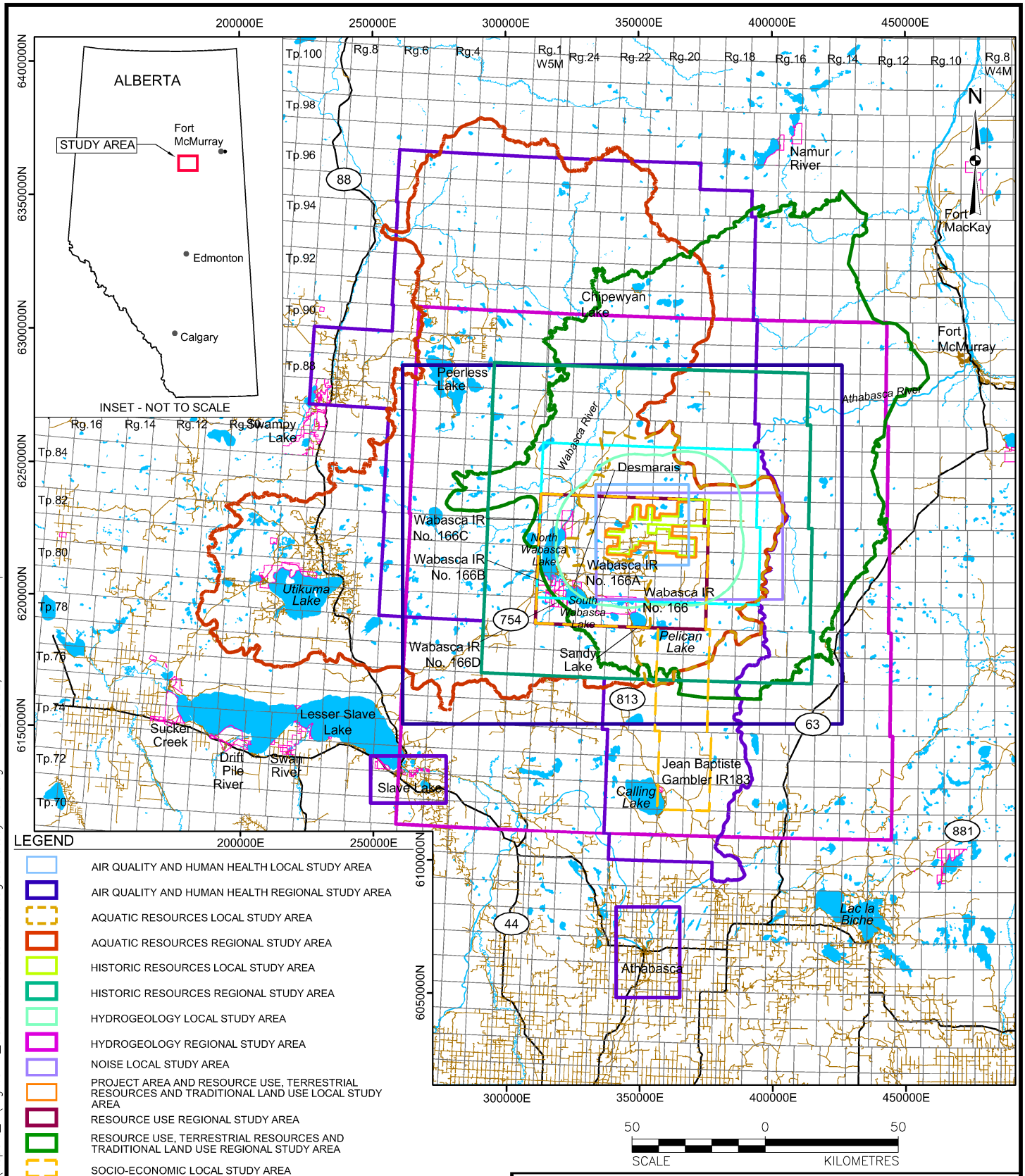
As part of the dispersion modelling process, the spatial extent of the effects of the Project on ambient air quality determines the region over which modelling is conducted. Four spatial areas were included in the assessment and were defined as follows:

- The **modelling domain** defines the region within which emission sources were quantified and air quality predictions were performed. The modelling domain chosen for the air quality assessment is shown in Figure 4.3-1. The modelling domain chosen for the air quality assessment of the Project extends north of Chipewyan Lake, south of Sandy Lake, east to Range 14 West of the Fourth Meridian and west to Ranges 5 and 6 West of the Fifth Meridian. It is large enough to encompass the effects related to air emissions from developments in the region.
- The **Air Quality Regional Study Area (RSA)** defines the region over which modelling results are presented and is smaller than the modelling domain. The RSA for the Project is defined by a 135 by 165 km area (Figure 4.3-1). The RSA is also large enough to capture the air quality effects associated with the Project.

- The **Air Quality Local Study Area (LSA)** defines the area in the immediate vicinity of the Project where the majority of air quality effects are expected to occur. The LSA represents a subset of the RSA and allows a more focused assessment of the effects associated with the Project. The LSA was sized to meet the AENV *Air Quality Model Guideline* requirements for study areas (AENV 2009). The LSA (Figure 4.3-1) is defined by an area of about 30 by 35 km, centred on the Project main facility.
- The plant site is an area outlined by the plant site boundary. The Alberta Ambient Air Quality Objectives (AAAQOs) are applicable outside the plant site boundary.

One of the aims of the air quality evaluation is to put the potential effects into perspective for regional stakeholders. To facilitate this, maximum air quality concentrations were predicted for each of the receptors indicated in Table 4.3-1. The list of receptors includes the following:

- Bigstone Cree Nation (BCN) Indian Reserves (IR) of Wabasca IRs 166, 166A, 166B, 166C and 166D;
- Wabasca-Desmarais (the hamlet of Wabasca was also included for completeness);
- the unincorporated communities of Chipewyan Lake, Trout Lake and Sandy Lake (Settlement);
- House River Cemetery, a location that is of Aboriginal significance;
- three recreational sites (i.e., Grand Rapids Provincial Park, North Wabasca Recreational Area and Pelican Portage);
- the Kamistikowik Lake air strip near the Project;
- two cabins near the Project;
- the on-site worker camp; and
- the maximum point of impingement (MPOI) within the LSA. The MPOI is the location outside the plant site boundary where the maximum estimated ground-level concentration or deposition occurs.



LEGEND

- AIR QUALITY AND HUMAN HEALTH LOCAL STUDY AREA
- AIR QUALITY AND HUMAN HEALTH REGIONAL STUDY AREA
- AQUATIC RESOURCES LOCAL STUDY AREA
- AQUATIC RESOURCES REGIONAL STUDY AREA
- HISTORIC RESOURCES LOCAL STUDY AREA
- HISTORIC RESOURCES REGIONAL STUDY AREA
- HYDROGEOLOGY LOCAL STUDY AREA
- HYDROGEOLOGY REGIONAL STUDY AREA
- NOISE LOCAL STUDY AREA
- PROJECT AREA AND RESOURCE USE, TERRESTRIAL RESOURCES AND TRADITIONAL LAND USE LOCAL STUDY AREA
- RESOURCE USE REGIONAL STUDY AREA
- RESOURCE USE, TERRESTRIAL RESOURCES AND TRADITIONAL LAND USE REGIONAL STUDY AREA
- SOCIO-ECONOMIC LOCAL STUDY AREA
- SOCIO-ECONOMIC REGIONAL STUDY AREA
- VISUAL RESOURCES LOCAL STUDY AREA
- INDIAN RESERVE
- OPEN WATER
- PAVED ROAD
- UNPAVED ROAD
- WATERCOURSE

REFERENCE

DIGITAL DATA OBTAINED FROM IHS ENERGY INC. BASE MAP ROADS OBTAINED FROM DMTI SPATIAL INC., USED UNDER LICENSE. DATUM: NAD83 PROJECTION: UTM ZONE 12

PROJECT

cenovus ENERGY

PELICAN LAKE
GRAND RAPIDS PROJECT

TITLE

LOCAL AND REGIONAL STUDY AREAS

Golder Associates
Calgary, Alberta

PROJECT	10.1346.0006.5000		FILE No.	10134600065000A003	
DESIGN	KM	22 Nov. 2011	SCALE	AS SHOWN	REV. 0
CADD	KJM	24 Nov. 2011	FIGURE: 4.3-1		
CHECK	KM	02 DEC. 2011			
REVIEW	DB	02 DEC. 2011			

L:\2010\1346\10-1346-0006\5000\Report_A\Fig4.3-1_10134600065C00A003RegionalStudyArea.dwg Dec 02, 2011 - 4:44pm

Table 4.3-1 Selected Receptors Included in the Air Quality Assessment

Receptors	Location[a]	
	Distance [km]	Direction
Aboriginal Communities/Areas of Importance		
Wabasca[b]	32.4	WSW
Wabasca-Desmarais[b]	33.6	SW
Wabasca (IR 166)	28.8	SSW
Wabasca (IR 166A)[b]	32.0	SW
Wabasca (IR 166B)[b]	38.2	WSW
Wabasca (IR 166C)	28.3	W
Wabasca (IR 166D)[b]	38.2	SW
Chipewyan Lake[c]	54.4	N
Sandy Lake Settlement	42.4	S
Trout Lake	81.5	WNW
House River Cemetery	55.8	E
Non-Aboriginal Areas		
Grand Rapids Provincial Park	46.6	ENE
North Wabasca Recreational Area	31.8	WSW
Pelican Portage	57.8	SE
Kamistikowik Lake (Air Strip)	5.0	NW
Cabins		
Cabin 1 (NE 3-82-23 W4M)	9.3	SW
Cabin 2 (NE 15-82-21 W4M)	13.1	ESE
Other		
On-Site Worker Camp	1.2	WNW
Maximum Point of Impingement[d]	–	–

(a) Distance and direction are relative to the B-01-2100 steam generator stack at the Project.

(b) The maximum prediction at these collective sites is provided in the air quality portion of the EIA.

(c) Because Chipewyan Lake is outside of the modelling domain, a surrogate receptor for Chipewyan Lake was placed just inside the RSA.

(d) Outside the plant site boundary and within the LSA.

– = Not applicable because MPOI is different for each case and compound.

For the purposes of this assessment, these 19 receptors (i.e., ten communities, one location of Aboriginal significance, three recreation areas, one air strip, two cabin locations, on-site worker camp and MPOI) are referred to as the selected receptors. The distance of these receptors from the Project are indicated in Table 4.3-1.

4.3.2 Noise

Noise levels were determined over a Noise LSA. The LSA was defined by a rectangle 40 km by 70 km in size, which was chosen to encompass potential noise effects of the Project, noise-sensitive receptors and the ERCB 1.5 km Criteria Boundary. The ERCB Criteria Boundary used in the Noise Assessment for the Project refers to 1.5 km buffer from the Project fenceline and existing well pads and other facilities. The fenceline for the Project is defined as the perimeter of the Project Area.

Noise-sensitive receptors are considered to be any permanent residences or seasonally occupied dwellings used at least six weeks out of the year outside the plant or Project boundary that may be affected by the Project. For the Noise Assessment, two noise receptors (i.e., hunter/trapper cabins) were considered because they are located in areas that may be affected by the Project. Both of the noise receptors are located within the Project Area boundary; location details are provided in Table 4.3-2.

Table 4.3-2 Pelican Lake Grand Rapids Project Noise Receptor Locations

Location	Easting [m]	Northing [m]
Cabin 1	343852	6217920
Cabin 2	363540	6220437

Note: Locations based on datum NAD83 and coordinate system Universal Transverse Mercator Zone 12.

A Noise Regional Study Area (RSA) is not defined for the Noise Assessment. As noise attenuates with distance, noise is considered to be a local effect. In the area beyond the LSA, noise emissions from the Project will attenuate to a level well below the ambient sound level resulting in negligible contributions from the Project.

4.3.3 Human Health

Effects to human health were evaluated on a local and regional basis. Locations for the assessment were selected based on areas where receptors are known to be present (i.e., communities, Aboriginal communities, recreational areas, hunter/trapper cabins and worker camps). The receptor locations were selected within the RSA, which has been defined in the Air Quality Assessment, as the region over which modelling results are presented. The RSA is defined by a 135 by 165 km area and is large enough to capture the air quality effects associated with the Project; the LSA is the area in the immediate vicinity of the Project where the majority of air quality effects are expected to occur. The receptor locations included in the Human Health Risk Assessment are identified in Table 4.3-1.

Wildlife were assumed to live within areas where the highest air concentrations were predicted (i.e., at the MPOI). It was assumed that all wildlife species spent time in this maximally exposed area. The wildlife health risk assessment is intended to use the area inside the MPOI as a conservative assumption for exposure to the Project emissions.

4.3.4 Air Emissions Effects

The boundary of the aquatics analysis for waterbodies was the air modelling domain, while watercourses were evaluated in the Aquatic Resources LSA. The air modelling domain was used for waterbodies instead of the Aquatic or Terrestrial Resources Study Areas to maximize the likelihood of predicting environmental effects if they were present. Soil, vegetation and wildlife analyses were performed within the Terrestrial Resources RSA.

4.3.5 Aquatic Resources

The same Aquatic Resources RSA and LSA were used for the Hydrology, Water Quality and Fish and Fish Habitat components (Figure 4.3-1).

The Hydrogeology RSA and LSA are larger than the corresponding Aquatic Resources study areas (Figure 4.3-1). The Hydrogeology LSA was selected to be of adequate areal extent to encompass local effects of Project groundwater withdrawal and wastewater disposal and potential effects to groundwater quality. The Hydrogeology LSA also coincides with an area in which detailed geologic mapping was conducted. The Hydrogeology RSA was based on interpreted regional geology and groundwater flow patterns. The Hydrogeology RSA was selected to be of adequate areal extent to simulate cumulative effects of groundwater withdrawal and wastewater disposal in the vicinity of the Project.

4.3.5.1 Regional Study Area

Aquatic Resources

The RSA for the Aquatic Resources assessment was defined on the basis of potential effects of construction and operation of the Project on flows and water levels in regional rivers and lakes, including likely surface water/groundwater interactions, and on waterbodies supporting fish populations.

The Aquatic Resources RSA (Figure 4.3-1) includes the following major watercourses and waterbodies:

- Wabasca River watershed: Willow River, Muskwa River, Pastecho River, Trout River, Wood Buffalo River, Woodenhouse River, Chipewayn River, Liege River and Panny River; North Wabasca Lake, South Wabasca Lake, Utikama Lake and Peerless Lake; and
- Athabasca River watershed: Loon Creek, Pelican River, Pelican Lake and Unnamed Lake.

The total area of the Aquatic Resources RSA is about 27,500 km^2. The majority (90%) of the RSA is comprised of the upper watershed of the Wabasca River, upstream of its confluence with the Loon River. The remaining portion of the RSA (10%) is comprised of various small tributary watersheds of the Athabasca River.

Hydrogeology

The Hydrogeology RSA covers Townships 71 to 90 from Range 13 West of the Fourth Meridian (W4M) to Range 5 West of the Fifth Meridian (W5M) (Figure 4.3-1). The Hydrogeology RSA was defined on the basis of the locations of other operating oil sands projects in the region (i.e., existing Pelican Lake Wabiskaw Operations, Canadian Natural Resources Limited [Canadian Natural], Husky Oil Operations Limited [Husky], Laricina Energy Ltd. [Laricina] and BlackPearl) and a preliminary estimate of the potential extent of hydraulic head drawdown resulting from the current and future use of the regionally extensive Grand Rapids 'B' aquifer by all operators.

4.3.5.2 Local Study Area

Aquatic Resources

The extent of the Aquatic Resources LSA was defined based on the Project Area, local drainage basins and the requirements of the aquatics components including Water Quality, Hydrology and Fish and Fish Habitat. The Aquatic Resources LSA boundary was delineated mostly on the basis of the watershed boundaries of waterbodies and watercourses that may be directly or indirectly affected by the Project (Figure 4.3-1).

The LSA is entirely within the RSA and has a total area of about 4,460 km^2. The LSA ranges in elevation from about 380 to 870 masl, with an average elevation of about 580 masl.

The LSA is divided into eight sub-watersheds (Table 4.3-3). Three of the sub-watersheds, about 38% of the total LSA, discharge to the Wabasca River, and the remaining five sub-watersheds, about 62% of the total LSA, discharge to the Athabasca River.

Table 4.3-3 Sub-Watersheds in the Local Study Area and Receiving Waterbodies

Receiving Watershed/Waterbody	LSA Sub-Watershed	Effective Drainage Area [km^2]	Major Lakes in the Sub-Watershed
Wabasca River	Wood Buffalo River	888	Wood Buffalo Lake
	Unnamed Watercourse 1	314	Kamistikowik Lake
Wabasca River via North Wabasca Lake	Unnamed Watercourse 2	396	Horsetail Lake
Athabasca River	Loon Creek	627	-
	Deadman Creek	42	-
	Unnamed Basin 1	300	-
	Unnamed Watercourse 3	190	-
	Pelican River (including Muskeg River)	1,435	Pelican Lake

- = No major lakes in the sub-watershed.

Within the Aquatic Resources LSA, there are several small lakes that could be seasonally navigated by a canoe or small boat. Navigation on streams in the Project Area would either be impossible or impeded by low flows, debris, and in many locations by beaver dams. The watercourses and lakes within the Aquatic Resources LSA are not believed to be navigated regularly, if at all.

Hydrogeology

The Hydrogeology LSA extends from Township 80 to Township 85, Range 17 to Range 26, W4M (Figure 4.3-1). The Hydrogeology LSA includes the Project Area, existing Pelican Lake Wabiskaw Operations, the area where buried bedrock valleys have been mapped west of the Project Area, and the area where non-industrial (primarily domestic) water wells are located southwest of the Project Area.

4.3.6 Terrestrial Resources

4.3.6.1 Regional Study Area

The RSA was established to assess the contributions of the Project within the broader regional area (Figure 4.3-1). The RSA covers an area of 1,987,401 ha and is situated entirely within the Central Mixedwood Natural Subregion (NRC 2006). The RSA boundary was defined with consideration of the following parameters:

- ecodistrict and/or vegetation classification boundaries;
- geographic areas such as the Stony Mountain plateaus located to the southeast of the Project and the Utikama Uplands to the south of the Project;

- defined woodland caribou habitat areas (e.g., West Side Athabasca River Caribou Range);
- one female woodland caribou home range diameter (30 km; Stuart-Smith et al. 1997); and
- the average size of two moose home range diameters (22 km; Hauge and Keith 1981).

The regional vegetation is represented by a mix of wetlands in poorly drained areas and terrestrial vegetation on better drained soils. Typical terrestrial communities are dominated by pure or mixed stands of aspen and white spruce, with minor inclusions of balsam poplar and/or white birch. On drier sites with coarse-textured soils, jack pine is the dominant tree species. Poorly drained areas of the regional landscape are characterized by a diverse array of forested and non-forested wetlands types. These include peatlands such as black spruce and tamarack-dominated bogs and fens, as well as non-peatland marshes, swamps and areas of shallow open water. Shallow groundwater characteristics vary considerably among these wetlands types, resulting in considerable differences in plant species composition and structure. Fire has also been a prevalent form of natural disturbance throughout the area and as a result, many parts of the RSA are characterized by young forests that have regenerated following fire.

Landforms in the subregion are comprised predominantly of ground moraine and hummocky moraine, interspersed with some areas of aeolian dunes, sandy outwash plains and glaciolacustrine plains (NRC 2006). Post-glacial organic deposits overlay glacial and post-glacial mineral deposits in many areas. Overall, the terrain has low relief and a level to undulating surface. Dominant soil orders in this region include Organic, Luvisolic, Brunisolic and Gleysolic.

Disturbance footprints associated with each development in the RSA included in the assessment cases used for the EIA are outlined in Table 4.3-4.

Table 4.3-4 Disturbance Areas of Existing and Approved Developments in the Regional Study Area

Developments	Terrain and Soils [ha]	Terrestrial Vegetation, Wetlands and Forest Resources, Wildlife and Wildlife Habitat and Biodiversity [ha]
Baseline Case		
Athabasca Oil Sands Corp McKay Pilot	23.9	23.9
Athabasca Oil Sands Corp. Dover Pilot	38.5	38.5
Connacher, Great Divide Oil Sands Project	2,584.3	2,584.3
Laricina Energy Ltd Saleski Pilot	72.3	72.3
Laricina Energy Ltd. Germain Pilot	117.3	117.3
Serrano Energy Ltd Blackrod SAGD Pilot Project	10,933.8	10,933.8
Southern Pacific Resource Corp. McKay Project	1,570.9	1,570.9
Forest Operations	-	36,265.9
Municipalities and Communities	727.1	727.1
Pipelines, Roadways, East Athabasca Highway, Others	19,478.4	46905.9
Total Existing and Approved Developments	**35,546.5**	**99,239.9**
Application Case		
Pelican Lake Grand Rapids Project Footprint	2,300.8	3,291.4
Total Application Case Development	2,300.8	3,291.4
Planned Development Case		
Dover Operating Corp.: Dover Commercial Project	5,898.8	5,898.8
Laricina Energy Ltd.: Germain Phase 1	15,820.4	15,820.4
Laricina Energy Ltd.: Saleski Phase 1	17,575.7	17,575.7
MacKay Operating: MacKay River Commercial Project	2,125.0	2,125.0
Serrano Energy Ltd Blackrod SAGD Pilot Project	403.6	403.6
Southern Pacific Resources: McKay Thermal Project	3,154.8	3,154.8
Sunshine Oil Sands Ltd. West Ells Project	1,064.3	1,064.3
Forest Operations	-	29,358.1
Total Planned Developments	**46,042.7**	**75,400.8**

Notes: Differences in areas of developments between the Terrain and Soils, and the remaining terrestrial components are due to the disturbance types such as seismic lines and forestry activity, which are not considered to disturb soils in the RSA.
Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

4.3.6.2 Local Study Area

The LSA was established to assess the effects of the Project on Terrestrial Resources at the local scale (Figure 4.3-1). The LSA covers an area of 41,026 ha and falls completely within the Central Mixedwood Natural Subregion (NRC 2006). The LSA includes Cenovus Oil Sands Mineral holdings, the Resource Development Area (i.e., the Cenovus land with bitumen resources to be developed), as well as all lands subject to direct disturbance from the Project (i.e. all Project facilities and associated infrastructure), with a buffer of 500 m around these components.

Delineating the LSA based on a 500-m buffer is a method that has been consistently used, and accepted, in previous EIAs. The LSA represents a zone

in which potential direct and indirect effects of the Project may occur. Examples of indirect effects include air emissions on soils and vegetation, dust on vegetation, sensory disturbance to wildlife and surface water hydrology, all of which can have an effect on biodiversity in the area. Groundwater drawdown can result in changes to soil moisture regimes, shifts in vegetation communities from mesic to xeric conditions, shifts in wildlife species assemblages and changes to biodiversity.

The LSA is part of the Wabasca Plain District of the Wabasca Lowlands Section of the Northern Alberta Lowlands Region. The LSA includes undulating and gently rolling morainal landforms and a veneer of glaciofluvial deposits over morainal material (Pettapiece 1986). Organic materials overlay these morainal landforms in a large portion of the LSA. The Project area generally contains subdued relief with level to undulating topography in the plains and moderate rolling topography in the uplands. Elevations range from 200 masl over most of the Project area to about 1,050 masl. The lowland areas are dominated by peatlands (bogs and fens).

The LSA is characterized by a mosaic of upland and wetlands plant communities that have developed on subdued relief. The majority of the LSA is comprised of a range of bog and fen peatlands. Upland communities are dominated by aspen or mixedwood aspen-white spruce forests, with jack pine occurring on drier sites and black spruce on moister sites that are transitional to peatlands.

4.3.7 Socio-Economics

The socio-economic RSA (Figure 4.3-1) encompasses the area where socio-economic effects are more broadly dispersed and typically include some level of economic benefit from employment and contract opportunities, and fiscal benefits such as taxes and royalties. Economic and population effects are modelled at the RSA level, as well as the provincial level.

The RSA consists of the following communities:

- the Municipal District (MD) of Opportunity No. 17 (the jurisdiction in which the Project is located); and
- the towns of Athabasca and Slave Lake (the nearest larger service centres in relation to the Project).

The LSA includes communities that are expected to be directly affected by the Project due to their physical proximity. These effects may include increased

traffic, increased direct employment and increased demand on health, social and protective services.

Based on proximity to the Project and the likelihood of socio-economic effects, the following communities are included in the LSA:

- Wabasca (approximately 35 km from the Project); and
- the Bigstone Cree Nation (BCN) Indian Reserves (IRs) (approximate distances between the IRs and the Project are listed in parentheses):
  - Wabasca IRs 166 (25 km), 166A (30 km), 166B (35 km), 166C (25 km) and 166D (35 km); and
  - Jean Baptiste Gambler IR 183 (while not physically close to the Project, Jean Baptiste Gambler IR 183 is included in the BCN reserve information, and so has been included in the LSA discussion).

4.3.8 Traditional Land Use

4.3.8.1 Regional Study Area

The TLU RSA is based on the Terrestrial Resources RSA and is shown in Figure 4.3-1. Traditional land use areas primarily include land that is used to collect traditional resources including hunted game, and harvested berries or medicinal plants. These areas may also include cabins and other areas of spiritual or historical importance based on oral tradition. The RSA in this report considers the underlying TLU resources of the Terrestrial Resources RSA such as wildlife and vegetation which are important components of TLU activities. Traditional fishing is also considered within the context of the RSA.

Maps of the BCN traditional territories and TLU areas overlapping the RSA have not been included in this report at the request of the BCN for confidentiality reasons.

4.3.8.2 Local Registered Fur Management Areas and Local Study Area

The TLU LSA is based on the Terrestrial Resources LSA and is shown in Figure 4.3-1. The Registered Fur Management Areas (RFMAs) (also known as traplines) that overlap the LSA include RFMA #s 45, 148, 158, 369, 763, 1425 and 1682. Traplines overlapping the LSA provide an appropriate basis for assessing potential TLU, as they provide an indicator of the location from which

traditional activities such as trapping, are conducted. All traplines overlapping the LSA are held by Aboriginal trappers.

4.3.9 Historical Resources

The effects on historic resources from the Project will occur directly within areas scheduled for land surface disturbance. The entirety of the Project Area ground surface will not be affected by construction activities, due to the dispersed nature of the developments.

An analysis of the effects of the Project in combination with existing, approved and planned developments within the general region was facilitated through definition of the RSA (Figure 4.3-1). The RSA covers an area of 1,437,696 ha or 156 townships surrounding the Project. It extends from a western boundary of Range 2 W5M to the eastern edge of Range 16, W4M. The southern boundary of Township 77 forms the southern boundary of the RSA, while the northern boundary of Township 88 is its northern boundary. The RSA includes all or portions of 52 archaeological national registry (Borden) blocks identified in Alberta. The known distribution of historic resources and their landform associations within this area have been incorporated in a vegetation, hydrology and terrain-based predictive Geographic Information System (GIS) model that derives high, moderate and low historic resource potential areas.

The LSA includes the areas that will be directly affected by construction activities as well as surrounding areas within the HRIA Study area. This includes all or portions of 147 sections of land over an area of approximately 38,073 ha including: Sections 31 to 33 of 81-20 W4M; Section 36 of 81-21 W4M; Sections 32 to 36 of 81-23 W4M, Sections 4 to 9, 16 to 18 of 82-20 W4M, Sections 1 to 21, 28 to 30 of 82-22 W4M, Sections 5 to 8, 13 to 24, 27 to 34 of 82-22 W4M, Sections 1 to 3, 10 to 15, 19 to 26 and 36 of 82-23 W4M, Sections 6 to 7, 18 to 19, 30 to 31 of 83-19 W4M, Sections 1 to 36 of 83-20 W4M, Sections 1 to 6, 9 to 12 of 83-21 W4M, Sections 1 to 5, 9, 12 to 13, 16, 21 and 24 of 83-22 W4M. Development footprints extending outside of the originally proposed Project Area will affect an additional 35 sections of land including: Sections 31-36 Twp 81-21 W4M, Section 25-81-23 W4M, Section 19-82-20 W4M, Sections 22-24 and 27-82-21 W4M, Sections 10, 25, 26 and 35-82-22 W4M, Sections 3-5, 26-29 Twp 82-23 W4M, Sections 7-8, 13-16, 18-19 Twp 83-21 W4M and Sections 6, 8, 10-11, 17, 20-83-22 W4M. These additional sections will be addressed in future historic resource studies for the Project.

4.3.10 Resource Use

Three areas have been delineated to facilitate data presentation and assessment: a Regional Study Area (RSA), a Local Study Area (LSA) and a Land Status Automated System (LSAS) search area. The RSA encompasses resources that are potentially affected by the Project both directly and indirectly and is the same as the Terrestrial Resources RSA. The LSA encompasses resources that are potentially directly affected by the Project (i.e., Project disturbance areas) and is the same as the Terrestrial Resources LSA. The LSAS search area was designated to identify the surface and subsurface lease and licence holders overlapping the LSA. In total, the RSA is 1,987,401 ha and the LSA encompasses 41,025 ha. The Resource Use RSA and LSA are shown in Figure 4.3-1.

4.3.11 Visual Resources

One study area was identified for the assessment of potential effects on visual resources: a Visual Resources RSA. The RSA includes all areas within 20 km of the Project. Areas more than 20 km from the Project are likely to have poor views due to distance and atmospheric conditions with only the general form and outline of major features potentially discernable, even if a line-of-sight potentially exists (USDI 1986). No local study area was derived, since effects on visual resources cannot be assessed from the immediate vicinity of a development. The perceived effects would inevitably grow larger as viewpoints are placed in closer proximity to a development and the observed features would eventually dominate the view. Depending on the nature of the development, a minimum distance for viewpoints must be kept to allow for an assessment of the effects within the context of the existing landscape. The effects are therefore, best assessed on a regional scale.

4.4 TEMPORAL CONSIDERATIONS

The temporal considerations for the EIA are based on the Project Description (Volume 1, Section 1) and include unique conditions that may affect environmental components differently.

The main Project phases include construction, operations, decommissioning and reclamation. For most components, effects analyses considered construction and operations together. Construction is discussed separately, where that activity adds a measurable, short-term change to the component under consideration (e.g., the influence of the initial construction vehicles on air emissions).

Some EIA components, particularly the terrestrial components, examine the Project under three temporal conditions: construction, operation and reclamation activities. Although there will be some sequencing of both the removal and reclamation of terrestrial systems, this sequential development and reclamation process is not defined in the assessments. Assessments consider either that everything is undeveloped, developed or reclaimed. This is a conservative approach so that effects are not underestimated. Pending regulatory approvals, construction of the Project will occur in three phases from 2014 to 2024. Commissioning for each phase will occur upon construction completion. There will be overlap between phases as follows: Phase 1 (2014-2018); Phase 2 (2016 - 2022); and Phase 3 (2019-2024). Operations are scheduled to begin in the fourth quarter of 2017, with the first full year of operations at planned capacity occurring in 2025, and continuing until 2053. The schedule for the Project is detailed in Volume 1, Section 1.7. Additional details on temporal considerations are provided in the relevant EIA sections.

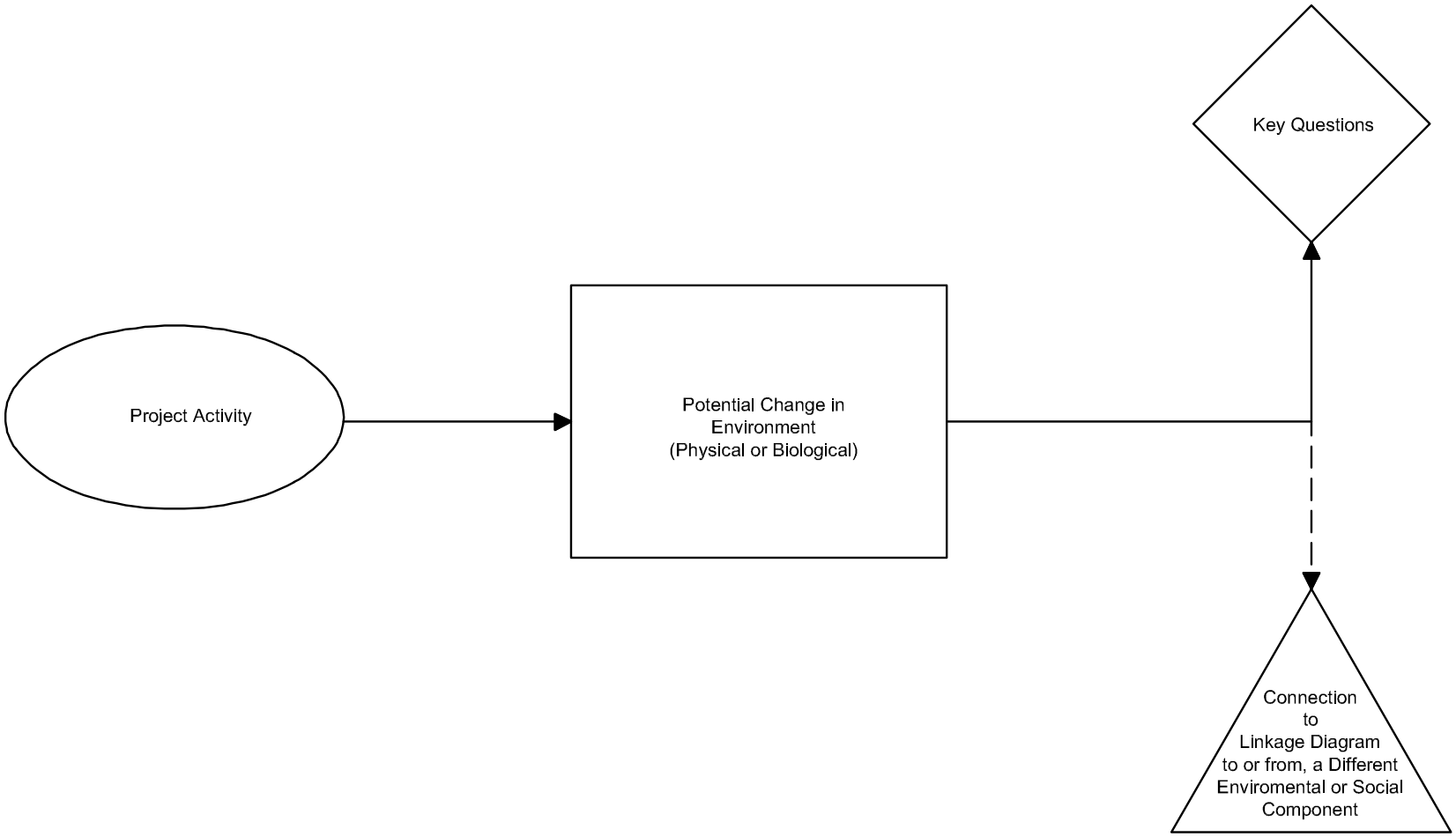
4.5 LINKAGE DIAGRAMS

The purpose of the EIA is to examine the relationships between the Project and its potential effects on human and natural environments. These relationships are defined in terms of linkage diagrams. Linkage diagrams provide a means of defining the interaction between project activities, potential environmental change and the analysis of the key questions. The analysis of this interaction allows for assessment of effects in a broader ecological context.

Linkage diagrams are used to clearly describe how project activities could potentially lead to environmental changes, which could in turn affect specific components of the environment. The general format of the linkage diagrams is illustrated in Figure 4.5-1. Symbols on the linkage diagrams include:

- ovals (project activities);
- rectangles (potential changes in the environment);
- diamonds (key questions); and
- triangles (connection to or from a different environmental or social component).

Linkage diagrams are used as tools to guide the effects analysis, which addresses each link on the diagram. They also show how the different environmental and social components are inter-related. The potential linkages between activities and effects are evaluated to determine whether they apply to the Project.



PROJECT

cenovus ENERGY

PELICAN LAKE
GRAND RAPIDS PROJECT

TITLE

KEY TO LINKAGE DIAGRAMS

Golder Associates
Calgary, Alberta

PROJ	10.1346.0006.5000		FILE No. 11134600065000A004	
DESIGN	KM	22 Nov. 2011	SCALE AS SHOWN	REV. 0
CADD	KJM	24 Nov. 2011	**FIGURE: 4.5-1**	
CHECK	KM	01 DEC. 2011		
REVIEW	DB	01 DEC. 2011		

The EIA considers each link on the component linkage diagram, with the analyses consisting of four main steps:

- identification of Project activities that could contribute to environmental change;
- analysis of potential linkages;
- analysis and classification of effects; and
- identification and description of mitigation measures and monitoring for potential residual effects.

When this evaluation indicates a potential effect, the linkage is ruled valid for assessment. When the evaluation does not indicate a potential effect, the linkage is ruled invalid for the Project and is not assessed in the EIA.

4.6 KEY INDICATOR RESOURCES

The linkage diagram analyses may also include consideration of Key Indicator Resources (KIRs) that provide definable assessment and measurement end points for some environmental components. These KIRs are representative species and/or communities that allow for a focused examination of the ways the Project may result in changes to the environment in terms of issues of importance to the species or communities.

Key Indicator Resources are the environmental attributes or components identified as having legal, scientific, cultural, economic or aesthetic value. The selection of KIRs is based on a process defined in detail by Golder Associates Ltd. (Golder 1999b) and a process used by the Cumulative Environmental Management Association (CEMA 2001). The Key Indicator Priority list of 2001 was revised in 2006 to focus more on ecosystem processes (CEMA 2006). In general, KIRs were selected based on:

- species presence/absence and abundance as determined during baseline surveys and/or historical studies;
- CEMA Sustainable Ecosystems Working Group (SEWG) wildlife indicators;
- importance as a traditional resource;
- monitoring value and/or social importance;
- ecological importance and vulnerability;
- representation of sport, non-sport and forage fish species; and
- species status provincially or federally (e.g., ASRD 2010, 2011; COSEWIC 2010; Species at Risk Public Registry 2011).

The identification of KIRs is not universal throughout the EIA, as some components assess all relevant attributes.

The KIRs selected for the Project are summarized in Table 4.6-1.

4.7 EFFECTS ANALYSES

Effects analyses focus on assessment of potential changes to receptors within the environment due to the construction, operation and reclamation of the Project. Not all key questions used in the Project result in completion of an effects assessment, because the answer to the question may be information on environmental changes that are passed to other components where the effects are evaluated.

The effects analysis includes validation of causal linkages between particular Project activities and potential environmental effects, as described in Section 4.5. These potential linkages between Project activities and environmental change were considered for each EIA component. Where the changes in an environmental component are affected by changes in another environmental component, the linkages are represented as triangles (Figure 4.5-1). Sub-headings are provided for each link on the linkage diagram. Within each of the sub-headings, the potential for the Project to result in an environmental change is determined and the link is classified as valid or invalid.

The process of evaluating potential effects of the Project on receptors may result in the identification of opportunities for project re-design to eliminate or minimize a potential effect. This iterative process is an integral component of the Project design engineering team working with those completing environmental and social effects assessments. Through this process, many potential effects of the Project were eliminated during the process of designing the Project.

Validation of the link includes consideration of the mitigation measures. Mitigation, within the context of this EIA, is defined as follows: “the application of design, construction or scheduling principles to minimize or eliminate potential adverse effects and, where possible, enhance environmental quality” (Sadar 1994). For certain activities, ongoing mitigation (e.g., changes in operating practices) can minimize or eliminate physical or chemical stresses, thereby rendering invalid the link between a Project activity and an environmental change.

Table 4.6-1 Key Indicator Resources and Rationale for Selection

Resource	Key Indicator Resources		Rationale
Aquatic Resources	**Waterbodies**		
	Horsetail Lake	northern pike (sport fish) white sucker (non-sport fish) brook stickleback (forage fish) benthic invertebrates	traditional resource, historical documentation, species with special status
	Kamistikowik Lake	white sucker (non-sport fish) brook stickleback (forage fish) benthic invertebrates	traditional resource, captured during baseline studies
	Unnamed Waterbody HL-DT1-WB1	benthic invertebrates	no fish were captured during spring and/or late summer baseline surveys, and there is no historical documentation of captured fish species
	Unnamed Waterbodies HL-UT1-WB1, KL-DT1-WB1, MR-UT1-UT1, WBR-UT1.1-WB1, WBR-UT1-WB2 and WBR-UT2-WB1	brook stickleback (forage fish) benthic invertebrates	brook stickleback was captured during baseline studies
	Watercourses		
	Unnamed Watercourse AR-UT1	lake chub (forage fish) brook stickleback (forage fish) benthic invertebrates	fish species captured or observed during baseline surveys, historical documentation
	Unnamed Watercourse HL-DT1	northern pike (sport fish) white sucker (non-sport fish) brook stickleback (forage fish) benthic invertebrates	fish species captured or observed during baseline studies, historical documentation, traditional resource
	Unnamed Watercourses HL-UT1.1, MR-UT1 and WBR-UT1	brook stickleback (forage fish) benthic invertebrates	fish species captured or observed during baseline studies
	Unnamed Watercourses HL-UT1 and HL-UT1.2	benthic invertebrates	no fish were captured during baseline studies, and there is no historical documentation of captured fish species
Terrestrial Vegetation and Wetlands	**Plant Community Level**		
	lichen jack pine (a1) communities		caribou habitat communities with restricted spatial distributions
	riparian communities		highly productive areas with high rare plant potential; form important wildlife habitat and corridor areas
	old growth forests		mature forest within the boreal forest with restricted distribution because of the fire regime
	peatlands (bogs and fens)		important boreal forest ecosystems; because of the complex interrelated hydrological, chemical and biotic conditions of peatlands, there is a high level of uncertainty regarding the potential to reclaim peatlands, especially within the Far Future timeframe considered in this assessment
	patterned fens		rare wetlands type with high rare plant potential; susceptible to physical disturbance
	tracked ecological and special plant communities		plant communities with restricted spatial distributions
	productive forests		important to the forest industry

Table 4.6-1 Key Indicator Resources and Rationale for Selection (continued)

Resource	Key Indicator Resources	Rationale
Terrestrial Vegetation and Wetlands (continued)	**Plant Species Level**	
	rare plants	federally and/or provincially recognized plants with restricted spatial, ecological and temporal distributions
	traditional use plants	plants traditionally used by Aboriginal peoples for food, medicine or spiritual purposes
Wildlife	**Mammals**	
	woodland caribou	CEMA SEWG environmental indicator, provincial and federal status (*Species at Risk Act* [SARA] listed species - threatened), the West Side Athabasca River (WSAR) caribou range overlaps the RSA and LSA, ecological importance (prey species), ease of monitoring, traditional importance, abundant information
	moose	CEMA SEWG environmental indicator, economic importance, recreational importance, ecological importance (primary prey species), ease of monitoring, traditional use importance, abundant information
	fisher	CEMA SEWG environmental indicator, provincial status – 'sensitive', ecological importance (carnivore), traditional and economic importance
	Birds	
	Canada warbler	member of the CEMA SEWG environmental indicator bird community - old growth forest birds, SARA listed 'threatened'
	rusty blackbird	riparian health indicator, SARA listed 'special concern'
	yellow rail	federal status (SARA listed species – special concern), representative of the marsh bird community, graminoid and shrubby fen indicator
	Amphibians	
	western toad	provincial status – 'may be at risk', riparian health indicator, ecological importance, abundant information

If a link between a Project activity and an environmental change is considered valid, the key question under consideration is examined. Where the environmental component has defined KIRs, the effects on each KIR are evaluated separately.

Quantitative methods of assessment are used where possible. Predictive modelling is used as a tool in the Air Quality, Hydrogeology, Hydrology, Water Quality and Wildlife Assessments. Risk assessment techniques are used to assess effects to human and wildlife health. Geographic information systems were used to help develop qualitative measures to assess effects on terrestrial resources and resource use. The detailed assessment techniques are described in the EIA component sections.

4.8 EFFECT DESCRIPTION CRITERIA

The environmental and socio-economic effects are assessed in terms of quantitative effects criteria that are defined in this section of the EIA. These effects criteria are based on attributes such as direction, magnitude, geographic extent, duration, reversibility and frequency. An important component is the degree of confidence in the data and analysis. The outcome is a rating system of the environmental consequences of the Project on specific environmental or socio-economic resources.

Residual effects are classified using quantification criteria to determine environmental consequence. Components where the potential change in a parameter results in an effect on another component do not provide an environmental consequence. For example, a change in water quality can result in an effect on fish and fish habitat. Therefore, water quality does not present an environmental consequence. Each effect is first described in terms of the following criteria: direction, magnitude, geographic extent, duration, reversibility and frequency (including seasonal effects). These criteria are defined and considered as per guidelines in the *Canadian Environmental Assessment Act Responsible Authorities Guide* (FEARO 1994).

Direction of an effect may be positive (beneficial), neutral or negative (adverse) with respect to the key question (e.g., a habitat gain for a KIR would be classed as positive, whereas a loss in habitat would be considered negative).

Magnitude describes the intensity, or severity of an effect. It is often described as the amount of change in a measurable parameter or variable relative to the baseline condition, guideline value or other defined standard. The specific definition used to determine the magnitude rating (negligible, low, moderate or high) is defined by each component. The ratings are relative to the characteristics being investigated, the methods available to measure the effect

and the accepted practice in each component. Definitions of magnitude are unique to the characteristics of the measured parameter or variable. The criteria are defined in detail in each component in specific sections describing the assessment methods.

Geographic extent is the spatial area that is affected by the Project in combination with other developments. It is generally based on the local and regional study areas developed by each component. The choice of study area strongly influences the final classification of the residual effect; therefore, the size of the study area is an important consideration (i.e., is it too small or large). The general principle followed in determining study areas follows the guidelines outlined in the *Cumulative Effects Assessment Practitioners Guide* (Hegmann et al. 1999). That document suggests that consideration of a "zone-of-influence" beyond which the effects of the action have diminished to an acceptable or trivial state (i.e., a very low probability of occurrence or acceptably small magnitude) is an acceptable approach.

Duration refers to the length of time over which an environmental effect is detectable. It considers the various phases of the Project, including construction, operation and reclamation during which the effects may occur as well as the length of time for the environmental component to recover from the disturbance.

Reversibility indicates the potential for recovery of the ecological endpoint. An effect is defined as irreversible if the resource element cannot be restored within the long-term as defined under duration. Because ecosystems are dynamic, a site is considered to be restored if natural succession processes are re-established. Reversibility does not necessarily require the establishment of a mature stage, but can be achievement of a development stage that is capable of sustaining the pre-development successional pattern.

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

The effect description criteria for each of the Project EIA components that determine an environmental consequence are detailed in Table 4.8-1. Criteria for direction, reversibility and frequency are the same for all environmental components. Magnitude, geographic extent and duration vary depending on the component. The effect description criteria table also provides numerical scores that are used to determine environmental consequence.

Table 4.8-1 Effect Description Criteria and Numerical Scores for the Project

Resource	Direction[a]	Magnitude[b]	Geographic Extent[c]	Duration[d]	Reversibility[e]	Frequency[f][g]
Noise	positive: a decrease in noise levels neutral: no change in noise levels negative: an increase in noise levels	negligible: no projected increase in ambient sound levels low: increased noise levels do not exceed the ERCB nighttime requirements moderate: increased noise levels exceed the ERCB nighttime requirements by <5 dB high: increased noise levels exceed the ERCB daytime requirements by more than 5 dB	local (0): occurring up to 1.5 km from the lease regional (+1): outside the limit of 1.5 km from the Project boundary	short-term (0): <3 years medium-term (+1): 3 to 30 years long-term (+2): >30 years	reversible (-3) or irreversible (+3)	low (0): occurs once medium (+1): occurs intermittently high (+2): occurs continuously
Hydrogeology/Groundwater	positive, negative or neutral for the measurement endpoints	negligible: no change from the Baseline Case low: near (i.e., slightly above) Baseline Case moderate: above Baseline Case high: substantially above Baseline Case	local: effect restricted to the LSA regional: effect extends beyond the LSA into the RSA beyond regional: effect extends beyond the RSA	short-term: <5 years medium-term: 5 to 30 years long-term: >30 years	reversible or irreversible	low: occurs once moderate: occurs intermittently high: occurs continuously
Hydrology	positive, negative or neutral for the measurement endpoints	negligible: <1% change low: 1 to 5% change moderate: 5 to 15% change high : >15% change	local: effect restricted to the LSA regional: effect extends beyond the LSA into the RSA beyond regional: effect extends beyond the RSA	short-term: <5 years medium-term: 5 to 30 years long-term: >30 years	reversible or irreversible	low: occurs once moderate: occurs intermittently (1 to 10 times per year) high: occurs frequently (>10 times per year)
Water Quality	positive, negative or neutral for the measurement endpoints	negligible: releases do not cause exceedance of guidelines low: releases contribute slightly to existing background exceedances moderate: releases cause exceedance of guidelines (where guidelines were not previously exceeded) high: releases cause substantial exceedance of guidelines	local: effect restricted to the LSA regional: effect extends beyond the LSA into the RSA beyond regional: effect extends beyond the RSA	short-term: <5 years medium-term: 5 to 30 years long-term: >30 years	reversible or irreversible	low: occurs once moderate: occurs intermittently high: occurs continuously

Table 4.8-1 Effect Description Criteria and Numerical Scores for the Project (continued)

Resource	Direction[a]	Magnitude[b]	Geographic Extent[c]	Duration[d]	Reversibility[e]	Frequency[f][g]
Fish and Fish Habitat	positive, negative or neutral for the measurement endpoints	negligible: no measurable change low: <10% change in measurement endpoint moderate: 10 to 20% change in measurement endpoint high: >20% change in measurement endpoint where guidelines or criteria[h] exist: negligible: releases do not cause exceedance of guidelines low: releases contribute slightly to existing background exceedances moderate: releases cause marginal exceedance of guidelines (where guidelines were not previously exceeded) high: releases cause substantial exceedance of guidelines	local: effect restricted to LSA regional: effect extends beyond the LSA into the RSA beyond regional: effect extends beyond the RSA	short-term: <5 years medium-term: 5 to 30 years long-term: >30 years	reversible or irreversible	low: occurs once moderate: occurs intermittently high: occurs continuously
Soil and Terrain	positive, negative or neutral for the measurement endpoints	negligible: no measurable effect (<1%) on the measurement endpoint low: <10% change in measurement endpoint moderate: 10 to 20% change in measurement endpoint high: >20% change in measurement endpoint	local: effect restricted to LSA regional: effect extends beyond the LSA into the RSA beyond regional: effect extends beyond the RSA	short-term: <5 years medium-term: 5 to 30 years long-term: >30 years	reversible or irreversible	low: occurs once moderate: occurs intermittently high: occurs continuously
Terrestrial Vegetation, Wetlands and Forestry	positive, negative or neutral for the measurement endpoints	negligible: no measurable effect to <1% low: 1 to <10% change in measurement endpoint moderate: 10 to 20% change in measurement endpoint high: >20% change in measurement endpoint	local : effect restricted to LSA regional: effect extends beyond the LSA into the RSA beyond regional: effect extends beyond the RSA	short-term: <5 years medium-term: 5 to 30 years long-term: >30 years	reversible or irreversible	low: occurs once moderate: occurs intermittently high: occurs continuously
Wildlife	positive, negative or neutral for the measurement endpoints	negligible: no measurable effect low: <10% change in measurement endpoint moderate: 10 to 20% change in measurement endpoint high: >20% change in measurement endpoint	local : effect restricted to LSA regional: effect extends beyond the LSA into the RSA beyond regional: effect extends beyond the RSA	short-term: <5 years medium-term: 5 to 30 years long-term: >30 years	reversible or irreversible	low: occurs once moderate: occurs intermittently high: occurs continuously

Table 4.8-1 Effect Description Criteria and Numerical Scores for the Project (continued)

Resource	Direction[a]	Magnitude[b]	Geographic Extent[c]	Duration[d]	Reversibility[e]	Frequency[f][g]
Air Emissions Effects on Ecological Receptors – Water Quality and Aquatic Biota	positive: a decrease in acid deposition negative: an increase in acid deposition	negligible (0): emissions cause no exceedance of the critical load or no measurable contribution to a Baseline Case exceedance low (+5): emissions contribute slightly to a Baseline Case exceedance moderate (+10): emissions cause an exceedance of the critical load high (+15): emissions cause a substantial exceedance of the critical load, or contribute substantially to a Baseline Case exceedance	local: effect restricted to the Project Area regional: effect restricted to the Air Quality RSA beyond regional: effect extends beyond the Air Quality RSA	short-term: <5 years medium-term: 5 to 30 years long-term: >30 years	reversible or irreversible	low: occurs once medium: occurs intermittently high: occurs continuously
Air Emissions Effects on Ecological Receptors – Soil	positive, negative or neutral for the measurement endpoints	negligible: <1% change in areas exceeding the critical loads low: <10% change in areas exceeding critical loads moderate: 10 to 20% change in areas exceeding critical loads high: >20% change in areas exceeding critical loads	local: effect restricted to around emission source regional: effect extends throughout the RSA beyond regional: effect extends beyond the RSA	short-term: <5 years medium-term: 5 to 30 years long-term: >30 years	reversible or irreversible	low: occurs once moderate: occurs intermittently high: occurs continuously
Biodiversity	positive, negative or neutral for the measurement endpoints	negligible: no measurable effect low: <10% change in measurement endpoint moderate : 10 to 20% change in measurement endpoint high : >20% change in measurement endpoint	local : effect restricted to LSA regional: effect extends beyond the LSA into the RSA beyond regional: effect extends beyond the RSA	short-term: <5 years medium-term: 5 to 30 years long-term: >30 years	reversible or irreversible	low: occurs once moderate: occurs intermittently high: occurs continuously
Resource Use	positive, negative or neutral for the measurement endpoints	negligible: <1% low: <10% change in measurement endpoint moderate : 10 to 20% change in measurement endpoint high: >20% change in measurement endpoint	local: effect restricted to LSA regional: effect extends beyond the LSA into the RSA beyond regional: effect extends beyond the RSA	short-term: <5 years medium-term: 5 to 30 years long-term: >30 years	reversible or irreversible	low: occurs once moderate: occurs more than once high: occurs continuously
Resource Use – Visual Quality	positive, negative or neutral for the measurement endpoints	negligible: plant site not visible low: plant site visible from a small number of locations moderate: plant site visible from many locations high: plant site visible from all locations	local: effect restricted to LSA regional: effect extends beyond the LSA into the RSA beyond regional: effect extends beyond the RSA	short-term: <5 years medium-term: 5 to 30 years long-term: >30 years	reversible or irreversible	low: occurs once moderate: occurs more than once high: occurs continuously

Table 4.8-1 Effect Description Criteria and Numerical Scores for the Project (continued)

Resource	Direction[a]	Magnitude[b]	Geographic Extent[c]	Duration[d]	Reversibility[e]	Frequency[f][g]
Historical Resources	positive: increase in information negative: loss of resources and/or contextual information	negligible (0): no physical effect occurs or no historical sites are expected to be present low (+5): minimal effect to valuable resources, or resources are few and of low value moderate (+10): moderate or partial effect to resources of high to moderate historical value high (+15): severe physical effect to resources of high historical value	local (0): effect restricted to areas of direct physical disturbance (LSA) regional (+1): effect extends to indirect effects of increased access/use in the region	short-term (0): <5 years medium-term (+1): 5-20 years long-term (+2): >20 years	reversible (-3) or irreversible (+3)	low: occurs once moderate: occurs intermittently high: occurs continuously
Human Health	positive, negative or neutral for the measurement endpoints	negligible: ER[i] <1 and no data gaps or 1<ER<10 due to naturally elevated background exposures and/or conservative exposure assumptions low: no ER due to lack of data, but anecdotal data suggests low hazard additional information necessary to characterize potential effect moderate: 10<ER<20 high: ER>20	local: effect restricted to LSA regional: effect extends beyond the LSA into the RSA beyond regional: effect extends beyond the RSA	short-term: <5 years medium-term: 5-30 years long-term: >30 years	reversible or irreversible	low: occurs once moderate: occurs intermittently high: occurs continuously

(a) Direction: positive or negative effect for measurement endpoints, as defined for the specific component.

(b) Magnitude: degree of change to analysis endpoint.

(c) Geographic Extent: area affected by the effect.

(d) Duration: length of time over which the environmental effect occurs.

(e) Reversibility: effect on the resource (or resource capability) can or cannot be reversed.

(f) Frequency: how often the environmental effect occurs.

(g) Season effects are assessed when relevant for a specific component as Spring, Summer, Fall or Year-Round.

(h) Criteria can include acute and chronic aquatic life as well as No Observed Effects Concentration (NOEC).

(i) ER: exposure ratio, the predicted exposure divided by the exposure limit.

4.8.1 Certainty and Prediction Confidence

The purpose of an EIA is to predict the future conditions of dynamic environmental and social components that are, by their very nature, continuously changing. As a result, within every EIA there is a degree of confidence (certainty or uncertainty) associated with the predictions therein.

The degree of confidence in predictions is assessed for each residual effect predicted in the EIA. Each component uses quantitative methods such as sensitivity analyses or semi-quantitative methods to assess prediction confidence to the extent reasonable. Other sources of information, such as the conservative nature of assumptions and experience gained from other projects, are also included when available.

Assumptions for statistical tests as well as details on models employed as part of the EIA are discussed within the applicable components. This information will generally be provided in the Baseline Reports or appendices to the EIA. The intent of the review is to show that the data meets statistical requirements and that models employed are justified for use in the EIA. Specific information provided for models includes:

- a pictorial representation for all model compartments and linkages including all subroutines and modules;
- a list of all parameters incorporated in the model (reference to pictorial representation above) with a brief description of their purpose, known range of values, whether set from literature, calibrated, or measured (derived from local data) and the value(s) used in the EIA predictions;
- a sensitivity analysis demonstrating which parameters have the largest influence on model output; and
- a discussion of error for the parameters to which the model is most sensitive and for the final model output.

Uncertainty in the Project EIA is also managed through use of assessment scenarios that evaluate what is often referred to as being a worst-case scenario. This conservatism is based on the fact that all developments considered in the EIA are assumed to be at the maximum extent in terms of surface disturbance and operational emissions. However, the vast majority of projects in the region will be operated in phases with progressive reclamation throughout the project's life. Therefore, the actual extent of these developments during operation and reclamation at any one time is overestimated. The application of conservative

assumptions means that predicted effects will likely be greater than the observed effects in the study area.

Based on the results of these methods, confidence is ranked qualitatively based on the following criteria and ranking system:

- quality and quantity of baseline information;
- confidence in measurements or analytical techniques (e.g., modelling) used to assess resource effects; and
- confidence in the success of mitigation and predicted residual effects after mitigation.

Each criterion receives a confidence rating from low to high. The three assigned rankings are then discussed to provide a rationale for the overall confidence rating.

4.8.2 Environmental Consequence

The environmental consequence rating has been developed to provide a measurement that consolidates the results of five criteria: magnitude, duration, frequency, geographic extent and reversibility. The purpose of assigning an environmental consequence is to provide a transparent process that consolidates the results of the criteria into one rating. The consolidation allows the effects from different components to be compared using a common rating so that areas of greatest potential concern can be identified.

Although a numerical system has been developed, the numbers are not an end in themselves. The intention is to use these numbers to provide a rating system that facilitates discussion and decision-making for the Project. The screening system used to estimate an environmental consequence for residual effects is shown in Table 4.8-2. The screening system details a numerical score for each of the parameters considered in evaluating an effect. The total is then used as a guide to assign environmental consequence of residual effects as follows:

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

Table 4.8-2 Screening System for Environmental Consequences

Magnitude (Severity)	Geographic Extent	Duration	Reversibility	Frequency
negligible (0)	local (0)	short-term (0)	reversible (-3)	low (0)
low (+5)	regional (+1)	medium-term (+1)		moderate (+1)
moderate (+10)	beyond regional (+2)	long-term (+2)	irreversible (+3)	high (+2)
high (+15)				

In some cases, the level of confidence on a prediction is low such that an estimate of environmental consequence cannot be made with a sufficient degree of certainty. Undetermined ratings are accompanied by recommendations for monitoring predictions and adaptive management success. Recommended follow-up activities are detailed within each of the EIA component sections.

4.8.3 Management and Monitoring

Cenovus uses the environmental consequence ratings to define the management approaches to be implemented for the predicted environmental effect. The management for the predicted effects could include:

- re-engineering of systems;
- redesign of operational plans;
- enhancement of mitigation plans or processes;
- improvements in monitoring systems to enhance information on effects; or
- collection of additional information to reduce levels of uncertainty in the assessment.

Cenovus views the definition of environmental consequences of Project effects as an important step to ensure sustainability of the environment, and uses this information to guide development of its Environmental Management System, detailed in Volume 1. Cenovus's current or planned monitoring activities are detailed in Volume 2, Appendix 2-V.

5 PROJECTS CONSIDERED IN THE ASSESSMENT CASES

The assessment cases for the EIA include the Baseline Case, the Application Case and the PDC. The Application Case includes the Baseline Case and the Project. The PDC considers any project or activity that has been publicly disclosed up to six months prior to the submission of the Project application and EIA report. The developments included in the three cases are listed in Table 5-1. Locations of developments included in the assessment cases are shown in Figure 5-1.

The EIA considers the effects of the developments included in each of the assessment cases, and predicts changes as a result of the addition of projects. The data available for these developments are taken from project applications, EIAs, update reports and other project-specific information that is publicly available. In addition, the potential effects of Baseline Case developments are monitored through the actions of project-specific and regional monitoring programs.

The only development added to the Baseline Case for consideration under the Application Case is the Project. The result of this focusing of the assessment is that any changes in environmental or social components identified from those reported for the Baseline Case are thereby directly associated with the Project. The data for the potential effects of the Project are based on the Project design and operational information, as provided in Volume 1 of the application.

The PDC adds the potential effects of a number of possible developments to the effects predicted for the Project in combination with the existing and approved developments. The determination of projects to be added in the PDC was made in compliance with the TOR conditions (AENV 2011) that stated that a planned project was one that had been publicly disclosed up to six months prior to the submission of the Project application and EIA (AENV 2011). Data used for the planned developments are based on:

- information provided by the developer in its public disclosure document;
- data that has been shown to be typical of similar types of operations in the region;
- information from Planned Development project applications and EIAs if such documents are available; and
- specific information provided by the developer on its proposed development, where available.

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Canadian Natural Horizon In-Situ Project
Total Joslyn Creek SAGD Phases 1 & 2 Commercial Project
Canadian Natural Horizon Oil Sands Project
PCOSI Fort Hills Mining Project
Syncrude Aurora North Mine
Shell Jackpine Mine - Phase 1
Imperial Oil Kearl Oil Sands Project
Syncrude Aurora South Mine
Husky Sunrise Thermal Project
Suncor Firebag SAGD
Albian Sands Muskeg River Mine and Expansion
Suncor Lease 86/17
Birch Mountain Resources Muskeg Valley Quarry
Suncor North Steepbank Extension
Suncor Millennium Mine
Suncor MD9
Suncor South Tailings Pond Project
Petro-Canada Dover SAGD-In-Situ and Vapex Pilot
Petro-Canada MacKay River In-Situ
Syncrude Mildred Lake Mining and Upgrading
Southern Pacific Resources Corp. McKay Project
Northland Forest Products Ltd. Sawmill
Suncor Voyageur Upgrader
Petro-Canada Meadow Creek In-Situ
OPTI/Nexen Long Lake Pilot and Commercial Project
OPTI/Nexen Long Lake Long Lake South
JACOS Hangingstone-In-Situ Pilot
ConocoPhillips Canada Surmont Commercial SAGD
Laricina Energy Ltd. Saleski Pilot
Laricina Energy Ltd. Germain Pilot
Husky McMullen Pilot
Statoil Leismer Demonstration Project
Cenovus Narrows Lake Project
MEG Christina Lake Regional Projects
Cenovus Christina Lake Thermal Project
Petrobank Whitesands Expansion
Petrobank Whitesands Pilot Project
Petrobank May River Project
Devon Jackfish SAGD Project 2
Devon Jackfish SAGD Project
Blackpearl Blackrod SAGD Pilot Project
Cenovus Foster Creek Pilot and Phases 1 and 2
Canadian Natural Primrose East (Burnt Lake) In-Situ Oil Sands Project
Husky Caribou Lake Thermal Demonstration Project
Canadian Natural Primrose In-Situ Project
Imperial Oil Nabiye Expansion
OSUM Taiga Project
Canadian Natural Wolf Lake In-Situ Project
Husky Tucker Thermal Project
Imperial Oil Cold Lake In-Situ Project
Cold Lake Imperial Oil Mahihkan North Expansion
Shell Orion EOR Project
Fort Chipewyan
Fort McMURRAY
Anzac
Cheecham
Janvier
Chard Siding
Quigley
COLD LAKE
BONNYVILLE
LAC LA BICHE
ATHABASCA
SMOKY LAKE
ST. PAUL
SLAVE LAKE
BARRHEAD
WESTLOCK
Thornhild
Fort McKay
ALBERTA
SASKATCHEWAN

LEGEND

- EXISTING AND APPROVED DEVELOPMENT
- PLANNED DEVELOPMENT
- PROJECT AREA
- OPEN WATER
- WATERCOURSE
- INDIAN RESERVE
- PAVED ROAD
- UNPAVED ROAD
- RAILWAY
- COMMUNITY

REFERENCE

DATUM: NAD83 PROJECTION: UTM ZONE 12

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PROJECT

cenovus ENERGY

PELICAN LAKE
GRAND RAPIDS PROJECT

TITLE

DEVELOPMENTS - EXISTING, APPROVED AND PLANNED

Golder Associates
Calgary, Alberta

PROJECT	10.1346.0006.5000		FILE No.	1-10134600065000A0
DESIGN	KM	22 Nov. 2011	SCALE AS SHOWN	REV. 0
CADD	KJM	24 Nov. 2011		
CHECK	KM	01 DEC. 2011		
REVIEW	DB	01 DEC. 2011		

FIGURE: 5-1

Table 5-1 Assessment Cases

Developments Included in Assessment Cases	
Baseline Case (Existing + Approved Developments)	• **Athabasca Oil Sands Corp:** MacKay River Pilot Project, Dover Pilot • **BlackPearl Resources Inc.:** Blackrod SAGD Pilot Project • **Connacher Oil and Gas Ltd.:** Great Divide Oil Sands Project • **Laricina Energy Ltd.:** Germain Pilot, Saleski Pilot • **Southern Pacific Resource Corp.:** McKay Project • **Cenovus Energy**: Pelican Lake Wabiskaw Operations, SAGD Well Pair Test Project • **Canadian Natural Resources Ltd**.: Brintnell Polymer Flood • **Aggregate Resources** • **Forestry** • **Gas Plants and Compressors** • **Municipalities and Communities** • **Pipelines, Roadways and Others**
Application Case (Existing + Approved Developments + Cenovus Pelican Lake Grand Rapids Project)	• **Cenovus Energy:** Pelican Lake Grand Rapids Project
Planned Development Case (Existing + Approved Developments + Cenovus Pelican Lake Grand Rapids Project + Planned Developments)	• **Athabasca Oil Sands Corp.:** MacKay River Commercial Project • **BlackPearl Resources Inc.:** Blackrod Commercial Project • **Dover Operating Corp.:** Dover Commercial Project • **Husky Energy:** Husky McMullen Thermal Pilot Project • **Laricina Energy Ltd.:** Germain Phase 1, Saleski Phase 1 • **Southern Pacific Resources:** McKay Thermal Project • **Sunshine Oil Sands Ltd.:** West Ells Project • **Cenovus Energy**: Pelican Lake Wabiskaw Operations expansion • **Canadian Natural Resources Ltd**.: Brintnell Polymer Flood • **Aggregate Resources:** • **Forestry** • **Major Pipelines, Utility Corridors, Roadways and Others** • **Municipal Growth**

Note: Planned Developments include projects publicly disclosed 6 months before the writing of this report.

A summary of the developments considered in the Project EIA and the environmental or social components in which each development were specifically considered is provided in Table 5-2 for the Application Case and Table 5-3 for the PDC. Where a project is shown not to be considered by a component that means there is no measurable overlap of potential effects with the Project.

Table 5-2 Developments Included and Components Considered in the Baseline and Application Cases

Development	EIA Component											
	Air Quality	Noise	Health	Air Emissions Effects	Hydrogeology	Aquatic Resources	Terrestrial Resources	Traditional Land Use	Resource Use	Historical Resources	Visual Resources	Socio-Economics
Cenovus Pelican Lake Grand Rapids Project (Application Case only)	●	●	●	●	●	●	●	●	●	●	●	●
Athasbasca Oil Sands Corp.												
MacKay River Pilot Project	●	n/a	●	●	n/a	n/a	●	●	●	n/a	n/a	n/a
Dover Pilot	●	n/a	●	●	n/a	n/a	●	●	●	n/a	n/a	n/a
BlackPearl Resources Inc.												
Blackrod SAGD Pilot Project	●	n/a	●	●	●	●	●	●	●	●	n/a	●
Connacher Oil and Gas Limited												
Great Divide Oil Sands Project	●	n/a	●	●	n/a	n/a	●	●	●	n/a	n/a	n/a
Laricina Energy Ltd.												
Germain Pilot	●	n/a	●	●	●	●	●	●	●	●	n/a	●
Saleski Pilot	●	n/a	●	●	●	●	●	●	●	●	n/a	●
Southern Pacific Resource Corp.												
McKay Pilot	●	n/a	●	●	n/a	n/a	●	●	●	n/a	n/a	n/a
Cenovus Energy Ltd.												
Pelican Lake Wabiskaw Operations	●	●	●	●	●	●	●	●	●	●	●	●
SAGD Well Pair Test Project	●	●	●	●	●	●	●	●	●	●	●	●
Canadian Natural Resources Ltd.												
Brintnell Polymer Flood	●	●	●	●	●	●	●	●	●	n/a	n/a	●
Aggregate Resources	●	n/a	●		n/a	n/a	●	●	●	●	n/a	●
Forestry	●	n/a	●	●	n/a	n/a	●	●	●	●	n/a	●
Gas Plants and Compressors	●	n/a	●	●	n/a	n/a	●	●	●	●	n/a	●
Municipalities and Communities	●	n/a	●	●	●	●	●	●	●	●	●	●
Pipelines, Roadways and Others	●	n/a	●	●	●	●	●	●	●	●	●	●

n/a = Not applicable.

● = Included in assessment.

Table 5-3 Developments Included and Components Considered in the Planned Development Case

Developments	EIA Component											
	Air Quality	Noise	Health	Air Emissions Effects	Hydrogeology	Aquatic Resources	Terrestrial Resources	Traditional Land Use	Resource Use	Historical Resources	Visual Resources	Socio-Economics
Athabasca Oil Sands Corporation												
MacKay River Commercial Project	●	n/a	●	●	n/a	n/a	●	●	●	n/a	n/a	n/a
BlackPearl Resources Inc.												
Blackrod Commercial Project	●	n/a	●	●	●	●	●	●	●	●	n/a	n/a
Connacher Oil and Gas Limited												
Great Divide SAGD Expansion Project	●	n/a	●	●	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Dover Operating Corp.												
Dover Commercial Project	●	n/a	●	●	n/a	n/a	●	●	●	n/a	n/a	n/a
Husky Energy												
Husky McMullen Thermal Pilot Project	●	n/a	●	●	●	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Laricina Energy Ltd.												
Germain Phase 1	●	n/a	●	●	●	●	●	●	●	●	n/a	●
Saleski Phase 1	●	n/a	●	●	●	●	●	●	●	●	n/a	n/a
Southern Pacific Resources												
McKay Thermal Project	●	n/a	●	●	n/a	n/a	●	●	●	n/a	n/a	n/a
Sunshine Oilsands Limited												
West Ells Project	●	n/a	●	●	n/a	n/a	●	●	●	n/a	n/a	●
Cenovus Energy Inc.												
Pelican Lake Wabiskaw Operations	●	●	●	●	n/a	n/a	n/a	n/a	n/a	n/a	n/a	●
SAGD Well Pair Test Project	●	●	●	●	●	n/a	n/a	n/a	n/a	n/a	n/a	●
Canadian Natural Resources Ltd.												
Brintnell Polymer Flood	●	n/a	●	●	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Aggregate Resources	●	n/a	●	●	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Forestry	●	n/a	●	●	n/a	●	●	●	●	●	n/a	n/a
Major Pipelines, Utility Corridors, Roadways and Others	●	n/a	●	●	●	●	●	●	●	●	n/a	n/a
Municipal Growth	●	n/a	●	●	●	●	●	●	●	●	n/a	●

n/a = Not applicable.
● = Included in assessment.

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7 ABBREVIATIONS

%	Percent
<	Less than
>	More than
°C	Temperature in degrees Celsius
AAAQO	Alberta Ambient Air Quality Objectives
AENV	Alberta Environment and Water
ASRD	Alberta Sustainable Resource Development
AVI	Alberta Vegetation Inventory
BCN	Bigstone Cree Nation
C&R	Conservation and Reclamation
CCS	Carbon Capture and Storage
CEA	Cumulative Effects Assessment
CEMA	Cumulative Environmental Management Association
Cenovus	Cenovus Energy Inc.
CO_2	Carbon dioxide
dB	Decibel, a measure of sound power
E	East
e.g.	For example
EIA	Environmental Impact Assessment
EPEA	*Environmental Protection and Enhancement Act*
ER	Exposure ratio
ERCB	Energy Resources Conservation Board
et.al.	Group of authors
EUB	Alberta Energy and Utilities Board (predecessor to the Energy Resources Conservation Board [ERCB])
GHG	Greenhouse Gas
GIS	Geographic Information System
Golder	Golder Associates Ltd.
ha	Hectare
i.e.	That is
IR	Indian Reserve
keq/ha/yr	Kiloequivalent per hectares per year
KIRs	Key Indicator Resources
km	Kilometre
km^2	Square

LIDAR	Light Detection and Ranging
LSA	Local Study Area
m	Metre
masl	metres above sea level
M.D.	Municipal District
N	North
NAD	North American Datum
NOEC	No Observed Effects Concentration
NO_X	Oxides of nitrogen (NO, NO_2) (gas), or all nitrogen species (e.g., NO_X, N_2O, N_3O)
NRCB	Natural Resources Conservation Board
NTDB	National Topographic Database
PAI_s	Soil net Potential Acid Input
PDC	Planned Development Case
PM	Particulate matter
$PM_{2.5}$	Particulate matter with a mean aerodynamic diameter of 2.5 microns (µm) or smaller
QA/QC	Quality Assurance/Quality Control
RAMP	Regional Aquatics Monitoring Program
RFMA	Registered Fur Management Areas
RMWB	Regional Municipality of Wood Buffalo
RSA	Regional Study Area
RSDS	Regional Sustainable Development Strategy for the Athabasca Oil Sands
S	South
SAGD	Steam-Assisted Gravity Drainage
SAP	Solvent Aided Process
SARA	Species at Risk
SEWG	Sustainable Ecosystems Working Group
SO_2	Sulphur dioxide
TOR	Terms of Reference
TLU	Traditional Land Use
UTM	Universal Transverse Mercator
W	West
W4M	West of the Fourth Meridian
WBEA	Wood Buffalo Environmental Association

8 GLOSSARY

Acidification — The decrease of acid neutralizing capacity in water, or base saturation in soil, caused by natural or anthropogenic processes. Acidification is exhibited as the lowering of pH.

Aeolian — Sedimentary deposits arranged by wind, such as sand and other loose substrates in dunes.

Alberta Ambient Air Quality Objective (AAAQO) — Alberta Ambient Air Quality Objective levels are established for several air compounds under Section 14 of the *Environmental Protection and Enhancement Act* (EPEA). The AAAQOs form an integral part of the management of air quality in the province, and are used for reporting the state of the environment, establishing approval conditions, evaluating proposed facilities with air emissions, assessing compliance near major air emission sources and guiding monitoring programs.

Alberta Energy and Utilities Board (EUB) now the Energy Resources Conservation Board (ERCB) — An independent, quasi-judicial agency of the Government of Alberta, the EUB was created in February 1995 by the amalgamation of the Energy Resources Conservation Board and the Public Utilities Board. The purpose of the EUB is to ensure that the discovery, development, and delivery of Alberta's resources take place in a manner that is fair, responsible and in the public interest.

Alberta Environment (AENV) — **Alberta Environment and Water (AEW):** Provincial ministry that looks after the following: establishes policies, legislation, plans, guidelines and standards for environmental management and protection; allocates resources through approvals, dispositions and licenses, and enforces those decisions; ensure water infrastructure and equipment are maintained and operated effectively; and prevents, reduces and mitigates floods, droughts, emergency spills and other pollution-related incidents.

Alberta Sustainable Resource Development (ASRD) — Alberta Sustainable Resource Development (ASRD) is one of the Alberta Ministries whose mission is to encourage balanced and responsible use of Alberta's natural resources through the application of leading practices in management, science and stewardship. ASRD works with Albertans across the province to ensure a balance between the economic, environmental and social values of our province. They fight forest fires, manage fish and wildlife, oversee the development of Alberta's forests, and manage the use of public lands.

Ambient Sound Level Background sound level: the sound level that is present in the acoustic environment of a defined area. Ambient sound can include sources from transportation equipment, animals and nature.

Application Case The Environmental Impact Assessment (EIA) case including the project that is the subject of the application, existing environmental conditions, and existing and approved projects or activities.

Aquifer A body of rock or soil that contains sufficient amounts of saturated permeable material to yield economic quantities of water to wells or springs.
Any water-saturated body of geological material from which enough water can be drawn at a reasonable cost for the purpose required. An aquifer in an arid prairie area required to supply water to a single farm may be adequate if it can supply 1 m^3/d. This would not be considered an aquifer by any industry looking for cooling water in volumes of 10,000 m^3/d. A common usage of the term aquifer is to indicate the water-bearing material in any area from which water is most easily extracted.

Attenuation (Noise) A reduction in sound level that occurs with sound propagation over distance by means of physical dissipation or absorption mechanisms, or a reduction in sound level that occurs by means of noise control measures applied to a sound source.

Baseline Case The EIA assessment case that includes existing environmental conditions as well as existing and approved projects or activities.

Benthic Invertebrates Invertebrate organisms living at, in or in association with the bottom (benthic) substrate of lakes, ponds and streams. Examples of benthic invertebrates include some aquatic insect species (such as caddisfly larvae) that spend at least part of their life stages dwelling on bottom sediments in the waterbody.

These organisms play several important roles in the aquatic community. They are involved in the mineralization and recycling of organic matter produced in the water above, or brought in from external sources, and they are important second and third links in the trophic sequence of aquatic communities. Many benthic invertebrates are major food sources for fish.

Biodiversity	The variety of plant and animal life in a particular habitat (e.g., plant community or a country). It includes all levels of organization, from genes to landscapes, and the ecological processes through which these levels are connected.
Biotic	The living organisms in an ecosystem.
Bog	Sphagnum or forest peat materials formed in an ombrotrophic environment due to the slightly elevated nature of the bog, which tends to disassociate it from the nutrient-rich groundwater or surrounding mineral soils. Characterized by a level, raised or sloping peat surface with hollows and hummocks. Mineral-poor, acidic and peat-forming wetlands that receives water only from precipitation.
Boreal Forest	The northern hemisphere, circumpolar, tundra forest type consisting primarily of black spruce and white spruce with balsam fir, birch and aspen.
Borrow Pit	A bank or pit from which earth is taken for use in filling or embanking. Often used in the construction of roads.
Carnivore	Any of an order of mammals that feed chiefly on flesh or other animal matter rather than plants.
Critical Load	A quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge. For waterbody acidification, the critical load represents an estimate of the amount of acidic deposition below which significant adverse changes are not expected to occur in a lake's ecosystem.
Diluent	A light liquid hydrocarbon added to bitumen to lower viscosity and density. The thinning agent is used by the oil sands to make heavy oil more fluid so it can be transported.
Drawdown	Lowering of water level caused by pumping. It is measured for a given quantity of water pumped during a specified period, or after the pumping level has become constant.
Ecodistrict	A broad subdivision of the landscape based on differences in landscape pattern, topography and dominant soils.

Ecosystem	An integrated and stable association of living and non-living resources functioning within a defined physical location. A community of organisms and its environment functioning as an ecological unit. For the purposes of assessment, the ecosystem must be defined according to a particular unit and scale.
Environmental Impact Assessment (EIA)	A review of the effects that a proposed development will have on the local and regional environment.
Exposure Ratio (ER) or Hazard Quotient (HQ)	A comparison between total exposure from all predicted routes of exposure and the exposure limits for chemicals of concern. This comparison is calculated by dividing the predicted exposure by the exposure limit. Also referred to as hazard quotient (HQ).
Fen	Sedge peat materials derived primarily from sedges with inclusions of partially decayed stems of shrubs formed in a eutrophic environment due to the close association of the material with mineral rich waters. Minerotropic peat-forming wetlands that receive surface moisture from precipitation and groundwater. Fens are less acidic than bogs, deriving most of their water from groundwater rich in calcium and magnesium.
Footprint	The proposed development area that directly affects the soil and vegetation components of the landscape.
Forage Fish	Small fish that provide food for larger fish (e.g., longnose sucker, fathead minnow).
Fragmentation	The process of breaking into pieces or sections. For example, dividing contiguous tracts of land into smaller and less connected sections through site clearing (e.g., for roads).
Geographic Information System (GIS)	Computer software designed to develop, manage, analyze and display spatially referenced data.
Glaciolacustrine (or Glacio-Lacustrine)	Sediments that were deposited in lakes that formed at the edge of glaciers when the glaciers receded. Glaciolacustrine sediments are commonly laminar deposits of fine sand, silt and clay.
Graminoid	Grasses and grass-like plants such as sedges and rushes.
Groundwater	That part of the subsurface water that occurs beneath the water table, in soils and geologic formations that are fully saturated.

Habitat	The place or environment where a plant or animal naturally or normally lives or occurs.
Historic Resources	Works of nature or of humans, valued for their palaeontological, archaeological, prehistoric, historic, cultural, natural, scientific or aesthetic interest.
Home Range	The area within which an animal normally lives, and traverses as part of its annual travel patterns.
Hummocky	A very complex sequence of slopes extending from somewhat rounded depression or kettles or various sizes to irregular to conical knolls or knobs. There is a general lack of concordance between knolls and depressions.
Hydrogeology	The study of the factors that deal with subsurface water (groundwater) and the related geologic aspects of surface water. Groundwater as used here includes all water in the zone of saturation beneath the earth's surface, except water chemically combined in minerals.
Hydrology	The science of waters of the earth, their occurrence, distribution, and circulation; their physical and chemical properties; and their reaction with the environment, including living beings.
In-Situ	Also known as "in place". Refers to methods of extracting deep deposits of oil sands without removing the groundcover. The in-situ technology in oil sands uses underground wells to recover the resources with less impact to the land, air and water than for oil sands mining.
Key Indicator Resources (KIRs)	Environmental attributes or components identified as a result of a social scoping exercise as having legal, scientific, cultural, economic or aesthetic value.
Lichen	Any complex organism of the group Lichenes, composed of a fungus in symbiotic union with an alga and having a greenish, grey, yellow, brown, or blackish thallus that grows in leaflike, crustlike, or branching forms on rocks, trees and other surfaces.
Local Study Area (LSA)	Defines the spatial extent directly or indirectly affected by the project.

Mesic	A moderate soil moisture regime value whereby water is removed somewhat slowly in relation to supply; neither wet nor dry. Available soil water reflects climatic inputs.
Moraine	Sediment generally consisting of well compacted material that is nonstratified and contains a heterogeneous mixture of particle sizes, often in a mixture of sand, silt, and clay that has been transported beneath, beside, on, within and in front of a glacier and not modified by any intermediate agent.
Old Growth Forest	An ecosystem distinguished by old trees and related structural attributes. Old growth encompasses the later stages of stand development that typically differ from earlier stages in a variety of characteristics which may include tree size, accumulations of large dead woody material, number of canopy layers, species, composition, and ecosystem function. Old growth forests are those forested areas where the annual growth equals annual losses, or where the mean annual increment of timber volume equals zero. They can be defined as those stands that are self-regenerating (i.e., having a specific structure that is maintained).
Particulate Matter	A mixture if small particles and liquid droplets, often including a number of chemicals, dust and soil particles.
Patterned Fen	Peatlands that display a distinctive pattern due to alterations between open wet areas (flarks) and drier shrubby to wooded areas (strings).
Peatland	Areas where there is an accumulation of peat material at least 40 cm thick. These are represented by bog and fen wetlands types.
Planned Development Case (PDC)	The Planned Development Case includes the Application Case components and planned developments that have been publicly disclosed at least six months prior to submission of the Environmental Impact Assessment.
Rare Plants	A native plant species found in restricted areas, at the edge of its range or in low numbers within a province, state, territory or country.
Receptor	The person or organism subjected to exposure to chemicals or physical agents.

Regional Aquatics Monitoring Program (RAMP)	RAMP was established to determine, evaluate and communicate the state of the aquatic environment in the Athabasca Oil Sands Region.
Regional Study Area (RSA)	Defines the spatial extent related to the cumulative effects resulting from the project and other regional developments.
Riparian	Refers to terrain, vegetation or simply a position next to or associated with a stream, floodplain or standing waterbody.
Risk	The likelihood or probability that the toxic effects associated with a chemical or physical agent will be produced in populations of individuals under their actual conditions of exposure. Risk is usually expressed as the probability of occurrence of an adverse effect, i.e., the expected ratio between the number of individuals that would experience an adverse effect at a given time and the total number of individuals exposed to the factor. Risk is expressed as a fraction without units and takes values from 0 (absolute certainty that there is no risk, which can never be shown) to 1.0, where there is absolute certainty that a risk will occur.
Risk Assessment	Process that evaluates the probability of adverse effects that may occur, or are occurring on target organism(s) as a result of exposure to one or more stressors.
Runoff	The portion of water from rain and snow that flows over land to streams, ponds or other surface waterbodies. It is the portion of water from precipitation that does not infiltrate into the ground, or evaporate.
Sedge	Any plant of the genus *Carex*, perennial herbs, often growing in dense tufts in marshy places. They have triangular jointless stems, a spiked inflorescence and long grass-like leaves which are usually rough on the margins and midrib. There are several hundred species.
Sediment	Solid material that is transported by, suspended in, or deposited from water. It originates mostly from disintegrated rocks; it also includes chemical and biochemical precipitates and decomposed organic material, such as humus. The quantity, characteristics and cause of the occurrence of sediment in streams are influenced by environmental factors. Some major factors are degree of slope, length of slope soil characteristics, land usage and quantity and intensity of precipitation.

Soil Moisture Regime	The available moisture supply for plant growth on a relative scale ranging from very dry (xeric) to very wet (hydric) classes.
Solvent Aided Process (SAP)	Solvent aided process is an enhancement of steam-assisted gravity drainage where a small amount of solvent (5 to 20% by mass) is added to the injected steam. When this steam solvent mixture contacts the reservoir, the oil in the reservoir drains faster as its viscosity is reduced due to both dilution and heating. This results in greater and faster recovery, improved economics, and reduced carbon dioxide (CO_2) emissions from steam generation.
Species	A group of organisms that actually or potentially interbreed and are reproductively isolated from all other such groups; a taxonomic grouping of genetically and morphologically similar individuals; the category below genus.
Sport/Game Fish	Large fish caught for food or sport (e.g., northern pike, Arctic grayling).
Steam-Assisted Gravity Drainage (SAGD)	An in-situ oil sands recovery technique that involves the use of two horizontal wells, one to inject steam and a second to produce the bitumen.
Suspended Sediments	Particles of matter suspended in the water. Measured as the oven dry weight of the solids, in mg/L, after filtration through a standard filter paper. Less than 25 mg/L would be considered clean water, while an extremely muddy river might have 200 mg/L of suspended sediments.
Traditional Land Use (TLU)	Activities involving the harvest of traditional resources such as hunting and trapping, fishing, gathering medicinal plants and travelling to engage in these activities. Land use maps document locations where the activities occur or are occurring.
Waterbody	A general term that refers to ponds, bays, lakes, estuaries and marine areas.
Watercourse	A general term that refers to riverine systems such as creeks, brooks, streams and rivers.
Watershed	The area of land bounded by topographic features that drains water to a larger waterbody such as a river, wetlands or lake. Watershed can range in size from a few hectares to thousands of kilometres.

Wetlands Wetlands are land where the water table is at, near or above the surface or which is saturated for a long enough period to promote such features as wet-altered soils and water tolerant vegetation. Wetlands include organic wetlands or "peatlands," and mineral wetlands or mineral soil areas that are influenced by excess water but produce little or no peat.

Wildlife Under the *Species at Risk Act*, wildlife is defined as a species, subspecies, variety or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus that is wild by nature and is native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.

Worst-Case A semi-quantitative term referring to the maximum possible exposure, dose or risk that can conceivably occur, whether or not this exposure, dose, or risk actually occurs or is observed in a specific population. It should refer to a hypothetical situation in which everything that can plausibly happen to maximize exposure, dose, or risk does happen. The worst-case may occur in a given population, but since it is usually a very unlikely set of circumstances in most cases, a worst-case estimate will be somewhat higher than what occurs in a specific population.

Xeric Soil moisture conditions where water is removed very rapidly in relation to supply. Soil is only moist for a very short time following precipitation.

APPENDIX 2-I

FINAL TERMS OF REFERENCE

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PURPOSE OF THE TERMS OF REFERENCE

Cenovus Energy Inc. (Cenovus) is seeking approval for the proposed Pelican Lake Grand Rapids Project (the Project). The Project is located in northeast Alberta, about 300 km north of Edmonton, primarily in Townships 81 to 83, Ranges 20 to 23, West of the Fourth Meridian. The closest populated areas are the hamlet of Wabasca-Desmarais (Wabasca) and the Bigstone Cree Nation.

The Project will use Steam-Assisted Gravity Drainage (SAGD) technology for enhanced oil recovery. Once the SAGD operation is established, Cenovus may incorporate co-injection of light hydrocarbons, referred to as Solvent Aided Process (SAP), where economically feasible. The Project is expected to have a maximum production capacity of approximately 180,000 barrels of oil per day and will be constructed in three phases over the estimated 40-year life of the Project. The central processing site will cover about 1.5 km^2. The proposed development is expected to include up to 200 well pads over the life of the Project, supporting up to 3,700 well pairs. Wherever reasonably possible, the Project will use existing clearings and infrastructure.

The Project is expected to require other related infrastructure projects including electrical power lines, fuel gas pipelines, produced oil pipelines, and diluent/condensate supply pipelines. These related infrastructure projects will be applied for separately, as appropriate.

SCOPE OF THE EIA REPORT

Cenovus shall prepare and submit an EIA report that examines the environmental and socio-economic effects of the Project.

The EIA report shall be prepared considering all applicable provincial and federal legislation, codes of practice, guidelines, standards and directives.

The EIA report shall be prepared in accordance with these Terms of Reference and the environmental information requirements prescribed under EPEA and associated regulations, and the *Canadian Environmental Assessment Act* if applicable. The EIA report will form part of Cenovus's application to the Energy Resources Conservation Board (ERCB). An EIA report summary will also be included as part of the ERCB Application.

Cenovus shall refer to the *Guide to Preparing Environmental Impact Assessment Reports for In-Situ Projects in Alberta* published by Alberta Environment (the

In-Situ Guide) and these Terms of Reference when preparing the Environmental Impact Assessment report. In any case where there is a difference in requirements between the Guide and these Terms of Reference, the Terms of Reference shall take precedence.

CONTENT OF THE EIA REPORT

1 PUBLIC ENGAGEMENT AND ABORIGINAL CONSULTATION

[A] Describe the concerns and issues expressed by the public and the actions taken to address those concerns and issues, including how public input was incorporated into the Project development, impact mitigation and monitoring.

[B] Describe the concerns and issues expressed by aboriginal communities and the actions taken to address those concerns and issues, including how aboriginal community input was incorporated into the Project design, EIA development, impact mitigation, monitoring and reclamation. Describe consultation undertaken with aboriginal communities and groups with respect to traditional ecological knowledge and traditional use of land.

[C] Discuss Cenovus's view on the effectiveness of its aboriginal consultation, considering the approved First Nations Consultation Plan for the Project.

[D] Describe plans to maintain the public engagement and aboriginal consultation process following completion of the EIA report to ensure that the public and aboriginal peoples will have an appropriate forum for expressing their views on the ongoing development, operation and reclamation of the Project.

2 PROJECT DESCRIPTION

2.1 OVERVIEW

[A] Provide a brief project description in sufficient detail to provide context for the EIA, including:

a) Cenovus information;

b) proposed extraction and bitumen processing technology;

c) amount and source of energy required for the Project;

d) water supply and disposal requirements, including process water and potable water requirements;

e) proposed method to transport product to markets; and

f) development plan and schedule.

[B] Provide maps and/or drawings of the Project components and activities including:

a) existing infrastructure, leases and clearings, including exploration clearings;

b) proposed central processing/treatment and field facilities;

c) other buildings and infrastructure (pipelines and utilities);

d) temporary structures;

e) transportation and access routes;

f) on-site hydrocarbon storage;

g) containment structures such as retention ponds and storage ponds (e.g., lime sludge, stormwater runoff, boiler blow-down);

h) water wells/intakes, pipelines, and storage structures;

i) sources of aggregate resources, borrow material and other construction material and locations of any stockpiles that will be developed; and

j) waste storage area and disposal sites.

[C] Discuss the implications of a delay in proceeding with the Project, or any phase of the Project, or not going ahead with the Project.

[D] Describe the benefits of the project, including jobs created, local training, employment and business opportunities, and royalties and taxes generated that accrue to:

a) Cenovus;

b) local and regional communities, including Aboriginal communities;

c) the local authority;

d) Alberta; and

e) Canada.

[E] Provide the adaptive management approach that will be implemented throughout the life of the Project. Include how monitoring, mitigation and evaluation were incorporated.

2.2 CONSTRAINTS

[A] Discuss the process and criteria used to identify constraints to development, and how the Project has been designed to accommodate those constraints. Include the following:

a) any applicable *Alberta Land Stewardship Act* Regional Plan;

b) land use policies and resource management initiatives that pertain to the Project including Woodland Caribou Zones and Trumpeter Swan Waterbodies;

c) traditional land use setting and any sensitive sites or areas identified by aboriginal communities;

d) all known traplines;

e) the environmental setting;

f) cumulative environmental impacts in the region;

g) cumulative social impacts in the region;

h) results of Project-specific or regional monitoring;

i) potential for new or additional technology to increase resource recovery at later times; and

j) potential for changes in the regulatory regime.

[B] Discuss the selection criteria used, options considered, and rationale for selecting:

a) location of facilities and infrastructure (including linear infrastructure); and

b) thermal energy and electric power required for the Project;

[C] Provide a list of facilities for which locations will be determined later. Discuss the selection criteria that will be used to determine the specific location of these facilities.

2.3 REGIONAL AND COOPERATIVE EFFORTS

[A] Discuss Cenovus's involvement in regional and cooperative efforts to address environmental and socio-economic issues associated with regional development.

[B] Describe opportunities for sharing infrastructure (e.g., access roads, utility corridors, water infrastructure) with other resource development stakeholders. Provide rationale where these opportunities will not be implemented.

2.4 TRANSPORTATION INFRASTRUCTURE

[A] Prepare a Traffic Impact Assessment (TIA) as per Alberta Transportation's TIA Guideline (http://www.transportation.alberta.ca/613.htm). If there are any previous Traffic Impact Assessment studies that have been carried out for the Project, review and validate the findings and recommendations.

a) Describe the anticipated changes to highway traffic (e.g., type, volume) due to the Project;

b) assess potential traffic impacts for all stages of the Project; and

c) consider other existing and planned uses of the same highway.

[B] Describe and map the locations of any new road or intersection construction, or any improvements to existing roads or intersections, related to the development of the Project, from the boundary of the Project Area up to and including the highway access point, and

a) describe access corridors needed and/or planned by other resource development stakeholders, and any opportunities for cooperation in access development;

b) discuss the alternatives and the rationale for selection of the preferred alternative;

c) provide a proposed schedule for the work; and

d) provide a summary of consultation with Alberta Transportation and local authorities, including their views on the compatibility of the proposed work with their own local or regional infrastructure development plans.

2.5 AIR EMISSIONS MANAGEMENT

[A] Provide emission profiles (type, rate and source) for the Project's operating and construction emissions including point and non-point sources and fugitive emissions. Consider both normal and upset conditions. Discuss:

a) odorous or visible emissions from the proposed facilities;

b) annual and total greenhouse gas emissions during all stages of the Project. Identify the primary sources and provide detailed calculations;

c) the intensity of greenhouse gas emissions per unit of bitumen produced;

d) the Project's contribution to total provincial and national greenhouse gas emissions on an annual basis;

e) Cenovus's overall greenhouse gas management plans;

f) amount and nature of Criteria Air Contaminants emissions;

g) the amount and nature of acidifying emissions, probable deposition patterns and rates;

h) control technologies used to minimize air emissions;

i) emergency flaring scenarios (e.g., frequency and duration) and proposed measures to ensure flaring events are minimized;

j) upset condition scenarios (e.g., frequency and duration) and proposed measures to ensure upset conditions are minimized;

k) gas collection and conservation, and the applicability of vapour recovery technology;

l) applicability of sulphur recovery, acid gas re-injection or flue gas desulphurization to reduce sulphur emissions; and

m) fugitive emissions control technology to detect, measure and control emissions and odours from equipment leaks.

2.6 WATER MANAGEMENT

2.6.1 Water Supply

[A] Describe the water supply requirements for the Project, including:

a) the expected water balance during all stages of the Project. Discuss assumptions made or methods chosen to arrive at the water balances;

b) the process water, potable water, and non-potable water requirements and sources for construction (including but not limited to road construction, winter road construction, lease construction, production well drilling and dust suppression), start-up, normal and emergency operating situations, decommissioning and reclamation. Identify the volume of water to be withdrawn from each source, considering plans for wastewater reuse;

c) the location of sources/intakes and associated infrastructure (e.g., pipelines for water supply);

d) the variability in the amount of water required on an annual and seasonal basis as the Project is implemented;

e) the expected cumulative effects on water losses/gains resulting from the Project operations;

f) potable water treatment systems for all stages of the Project;

g) type and quantity of potable water treatment chemicals used; and

h) measures for ensuring efficient use of water including alternatives to reduce the consumption of non-saline water such as water use minimization, recycling, conservation, and technological improvements.

2.6.2 Surface Water

[A] Describe the surface water management strategy for all stages of the Project, including:

a) design factors considered; and

b) permanent or temporary alterations or realignments of watercourses, wetlands and other waterbodies.

[B] Describe crossings of watercourses or waterbodies (including bridges, culverts and pipelines) required.

2.6.3 Wastewater Management

[A] Describe the wastewater management strategy, including:

a) the source, quantity and composition of each wastewater stream from each component of the proposed operation (e.g., bitumen extraction and associated facilities) for all Project conditions, including normal, start-up, worst-case and upset conditions;

b) the proposed disposal locations and methods for each wastewater stream;

c) formations for the disposal of wastewaters;

d) design of facilities that will collect, treat, store and release wastewater streams;

e) type and quantity of chemicals used in wastewater treatment; and

f) sewage treatment and disposal.

2.7 WASTE MANAGEMENT

[A] Characterize and quantify the anticipated dangerous goods, and hazardous, non-hazardous, and recyclable wastes generated by the Project, and:

a) describe the composition and volume of specific waste streams and discuss how each stream will be managed;

b) describe how the disposal sites and sumps will be constructed; and

c) describe plans for pollution prevention, waste minimization, recycling, and management to reduce waste quantities for all stages of the Project.

2.8 CONSERVATION AND RECLAMATION

[A] Provide a conceptual conservation and reclamation plan for the Project. Describe and map as applicable:

a) current land use and capability and proposed post-development land use and capability;

b) anticipated timeframes for completion of reclamation stages and release of lands back to the Crown including an outline of the key milestone dates for reclamation and how progress to achieve these targets will be measured;

c) constraints to reclamation such as timing of activities, availability of reclamation materials and influence of natural processes and cycles including natural disturbance regimes;

d) a revegetation plan for the disturbed terrestrial, riparian and wetland areas;

e) reclamation material salvage, storage areas and handling procedures; and

f) existing and final reclaimed site drainage plans.

[B] Discuss, from an ecological perspective, the expected timelines for establishment and recovery of vegetative communities and wildlife habitat, the expected success of establishment and recovery.

[C] Discuss uncertainties related to the conceptual reclamation plan.

[D] Describe how Cenovus considered the use of progressive reclamation in project design and reclamation planning.

3 ENVIRONMENTAL ASSESSMENT

3.1 AIR QUALITY, CLIMATE AND NOISE

3.1.1 Baseline Information

[A] Discuss the baseline climatic and air quality conditions including:

a) the type and frequency of meteorological conditions that may result in poor air quality; and

b) appropriate ambient air quality parameters.

3.1.2 Impact Assessment

[A] Identify components of the Project that will affect air quality, and:

a) describe the potential for reduced air quality (including odours and visibility) resulting from the Project and discuss any implications of the expected air quality for environmental protection and public health;

b) estimate ground-level concentrations of appropriate air quality parameters;

c) discuss any expected changes to particulate deposition, nitrogen deposition or acidic deposition patterns;

d) identify areas that are predicted to exceed Potential Acid Input (PAI) critical loading criteria; and

e) discuss interactive effects that may occur resulting from co-exposure of a receptor to all emissions.

[B] Identify stages or elements of the Project that are sensitive to changes or variability in climate parameters, including frequency and severity of extreme weather events and discuss the potential impacts over the life of the Project.

[C] Summarize the results of the noise assessment conducted for the ERCB, and:

a) identify the nearest receptor used in the assessment; and

b) discuss the design, construction and operational factors to be incorporated into the Project to comply with the ERCB's Directive 38: Noise Control.

[D] Discuss mitigation strategies to minimize the potential impact of the Project on air quality and noise.

3.2 HYDROGEOLOGY

3.2.1 Baseline Information

[A] Provide an overview of the existing geologic and hydrogeologic setting from the ground surface down to, and including, the oil producing zones and disposal zones, and:

a) present regional and Project Area geology to illustrate depth, thickness and spatial extent of lithology, stratigraphic units and structural features; and

b) present regional and Project Area hydrogeology describing:

i) the major aquifers, aquitards and aquicludes (Quaternary and bedrock), their spatial distribution, properties, hydraulic connections between aquifers, hydraulic heads, gradients, groundwater flow directions and velocities. Include maps and cross sections,

ii) the chemistry of groundwater aquifers including baseline concentrations of major ions, metals and hydrocarbon indicators,

iii) the potential discharge zones, potential recharge zones and sources, areas of groundwater-surface water interaction and areas of Quaternary aquifer-bedrock groundwater interaction,

iv) water well development and groundwater use, including an inventory of groundwater users,

v) the recharge potential for Quaternary aquifers,

vi) potential hydraulic connection between bitumen production zones, deep disposal formations and other aquifers resulting from Project operations,

vii) the characterization of formations chosen for deep well disposal, including chemical compatibility and containment potential,

injection capacity, hydrodynamic flow regime, and water quality assessments, and

viii) the locations of major facilities associated with the Project including facilities for waste storage, treatment and disposal (e.g., deep well disposal) and describe site-specific aquifer and shallow groundwater conditions beneath these proposed facilities. Provide supporting geological information.

3.2.2 Impact Assessment

[A] Describe Project components and activities that have the potential to affect groundwater resource quantity and quality at all stages of the Project.

[B] Describe the nature and significance of the potential Project impacts on groundwater with respect to:

a) inter-relationship between groundwater and surface water in terms of both groundwater and surface water quantity and quality;

b) implications for terrestrial or riparian vegetation, wildlife and aquatic resources including wetlands;

c) changes in groundwater quality, quantity and flow;

d) conflicts with other groundwater users, and proposed resolutions to these conflicts;

e) potential implications of seasonal variations;

f) groundwater withdrawal for Project operations, including any expected alterations in the groundwater flow regime during and following Project operations;

g) steaming and bitumen production (e.g. ground heave and/or subsidence); and

h) wastewater disposal for Project operations, including any expected alterations in the groundwater flow regime during and following Project operations.

[C] Discuss mitigation strategies to minimize the potential impact of the Project on hydrogeology.

3.3 HYDROLOGY

3.3.1 Baseline Information

[A] Describe and map the surface hydrology in the Project Area.

[B] Identify any surface water users who have existing approvals, permits or licenses.

3.3.2 Impact Assessment

[A] Describe the extent of hydrological changes that will result from disturbances to groundwater and surface water movement:

a) include changes to the quantity of surface flow, water levels and channel regime in watercourses (during minimum, average and peak flows) and water levels in waterbodies;

b) assess the potential impact of any alterations in flow on the hydrology and identify all temporary and permanent alterations, channel realignments, disturbances or surface water withdrawals;

c) discuss the effect of these changes on hydrology (e.g., timing, volume, peak and minimum flow rates, river regime and lake levels), including the significance of effects for downstream watercourses; and

d) identify any potential erosion problems in watercourses resulting from the Project.

[B] Describe impacts on other surface water users resulting from the Project. Identify any potential water use conflicts.

[C] Discuss the impact of low flow conditions and in-stream flow needs on water supply and water and wastewater management strategies.

[D] Discuss mitigation strategies to minimize the potential impact of the Project on hydrology.

3.4 SURFACE WATER QUALITY

3.4.1 Baseline Information

[A] Describe the baseline water quality of watercourses and waterbodies.

3.4.2 Impact Assessment

[A] Describe the potential impacts of the Project on surface water quality and proposed mitigation measures to maintain surface water quality at all stages of the Project.

3.5 AQUATIC ECOLOGY

3.5.1 Baseline Information

[A] Describe and map the fish, fish habitat and aquatic resources (e.g., aquatic and benthic invertebrates) of the lakes, rivers, ephemeral water bodies and other waters. Describe the species composition, distribution, relative abundance, movements and general life history parameters of fish resources. Also identify any species that are:

a) listed as “at Risk, May be at Risk and Sensitive” in The Status of Alberta Species (Alberta Sustainable Resource Development);

b) listed in the federal *Species at Risk Act*;

c) listed by COSEWIC; and

d) traditionally used species.

[B] Identify barriers to fish passage.

[C] Describe and map existing critical or sensitive areas such as spawning, rearing, and over-wintering habitats, seasonal habitat use including migration and spawning routes.

[D] Describe the current and potential use of the fish resources by aboriginal, sport or commercial fisheries.

[E] Identify the key aquatic indicators that Cenovus used to assess project impacts. Discuss the rationale for their selection.

3.5.2 Impact Assessment

[A] Describe and assess the potential impacts of the Project to fish, fish habitat, and other aquatic resources, considering:

a) habitat loss and alteration;

b) creation of barriers to fish passage;

c) riparian areas that could affect aquatic biological resources and productivity;

d) increased fishing pressures in the region that could arise from the increased workforce and improved access from the Project;

e) changes to benthic invertebrate communities that might affect food quality and availability for fish;

f) increased habitat fragmentation;

g) acidification; and

h) groundwater/surface water interactions.

[B] Discuss mitigation measures to avoid or minimize potential impacts of the Project on fish, fish habitat and other aquatic resources. Clearly identify those mitigation measures that will be implemented and provide the rationale for their selection.

[C] Identify plans proposed to offset any loss in the productivity of fish habitat. Indicate how environmental protection plans address applicable provincial and federal policies on fish habitat including the development of a “No Net Loss” fish habitat objective.

[D] Discuss expected timelines for the establishment and recovery of fish communities and the expected differences in those communities following the project.

3.6 VEGETATION

3.6.1 Baseline Information

[A] Describe and map the vegetation communities, wetlands, rare plants, old growth forests, and communities of limited distribution. Identify the occurrence, relative abundance and distribution of any species that are:

a) listed as “at Risk, May be at Risk and Sensitive” in The Status of Alberta Species (Alberta Sustainable Resource Development);

b) listed in Schedule 1 of the federal *Species at Risk Act*;

c) listed as “at risk” by COSEWIC; and

d) traditionally used species.

[B] Describe and quantify the current extent of habitat fragmentation.

3.6.2 Impact Assessment

[A] Describe and assess the potential impacts of the Project on vegetation communities, considering:

a) both temporary (include timeframe) and permanent impacts;

b) species richness, abundance and vegetative health;

c) the potential for introduction and colonization of weeds and non-native invasive species;

d) potential increased fragmentation and loss of upland, riparian and wetland habitats; and

e) implications of vegetation changes for other environmental resources (e.g., terrestrial and aquatic habitat diversity and quantity, water quality and quantity, erosion potential).

[B] Identify key vegetation indicators, including any species listed under the federal *Species at Risk Act* and COSEWIC used to assess the Project impacts. Discuss the rationale for their selection.

[C] Discuss the mitigation measures to avoid or minimize impacts on vegetation communities, wetlands, rare plants, old growth forests and communities of limited distribution. Clearly identify those mitigation measures that will be implemented and provide the rationale for their selection.

3.7 WILDLIFE

3.7.1 Baseline Information

[A] Describe and map the wildlife resources (amphibians, reptiles, birds, and terrestrial and aquatic mammals). Describe species relative abundance,

distribution and their use and potential use of habitats. Also identify any species that are:

a) listed as “at Risk, May be at Risk and Sensitive” in The Status of Alberta Species (Alberta Sustainable Resource Development);

b) listed in Schedule 1 of the federal *Species at Risk Act*;

c) listed as “at risk” by COSEWIC; and

d) traditionally used species.

[B] Describe and map existing wildlife habitat, important wildlife areas and habitat disturbance (including exploration activities). Identify those habitat disturbances that are related to existing and approved Project operations.

[C] Identify the key wildlife and habitat indicators used to assess Project impacts. Discuss the rationale for their selection.

3.7.2 Impact Assessment

[A] Describe and assess the potential impacts of the Project to wildlife and wildlife habitats, considering:

a) how the Project will affect wildlife relative abundance, mortality, distribution and movement patterns, as well as habitat availability all stages of the Project;

b) how improved or altered access may affect wildlife, including increased vehicle-wildlife collisions and increased hunting pressure;

c) how increased habitat fragmentation may affect wildlife considering edge effects and the influence of linear features and infrastructure on wildlife movements and predator-prey relationships;

d) potential effects on wildlife resulting from changes to air and water quality, including both acute and chronic effects to animal health;

e) potential effects on wildlife from Cenovus’s proposed and planned exploration, seismic and core hole activities, including monitoring/4D seismic; and

f) the resilience and recovery capabilities of wildlife populations and habitats to disturbance.

[B] Discuss mitigation measures to avoid or minimize the potential impact of the Project on wildlife and wildlife habitat. Clearly identify those mitigation

measures that will be implemented and provide the rationale for their selection.

3.8 BIODIVERSITY

3.8.1 Baseline Information

[A] Describe and map the existing biodiversity.

[B] Identify the biodiversity metrics, biotic and abiotic indicators that are used to characterize the baseline biodiversity and to assess project impacts. Discuss the rationale for their selection.

3.8.2 Impact Assessment

[A] Describe and assess the potential impacts of the Project to biodiversity considering:

a) the effects of fragmentation on biodiversity potential;

b) the contribution of the Project to any anticipated changes in regional biodiversity and the potential impact to local and regional ecosystems; and

c) effects during construction, operations and post-reclamation and the significance of these changes in a local and regional context.

[B] Discuss mitigation measures to avoid or minimize the potential impact of the Project on biodiversity. Clearly identify those mitigation measures that will be implemented and provide the rationale for their selection.

3.9 TERRAIN AND SOILS

3.9.1 Baseline Information

[A] Describe and map the terrain and soils conditions in the Project Area.

[B] Describe and map soil types in the areas that are predicted in 3.1.2[A]d) to exceed Potential Acid Input (PAI) critical loading criteria.

3.9.2 Impact Assessment

[A] Describe Project activities and other related issues that could affect soil quality (e.g., compaction, contaminants) and:

a) indicate the amount (ha) of surface disturbance from plant, field (pads, pipelines, access roads), aggregate and borrow sites, construction camps, drilling waste disposal and other infrastructure-related construction activities;

b) discuss the relevance of any changes for the local and regional landscapes, biodiversity, productivity, ecological integrity, aesthetics and future use;

c) identify the potential acidification impact on soils and discuss the significance of predicted impacts by acidifying emissions; and

d) describe potential sources of soil contamination.

[B] Discuss:

a) the environmental effects of proposed drilling methods on the landscape and surficial and bedrock geology;

b) the potential for changes in the ground surface during steaming and recovery operations (e.g., ground heave and/or subsidence) and their environmental implications; and

c) the potential impacts caused by the mulching and storage of woody debris considering, but not limited to vulnerability to fire, degradation of soil quality, increased footprint, etc.

[C] Discuss mitigation strategies to minimize the potential impact of the Project on soils or terrain.

3.10 LAND USE AND MANAGEMENT

3.10.1 Baseline Information

[A] Describe and map the current land uses in the Project Area, including all Crown land and Crown Reservations (Holding Reservation, Protective Notation, and Consultative Notation).

[B] Indicate where Crown land dispositions may be needed for roads or other infrastructure for the Project.

[C] Identify and map unique sites or special features in the Project Area and Local Study Area such as Parks and Protected Areas, Heritage Rivers, Historic Sites, Environmentally Significant Areas, culturally significant sites or areas and other designations (World Heritage Sites, Ramsar Sites, Internationally Important Bird Areas, etc).

[D] Describe and map land clearing activities, showing the timing of the activities.

[E] Describe the status of timber harvesting arrangements, including species and timing.

[F] Describe existing access control measures in the Project Area.

3.10.2 Impact Assessment

[A] Identify the potential impact of the Project on land uses, including:

a) unique sites or special features;

b) changes in public access arising from linear development, including secondary effects related to increased hunter, angler and other recreational access and facilitated predator movement;

c) aggregate reserves that may be located on land under the Cenovus's control and reserves in the region;

d) development and reclamation on commercial forest harvesting and fire management in the Project Area;

e) the amount of commercial and non-commercial forest land base that will be disturbed by the Project, including the Timber Productivity Ratings for the Project Area. Compare the baseline and reclaimed percentages and distribution of all forested communities in the Project Area;

f) how the Project impacts Annual Allowable Cuts and quotas within the Forest Management Agreement area;

g) the baseline topography, elevation and drainage pattern within the Project Area; and

h) access control for public, regional recreational activities, aboriginal land use and other land uses during and after development activities.

[B] Provide a fire control plan highlighting:

a) measures taken to ensure continued access for firefighters to adjacent wildland areas;

b) forest fire prevention, detection, reporting, and suppression measures, including proposed fire equipment;

c) measures for determining the clearing width of power line rights-of-way; and

d) required mitigative measures for areas adjacent to the Project Area based on the FireSmart Wildfire Assessment System.

[C] Discuss mitigation strategies to minimize the potential impact of the Project on land uses.

4 HISTORIC RESOURCES

4.1 BASELINE INFORMATION

[A] Provide a brief overview of the regional historic resources settings including a discussion of the relevant archaeological, historic and paleontological records.

[B] Describe and map known historic resources sites in the Project Area, considering:

a) Site type and assigned Historic Resources Values (HRVs) and

b) Existing site specific *Historical Resources Act* requirements (if applicable).

[C] Provide an overview of previous Historic Resources Impact Assessments (HRIAs) that have been conducted within the Project Area, including:

a) a description of the special extent of previous assessments relative to the Project Area, noting any assessment gap areas; and

b) a summary of the *Historical Resources Act* requirements and/or clearances that have been issued for the Project to date (if applicable).

[D] Describe locations within the Project Area that are likely to contain previously unrecorded historical resources. Thoroughly describe the methods used to identify these areas.

4.1.1 Impact Assessment

[A] Describe Project components and activities that have the potential to affect historic resources at all stages of the Project.

[B] Describe the nature and significance of the potential Project impacts on historical resources, considering:

a) effects on historic resources site integrity; and

b) implications for the interpretation of the archaeological, historic and paleontological records.

[C] Discuss mitigation measures that can be used to minimize impacts on historical resources. Clearly identify those mitigation measures that will be implemented and provide rationale for their selection.

5 TRADITIONAL ECOLOGICAL KNOWLEDGE AND LAND USE

[A] Provide:

a) a map and description of traditional land use areas including fishing, hunting, trapping and nutritional, medicinal or cultural plant harvesting by affected aboriginal peoples (if the aboriginal community or group is willing to have these locations disclosed);

b) a map of cabin sites, spiritual sites, cultural sites, graves and other traditional use sites considered historic resources under the *Historical Resources Act* (if the aboriginal community or group is willing to have these locations disclosed), as well as traditional trails and resource activity patterns; and

c) a discussion of:

i) the availability of vegetation, fish and wildlife species for food, traditional, medicinal and cultural purposes in the identified traditional land use areas considering all Project related impacts;

ii) access to traditional lands in the Project Area during all stages of the Project, and

iii) aboriginal views on land reclamation.

[B] Describe how TEK and TLU information was incorporated into the project design and development components of the EIA, the conservation and reclamation plan, monitoring and mitigation.

[C] Determine the impact of the Project on traditional, medicinal and cultural purposes and identify possible mitigation strategies.

6 PUBLIC HEALTH AND SAFETY ASSESSMENT

6.1 PUBLIC HEALTH

[A] Describe those aspects of the Project that may have implications for public health or the delivery of regional health services. Determine quantitatively whether there may be implications for public health arising from the Project.

[B] Document any health concerns raised by stakeholders during consultation on the Project.

[C] Document any health concerns identified by aboriginal communities or groups resulting from impacts of existing development and of the Project specifically on their traditional lifestyle and include an aboriginal receptor type in the assessment.

[D] Describe the potential health impacts resulting from higher regional traffic volumes and the increased risk of accidental leaks and spills.

[E] Discuss mitigation strategies to minimize the potential impact of the Project on human health.

6.2 PUBLIC SAFETY

[A] Describe those aspects of the Project that may have implications for public safety. Determine whether there may be implications for public safety arising from the Project. Specifically:

a) describe Cenovus's emergency response plan, including public notification protocol and safety procedures to minimize adverse environmental effects, including emergency reporting procedures for spill containment and management;

b) document any safety concerns raised by stakeholders during consultation on the Project;

c) describe how local residents will be contacted during an emergency and the type of information that will be communicated to them;

d) describe the existing agreements with area municipalities or industry groups such as safety cooperatives, emergency response associations, regional mutual aid programs and municipal emergency response agencies; and

e) describe the potential safety impacts resulting from higher regional traffic volumes.

7 SOCIO-ECONOMIC ASSESSMENT

7.1 BASELINE INFORMATION

[A] Describe the existing socio-economic conditions in the region and in the communities in the region.

[B] Describe factors that may affect existing socio-economic conditions including:

a) population changes;

b) workforce requirements for the Project, including a description of when peak activity periods will occur;

c) planned accommodations for the workforce for all stages of the Project;

d) Cenovus's policies and programs regarding the use of regional and Alberta goods and services;

e) the project schedule; and

f) the overall engineering and contracting plan for the Project.

7.2 IMPACT ASSESSMENT

[A] Describe the effects of construction and operation of the Project on:

a) housing;

b) availability and quality of health care services;

c) local and regional infrastructure and community services;

d) recreational activities;

e) hunting, fishing, trapping and gathering; and

f) First Nations and Métis (e.g., traditional land use and social and cultural implications).

[B] Describe the socio-economic effects of any construction camp required for the Project and identify:

a) its location;

b) the number of workers it is intended to house;

c) whether the camp will service the Project only or other clients;

d) the length of time the camp will be in service; and

e) describe what services will be provided in the camp (e.g., security, recreation and leisure, medical services).

[C] Describe the need for additional Crown land to manage the effects in [A] and [B].

[D] Discuss plans to work with First nations and Métis communities and groups, other local residents and businesses regarding employment, training needs and other economic development opportunities arising from the Project.

[E] Provide the estimated total Project cost, including a breakdown for engineering and project management, equipment and materials, and labour for both construction and operation stages. Indicate the percentage of expenditures expected to occur in the region, Alberta, Canada, outside of Alberta, and outside of Canada.

[F] Discuss mitigation strategies to minimize the potential impact of the Project on socio-economic conditions in the region and communities in the region.

8 RESIDUAL IMPACTS

[A] Describe the residual impacts of the Project following implementation of Cenovus's mitigation measures and Cenovus's plans to manage those residual impacts.

9 MONITORING

[A] Describe Cenovus's current and proposed monitoring programs.

[B] Describe the monitoring programs proposed to assess any Project impacts and to measure the effectiveness of mitigation plans.

[C] Discuss Cenovus's regional monitoring activities including:

a) monitoring that will be undertaken to assist in managing environmental effects, confirm performance of mitigation measures and improve environmental protection strategies;

b) monitoring done independently by Cenovus and how these monitoring programs are consistent with other current or proposed regional monitoring programs;

c) monitoring performed in conjunction with other stakeholders, including aboriginal communities and groups; and

d) new monitoring initiatives that may be required as a result of the Project.

[D] Discuss:

a) Cenovus's plans for addressing and mitigating environmental impacts identified in the monitoring program;

b) how monitoring data will be disseminated to the public or other interested parties; and

c) how the results of monitoring programs and publicly available monitoring information will be integrated with Cenovus's environmental management system.

APPENDIX 2-II

CONCORDANCE TABLES

LIST OF TABLES

Table 1 Final Terms of Reference Issued by Alberta Environment – Concordance Table

TOR Section	Environmental Assessment or Topic	Location TOR Addressed
PURPOSE OF THE TERMS OF REFERENCE		
Purpose of the Terms of Reference	The purpose of this document is to identify for Cenovus Energy Inc. (Cenovus), aboriginal communities and appropriate stakeholders the information required by government agencies for an Environmental Impact Assessment (EIA) report prepared under the *Environmental Protection and Enhancement Act* (EPEA) for the Pelican Lake Grand Rapids Project (the Project). Cenovus Energy Inc. ("Cenovus") is seeking approval for the proposed Project. The proposed Project is located in north east Alberta, approximately 300 kilometres north of Edmonton, primarily in Townships 81-83, Ranges 20-23 W4M. The closest populated areas are Wabasca and the Bigstone Cree Nation. The proposed Project will use a technology called Steam-Assisted Gravity Drainage (SAGD). Once the SAGD operation is established, our plans are to incorporate co-injection of light hydrocarbons, referred to as Solvent Aided Process, where economically feasible. We are seeking approval to produce at a maximum production capacity of 180,000 barrels of oil per day (bbls/d). The Project is expected to be constructed in phases over the estimated 40 year life of the project. The proposed Grand Rapids central processing site is expected to cover about 1.5 square kilometers. The proposed development is expected to have up to 200 well pads over the life of the project supporting up to 2500 well pairs. Wherever possible, the Project will utilize existing clearings and infrastructure. The proposed Project is expected to require other related infrastructure projects including electrical power lines, fuel gas pipelines, produced oil pipelines, and diluent/condensate supply pipelines. These related infrastructure projects will be applied for separately, as appropriate.	Volume 1, Section 1 Introduction
Scope of the Environmental Impact Assessment Report	Cenovus shall prepare and submit an EIA report that examines the environmental and socio-economic effects of the Project. The EIA report shall be prepared considering all applicable provincial and federal legislation, codes of practice, guidelines, standards and directives. The EIA report shall be prepared in accordance with these Terms of Reference and the environmental information requirements prescribed under EPEA and associated regulations, and the *Canadian Environmental Assessment Act* if applicable. The EIA report will form part of Cenovus' application to the Energy Resources Conservation Board (ERCB). An EIA report summary will also be included as part of the ERCB Application. Cenovus shall refer to the *Guide to Preparing Environmental Impact Assessment Reports for In-Situ Projects in Alberta* published by Alberta Environment (the In-Situ Guide) and these Terms of Reference when preparing the Environmental Impact Assessment report. In any case where there is a difference in requirements between the Guide and these Terms of Reference, the Terms of Reference shall take precedence.	Volumes 2 to 6
CONTENT OF THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT		
1.0 Public Engagement and Aboriginal Consultation		
1.0 Public Engagement and Aboriginal Consultation	[A] Describe the concerns and issues expressed by the public and the actions taken to address those concerns and issues, including how public input was incorporated into the Project development, impact mitigation and monitoring.	[A] Volume 1, Section 2.3 Community-Based Consultation and Relationship Bodies Volume 1, Sections 2.3.6 Issues and Concerns Identified Volume 1, Sections 2 Public Consultation Volume 1, Section 10 Regional Co-operation
	[B] Describe the concerns and issues expressed by aboriginal communities and the actions taken to address those concerns and issues, including how aboriginal community input was incorporated into the Project design, EIA development, impact mitigation, monitoring and reclamation. Describe consultation undertaken with aboriginal communities and groups with respect to traditional ecological knowledge and traditional use of land.	[B] Volume 1, Section 2 Public Consultation Volume 6, Section 2 Traditional Land Use Assessment
	[C] Discuss Cenovus' view on the effectiveness of its aboriginal consultation, considering the approved First Nations Consultation Plan for the Project.	[C] Volume 1, Section 2.4 Ongoing Consultation
	[D] Describe plans to maintain the public engagement and aboriginal consultation process following completion of the EIA report to ensure that the public and aboriginal peoples will have an appropriate forum for expressing their views on the ongoing development, operation and reclamation of the Project.	[D] Volume 1, Section 2.4 Ongoing Consultation
2.0 Project Description		
2.1 Overview	[A] Provide a brief project description in sufficient detail to provide context for the EIA, including: a) Cenovus information;	[A] a) Volume 1, Section 1 Introduction
	b) proposed extraction and bitumen processing technology;	b) Volume 1, Section 4 Bitumen Recovery Process
	c) amount and source of energy required for the Project;	c) Volume 1, Section 5 Central Plant Facility Volume 1, Appendix VIII Block Flow Diagrams
	d) water supply and disposal requirements, including process water and potable water requirements;	d) Volume 1, Section 6 Water Source Management
	e) proposed method to transport product to markets; and	e) Volume 1, Section 5.7 Offsites
	f) development plan and schedule.	f) Volume 1, Section 1.7 Project Schedule
	[B] Provide maps and/or drawings of the Project components and activities including: a) existing infrastructure, leases and clearings, including exploration clearings;	[B] a) Volume 1, Section 1.3 Project Location, Figures 1.3-1 and 1.3-2
	b) proposed central processing/treatment and field facilities;	b) Volume 1, Appendix 1-VII Plot Plan and Equipment List
	c) other buildings and infrastructure (pipelines and utilities);	c) Volume 1, Appendix 1-VII Plot Plan and Equipment List
	d) temporary structures;	d) Volume 1, Appendix 1-VII Plot Plan and Equipment List
	e) transportation and access routes; f) on-site hydrocarbon storage;	e) Volume 1, Section 1.3 Project Location, Figures 1.3-1 and 1.3-2 f) Volume 1, Appendix 1-VII Plot Plan and Equipment List
	g) containment structures such as retention ponds and storage ponds (e.g., lime sludge, stormwater runoff, boiler blow-down);	g) n/a
	h) water wells/intakes, pipelines, and storage structures;	h) Volume 1, Section 1.3 Project Location, Figures 1.3-1 and 1.3-2 Volume 4, Section 5.1 Hydrogeology Application Case, Figure 5.1-3
	i) sources of aggregate resources, borrow material and other construction material and locations of any stockpiles that will be developed; and	i) Volume 6, Section 3.5.3.2 Aggregate Resources
	j) waste storage area and disposal sites.	j) Volume 1, Section 8.5.3 Waste Management Volume 1, Appendix 1-VII Plot Plan and Equipment List
2.1	[C] Discuss the implications of a delay in proceeding with the Project, or any phase of the Project, or not going ahead with the Project.	[C] Volume 1, Section 1.6 Resource and Development Need

Table 1 Final Terms of Reference Issued by Alberta Environment – Concordance Table (continued)

TOR Section	Environmental Assessment or Topic	Location TOR Addressed
2.1 Overview (continued)	[C] Discuss the implications of a delay in proceeding with the Project, or any phase of the Project, or not going ahead with the Project.	[C] Volume 1, Section 1.6 Resource and Development Need Volume 1, Section 1.7 Project Schedule
	[D] Describe the benefits of the project, including jobs created, local training, employment and business opportunities, and royalties and taxes generated that accrue to: a) Cenovus; b) local and regional communities, including Aboriginal communities; c) the local authority; d) Alberta; and e) Canada.	[D] a), b), c), d), e) Volume 6, Section 6.5 Economic Effects
	[E] Provide the adaptive management approach that will be implemented throughout the life of the Project. Include how monitoring, mitigation and evaluation were incorporated.	[E] Volume 1, Section 4.4 Scheme Design and Strategy Volume 2, Appendix 2-V Monitoring Programs
2.2 Constraints	[A] Discuss the process and criteria used to identify constraints to development, and how the Project has been designed to accommodate those constraints. Include the following: a) any applicable Alberta Land Stewardship Act Regional Plan;	[A] a) Volume 6, Section 3 Resource Use Assessment
	b) land use policies and resource management initiatives that pertain to the Project including Woodland Caribou Zones and Trumpeter Swan Waterbodies;	b) Volume 6, Section 3 Resource Use Assessment Volume 5, Section 6.3 Wildlife
	c) traditional land use setting and any sensitive sites or areas identified by aboriginal communities;	c) Volume 6, Section 2 Traditional Land Use Assessment
	d) all known traplines;	d) Volume 6, Section 2 Traditional Land Use Assessment Volume 1, Section 1.4 Surface Rights
	e) the environmental setting;	e), f) Volumes 2 to 6
	f) cumulative environmental impacts in the region;	
	g) cumulative social impacts in the region;	g) Volume 6, Section 6 Socio-economic Assessment
	h) results of Project-specific or regional monitoring;	h) Volume 1, Section 10 Regional Cooperation Volume 2, Appendix 2-V Monitoring Programs Volume 1, Section 12 Conservation and Reclamation Plan
	i) potential for new or additional technology to increase resource recovery at later times; and	i) Volume 1, Section 4.4 Scheme Design and Strategy
	j) potential for changes in the regulatory regime.	j) Volume 1, Sections 1.9 and 1.10 Volume 1, Section 12 Conservation and Reclamation Plan Volume 2, Appendix 2-V Monitoring Programs
	[B] Discuss the selection criteria used, options considered, and rationale for selecting: a) location of facilities and infrastructure (including linear infrastructure); and b) thermal energy and electric power required for the Project;	[B] a), b) Volume 1, Section 5.6 Central Plant Facility Volume 1, Section 5.7 Offsites Volume 1, Section 4 Bitumen Recovery Process; Volume 1, Section 9, Alternatives Considered
	[C] Provide a list of facilities for which locations will be determined later. Discuss the selection criteria that will be used to determine the specific location of these facilities.	[C] n/a
2.3 Regional and Cooperative Efforts		
2.3 Regional and Cooperative Efforts	[A] Discuss Cenovus' involvement in regional and cooperative efforts to address environmental and socio-economic issues associated with regional development. [B] Describe opportunities for sharing infrastructure (e.g., access roads, utility corridors, water infrastructure) with other resource development stakeholders. Provide rationale where these opportunities will not be implemented.	[A] Volume 1, Section 10.1 Co-Operative Efforts [B] Volume 1, Section 10.1 Co-Operative Efforts; Volume 1, Section 1.4 Surface Rights
2.4 Transportation Infrastructure		
2.4 Transportation Infrastructure	[A] Prepare a Traffic Impact Assessment (TIA) as per Alberta Transportation's TIA Guideline (http://www.transportation.alberta.ca/613.htm). If there are any previous Traffic Impact Assessment studies that have been carried out for the Project, review and validate the findings and recommendations. a) Describe the anticipated changes to highway traffic (e.g., type, volume) due to the Project; b) assess potential traffic impacts for all stages of the Project; and c) consider other existing and planned uses of the same highway.	[A] Volume 6, Section 6.6.7 Traffic and Transportation
	[B] Describe and map the locations of any new road or intersection construction, or any improvements to existing roads or intersections, related to the development of the Project, from the boundary of the Project Area up to and including the highway access point, and a) describe access corridors needed and/or planned by other resource development stakeholders, and any opportunities for cooperation in access development; b) discuss the alternatives and the rationale for selection of the preferred alternative; c) provide a proposed schedule for the work; and d) provide a summary of consultation with Alberta Transportation and local authorities, including their views on the compatibility of the proposed work with their own local or regional infrastructure development plans.	[B] Volume 6, Section 6.6.7 Traffic and Transportation
2.5 Air Emissions Management	[A] Provide emission profiles (type, rate and source) for the Project's operating and construction emissions including point and non-point sources and fugitive emissions. Consider both normal and upset conditions. Discuss: a) odorous or visual emissions from the proposed facilities;	[A] a) Volume 3, Section 1.8.6 Key Question AQAC-5: What Effects Could Existing and Approved Developments and the Project Have on Odours at the Selected Receptors? Volume 6, Section 4 Visual Resources Assessment
	b) annual and total greenhouse gas emissions during all stages of the Project. Identify the primary sources and provide example of calculations;	b) Volume 3, Section 1.8.7.2 Approach to Managing Greenhouse Gases

Table 1 Final Terms of Reference Issued by Alberta Environment – Concordance Table (continued)

TOR Section	Environmental Assessment or Topic	Location TOR Addressed
2.5 Air Emissions Management (continued)	c) the intensity of the greenhouse gas emissions per unit of bitumen produced and discuss how it compares with similar projects;	c) Volume 3, Section 1.8.7.2 Approach to Managing Greenhouse Gases
	d) the Project's contribution to total provincial and national greenhouse gas emissions on an annual basis;	d) Volume 3, Section 1.8.7.2 Approach to Managing Greenhouse Gases
	e) Cenovus' overall greenhouse gas management plans;	e) Volume 3, Section 1.8.7.2 Approach to Managing Greenhouse Gases Volume 1, Section 8.4 Greenhouse Gas Management
	f) amount and nature of Criteria Air Contaminant emissions;	f) Volume 3, Section 1.6 Baseline Case Volume 3, Section 1.8 Application Case Volume 3, Section 1.9 Planned Development Case Volume 3, Appendix 3-I Emission Source Details
	g) the amount and nature of acidifying emissions, probable deposition patterns and rates;	g) Volume 3, Section 1.6 Baseline Case Volume 3, Section 1.8 Application Case Volume 3, Section 1.9 Planned Development Case Volume 3, Appendix 3-I Emission Source Details
	h) control technologies used to minimize air emissions;	h) Volume 3, Section 1.8.5 Key Question AQAC-4: Will Emissions From the Project be in Compliance With Relevant Provincial and Federal Emission Guidelines? Volume 3, Section 1.4 Mitigation
	i) emergency flaring scenarios (e.g., frequency and duration) and proposed measures to ensure flaring events are minimized;	i) Volume 3, Appendix 3-II Upset Conditions
	j) upset condition scenarios (e.g., frequency and duration) and proposed measures to ensure upset conditions are minimized;	j) Volume 3, Appendix 3-II Upset Conditions
	k) gas collection and conservation and the applicability of vapour recovery technology;	k) Volume 1, Section 5.6.10 Vapour Recovery System
	l) applicability of sulphur recovery, acid gas re-injection, or flue gas desulphurization to reduce sulphur emissions; and	l) Volume 3, Appendix 3-I Emission Source Details
	m) fugitive emissions control technologies to detect, measure and control emissions and odours from equipment leaks.	m) Volume 3, Section 1.8.5 Key Question AQAC-4: Will Emissions From the Project be in Compliance With Relevant Provincial and Federal Emission Guidelines?
2.6 Water Management		
2.6.1 Water Supply	[A] Describe the water supply requirements for the Project, including:	[A] Volume 1, Section 6. Water Source Management
	a) the expected water balance during all stages of the Project. Discuss assumptions made or methods chosen to arrive at the water balances;	a) Volume 1, Appendix 1-XI Detailed Water Balances
	b) the process water, potable water, and non-potable water requirements and sources for construction (including but not limited to road construction, winter road construction, lease construction, production well drilling and dust suppression), start-up, normal and emergency operating situations, decommissioning and reclamation. Identify the volume of water to be withdrawn from each source, considering plans for wastewater reuse;	b) Volume 1, Section 4.4.7, Section 5, Section 6, and Section 8.5 Volume 4, Section 5.2
	c) the location of sources/intakes and associated infrastructure (e.g., pipelines for water supply);	c) Volume 1, Section 4.4.7 Service Wells Volume 1, Section 6 Water Source Management
	d) the variability in the amount of water required on an annual and seasonal basis as the Project is implemented;	d) Volume 4, Section 5.2 Hydrology
	e) the expected cumulative effects on water losses/gains resulting from the Project operations;	e) Volume 4, Section 5.1, Section 5.2, Section 6.1 and Section 6.2
	f) potable water treatment systems for all stages of the Project;	f) Volume 1, Section 6.2, Section 8.5
	g) type and quantity of potable water treatment chemicals used; and	g) Volume 1, Section 6.2 Fresh Water Supply
	h) measures for ensuring efficient use of water including alternatives to reduce the consumption of non-saline water such as water use minimization, recycling, conservation, and technological improvements.	h) Volume 1, Section 6, Section 8.5, Section 9.3 and Section 9.4
2.6.2 Surface Water	[A] Describe the surface water management strategy for all stages of the Project, including: a) design factors considered; and	[A] a) Volume 1,Section 6 Water Source Management Volume 4, Section 3.2.1 Central Facilities, Camp Sites, Pump Stations and Well Pads
	b) permanent or temporary alterations or realignments of watercourses, wetlands and other waterbodies.	b) n/a
	[B] Describe crossings of watercourses or waterbodies (including bridges, culverts and pipelines) required.	[B] Volume 4, Section 3.2.3 Watercourse Crossings
2.6.3 Wastewater Management	[A] Describe the wastewater management strategy, including: a) the source, quantity and composition of each wastewater stream from each component of the proposed operation (e.g., bitumen extraction and associated facilities) for all Project conditions, including normal, start-up, worst-case and upset conditions;	[A] a) Volume 1, Section 8.5 Waste Management
	b) the proposed disposal locations and methods for each wastewater stream;	b) Volume 1, Section 8.5 Waste Management
	c) formations for the disposal of wastewaters;	c) Volume 1, Section 4.4.7, Section 6
	d) design of facilities that will collect, treat, store and release wastewater streams;	d) Volume 1, Section 4.4.7, Section 6
	e) type and quantity of chemicals used in wastewater treatment; and	e) Volume 1, Section 8.5 Waste Management
	f) sewage treatment and disposal.	f) Volume 1, Section 8.5 Waste Management Volume 4, Section 5.3 Water Quality

Table 1 Final Terms of Reference Issued by Alberta Environment – Concordance Table (continued)

TOR Section	Environmental Assessment or Topic	Location TOR Addressed
2.7 Water Management		
2.7 Water Management	[A] Characterize and quantify the anticipated dangerous goods, and hazardous, non-hazardous, and recyclable wastes generated by the Project, and:	[A] Volume 1, Section 8.5 Waste Management
	a) describe the composition and volume of specific waste streams and discuss how each stream will be managed;	a) Volume 1, Section 8.5 Waste Management
	b) describe how the disposal sites and sumps will be constructed; and	b) Volume 1, Section 4.4.7 Service Wells
	c) describe plans for pollution prevention, waste minimization, recycling, and management to reduce waste quantities for all stages of the Project.	c) Volume 1, Section 8.5 Waste Management
2.8 Conservation and Reclamation	[A] Provide a conceptual conservation and reclamation plan for the Project. Describe and map as applicable:	[A] Sections 12.3.6 and 12.3.6.1
	a) current land use and capability and proposed post-development land use and capability;	a) Sections 12.3.3.2; 12.3.6.3 and 12.6
	b) anticipated timeframes for completion of reclamation stages and release of lands back to the Crown including an outline of the key milestone dates for reclamation and how progress to achieve these targets will be measured;	b) Sections 12.3.3.2; 12.3.6.3 and 12.4.3.2
	c) constraints to reclamation such as timing of activities, availability of reclamation materials and influence of natural processes and cycles including natural disturbance regimes;	c) Section 12.4.3.2
	d) a revegetation plan for the disturbed terrestrial, riparian and wetlands areas;	d) Sections 12.4.1.3 and 12.4.3.1
	e) reclamation material salvage, storage areas and handling procedures;	e) Sections 12.4.1.4 and 12.4.2.2;
	f) existing and final reclaimed site drainage plans.	f) Sections 12.3.6.3; 12.4.3.2 and 12.4.3.3;
	[B] Discuss, from an ecological perspective, the expected timelines for establishment and recovery of vegetative communities and wildlife habitat, the expected success of establishment and recovery.	[B] Sections 12.2.2 and 12.4.3.3
	[C] Discuss uncertainties related to the conceptual reclamation plan.	[C] Section 12.2.2
	[D] Describe how Cenovus considered the use of progressive reclamation in project design and reclamation planning.	[D] Section 12.3.1
3 Environmental Assessment		
3.1 Air Quality, Climate and Noise		
3.1.1 Baseline Information	[A] Discuss the baseline climatic and air quality conditions including: a) the type and frequency of meteorological conditions that may result in poor air quality; and	[A] a) Volume 3, Section 1.5.1 Existing Air Quality Volume 3, Section 1.5.2 Climate
	b) appropriate ambient air quality parameters.	b) Volume 3, Section 1.3 Air Quality Criteria
3.1.2 Impact Assessment	[A] Identify components of the Project that will affect air quality, and:	[A] Volume 3, Appendix 3-I Emission Source Details
	a) describe the potential for reduced air quality (including odours and visibility) resulting from the Project and discuss any implications of the expected air quality for environmental protection and public health;	a) Volume 3, Section 1.8 Application Case
	b) estimate ground-level concentrations of appropriate air quality parameters;	b) Volume 3, Section 1.6 Baseline Case Volume 3, Section 1.8 Application Case Volume 3, Section 1.9 Planned Development Case Volume 3, Appendix 3-IV Air Quality Predictions
	c) discuss any expected changes to particulate deposition, nitrogen deposition or acidic deposition patterns; d) identify areas that are predicted to exceed Potential Acid Input (PAI) critical loading criteria; and	c), d) Volume 3, Section 1.6 Baseline Case Volume 3, Section 1.8 Application Case Volume 3, Section 1.9 Planned Development Case Volume 3, Appendix 3-IV Air Quality Predictions
	e) discuss interactive effects that may occur resulting from co-exposure of a receptor to all emissions.	e) Volume 3, Section 3 Environmental Health Risk Assessment Volume 3, Section 4 Air Emissions Effects Assessment
	[B] Identify stages or elements of the Project that are sensitive to changes or variability in climate parameters, including frequency and severity of extreme weather events and discuss the potential impacts over the life of the Project.	[B] Volume 3, Section 1.5.2 Climate Volume 2, Section 4.2.1.2
	[C] Summarize the results of the noise assessment conducted for the ERCB, and: a) identify the nearest receptor used in the assessment; and b) discuss the design, construction and operational factors to be incorporated into the Project to comply with the ERCB's Directive 38: Noise Control.	[C] a) Volume 3, Section 2.3 Baseline Summary Volume 3, Appendix 3-VI Noise Baseline b) Volume 3, Section 2.7 Application Case Effects Assessment
	[D] Discuss mitigation strategies to minimize the potential impact of the Project on air quality and noise.	[D] Volume 3, Section 1.4 Mitigation Volume 3, Section 2.4 Mitigation
3.2 Hydrogeology		
3.2.1 Baseline Information	[A] Provide an overview of the existing geologic and hydrogeologic setting from the ground surface down to, and including, the oil producing zones and disposal zones, and:	[A] Volume 4, Appendix 4-IV, Sections 4 and 5
	a) present regional and Project Area geology to illustrate depth, thickness and spatial extent of lithology, stratigraphic units and structural features; and	a) Volume 4, Appendix 4-IV, Section 4
	b) present regional and Project Area hydrogeology describing: i. the major aquifers, aquitards and aquicludes (Quaternary and bedrock), their spatial distribution, properties, hydraulic connections between aquifers, hydraulic heads, gradients, groundwater flow directions and velocities. Include maps and cross sections,	b) i. Volume 4, Appendix 4-IV, Section 5.1 and Attachment A
	ii. the chemistry of groundwater aquifers including baseline concentrations of major ions, metals and hydrocarbon indicators,	ii. Volume 4, Appendix 4-IV, Section 5.4 and Attachment B
	iii. the potential discharge zones, potential recharge zones and sources, areas of groundwater-surface water interaction and areas of Quaternary aquifer-bedrock groundwater interaction,	iii. Volume 4, Appendix 4-IV, Sections 5.2 and 5.3
	iv. water well development and groundwater use, including an inventory of groundwater users,	iv. Volume 4, Appendix 4-IV, Section 5.5
	v. the recharge potential for Quaternary aquifers,	v. Volume 4, Appendix 4-IV, Section 5.3

Table 1 Final Terms of Reference Issued by Alberta Environment – Concordance Table (continued)

TOR Section	Environmental Assessment or Topic	Location TOR Addressed
3.2.1 Baseline Information (continued)	vi. potential hydraulic connection between bitumen production zones, deep disposal formations and other aquifers resulting from Project operations,	vi. Volume 4, Appendix 4-IV, Section 5.3
	vii. the characterization of formations chosen for deep well disposal, including chemical compatibility and containment potential, injection capacity, hydrodynamic flow regime, and water quality assessments, and	vii. Volume 1, Section 4.3, Section 4.4.7.3
	viii. the locations of major facilities associated with the Project including facilities for waste storage, treatment and disposal (e.g., deep well disposal) and describe site-specific aquifer and shallow groundwater conditions beneath these proposed facilities. Provide supporting geological information.	viii. Volume 1, Section 4.3, Section 4.4.7.3, Section 4.4.9 Volume 4, Section 7.1
3.2.2 Impact Assessment	[A] Describe Project components and activities that have the potential to affect groundwater resource quantity and quality at all stages of the Project.	[A] Volume 4, Section 5.1.1
	[B] Describe the nature and significance of the potential Project impacts on groundwater with respect to:	
	a) inter-relationship between groundwater and surface water in terms of both groundwater and surface water quantity and quality;	a) Volume 4, Sections 5.1.2 and 5.2.3
	b) implications for terrestrial or riparian vegetation, wildlife and aquatic resources including wetlands;	b) Volume 4, Section 5.1.2
	c) changes in groundwater quality, quantity and flow;	c) Volume 4, Sections 5.1.2 and 5.1.3
	d) conflicts with other groundwater users, and proposed resolutions to these conflicts;	d) Volume 4, Section 3.1.2
	e) potential implications of seasonal variations;	e) Volume 4, Section 5.1.2
	f) groundwater withdrawal for Project operations, including any expected alterations in the groundwater flow regime during and following Project operations;	f) Volume 4, Section 5.1.2
	g) steaming and bitumen production (e.g. ground heave and/or subsidence); and	g) Volume 1, Section 4.3 Reservoir Simulation
	h) wastewater disposal for Project operations, including any expected alterations in the groundwater flow regime during and following Project operations.	h) Appendix 4-I, Section 1.2
	[C] Discuss mitigation strategies to minimize the potential impact of the Project on hydrogeology.	[C] Volume 4, Sections 3 and 7
3.3 Hydrology		
3.3.1 Baseline Information	[A] Describe and map the surface hydrology in the Project Area. [B] Identify any surface water users who have existing approvals, permits or licenses.	[A], [B] Volume 4, Section 4.2 Appendix 4-V Hydrology Baseline
3.3.2 Impact Assessment	[A] Describe the extent of hydrological changes that will result from disturbances to groundwater and surface water movement: a) include changes to the quantity of surface flow, water levels and channel regime in watercourses (during minimum, average and peak flows) and water levels in waterbodies; b) assess the potential impact of any alterations in flow on the hydrology and identify all temporary and permanent alterations, channel realignments, disturbances or surface water withdrawals; c) discuss the effect of these changes on hydrology (e.g., timing, volume, peak and minimum flow rates, river regime and lake levels), including the significance of effects for downstream watercourses; and d) identify any potential erosion problems in watercourses resulting from the Project. [B] Describe impacts on other surface water users resulting from the Project. Identify any potential water use conflicts. [C] Discuss the impact of low flow conditions and in-stream flow needs on water supply and water and wastewater management strategies.	[A], [B], [C] Volume 4, Section 5.2, Section 6.2
	[D] Discuss mitigation strategies to minimize the potential impact of the Project on hydrology.	[D] Volume 4, Section 3.2
3.4 Surface Water Quality		
3.4.1 Baseline Information	[A] Describe the baseline water quality of watercourses and waterbodies.	[A] Volume 4, Section 4.3 Appendix VI Water Quality Baseline
3.4.2 Impact Assessment	[A] Describe the potential impacts of the Project on surface water quality and proposed mitigation measures to maintain surface water quality at all stages of the Project.	[A] Volume 4, Section 5.3, Section 6.3
3.5 Aquatic Ecology		
3.5.1 Baseline Information	[A] Describe and map the fish, fish habitat and aquatic resources (e.g., aquatic and benthic invertebrates) of the lakes, rivers, ephemeral water bodies and other waters. Describe the species composition, distribution, relative abundance, movements and general life history parameters of fish resources. Also identify any species that are: a) listed as "at Risk, May be at Risk and Sensitive" in The Status of Alberta Species (Alberta Sustainable Resource Development); b) listed in the federal Species at Risk Act; c) listed by COSEWIC; and d) traditionally used species. [B] Identify barriers to fish passage. [C] Describe and map existing critical or sensitive areas such as spawning, rearing, and over-wintering habitats, seasonal habitat use including migration and spawning routes.	[A], [B], [C] Volume 4, Section 4.4 Appendix VII Fish and Fish Habitat Baseline
	[D] Describe the current and potential use of the fish resources by aboriginal, sport or commercial fisheries.	[D] Volume 6, Appendix 6-I, Appendix 6-II
	[E] Identify the key aquatic indicators that Cenovus used to assess project impacts. Discuss the rationale for their selection.	[E] Volume 4, Section 2.7; Appendix 4-III
3.5.2 Impact Assessment	[A] Describe and assess the potential impacts of the Project to fish, fish habitat, and other aquatic resources, considering: a) habitat loss and alteration;	[A] Volume 4, Appendix 4-III a) Volume 4, Section 5.4, Section 6.4
	b) creation of barriers to fish passage;	b) Volume 4, Section 5.4, Section 6.4
	c) riparian areas that could affect aquatic biological resources and productivity;	c) Volume 4, Section 5.4, Section 6.4
	d) increased fishing pressures in the region that could arise from the increased workforce and improved access from the Project;	d) Volume 4, Section 5.4, Section 6.4 Volume 6, Section 3 Resource Use Assessment
	e) changes to benthic invertebrate communities that might affect food quality and availability for fish;	e) Volume 4, Section 5.4, Section 6.4
	f) increased habitat fragmentation;	f) Volume 4, Section 5.4, Section 6.4
	g) acidification; and	g) Volume 4, Section 5.4, Section 6.4 Volume 3, Section 4 Air Emissions Effects Assessment

Table 1 Final Terms of Reference Issued by Alberta Environment – Concordance Table (continued)

TOR Section	Environmental Assessment or Topic	Location TOR Addressed
3.5.2 Impact Assessment (continued)	h) groundwater/surface water interactions.	h) Volume 4, Section 5.4 and Section 6.4
	[B] Discuss mitigation measures to avoid or minimize potential impacts of the Project on fish, fish habitat and other aquatic resources. Clearly identify those mitigation measures that will be implemented and provide the rationale for their selection.	[B] Volume 4, Section 3.1, Section 3.2
	[C] Identify plans proposed to offset any loss in the productivity of fish habitat. Indicate how environmental protection plans address applicable provincial and federal policies on fish habitat including the development of a "No Net Loss" fish habitat objective.	[C], [D] Volume 4, Section 5.4
	[D] Discuss expected timelines for the establishment and recovery of fish communities and the expected differences in those communities following the project.	
3.6 Vegetation		
3.6.1 Baseline Information	[A] Describe and map the vegetation communities, wetlands, rare plants, old growth forests, and communities of limited distribution. Identify the occurrence, relative abundance and distribution of any species that are:	[A] Volume 5, Section 4.2 Terrestrial Vegetation and Wetlands Appendix 5-II Terrestrial Vegetation, Wetlands and Forest Resources Baseline
	a) listed as "at Risk, May be at Risk and Sensitive" in The Status of Alberta Species (Alberta Sustainable Resource Development); b) listed in Schedule 1 of the federal Species at Risk Act; c) listed as "at risk" by COSEWIC; and d) traditionally used species.	a), b), c), d) Volume 5, Section 6.2.3 Key Indicator Resources Appendix 5-II Terrestrial Vegetation, Wetlands and Forest Resources Baseline
	[B] Describe and quantify the current extent of habitat fragmentation.	[B] Volume 5, Appendix 5-IV Biodiversity Baseline Volume 5, Section 6.4 Biodiversity
3.6.2 Impact Assessment	[A] Describe and assess the potential impacts of the Project on vegetation communities, considering:	[A] Volume 5, Section 6.2.2 Terrestrial Vegetation, Wetlands and Forest Resources Effects Analysis
	a) both temporary (include timeframe) and permanent impacts; b) species richness, abundance and vegetative health; c) the potential for introduction and colonization of weeds and non-native invasive species; d) potential increased fragmentation and loss of upland, riparian and wetland habitats; and e) implications of vegetation changes for other environmental resources (e.g., terrestrial and aquatic habitat diversity and quantity, water quality and quantity, erosion potential).	a), b), c), d), e) Volume 3, Section 4.4.1 Baseline Case Volume 3, Section 4.4.2 Application Case Volume 3, Section 4.4.3 Planned Development Case
	[B] Identify key vegetation indicators, including any species listed under the federal Species at Risk Act and COSEWIC used to assess the Project impacts. Discuss the rationale for their selection.	[B] Volume 5, Section 2.7.2.2
	[C] Discuss the mitigation measures to avoid or minimize impacts on vegetation communities, wetlands, rare plants, old growth forests and communities of limited distribution. Clearly identify those mitigation measures that will be implemented and provide the rationale for their selection.	[C] Volume 5, Section 3 Mitigation
3.7 Wildlife		
3.7.1 Baseline Information	[A] Describe and map the wildlife resources (amphibians, reptiles, birds, and terrestrial and aquatic mammals). Describe species relative abundance, distribution and their use and potential use of habitats. Also identify any species that are:	[A] Volume 5, Appendix 5-III Wildlife and Wildlife Habitat Baseline
	a) listed as "at Risk, May be at Risk and Sensitive" in The Status of Alberta Species (Alberta Sustainable Resource Development); b) listed in Schedule 1 of the federal Species at Risk Act; c) listed as "at risk" by COSEWIC; and d) traditionally used species.	a), b), c), d) Volume 5, Appendix 5-III Wildlife and Wildlife Habitat Baseline Volume 5, Appendix 5-V Wildlife Habitat Modelling Volume 5, Section 6.3 Wildlife Volume 5, Section 7.3 Wildlife
	[B] Describe and map existing wildlife habitat, important wildlife areas and habitat disturbance (including exploration activities). Identify those habitat disturbances that are related to existing and approved Project operations.	[B] Volume 5, Section 4.2 Terrestrial Vegetation, Wetlands and Forest Resources
	[C] Identify the key wildlife and habitat indicators used to assess Project impacts. Discuss the rationale for their selection.	[C] Volume 5, Section 2.7.2.3
3.7.2 Impact Assessment	[A] Describe and assess the potential impacts of the Project to wildlife and wildlife habitats, considering:	[A] Volume 5, Section 6.3 Wildlife Volume 5, Section 7.3 Wildlife Volume 5, Appendix 5-V Wildlife Habitat Modelling
	a) how the Project will affect wildlife relative abundance, mortality, distribution and movement patterns, as well as habitat availability all stages of the Project;	a) Volume 5, Section 6.3 Wildlife Volume 5, Section 7.3 Wildlife Volume 5, Appendix 5-V Wildlife Habitat Modelling
	b) how improved or altered access may affect wildlife, including increased vehicle-wildlife collisions and increased hunting pressure;	b) Volume 5, Section 6.3 Wildlife Volume 5, Appendix 5-V Wildlife Habitat Modelling
	c) how increased habitat fragmentation may affect wildlife considering edge effects and the influence of linear features and infrastructure on wildlife movements and predator-prey relationships;	c) Volume 5, Section 6.3 Wildlife Volume 5, Section 7.3 Wildlife Volume 5, Appendix 5-V Wildlife Habitat Modelling
	d) potential effects on wildlife resulting from changes to air and water quality, including both acute and chronic effects to animal health;	d) Volume 3, Section 3.4 Wildlife Health Risk Assessment Volume 3, Appendix 3-X Human and Wildlife Health Risk Assessment Methods and Results
	e) potential effects on wildlife from Cenovus' proposed and planned exploration, seismic and core hole activities, including monitoring/4D seismic; and	e) Volume 5, Section 6.3 Wildlife Volume 5, Section 7.3 Wildlife
	f) the resilience and recovery capabilities of wildlife populations and habitats to disturbance.	f) Volume 5, Section 6.3 Wildlife Volume 5, Section 7.3 Wildlife Volume 5, Appendix 5-V Wildlife Habitat Modelling

Table 1 Final Terms of Reference Issued by Alberta Environment – Concordance Table (continued)

TOR Section	Environmental Assessment or Topic	Location TOR Addressed
3.7.2 Impact Assessment (continued)	[B] Discuss mitigation measures to avoid or minimize the potential impact of the Project on wildlife and wildlife habitat. Clearly identify those mitigation measures that will be implemented and provide the rationale for their selection.	[B] Volume 5, Section 3 Mitigation
3.8 Biodiversity		
3.8.1 Baseline Information	[A] Describe and map the existing biodiversity.	[A] Volume 5, Appendix 5-II Terrestrial Vegetation, Wetlands and Forest Resources Baseline Volume 5, Appendix 5-IV Biodiversity Baseline
	[B] Identify the biodiversity metrics, biotic and abiotic indicators that are used to characterize the baseline biodiversity and to assess project impacts. Discuss the rationale for their selection.	[B] Volume 5, Appendix 5-IV Biodiversity Baseline Volume 5, Section 6.4 Biodiversity
3.8.2 Impact Assessment	[A] Describe and assess the potential impacts of the Project to biodiversity considering:	
	a) the effects of fragmentation on biodiversity potential;	a) Volume 5, Section 6.4.2 Biodiversity Effects Analysis
	b) the contribution of the Project to any anticipated changes in regional biodiversity and the potential impact to local and regional ecosystems; and	b) Volume 5, Appendix 5-IV Biodiversity Baseline Volume 5, Appendix 5-IV Biodiversity Baseline Attachments A and B Volume 5, Section 6.4 Biodiversity
	c) effects during construction, operations and post-reclamation and the significance of these changes in a local and regional context.	c) Volume 5, Section 3 Mitigation
	[B] Discuss mitigation measures to avoid or minimize the potential impact of the Project on biodiversity. Clearly identify those mitigation measures that will be implemented and provide the rationale for their selection.	[B] Volume 5, Section 3 Mitigation
3.9 Terrain and Soils		
3.9.1 Baseline Information	[A] Describe and map the terrain and soils conditions in the Project Area.	[A] Volume 5, Appendix 5-I Terrain and Soils Baseline
	[B] Describe and map soil types in the areas that are predicted in 3.1.2[A]d) to exceed Potential Acid Input (PAI) critical loading criteria.	[B] Volume 5, Section 6.1 Volume 5, Appendix 5-I Terrain and Soil
3.9.2 Impact Assessment	[A] Describe Project activities and other related issues that could affect soil quality (e.g., compaction, contaminants) and:	[A] Volume 5, Section 3 Mitigation; Volume 5, Section 5 Linkage Analysis
	a) indicate the amount (ha) of surface disturbance from plant, field (pads, pipelines, access roads), aggregate and borrow sites, construction camps, drilling waste disposal and other infrastructure-related construction activities;	a) Volume 5, Section 6.1 Terrain and Soils Volume 1, Section 4.9
	b) discuss the relevance of any changes for the local and regional landscapes, biodiversity, productivity, ecological integrity, aesthetics and future use;	b) Volume 5, Section 5 Linkage Analysis
	c) identify the potential acidification impact on soils and discuss the significance of predicted impacts by acidifying emissions; and	c) Volume 3, Section 4 Air Emissions Effects Assessment
	d) describe potential sources of soil contamination.	d) Volume 5, Section 3.2 Operations (Mitigation), Section 5 Linkage Analysis Volume 1, Section 8.5 Waste Management
	[B] Discuss:	
	a) the environmental effects of proposed drilling methods on the landscape and surficial and bedrock geology;	a) Volume 5, Section 5 Section 3.2 , Section 6.1 Volume 1, Section 4.4.4 Drilling and Completions Volume 1, Section 8 Environmental Management
	b) the potential for changes in the ground surface during steaming and recovery operations (e.g., ground heave and/or subsidence) and their environmental implications; and	b) Volume 5, Section 5, Section 6.1.2. Volume 1, Section 4.4.9 Surface Disturbance
	c) the potential impacts caused by the mulching and storage of woody debris considering, but not limited to vulnerability to fire, degradation of soil quality, increased footprint, etc.	c) Volume 5, Section 3.1, Section 6.1
	[C] Discuss mitigation strategies to minimize the potential impact of the Project on soils or terrain.	[C] Volume 5, Section 3 Mitigation Volume 5, Section 6.1 Terrain and Soil
3.10 Land Use and Management		
3.10.1 Baseline Information	[A] Describe and map the current land uses in the Project Area, including all Crown land and Crown Reservations (Holding Reservation, Protective Notation, and Consultative Notation).	[A] Volume 6, Appendix 6-II Resource Use Baseline Report, Section 3.1 Land Use Plans and Zoning and Section 3.4 Land Use Dispositions
	[B] Indicate where Crown land dispositions may be needed for roads or other infrastructure for the Project.	[B] Volume 6, Appendix 6-II Resource Use Baseline Report, Section 3.1 Land Use Plans and Zoning and Section 3.4 Land Use Dispositions
	[C] Identify and map unique sites or special features in the Project Area and Local Study Area such as Parks and Protected Areas, Heritage Rivers, Historic Sites, Environmentally Significant Areas, culturally significant sites or areas and other designations (World Heritage Sites, Ramsar Sites, Internationally Important Bird Areas, etc).	[C] Volume 6, Appendix 6-II Resource Use Baseline Report, Section 3.7 Environmentally Important Areas
	[D] Describe and map land clearing activities, showing the timing of the activities.	[D] Volume 1, Sections 1.4 and 4.4.9 Volume 6, Section 3.5.1
	[E] Describe the status of timber harvesting arrangements, including species and timing.	[E] Volume 6, Appendix 6-II Resource Use Baseline Report, Section 3.9 Forestry Volume 6, Sections 3.5.3.1 Linkage Analysis, 3.5.3.2 Mitigation and 3.6.3.1 Mitigation
	[F] Describe existing access control measures in the Project Area.	[F] Volume 6, Sections 3.5.2.2 Mitigation and 3.6.3.1 Mitigation
3.10.2 Impact Assessment	[A] Identify the potential impact of the Project on land uses, including: a) unique sites or special features;	[A] a) Volume 6, Section 3.5.2 Effects on Environmentally Important Areas
	b) changes in public access arising from linear development, including secondary effects related to increased hunter, angler and other recreational access and facilitated predator movement;	b) Volume 6, Section 3.5.3 Effects on Resource Use and Users

Table 1 Final Terms of Reference Issued by Alberta Environment – Concordance Table (continued)

TOR Section	Environmental Assessment or Topic	Location TOR Addressed
3.10.2 Impact Assessment (continued)	c) aggregate reserves that may be located on land under the Cenovus' control and reserves in the region;	c) Volume 6, Section 3.5.3 Effects on Resource Use and Users
	d) development and reclamation on commercial forest harvesting and fire management in the Project Area;	d) Volume 6, Sections 3.5.3 Effects on Resource Use and Users, 3.5.3.2 Mitigation and 3.6.3.1 Mitigation
	e) the amount of commercial and non-commercial forest land base that will be disturbed by the Project, including the Timber Productivity Ratings for the Project Area. Compare the baseline and reclaimed percentages and distribution of all forested communities in the Project Area;	e) Volume 6, Section 3.5.3.3 Effects Analysis and Table 3.5-8
	f) how the Project impacts Annual Allowable Cuts and quotas within the Forest Management Agreement area;	f) Volume 5, Section 6.2.3.5 Annual Allowable Cut Volume 6, Section 3.5.3.3 Effects Analysis
	g) the baseline topography, elevation and drainage pattern within the Project Area; and	g) Volume 5, Section 6.2.2 Terrestrial Vegetation, Wetlands and Forest Resources Effects Analysis Volume 4, Section 5.2 Hydrology
	h) access control for public, regional recreational activities, aboriginal land use and other land uses during and after development activities.	h) Volume 6, Section 3.5.3 Effects on Resource Use and Users Volume 6, Section 2 Traditional Land Use
	[B] Provide a fire control plan highlighting: a) measures taken to ensure continued access for firefighters to adjacent wildland areas;	[B] a) Volume 1, Section 8.3
	b) forest fire prevention, detection, reporting, and suppression measures, including proposed fire equipment;	b) Volume 1, Section 8.3
	c) measures for determining the clearing width of power line rights-of-way; and	c) Volume 1, Section 4.4.9
	d) required mitigative measures for areas adjacent to the Project Area based on the FireSmart Wildfire Assessment System.	d) Volume 1, Section 8.3
	[C] Discuss mitigation strategies to minimize the potential impact of the Project on land uses.	[C] Volume 6, Sections 3.5.2.2 Mitigation and 3.6.3.1 Mitigation
4.0 Historical Resources		
4.1 Baseline Information		
4.1 Baseline Information	[A] Provide a brief overview of the regional historical resources settings including a discussion of the relevant archaeological, historic and paleontological records.	[A] Volume 6, Section 5.1 Introduction Volume 6, Section 5.2.5.1 Historic Resources Impact Assessment Process Volume 6, Section 5.4.2 Regional Study Area
	[B] Describe and map known historic resources sites in the Project Area, considering:	[B] Volume 6, Section 5.4 Baseline Case
	a) Site type and assigned Historic Resources Values (HRVs) and	a) Volume 6, Section 5.4.2 Regional Study Area
	b) Existing site specific Historic Resources Act requirements (if applicable).	b) Volume 6, Section 5.2.5 Assessment Methodology
	[C] Provide an overview of previous Historical Resources Impact Assessments (HRIAs) that have been conducted within the Project Area, including:	[C] Volume 6, Section 5.4 Baseline Case
	a) a description of the special extent of previous assessments relative to the Project Area, noting any assessment gap areas; and	a) Volume 6, Section 5.2.3 Spatial Considerations, Section 5.4 Baseline Case
	b) a summary of the Historical Resources Act requirements and/or clearances that have been issued for the Project to date (if applicable).	b) Volume 6, Section 5.2.1 Definition of Historic Resources Volume 6, Section 5.2.5 Assessment Methodology
	[D] Describe locations within the Project Area that are likely to contain previously unrecorded historical resources. Thoroughly describe the methods used to identify these areas.	[D] Volume 6, Section 5.2.3 Spatial Considerations Volume 6 Section 5.10 Follow-up Before Construction
4.1.1 Impact Assessment	[A] Describe Project components and activities that have the potential to affect historic resources at all stages of the Project.	[A] Volume 6, Section 5.7 Planned Development Case Volume 6, Section 5.6.1.4 Palaeontological Resources
	[B] Describe the nature and significance of the potential Project impacts on historical resources, considering:	[B] Volume 6, Section 5.5 Linkage Analysis Volume 6, Section 5.6 Application Case
	a) effects on historic resources site integrity; and	a) Volume 6, Section 5.7 Planned Development Case
	b) implications for the interpretation of the archaeological, historic and paleontological records.	b) Volume 6, Section 5.6.1 Local Study Area
	[C] Discuss mitigation measures that can be used to minimize impacts on historical resources. Clearly identify those mitigation measures that will be implemented and provide rationale for their selection.	[C] Volume 6, Section 5.3 Mitigation Volume 6, Section 5.8 Monitoring
5.0 TRADITIONAL ECOLOGICAL KNOWLEDGE AND LAND USE		
5.0 Historic Resources	[A] Provide: a) a map and description of traditional land use areas including fishing, hunting, trapping and nutritional, medicinal or cultural plant harvesting by affected aboriginal peoples (if the aboriginal community or group is willing to have these locations disclosed); b) a map of cabin sites, spiritual sites, cultural sites, graves and other traditional use sites considered historic resources under the Historical Resources Act (if the aboriginal community or group is willing to have these locations disclosed), as well as traditional trails and resource activity patterns; and c) a discussion of: i. the availability of vegetation, fish and wildlife species for food, traditional, medicinal and cultural purposes in the identified traditional land use areas considering all Project related impacts; ii. access to traditional lands in the Project Area during all stages of the Project, and iii. aboriginal views on land reclamation.	[A] a) Bigstone Cree Nation (BCN) did not want this information included Volume 6, Section 2.3, Appendix 6-I Traditional Land Use Baseline b) BCN did not want this information included Volume 6, Section 5, Historical Resources Assessment Volume 6, Appendix 6-I Traditional Land Use Baseline c) Volume 6, Appendix 6-I Traditional Land Use Baseline Volume 6, Section 2.5 TLU Application Case
	[B] Describe how TEK and TLU information was incorporated into the project design and development components of the EIA, the conservation and reclamation plan, monitoring and mitigation.	[B] Volume 1, Section 12.6 Conservation and Reclamation Monitoring Volume 4, Section 3 and Section 7 (Fish and Fish Habitat Assessment) Volume 5, Section 3 and Section 8 (Terrestrial Resources)

Table 1 Final Terms of Reference Issued by Alberta Environment – Concordance Table (continued)

TOR Section	Environmental Assessment or Topic	Location TOR Addressed
5.0 Historic Resources (continued)	[C] Determine the impact of the Project on traditional, medicinal and cultural purposes and identify possible mitigation strategies.	[C] Volume 6, Section 2.5 TLU Application Case Volume 6, Section 2.7 TLU Planned Development Case
6.0 Public Health and Safety Assessment		
6.1 Public Health and Safety Assessment	[A] Describe those aspects of the Project that may have implications for public health or the delivery of regional health services. Determine quantitatively whether there may be implications for public health arising from the Project.	[A] Volume 3, Section 3.3.Human Health Risk Assessment Volume 6, Section 6.6.4
	[B] Document any health concerns raised by stakeholders during consultation on the Project.	[B] Volume 1, Section 2 Public Consultation
	[C] Document any health concerns identified by aboriginal communities or groups resulting from impacts of existing development and of the Project specifically on their traditional lifestyle and include an aboriginal receptor type in the assessment.	[C] Volume 1, Section 2 Public Consultation Volume 6, Section 2.7 Volume 3, Section 3.3.2.1
	[D] Describe the potential health impacts resulting from higher regional traffic volumes and the increased risk of accidental leaks and spills.	[D] Volume 6, Section 6.6.7 Traffic and Transportation Volume 3, Section 3.3.4
	[E] Discuss mitigation strategies to minimize the potential impact of the Project on human health.	[E] Volume 3, Section 3.3.8
6.2 Public Safety	[A] Describe those aspects of the Project that may have implications for public safety. Determine whether there may be implications for public safety arising from the Project. Specifically: a) describe Cenovus' emergency response plan, including public notification protocol and safety procedures to minimize adverse environmental effects, including emergency reporting procedures for spill containment and management;	[A] a) Volume 1, Section 8.2 Emergency Management
	b) document any safety concerns raised by stakeholders during consultation on the Project;	b) Volume 1, Section 2 Public Consultation
	c) describe how local residents will be contacted during an emergency and the type of information that will be communicated to them;	c) Volume 1, Section 8.2 Emergency Management
	d) describe the existing agreements with area municipalities or industry groups such as safety cooperatives, emergency response associations, regional mutual aid programs and municipal emergency response agencies; and	d) Volume 1, Section 8.2 Emergency Management Volume 6, Section 6.4
	e) describe the potential safety impacts resulting from higher regional traffic volumes.	e) Volume 6, Section 6.6.7 Traffic and Transportation
7.0 Socio-Economic Assessment		
7.1 Baseline Information	[A] Describe the existing socio-economic conditions in the region and in the communities in the region.	[A] Volume 6, Appendix 6-III Volume 6, Section 6.3
	[B] Describe factors that may affect existing socio-economic conditions including: a) population changes;	[B] a) Volume 6, Section 6.6.1
	b) workforce requirements for the Project, including a description of when peak activity periods will occur;	b) Volume 6, Section 6.5.1 Volume 6, Section 6.4.2
	c) planned accommodations for the workforce for all stages of the Project;	c) Volume 1, Section 1.2 and Section 1.3 Volume 6, Section 6.4.3
	d) Cenovus' policies and programs regarding the use of regional and Alberta goods and services;	d) Volume 6, Section 6.5.1
	e) the project schedule; and	e) Volume 1, Section 1.7 Project Schedule
	f) the overall engineering and contracting plan for the Project.	f) Volume 6, Section 6.4
7.2 Impact Assessment	[A] Describe the effects of construction and operation of the Project on:	
	a) housing;	a) Volume 6, Section 6.6.2
	b) availability and quality of health care services;	b) Volume 6, Section 6.6.4
	c) local and regional infrastructure and community services;	c) Volume 6, Sections 6.6.3, 6.6.5, 6.6.6, 6.6.7, and 6.6.8
	d) recreational activities;	d) Volume 6, Sections 3.5.3 and 6.6.9
	e) hunting, fishing, trapping and gathering; and	e) Volume 6, Sections 2.5, 2.6 and 3.5.3
	f) First Nations and Métis (e.g., traditional land use and social and cultural implications).	f) Volume 6, Sections 2.5, 2.6
	[B] Describe the socio-economic effects of any construction camp required for the Project and identify:	
	a) its location;	a) Volume 1, Sections 1.2 and 1.3
	b) the number of workers it is intended to house;	b) Volume 6, Section 6.4.3
	c) whether the camp will service the Project only or other clients;	c) Volume 6, Section 6.4.3
	d) the length of time the camp will be in service; and	d) Volume 6, Section 6.4.3
	e) describe what services will be provided in the camp (e.g., security, recreation and leisure, medical services).	e) Volume 6, Sections 6.4.3, 6.6.4 and 6.6.6
	[C] Describe the need for additional Crown land to manage the effects in [A] and [B].	[C] Volume 6, Section 6.6.2.1
	[D] Discuss plans to work with First nations and Métis communities and groups, other local residents and businesses regarding employment, training needs and other economic development opportunities arising from the Project.	[D] Volume 6, Sections 6.4.2, 6.4.4 and 6.4.6
	[E] Provide the estimated total Project cost, including a breakdown for engineering and project management, equipment and materials, and labour for both construction and operation stages. Indicate the percentage of expenditures expected to occur in the region, Alberta, Canada, outside of Alberta, and outside of Canada.	[E] Volume 6, Section 6.5.1
	[F] Discuss mitigation strategies to minimize the potential impact of the Project on socio-economic conditions in the region and communities in the region.	[F] Volume 6, Section 6.5.1, Section 6.6
7.2.2 Impact Assessment	[A] d) potential effects on wildlife resulting from changes to air and water quality, including both acute and chronic effects on animal health;	[A] d) Volume 3, Section 3.4 Wildlife Health Risk Assessment

Table 1 Final Terms of Reference Issued by Alberta Environment – Concordance Table (continued)

TOR Section	Environmental Assessment or Topic	Location TOR Addressed
8 Residual Impacts		
8 Residual Impacts	[A] Describe the residual impacts of the Project following implementation of Cenovus' mitigation measures and Cenovus' plans to manage those residual impacts.	[A] Volume 1, Section 11 Summary of the EIA Volumes 3 to 6
9 Monitoring		
9 Monitoring	[A] Describe Cenovus' current and proposed monitoring programs.	[A] Volume 2, Appendix 2-V Volume 1, Section 10 Regional Cooperation
	[B] Describe the monitoring programs proposed to assess any Project impacts and to measure the effectiveness of mitigation plans.	[B] Volume 2, Appendix 2-V
	[C] Discuss Cenovus' regional monitoring activities including: a) monitoring that will be undertaken to assist in managing environmental effects, confirm performance of mitigation measures and improve environmental protection strategies; b) monitoring done independently by Cenovus and how these monitoring programs are consistent with other current or proposed regional monitoring programs; c) monitoring performed in conjunction with other stakeholders, including aboriginal communities and groups; and d) new monitoring initiatives that may be required as a result of the Project.	[C] a), b), c), d) Volume 2, Appendix 2-V Volume 1, Section 10 Regional Cooperation
	[D] Discuss: a) Cenovus' plans for addressing and mitigating environmental impacts identified in the monitoring program; b) how monitoring data will be disseminated to the public or other interested parties; and c) how the results of monitoring programs and publicly available monitoring information will be integrated with Cenovus' environmental management system.	[D] a), b), c) Volume 2, Appendix 2-V Volume 1, Section 8 Environmental Management

Table 2 Energy Resources Conservation Board Directive 023 Information Requirements (EUB 1991)

Directive 023 Section	Requirement (abridged)	Locations in Volume 1 unless otherwise noted
1.0 GENERAL INFORMATION		
1.5	**Project description**	
1.5.1	Applicable Acts and Sections under which the application is made	Volume 1, Section 1.9 Request for Approval
1.5.2	Name and address of the application and any partners involved and the details of company incorporation	Volume 1, Section 1.12 Contact Information
1.5.3	Statement of need and project timing	Volume 1, Section 1.6 Resource and Development Need Volume 1, Section 1.7 Project Schedule
1.5.4	Overall project description and discussion of schedule Including: location, size and scope, schedule of preconstruction, construction, start up, duration of operations, and a discussion of the reasons for selecting the proposed schedule.	Volume 1, Section 1 Introduction
1.5.5	Regional setting and reference to existing and proposed land use	Volume 1, Section 1.3 Project Location Volume 1, Section 1.4 Surface Rights
1.5.6	a. Maps showing freehold, leasehold, mineral and surface rights of the proposed scheme and surrounding area. b. Maps with legal descriptions showing the locations of landowners and their dwellings in relation to the proposed oil sands site	Volume 1, Section 1.3 Project Location Figure 1.3-1 Volume 1 Section 1.5 Minerals Land, Figure 1.5-1 Volume 2, Section 5, Figure 5-1
1.5.7	Map showing topography, exiting areas of habitation, industry, the proposed site and any development in the Project area	Volume 1, Section 1.3 Project Location, Figure 1.3-1
1.5.8	Aerial photomosaic at an appropriate scale to illustrate the locations of the Project components including the mine area, wells, extraction plant, upgrader unit, tanks, discard storage sites including tailing ponds, access roads, railways, pipelines and utility corridors.	Volume 1, Section 1.3 Project Location, Figure 1.3-2
1.5.9	Description of storage and transportation facilities of the final hydrocarbon product, including detail of size and ownership of any pipeline which may be utilized	Volume 1, Section 5.7 Offsites
1.5.10	Proposed rate of production over the life of the Project	Volume 1, Section 1.2 Pelican Lake Grand Rapids - Project Overview
1.5.11	Description of the subject oil sands	Volume 1, Section 3.3 Reservoir Characteristics

Table 2 Energy Resources Conservation Board Directive 023 Information Requirements (EUB 1991) (continued)

Directive 023 Section	Requirement (abridged)	Locations in Volume 1 unless otherwise noted
1.5.12	Status of negotiations held or to be held with the freehold, leasehold, mineral surface rights owners	Volume 1, Section 1.4 Surface Rights Volume 1, Section 1.5 Minerals Land
1.5.13	Proposed energy source, alternatives, resource use, sources and supply	Volume 1, Section 5 Central Plant Facility Volume 1, Section 9, Alternatives Considered Volume 1, Appendix 1-VIII Block Flow Diagram and Simplified Water Balance
1.5.14	Description and results of public information program	Volume 1, Section 2 Public Consultation
1.5.15	The term of the approval sought, including expected project start and completion dates	Volume 1, Section 1 Introduction
1.5.16	Name of responsible person to contact	Volume 1, Section 1.12 Contact Information
2.0 TECHNICAL INFORMATION		
2.1	Surface mining operations	n/a
2.2	Underground access and development	n/a
2.3	In-situ operations	Volume 1, Section 4 Bitumen Recovery Process
2.4 Processing Plant		
2.4.1	A separate description of the bitumen extraction, upgrading, utilities, refining and sulphur recovery facilities, including; a discussion of the process process flow diagrams indicating major equipment, stream rates and composition, and the proposed production measurement devices, characteristics and locations chemical and physical characteristics and properties of feeds and product materials	Volume 1, Section 4 Bitumen Recovery Process; Volume 1, Section 5 Central Plant Facility Volume 1, Appendix 1-IX Process Flow Diagrams
2.4.2	Overall material and energy balances, including information with respect to hydrocarbon and sulphur recoveries, water use and energy efficiency	Volume 1, Appendix 1-VIII Block Flow Diagram and Simplified Water Balance Volume 1, Appendix 1-X Heat and Material Balances
2.4.3	Quantity of products, by-products and waste and their disposition	Volume 1, Section 5 Central Plant Facility Volume 1, Section 8.5 Waste Management

Table 2 Energy Resources Conservation Board Directive 023 Information Requirements (EUB 1991) (continued)

Directive 023 Section	Requirement (abridged)	Locations in Volume 1 unless otherwise noted
2.4.4	Surface drainage within the areas of the processing plant, product storage and waste treatment and disposal	Volume 1, Section 8.5 Waste Management Volume 4, Section 3 .2Surface Facilities and Infrastructure Volume 4, Section 7.2.1 Surface Disturbances
2.4.5	Comparison of proposed process to alternatives considered on the basis of overall recovery, energy efficiency, cost, commercial availability and environmental considerations and the reasons for selecting the proposed process	Volume 1, Section 9 Alternatives Considered
2.4.6	This number has been omitted from Directive 023	n/a
2.4.7	Example of production accounting reports	Volume 1, Section 7 Measurement Accounting and Reporting Plan
2.5	**Electrical Utilities and External Energy Sources**	
2.5.1	A description of any facilities to be provided for the generation of electricity to be used by the Project.	n/a
2.5.2	Identification of the source, quantity and quality of any fuel, electricity or steam to be obtained from sources beyond the Project site	Volume 1, Section 5.7 Offsites
2.5.3	Where energy resources from outside the Project boundaries are to be supplied to the Project, a detailed appraisal of the options available to eliminate the need for such resources, with consideration for overall recovery, energy balance, costs, technical limitations and environmental implications	Volume 1, Section 5.7 Offsites
2.6	**Environmental Control**	
2.6.1	A description of air and water pollution control and monitoring facilities, as well as a liquid spill contingency plan	Volume 1, Section 8 Environmental Management Volume 4, Section 7 Monitoring
2.6.2	A description of the water management program, including the proposed water source and expected withdrawal the source-water quality control the waste-water disposal program water balance for the proposed scheme the produced-water clean-up/recycle program	Volume 1, Section 6 Water Source Management Volume 1, Appendix 1-XI Detailed Water Balances Volume 4, Section 5.1.1 Linkage Analysis Volume 4, Section 3.2 Surface Facilities and Infrastructure

Table 2 Energy Resources Conservation Board Directive 023 Information Requirements (EUB 1991) (continued)

Directive 023 Section	Requirement (abridged)	Locations in Volume 1 unless otherwise noted
2.6.3	The manner in which surface water drainage within the Project area would be collected, treated and disposed	Volume 1, Section 8.5 Waste Management Volume 4, Section 3.2 Surface Facilities and Infrastructure Volume 4, Section 7.2.1 Surface Disturbances
2.6.4	A description of the air and water pollution control and monitoring facilities	Volume 1, Section 8.5 Waste Management Volume 3, Section 1 Air Quality Assessment Volume 4, Section 3.2 Surface Facilities and Infrastrucuture Volume 1, Section 6 Water Source Management
2.6.5	A description of the emission control system, including stack design criteria and process data any additions of residue gas or natural gas to the flare system to ensure combustion of hydrogen sulphide for both normal operating conditions and maximum emission conditions methods proposed for the control of all air pollutants from all potential or actual emission sources at the operation (including all vents, stacks, flares, product storage tanks, sulphur handling areas, ponds, wells and other fugitive emission sources) during normal, emergency and maximum operating conditions monitoring program for hydrogen sulphide, sulphur dioxide, total sulphation, hydrogen sulphide sulphation, soil pH, nitrogen oxides and hydrocarbons in the surrounding area	Volume 1, Section 8 Environmental Management Volume 3, Appendix 3-I Emission Source Details Volume 3, Section 1.12 Monitoring
3.1 Commercial Viability		
3.1.1	An appraisal and projections, on an annual basis of revenues, capital and operating costs (including a breakdown of fuel costs and non-fuel operating costs), royalties and taxes, net cash flow, marketing arrangements, fuel and electric power arrangements	Volume 6, Section 6 Socio-Economic Assessment
3.1.2	A description of project costs which include capital and operating cost, including a breakdown of capital and operating costs for each component of the Project including site preparation, well drilling and completion, central processing facilities (including steam generation, waster treatment and recycling), satellite and surface facilities, production/injection distribution system, upgrading, utilities and off-sites depreciation	Volume 6, Section 6 Socio-Economic Assessment

Table 2 Energy Resources Conservation Board Directive 023 Information Requirements (EUB 1991) (continued)

Directive 023 Section	Requirement (abridged)	Locations in Volume 1 unless otherwise noted
3.2 Benefit-Cost Analysis		
3.2.1	A summary of quantifiable public benefits and costs incurred during the construction and operation of the Project	Volume 6, Section 6 Socio-Economic Assessment
3.2.2	A summary of non-quantifiable public benefits and costs incurred each year during construction and operation of the Project	Volume 6, Section 6 Socio-Economic Assessment
3.3 Economic Impact		
3.3.1	An appraisal of the economic impact of the Project on the region, province and nation	Volume 6, Section 6 Socio-Economic Assessment
3.3.2	A discussion of any initiatives undertaken to accommodate regional economic priorities and interests	Volume 6, Section 6 Socio-Economic Assessment
3.3.3	An assessment of direct and indirect employment opportunities for all groups associated with the Project including projected max and min workforce demand by skill categories in the construction and operating phases and an analysis of how these demands shall be met an analysis of the indirect and induced employment generated by the Project due to employment multiplier effects a discussion of the employment and training arrangements provided by applicant that would enable residents of the region to participate in meeting the workforce demands	Volume 6, Section 6 Socio-Economic Assessment
4.0	Environmental Impact Assessment	Volumes 2 to 6
5.0	Biophysical Impact Assessment	Volume 5 Terrestrial Resources Assessment Report
6.0	Social Impact Assessment	Volume 6, Section 6 Socio-Economic Assessment
7.0	Describe the environmental protection plan including mitigation measures, environmental monitoring and research	Volume 1, Section 11 Summary of Environmental Impact Assessment Volumes 2 to 6 Volume 2, Appendix 2-V Monitoring Programs
8.0	Conceptual Development and Reclamation Plan	Volume 1, Section 12 Conservation and Reclamation Plan
9.0	Solid Waste Management Plan	Volume 1, Section 8.5 Waste Management

APPENDIX 2-III

COMMON AND SCIENTIFIC NAMES

Common Name	Scientific Name
Vegetation[(a)(b)]	
Tree	
aspen	*Populus tremuloides*
balsam fir	*Abies balsamea*
balsam poplar	*Populus balsamifera*
black spruce	*Picea mariana*
jack pine	*Pinus banksiana*
tamarack	*Larix laricina*
white birch	*Betula papyrifera*
white spruce	*Picea glauca*
Shrub	
Alaska willow	*Salix alaxensis*
autumn willow	*Salix serissima*
basket willow	*Salix petiolaris*
beaked willow	*Salix bebbiana*
bearberry	*Arctostaphylos uva-ursi*
blueberry	*Vaccinium myrtilloides*
bog cranberry	*Vaccinium vitis-idaea*
bog rosemary	*Andromeda polifolia*
bog willow	*Salix pedicellaris*
bracted honeysuckle	*Lonicera involucrata*
bristly black currant	*Ribes lacustre*
Canada buffaloberry	*Shepherdia canadensis*
crowberry	*Empetrum nigrum*
dwarf bilberry	*Vaccinium caespitosum*
dwarf birch	*Betula pumila*
false mountain willow	*Salix pseudomonticola* (also *S. monticola*)
flat-leaved willow	*Salix planifolia*
green alder	*Alnus viridis* ssp. *crispa*
high-bush cranberry	*Viburnum opulus*
hoary willow	*Salix candida*
Labrador tea	*Ledum groenlandicum*
leatherleaf	*Chamaedaphne calyculata*
low-bush cranberry	*Viburnum edule*
myrtle-leaved willow	*Salix myrtillifolia*
northern black currant	*Ribes hudsonianum*
northern gooseberry	*Ribes oxyacanthoides*
northern laurel	*Kalmia polifolia*
pin cherry	*Prunus pensylvanica*
prickly rose	*Rosa acicularis*
red-osier dogwood	*Cornus stolonifera*
Ribes species	*Ribes* sp.
river alder	*Alnus incana* ssp. *tenuifolia* (also *A. rugosa*)
saskatoon	*Amelanchier alnifolia*
skunk currant	*Ribes glandulosum*
small bog cranberry	*Oxycoccus microcarpus*
smooth willow	*Salix glauca*
snowberry	*Symphoricarpos albus*
sweet gale	*Myrica gale*
twinflower	*Linnaea borealis*
twining honeysuckle	*Lonicera dioica*
velvet-fruited willow	*Salix maccalliana*
wild red currant	*Ribes triste*
wild red raspberry	*Rubus idaeus*
willow species	*Salix* sp.

Common Name	Scientific Name
Forb	
-	*Chrysosplenium* sp.
alsike clover	*Trifolium hybridum*
American milk vetch	*Astragalus americanus*
Antennaria species	*Antennaria* sp.
arctic sweet coltsfoot	*Petasites frigidus*
arrow-leaved coltsfoot	*Petasites frigidus* var. *sagittatus*
Aster species	*Aster* sp.
Bicknell's geranium	*Geranium bicknellii*
bishop's-cap	*Mitella nuda*
bitter cress	*Cardamine pensylvanica*
bladderwort species	*Utricularia* sp.
blunt-leaved bog orchid	*Platanthera obtusata* (also *Habenaria obtusata*)
blunt-leaved sandwort	*Moehringia lateriflora*
bog violet	*Viola nephrophylla*
bristly buttercup	*Ranunculus pensylvanicus*
buck-bean	*Menyanthes trifoliata*
bunchberry	*Cornus canadensis*
cattail	*Typha latifolia*
celery-leaved buttercup	*Ranunculus sceleratus*
cinquefoil species	*Potentilla* sp.
cloudberry	*Rubus chamaemorus*
common bladderwort	*Utricularia vulgaris*
common dandelion	*Taraxacum officinale*
common duckweed	*Lemna minor*
common horsetail	*Equisetum arvense*
common mare's-tail	*Hippuris vulgaris*
common nettle	*Urtica dioica*
common pink wintergreen	*Pyrola asarifolia*
common plantain	*Plantago major*
common yarrow	*Achillea millefolium*
cream-colored vetchling	*Lathyrus ochroleucus*
creeping thistle	*Cirsium arvense*
curled dock	*Rumex crispus*
dewberry	*Rubus pubescens*
dwarf raspberry	*Rubus arcticus* (also *R. acaulis*)
dwarf scouring-rush	*Equisetum scirpoides*
elephant's-head	*Pedicularis groenlandica*
fairybells	*Disporum trachycarpum*
fireweed	*Epilobium angustifolium*
flat-leaved bladderwort	*Utricularia intermedia*
fleshy stitchwort	*Stellaria crassifolia*
floating marsh-marigold	*Caltha natans*
Fries' pondweed	*Potamogeton friesii*
giant bur-reed	*Sparganium eurycarpum*
golden saxifrage	*Chrysosplenium iowense*
green saxifrage	*Chrysosplenium tetrandrum*
greenish-flowered wintergreen	*Pyrola chlorantha* (also *Pyrola virens*)
ground-cedar	*Diphasiastrum complanatum* (also *Lycopodium complanatum*)
ground-pine	*Lycopodium obscurum*
heart-leaved arnica	*Arnica cordifolia*
heart-leaved twayblade	*Listera cordata*
hemlock species	*Cicuta* sp.
hooded ladies'-tresses	*Spiranthes romanzoffiana*
Labrador lousewort	*Pedicularis labradorica*

Common Name	Scientific Name
lady fern	*Athyrium filix-femina*
Lapland buttercup	*Ranunculus lapponicus*
large-leaved white water crowfoot	*Ranunculus aquatilis*
large-leaved yellow avens	*Geum macrophyllum*
lesser rattlesnake plantain	*Goodyera repens*
lesser wintergreen	*Pyrola minor*
Lindley's aster	*Aster ciliolatus*
long-leaved chickweed	*Stellaria longifolia*
long-stalked chickweed	*Stellaria longipes*
lousewort species	*Pedicularis* sp.
many-flowered yarrow	*Achillea sibirica*
marsh cinquefoil	*Potentilla palustris*
marsh skullcap	*Scutellaria galericulata*
marsh willowherb	*Epilobium palustre*
marsh-marigold	*Caltha palustris*
meadow horsetail	*Equisetum pratense*
moschatel	*Adoxa moschatellina*
narrow-leaved bur-reed	*Sparganium angustifolium*
narrow-leaved hawkweed	*Hieracium umbellatum*
narrow-leaved willowherb	*Epilobium leptophyllum*
northern bastard toadflax	*Geocaulon lividum*
northern bedstraw	*Galium boreale*
northern grass-of-parnassus	*Parnassia palustris*
northern green bog orchid	*Platanthera hyperborea* (also *Habenaria hyperborea*)
northern starflower	*Trientalis borealis*
northern stitchwort	*Stellaria calycantha*
northern water-horehound	*Lycopus uniflorus*
northern willowherb	*Epilobium ciliatum*
oak fern	*Gymnocarpium dryopteris*
oblong-leaved sundew	*Drosera anglica*
one-flowered wintergreen	*Moneses uniflora*
one-sided wintergreen	*Orthilia secunda* (also *Pyrola secunda*)
pale coralroot	*Corallorhiza trifida*
palmate-leaved coltsfoot	*Petasites frigidus* var. *palmatus*
peavine species	*Lathyrus* sp.
perennial sow-thistle	*Sonchus arvensis*
phlox species	*Phlox* sp.
pitcher-plant	*Sarracenia purpurea*
pondweed species	*Potamogeton* sp.
purple avens	*Geum rivale*
purple peavine	*Lathyrus venosus*
red and white baneberry	*Actaea rubra*
rough cinquefoil	*Potentilla norvegica*
round-leaved bog orchid	*Platanthera orbiculata* (also *Habenaria orbiculata*)
round-leaved orchid	*Amerorchis rotundifolia* (also *Orchis rotundifolia*)
round-leaved sundew	*Drosera rotundifolia*
running club-moss	*Lycopodium clavatum*
scentless chamomile	*Matricaria perforata* (also *Tripleurospermum inodorum*)
scheuchzeria	*Scheuchzeria palustris*
scouring-rush	*Equisetum hyemale*
seaside arrow-grass	*Triglochin maritima*
small bedstraw	*Galium trifidum*
small bladderwort	*Utricularia minor*
small enchanter's nightshade	*Circaea alpina*
sow-thistle species	*Sonchus* sp.
spotted coralroot	*Corallorhiza maculata*

Common Name	Scientific Name
spotted touch-me-not	*Impatiens capensis*
stiff club-moss	*Lycopodium annotinum*
swamp horsetail	*Equisetum fluviatile*
swamp lousewort	*Pedicularis parviflora*
sweet-scented bedstraw	*Galium triflorum*
tall Jacob's-ladder	*Polemonium acutiflorum*
tall lungwort	*Mertensia paniculata*
three-leaved Solomon's-seal	*Smilacina trifolia*
tufted loosestrife	*Lysimachia thyrsiflora*
violet species	*Viola* sp.
water arum	*Calla palustris*
water parsnip	*Sium suave*
water smartweed	*Polygonum amphibium*
water-hemlock	*Cicuta maculata*
western Canada violet	*Viola canadensis*
western dock	*Rumex occidentalis*
white sweet-clover	*Melilotus alba*
wild lily-of-the-valley	*Maianthemum canadense*
wild sarsaparilla	*Aralia nudicaulis*
wild strawberry	*Fragaria virginiana*
wild vetch	*Vicia americana*
willowherb species	*Epilobium* sp.
wintergreen species	*Pyrola* sp.
woodland horsetail	*Equisetum sylvaticum*
woodland strawberry	*Fragaria vesca*
yellow pond-lily	*Nuphar lutea* ssp. *variegata*
yellow rattle	*Rhinanthus minor*
yellow sweet-clover	*Melilotus officinalis*
yellow water crowfoot	*Ranunculus gmelinii*
Graminoid	
beautiful sedge	*Carex concinna*
Bebb's sedge	*Carex bebbii*
bent sedge	*Carex deflexa*
bluegrass species	*Poa* sp.
bluejoint	*Calamagrostis canadensis*
bog muhly	*Muhlenbergia glomerata*
bog sedge	*Carex paupercula*
bristle-stalked sedge	*Carex leptalea*
brome species	*Bromus* sp.
brownish sedge	*Carex brunnescens*
common great bulrush	*Schoenoplectus tabernaemontani* (also *Scirpus validus*)
common tall manna grass	*Glyceria grandis*
cottongrass species	*Eriophorum* sp.
creeping spike-rush	*Eleocharis palustris*
fowl bluegrass	*Poa palustris*
foxtail barley	*Hordeum jubatum*
fringed brome	*Bromus ciliatus*
golden sedge	*Carex aurea*
graceful sedge	*Carex praegracilis*
green sedge	*Carex viridula*
hairy wild rye	*Leymus innovatus* (also *Elymus innovatus*)
hairy-fruited sedge	*Carex lasiocarpa*
hardstem bulrush	*Schoenoplectus acutus* var. *acutus* (also *Scirpus lacustris*)
inland sedge	*Carex interior*
Kentucky bluegrass	*Poa pratensis*
lakeshore sedge	*Carex lacustris*

Common Name	Scientific Name
lakeshore sedge	*Carex lenticularis*
mud sedge	*Carex limosa*
needle spike-rush	*Eleocharis acicularis*
northern bog sedge	*Carex gynocrates*
Norway sedge	*Carex norvegica*
prostrate sedge	*Carex chordorrhiza*
quack grass	*Elytrigia repens*
reed canary grass	*Phalaris arundinacea*
rye-grass sedge	*Carex loliacea*
sand sedge	*Carex houghtoniana*
Scirpus species	*Scirpus* sp.
sedge	*Carex pachystachya*
sedge species	*Carex* sp.
sheathed cotton grass	*Eriophorum vaginatum*
sheathed sedge	*Carex vaginata*
short sedge	*Carex canescens*
short-awned foxtail	*Alopecurus aequalis*
silvery-flowered sedge	*Carex aenea*
slender cotton grass	*Eriophorum gracile*
slough grass	*Beckmannia syzigachne*
small bottle sedge	*Carex utriculata*
small-flowered wood-rush	*Luzula parviflora*
tall cotton-grass	*Eriophorum angustifolium*
thin-flowered sedge	*Carex tenuiflora*
thin-leaved cotton grass	*Eriophorum viridi-carinatum*
timothy	*Phleum pratense*
tufted hair grass	*Deschampsia cespitosa*
two-seeded sedge	*Carex disperma*
two-stamened sedge	*Carex diandra*
water sedge	*Carex aquatilis*
wood-rush species	*Luzula* sp.
Bryophyte	
acute-leaved peat moss	*Sphagnum capillifolium*
amblystegium moss	*Amblystegium serpens*
aspen moss	*Orthotrichum speciosum*
awned hair-cap	*Polytrichum piliferum*
Blandlow's feather moss	*Helodium blandowii*
blunt-leafed peat moss	*Sphagnum obtusum*
brachythecium moss	*Brachythecium campestre*
brachythecium moss	*Brachythecium mildeanum*
brachythecium moss	*Brachythecium salebrosum*
brachythecium moss	*Brachythecium* sp.
brachythecium moss	*Brachythecium starkei*
broom moss	*Dicranum scoparium*
brown moss	*Drepanocladus aduncus*
brown moss	*Hamatocaulis vernicosus* (also *Drepanocladus vernicosus*)
brown moss	*Sanionia uncinata* (also *Drepanocladus uncinatus*)
brown moss	*Warnstorfia tundrae*
brown moss species	*Drepanocladus* sp.
brown tapering splachnum	*Tetraplodon mnioides*
Bryohaplocladium species	*Bryohaplocladium microphyllum*
bryum moss	*Bryum caespiticium*
bryum moss species	*Bryum* sp.
campylium moss	*Campylium hispidulum*
campylium moss	*Campylium polygamum*
cephaloziella liverwort species	*Cephaloziella* sp.

Common Name	Scientific Name
common green bryum moss	*Bryum pseudotriquetrum*
common hair-cap	*Polytrichum commune*
common tree moss	*Climacium dendroides*
copper wire moss	*Pohlia nutans*
cord moss	*Funaria hygrometrica*
cushion moss	*Dicranum acutifolium*
cushion moss	*Dicranum fragilifolium*
dicranum moss species	*Dicranum* sp.
Drummond's plagiomnium moss	*Plagiomnium drummondii*
elliptic plagiomnium moss	*Plagiomnium ellipticum*
eurhynchium moss	*Eurhynchium pulchellum*
flagon-fruited splachnum	*Splachnum ampullaceum*
fuscous moss	*Dicranum fuscescens*
giant water moss	*Calliergon giganteum*
Girgensohn's moss	*Sphagnum girgensohnii*
golden moss	*Tomentypnum falcifolium*
golden moss	*Tomentypnum nitens*
hair-cap moss	*Polytrichum* sp.
Herzogiella species	*Herzogiella turfacea*
hypnum moss	*Hypnum pratense*
Jungermann's platydictya moss	*Platydictya jungermannioides*
juniper hair-cap	*Polytrichum juniperinum*
knight's plume moss	*Ptilium crista-castrensis*
leptobryum moss	*Leptobryum pyriforme*
Lindberg's hypnum moss	*Hypnum lindbergii*
liverwort	*Anastrophyllum helleranum*
liverwort	*Blepharostoma trichophyllum*
liverwort	*Calypogeia integristipula*
liverwort	*Calypogeia sphagnicola*
liverwort	*Cephalozia connivens*
liverwort	*Cephalozia lunulifolia*
liverwort	*Geocalyx graveolens*
liverwort	*Jamesoniella autumnalis*
liverwort	*Leiomylia anomala* (also *Mylia anomala*)
liverwort	*Lepidozia reptans*
liverwort	*Lophocolea heterophylla*
liverwort	*Lophocolea minor*
liverwort	*Lophozia ascendens*
liverwort	*Lophozia excisa*
liverwort	*Lophozia guttulata*
liverwort	*Lophozia ventricosa*
liverwort	*Marchantia polymorpha*
liverwort	*Plagiochila asplenioides*
liverwort	*Ptilidium ciliare*
liverwort	*Ptilidium pulcherrimum*
liverwort	*Riccardia palmata*
liverwort	*Scapania curta*
liverwort	*Scapania glaucocephala*
meesia moss	*Meesia triquetra*
midway peat moss	*Sphagnum magellanicum*
mnium moss	*Mnium spinulosum*
mnium moss species	*Mnium* sp.
mountain curved-back moss	*Oncophorus wahlenbergii*
myurella moss	*Myurella julacea*
narrow-leaved splachnum	*Tetraplodon angustatus*
obtuseleaf aspen moss	*Orthotrichum obtusifolium*

Common Name	Scientific Name
peat moss	*Sphagnum angustifolium*
peat moss	*Sphagnum majus*
peat moss	*Sphagnum* sp.
plagiomnium moss	*Plagiomnium medium*
plagiomnium moss species	*Plagiomnium* sp.
plagiothecium moss	*Plagiothecium laetum*
platygyrium moss	*Platygyrium repens*
purple horn-toothed moss	*Ceratodon purpureus*
pylaisiella moss	*Pylaisiella polyantha*
red leaf moss	*Bryoerythrophyllum recurvirostre*
rhizomnium moss	*Rhizomnium gracile*
rhizomnium moss	*Rhizomnium pseudopunctatum*
Richardson's water moss	*Calliergon richardsonii*
rusty peat moss	*Sphagnum fuscum*
Schreber's moss	*Pleurozium schreberi*
shore-growing peat moss	*Sphagnum riparium*
slender hair-cap	*Polytrichum strictum*
squarrose peat moss	*Sphagnum squarrosum*
stair-step moss	*Hylocomium splendens*
straw-coloured water moss	*Calliergon stramineum*
Tetraphis moss	*Tetraphis pellucida*
thin-leafed peat moss	*Sphagnum teres*
thuidium moss	*Thuidium recognitum*
toothed plagiomnium moss	*Plagiomnium cuspidatum*
tufted moss	*Aulacomnium palustre*
Warnstorf's peat moss	*Sphagnum warnstorfii*
water hook moss	*Warnstorfia fluitans* (also *Drepanocladus fluitans*)
water moss species	*Calliergon cordifolium*
wavy dicranum	*Dicranum polysetum*
wavy dicranum	*Dicranum undulatum*
whip fork moss	*Dicranum flagellare*
wide-tongued peat moss	*Sphagnum russowii*
yellow star moss	*Campylium stellatum*
Lichens and Epiphytes	
-	*Agyrium rufum*
-	*Arthonia apatetica*
-	*Arthonia dispersa sensu lato*
-	*Arthonia edgewoodensis*
-	*Arthonia patellulata*
-	*Arthonia spadicea*
-	*Arthonia vinosa*
-	*Bacidia circumspecta*
-	*Bacidia rosellizans*
-	*Bacidia* sp.
-	*Baeomyces rufus*
-	*Biatora pallens*
-	*Biatora turgidula* (also *Lecidea turgidula*)
-	*Buellia arborea*
-	*Buellia triphragmioides*
-	*Buellia triseptata*
-	*Calicium parvum*
-	*Calicium salicinum*
-	*Caloplaca ahtii*
-	*Caloplaca cerina*
-	*Caloplaca holocarpa*
-	*Caloplaca ulcerosa*

Common Name	Scientific Name
-	*Candelaria concolor*
-	*Cetraria cucullata* (also *Flavocetraria cucullata*)
-	*Chaenotheca chrysocephala*
-	*Chaenothecopsis nana*
-	*Collema furfuraceum*
-	*Lecania dubitans*
-	*Lecanora allophana*
-	*Lecanora anopta*
-	*Lecanora chlarotera*
-	*Lecanora farinaria*
-	*Lecanora hagenii*
-	*Lecanora hybocarpa*
-	*Lecanora impudens*
-	*Lecidea hypnorum*
-	*Lecidea nylanderi*
-	*Lecidea plebeja*
-	*Lecidella euphorea*
-	*Leptogium saturninum*
-	*Leptogium teretiusculum*
-	*Leptorhaphis epidermidis*
-	*Lichenomphalia umbellata*
-	*Melanelia exasperatula*
-	*Melanelia subelegantula*
-	*Melanelia subolivacea*
-	*Micarea misella*
-	*Micarea paupercula ined.*
-	*Mycobilimbia carneoalbida*
-	*Mycobilimbia epixanthoides*
-	*Mycocalicium subtile*
-	*Myochroidea porphyrospoda*
-	*Nephroma parile*
-	*Nephroma resupinatum*
-	*Peltigera cinnamomea*
-	*Peltigera didactyla*
-	*Peltigera didactyla* var. *extenuata*
-	*Peltigera elisabethae*
-	*Peltigera neckeri*
-	*Peltigera polydactyla*
-	*Peltigera praetextata*
-	*Peltigera retifoveata*
-	*Peltigera rufescens*
-	*Pertusaria pupillaris*
-	*Phaeocalicium populneum*
-	*Phaeophyscia hirsuta*
-	*Phaeophyscia hispidula*
-	*Phaeophyscia kairamoi*
-	*Phlyctis argena*
-	*Physcia alnophila*
-	*Placynthiella oligotropha*
-	*Protoparmelia ochrococca*
-	*Punctelia perreticulata*
-	*Pycnora elachista ined.*
-	*Pycnora leucococca*
-	*Pycnora sorophora*
-	*Pycnora xanthococca*
-	*Ramalina thrausta*

Common Name	Scientific Name
-	*Rinodina austroborealis*
-	*Rinodina degeliana*
-	*Rinodina efflorescens*
-	*Rinodina grandilocularis*
-	*Rinodina griseosoralifera*
-	*Rinodina metaboliza*
-	*Rinodina orculata*
-	*Rinodina pyrina*
-	*Rinodina septentrionalis*
-	*Rinodina sheardii*
-	*Scoliciosporum perpusillum*
-	*Usnea* sp.
-	*Xanthoria fallax*
-	*Xylographa soralifera*
-	*Xylographa trunciseda*
abraded camoflage lichen	*Melanelia subaurifera*
alder needles	*Phaeocalicium compressulum*
alder stickpin	*Stenocybe pullatula*
alpine kidney lichen	*Nephroma bellum*
beard lichen	*Usnea fulvoreagens*
beard lichen	*Usnea subfloridana*
beard lichen	*Usnea substerilis*
bighorn cladonia	*Cladonia cornuta*
black woodscript lichen	*Xylographa parallela* (also *X. abietina*)
black-eyed rim lichen	*Lecanora circumborealis*
board lichen	*Trapeliopsis flexuosa*
boreal oakmoss lichen	*Evernia mesomorpha*
British soldiers	*Cladonia cristatella*
button lichen	*Buellia griseovirens*
button lichen	*Buellia punctata*
carpet pelt	*Peltigera neopolydactyla*
catinaria lichen	*Catinaria atropurpurea*
common goldspeck lichen	*Candelariella vitellina*
crowned pixie-cup	*Cladonia carneola*
cup lichen	*Cladonia amaurocraea*
cup lichen	*Cladonia bacilliformis*
cup lichen	*Cladonia coniocraea*
cup lichen	*Cladonia cyanipes*
cup lichen	*Cladonia gracilis* ssp. *turbinata*
cup lichen	*Cladonia squamosa*
cup lichen	*Cladonia subulata*
cup lichen	*Cladonia umbrosa*
cup lichen species	*Cladonia* sp.
dog lichen	*Peltigera canina*
dot lichen	*Micarea denigrata*
dot lichen	*Micarea prasina*
felt cladonia	*Cladonia phyllophora*
felt lichen	*Peltigera neopolydactyla* (also *Peltigera occidentalis*)
felt lichen species	*Peltigera* sp.
fishbone beard lichen	*Usnea filipendula*
fringed wrinkle-lichen	*Tuckermannopsis americana* (also *Cetraria halei* or *C. ciliaris*)
fused rim-lichen	*Lecanora symmicta*
gray starburst lichen	*Parmeliopsis hyperopta*
Gray's cup lichen	*Cladonia grayi*
greater sulphur cup	*Cladonia sulphurina*

Common Name	Scientific Name
green reindeer lichen	*Cladina mitis*
green starburst lichen	*Parmeliopsis ambigua*
grey reindeer lichen	*Cladina rangiferina*
hammered shield moss	*Parmelia sulcata*
hidden dot lichen	*Japewia tornoensis*
hooded rosette lichen	*Physcia adscendens*
horsehair	*Bryoria furcellata*
Iceland lichen	*Cetraria ericetorum*
lesser sulphur-cup	*Cladonia deformis*
lipstick powderhorn	*Cladonia macilenta*
mealy pixie-cup	*Cladonia chlorophaea*
membraneous dog-lichen	*Peltigera membranacea*
monk's-hood lichen	*Hypogymnia physodes*
mottled-disk lichen	*Trapeliopsis granulosa*
northern camoflage lichen	*Melanelia septentrionalis*
northern measle lichen	*Pyrrhospora cinnabarina* (also *Lecidea cinnabarina*)
northern reindeer lichen	*Cladina stellaris*
old man's beard	*Bryoria capillaris*
old man's beard	*Bryoria glabra*
old man's beard	*Bryoria implexa*
old man's beard	*Bryoria simplicior*
old man's beard	*Usnea cavernosa*
old man's beard	*Usnea glabrata*
organ-pipe lichen	*Cladonia crispata*
pebbled pixie-cup	*Cladonia pyxidata*
pelt lichen	*Peltigera conspersa ined.*
powdered beard lichen	*Usnea lapponica*
powdered funnel lichen	*Cladonia cenotea*
powdered sunshine lichen	*Vulpicida pinastri* (also *Tuckermannopsis pinastri*)
powdery saucer lichen	*Ochrolechia androgyna*
punctured ramalina	*Ramalina dilacerata*
red pixie-cup	*Cladonia borealis*
red-fruited pixie-cup	*Cladonia pleurota*
reindeer lichen	*Cladina arbuscula*
reindeer lichen species	*Cladina* sp.
rim-lichen	*Lecanora boligera*
rim-lichen	*Lecanora laxa*
rim-lichen	*Lecanora pulicaris*
rim-lichen	*Lecanora subintricata*
rock ramalina	*Ramalina intermedia*
ruffled freckle pelt	*Peltigera leucophlebia*
salted starburst lichen	*Imshaugia aleurites*
shaggy beard lichen	*Usnea hirta*
sieve lichen	*Cladonia multiformis*
smooth-footed powderhorn	*Cladonia ochrochlora*
speckled horsehair	*Bryoria fuscescens*
split-peg lichen	*Cladonia cariosa*
spraypaint	*Icmadophila ericetorum*
star rosette lichen	*Physcia stellaris*
straw beard lichen	*Usnea scabrata*
studded leather lichen	*Peltigera aphthosa*
tar-spot lichen	*Placynthiella dasaea*
tar-spot lichen	*Placynthiella icmalea*
tar-spot lichen	*Placynthiella uliginosa*
thorn cladonia	*Cladonia uncialis*
tile lichen	*Lecidea leprarioides*

Common Name	Scientific Name
trumpet lichen	*Cladonia fimbriata*
tuckermannopsis lichen	*Cetraria sepincola*
variable wrinkle-lichen	*Tuckermannopsis orbata* (also *Cetraria orbata*)
veinless pelt	*Peltigera malacea*
wooden soldiers	*Cladonia botrytes*
woodscript lichen	*Xylographa vitiligo*
wooly foam lichen	*Stereocaulon tomentosum*
yellow collar stubble lichen	*Calicium trabinellum*
Wildlife[(c)]	
Mammals[(d)(e)]	
Artiodactyla	
deer species	*n/a*
moose	*Alces alces*
white-tailed deer	*Odocoileus virginianus*
woodland caribou	*Rangifer tarandus*
Carnivora	
American pine marten	*Martes americana*
black bear	*Ursus americanus*
Canada lynx	*Lynx canadensis*
coyote	*Canis latrans*
fisher	*Martes pennanti*
fisher/marten	*Martes* species
grey wolf	*Canis lupus*
mink	*Neovison vison*
red fox	*Vulpes vulpes*
river otter	*Lutra canadensis*
weasel spp.	*Mustela* species
Castoridae	
beaver	*Castor canadensis*
Chiroptera	
bat spp.	*n/a*
hoary bat	*Lasiurus cinereus*
little brown bat	*Myotis lucifugus*
northern myotis	*Myotis septentrionalis*
red bat	*Lasiurus borealis*
silver-haired bat	*Lasionycteris noctivagans*
Lagomorpha	
snowshoe hare	*Lepus americanus*
Rodentia	
mouse species	*n/a*
muskrat	*Ondatra zibethicus*
red squirrel	*Tamiasciurus hudsonicus*
woodchuck	*Marmota monax*
Amphibians/Reptiles	
Anura	
boreal chorus frog	*Pseudacris triseriata*
western toad	*Bufo boreas*
wood frog	*Rana sylvatica*
Birds	
Anseriformes	
bufflehead	*Bucephala albeola*
Canada goose	*Branta canadensis*
common goldeneye	*Bucephala clangula*
mallard	*Anas platyrhynchos*
ring-necked duck	*Aythya collaris*

Common Name	Scientific Name
Caprimulgiformes	
common nighthawk	*Chordeiles minor*
Charadfriformes	
black tern	*Chlidonias niger*
greater yellowlegs	*Tringa melanoleuca*
killdeer	*Charadrius vociferus*
lesser yellowlegs	*Tringa flavipes*
solitary sandpiper	*Tringa solitaria*
Wilson's snipe (common snipe)	*Gallinago gallinago*
Ciconiformes	
American bittern	*Botaurus lentiginosus*
great blue heron	*Ardea herodias*
Coraciformes	
belted kingfisher	*Megaceryle alcyon*
Falconiformes	
American kestrel	*Falco sparverius*
bald eagle	*Haliaeetus leucocephalus*
golden eagle	*Aquila chrysaetos*
merlin	*Falco columbarius*
northern harrier	*Circus cyaneus*
red-tailed hawk	*Buteo jamaicensis*
rough-legged hawk	*Buteo lagopus*
Galliformes	
ruffed grouse	*Bonasa umbellus*
sharp-tailed grouse	*Tympanuchus phasianellus*
spruce grouse	*Falcipennis canadensis*
Gaviformes	
common loon	*Gavia immer*
Gruiformes	
sandhill crane	*Grus canadensis*
sora	*Porzana carolina*
Passeriformes	
alder flycatcher	*Empidonax alnorum*
American crow	*Corvus brachyrhynchos*
American redstart	*Setophaga ruticilla*
American robin	*Turdus migratorius*
bank swallow	*Riparia riparia*
barn swallow	*Hirundo rustica*
bay-breasted warbler	*Dendroica castanea*
black-and-white warbler	*Mniotilta varia*
black-capped chickadee	*Parus atricapillus*
blue-headed vireo	*Vireo solitarius*
boreal chickadee	*Poecile hudsonicus*
brown creeper	*Certhia Americana*
Canada warbler	*Wilsonia canadensis*
Cape May warbler	*Dendrocia tigrina*
cedar waxwing	*Bombycilla cedrorum*
chipping sparrow	*Spizella passerina*
clay-coloured sparrow	*Spizella pallida*
common raven	*Corvus corax*
common yellowthroat	*Geothlypis trichas*
Connecticut warbler	*Oporornis agilis*
dark-eyed junco	*Junco hyemalis*
eastern kingbird	*Tyrannus tyrannus*
evening grosbeak	*Coccothraustes vespertinus*
gray jay	*Perisoreus canadensis*

Common Name	Scientific Name
hermit thrush	*Catharus guttatus*
Le Conte's sparrow	*Ammodramus leconteii*
least flycatcher	*Empidonax minimus*
Lincoln's sparrow	*Melospiza lincolnii*
magnolia warbler	*Dendroica magnolia*
mourning warbler	*Oporornis philadelphia*
northern flicker	*Colaptes auratus*
northern waterthrush	*Seiurus noveboracensis*
olive-sided flycatcher	*Contopus cooperi*
orange-crowned warbler	*Vermivora celata*
ovenbird	*Seiurus aurocapillus*
palm warbler	*Dendroica palmarum*
Philadelphia vireo	*Vireo philadelphicus*
pine siskin	*Carduelis pinus*
purple finch	*Carpodacus purpureus*
red crossbill	*Loxia curvirostra*
red-breasted nuthatch	*Sitta canadensis*
red-eyed vireo	*Vireo olivaceus*
red-winged blackbird	*Agelaius phoeniceus*
rose-breasted grosbeak	*Pheucticus ludovicianus*
ruby-crowned kinglet	*Regulus calendula*
rusty blackbird	*Euphagus carolinus*
savannah sparrow	*Passerculus sandwichensis*
song sparrow	*Melospiza melodia*
Swainson's thrush	*Catharus ustulatus*
swamp sparrow	*Melospiza georgiana*
Tennessee warbler	*Vermivora peregrina*
tree swallow	*Iridoprocne bicolor*
warbling vireo	*Vireo gilvus*
western tanager	*Piranga ludoviciana*
western wood pewee	*contopus sordidulus*
white-throated sparrow	*Zonotrichia albicollis*
white-winged crossbill	*Loxia leucoptera*
Wilson's warbler	*Wilsonia pusilla*
winter wren	*Troglodytes troglodytes*
yellow rumped warbler	*Dendroica coronata*
yellow warbler	*Dendrocia petechia*
Pelecaniformes	
American white pelican	*Pelecanus erythrorhynchos*
double crested cormorant	*Phalocrocorax auritus*
Piciformes	
pileated woodpecker	*Dryocopus pileatus*
sapsucker species	*n/a*
woodpecker species	*n/a*
yellow-bellied sapsucker	*Sphyrapicus varius*
Podicipediformes	
eared grebe	*Podiceps nigricollis*
red-necked grebe	*Podiceps grisegena*
western grebe	*Aechmophorus occidentalis*
Strigiformes	
barred owl	*Strix varia*
boreal owl	*Aegolius funereus*
great gray owl	*Strix nebulosa*
great horned owl	*Bubo virginianus*
long-eared owl	*Asio otus*
northern hawk-owl	*Surnia ulula*

Common Name	Scientific Name
northern saw-whet owl	*Aegolius acadicus*
owl species	*n/a*
Fish[f]	
Arctic grayling	*Thymallus articus*
brook stickleback	*Culea inconstans*
burbot	*Lota lota*
cisco	*Coregonus artedi*
flathead chub	*Platygobio gracilis*
goldeye	*Hiodon alosoides*
lake chub	*Couesius plumbeus*
lake whitefish	*Coregonus clupeaformis*
longnose dace	*Rhinichthys cataractae*
northern pike	*Esox lucius*
pearl dace	*Margariscus margarita*
slimy sculpin	*Cottus cognatus*
spottail shiner	*Notropis hudsonius*
trout-perch	*Percopsis omiscomaycus*
walleye	*Sander vitreus*
white sucker	*Catostomus commersoni*
yellow perch	*Perca flavescens*
Invertebrates[g][c]	
amphipods	Amphipoda
amphipods	Gammaridae
amphipod	*Gammarus lacustrus*
amphipods	Hyalellidae
amphipod	*Hyalella azteca*
aquatic worms	Oligochaeta
aquatic worms	Enchytraeidae
aquatic worms	Naididae
aquatic worms	Tubificidae
beetles	Coleoptera
beetles - predacious water beetles	Dytiscidae
beetle - predaceous water beetles	*Ilybius*
beetle - crawling water beetle	*Haliplus*
beetle - leaf beetles	Chrysomelidae
beetle - leaf beetles	*Donacia*
caddisflies	Trichoptera
caddisflies	Hydroptilidae
caddisfly	*Oxyethira*
caddisflies	Leptoceridae
caddisfly	*Oecetis*
caddisflies	Phryganeidae
caddisfly	*Agrypnia*
caddisflies	Polycentropodidae
caddisfly	*Polycentropus*
clams	Pelecypoda
clam – fingernail clam	*Pisidium*
clam – fingernail clam	*Pisidiidae*
clam – fingernail clam	*Sphaerium*
copepod	Copepoda
damselflies and dragonflies	Odonata
damselflies	Zygoptera
damselflies	Coenagrionidae
damselfly	*Enallagma*
dragonflies	Anisoptera
dragonflies	Corduliidae

Common Name	Scientific Name
Dragonfly	*Somatochlora*
leeches	Hirudinea
leeches	Erpobdellidae
leech	*Erpobdella punctata*
leech	*Nephelopsis obscura*
leeches	Glossiphoniidae
leech	*Glassiphonia complanata*
leech	*Helobdella stagnalis*
leeches	*Placobdella* sp.
mayflies	Ephemeroptera
mayflies	Caenidae
mayfly	*Caenis*
roundworms	Nematoda
seed shrimp	Ostracoda
snails	Gastropoda
snails	*Menetus cooperi*
snails	Lymnaeidae
snail	*Lymnaea*
snails	Physidae
snail	*Physa*
snails	Planorbidae
snail	*Helisoma*
snail	*Gyraulus*
snail	*Promenetus*
snail	*Valvata sincera*
snail	*Valvata tricarinata*
true flies	Diptera
true flies - biting midges	Ceratopogonidae
true fly - biting midge (no-see-um)	*Bezzia*
true fly - biting midge (no-see-um)	*Probezzia*
true fly - biting midge (no-see-um)	*Sphaeromias*
true fly - black fly	*Simulium*
true flies - deer flies and horse flies	Tabanidae
true flies - crane flies	*Tipulidae*
true flies - crane flies	*Helius*
true flies - crane flies	*Rhabdomastix*
true fly - deer fly	*Chrysops*
true flies - midges	Chironomidae
true fly - midge	*Chironomus*
true fly - midge	*Cladopelma*
true fly - midge	*Cryptochironomus*
true fly - midge	*Dicrotendipes*
true fly - midge	*Einfeldia*
true fly - midge	*Endochironomus*
true fly - midge	*Glyptotendipes*
true fly - midge	*Microtendipes*
true fly - midge	*Polypedilum*
true fly - midge	Sergentia
true fly - midge	*Tribelos*
true fly - midge	*Cladotanytarsus*
true fly - midge	*Paratanytarsus*
true fly - midge	*Micropsectra*
true fly - midge	*Rheotanytarsus*
true fly - midge	*Stempellinella*
true fly - midge	*Tanytarsus*
true fly - midge	*Acricotopus*

Common Name	Scientific Name
true flies - midges	Orthocladiinae
true fly - midge	*Heterotrissocladius*
true fly - midge	*Nanocladius*
true fly - midge	*Psectrocladius*
true fly - midge	*Synorthocladius*
true fly - midge	*Zalutschia*
true fly - midge	*Psilometriocnemus*
true fly - midge	*Cricotopus/Orthocladius*
true fly - midge	*Ablabesmyia*
true fly - midge	*Clinotanypus*
true fly - midge	*Procladius*
true fly - midge	*Potthastia longimana* gr.
water mites	Hydracarina
-	*Harpacticoid Copepoda*

(a) Johnson et. al. 1995.

(b) Moss 1983.

(c) Merritt and Cummins 1996.

(d) Smith 1993.

(e) Burt 1976.

(f) Nelson and Paetz 1992.

(g) Clifford 1991.

n/a = Not applicable.

– = No common/scientific name available.

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APPENDIX 2-IV

QUALITY ASSURANCE AND QUALITY CONTROL

TABLE OF CONTENTS

SECTION **PAGE**

1 INTRODUCTION

Data used in support of Environmental Impact Assessments (EIAs) must be of sufficient quality to ensure that the conclusions are not compromised. Established and proven Quality Assurance and Quality Control (QA/QC) procedures have been applied to the completion of the Cenovus Energy Inc. (Cenovus) Pelican Lake Grand Rapids (the Project). These procedures were implemented to ensure that the data collected are of known, acceptable and defensible quality and that proper procedure (e.g., database management, electronic file management, document control, report reviewing procedures) were followed.

An overview of the components of the QA/QC procedures and overall objectives are presented below:

- use of standardized field sampling protocols for the EIA including:
  - relevant technical procedures and Specific Work Instructions (SWIs) for baseline field activities;
  - established and consistent procedures for recording field data;
  - established and consistent procedures for sample handling including identification, preservation and transport; and
  - proper health and safety procedures.
- selection of accredited laboratories to ensure high-quality analytical data; and
- application of established and rigorous documentation management processes including:
  - data entry, database management and audit procedures;
  - document control procedures (e.g., coding, version control, back-up management and safe storage of documents related to the Project); and
  - document review procedures.

The EIA team includes a management team to oversee the entire EIA and a technical team for each component of the EIA (e.g., wildlife, water quality). Each component has a Component Lead who ensures their component meets all its objectives. The component-specific issues, technical approach and scope of work for each component of the EIA are described in detail in the corresponding sections of this Application. Component Leads were responsible for ensuring compliance with the QA/QC procedures.

2 FIELD PROCEDURES

The following sections describe the field procedures, including protocols for field methods, audits, record keeping, sample handling (i.e., sample identification, preservation, sample QC, shipping), and health and safety. Field procedures are developed with consideration of recognized regulatory guidelines and requirements.

2.1 FIELD METHODS

Technical Procedures are detailed sampling protocols used by field personnel to ensure sampling techniques are standardized and defensible. Established Technical Procedures were used for most field sampling programs; however, where alternate methods were used, they are described in detail in the appropriate section of the EIA.

Specific Work Instructions were also used for field sampling programs. The SWIs included: project personnel; details of where and when to sample; specific sampling instructions (including reference to relevant Technical Procedures); level of effort required; schedule for the fieldwork; site map; and any applicable contingency plans.

2.2 FIELD RECORD KEEPING

The Field Crew Lead was responsible for ensuring that all pertinent information on field activities and sampling efforts were recorded in the appropriate data sheet and/or in a waterproof bound logbook. Field notes and data sheets were coded and stored within each component's filing system. A tracking sheet of these file locations was kept in the Project master file.

2.3 SAMPLE HANDLING

Sampling protocols (including sample identification, preservation, sample QC and storage), selection of sample containers and the amount of material collected followed detailed Technical Procedures and the requirements of the analytical laboratory (e.g., sample volumes or weights). The laboratory requirements, as well as sample containers and preservatives, were provided by the selected laboratory based on the parameters to be analyzed and the required detection limits.

2.4 SAMPLE SHIPPING

Sample shipping required the use of Chain-of-Custody (COC) forms, which documented the travel of samples from the field crew's possession to the laboratory log-in. Chain-of-custody forms provide a complete list of the contents of the shipment (i.e., sample codes), dates and times samples were collected, analysis requested, shipping information and possession history of the shipment.

Sample containers were securely packed inside a cooler with appropriate packing materials and ice packs before shipping. The original signed COC forms were placed in a zip-locked bag inside the cooler. The Field Crew Lead retained a copy of the COC documentation. Samples were transported from the sampling area to the selected laboratory by an authorized carrier as soon as possible after collection.

The COC form was completed when the container arrived at the laboratory and the log-in personnel recorded the date, time and condition of the sample arrival. The laboratory was aware of the sampling date and time to ensure that analysis was completed within the specified time limits.

2.5 HEALTH AND SAFETY

Each field program for the Project required a detailed Health and Safety Plan (HASP) to be completed by the Field Crew Lead, which was then reviewed and approved by the Component Lead, the Project Manager and the Project Health and Safety Administrator. Completed HASPs contain site-specific information (including site map(s) and Universal Transverse Mercator [UTM] co-ordinates), field personnel contact information, emergency information, field-level risk assessment, emergency call down procedure, pre-field meeting notes, tail-gate meeting notes, check-in logs and a blank incident/accident report form. At the end of each program a post-field debrief meeting between the Project Health and Safety Administrator and the field crew was conducted and noted in the HASP. Relevant information (including hazard identifications) was communicated to other crews working in the areas and the completed HASPs were filed in the Project Master File. Any near misses or incidents were reported immediately to Golder Associates Ltd.'s (Golder's) Health and Safety department as well as to Cenovus.

3 LABORATORY PROCEDURES

Only laboratories accredited by the Canadian Association for Environmental Analytical Laboratories (CAEAL) were selected to complete analysis of samples for the Project. Under CAEAL's accreditation program, a performance evaluation assessment is conducted annually for the laboratory's procedures, methods and internal quality control. Laboratories were also required to provide written protocols for the analytical methods used, including the target detection limit for each chemical tested.

The COC form provided clear instructions to the laboratory on the analysis requested for each sample. Samples were identified and tracked by means of sample location (station) and replicate identifiers. Any transfer of samples between or within laboratories was tracked through COC procedures.

Laboratory quality control criteria included analysis of QC samples. Field blanks were used to evaluate the effects of collection, handling and analysis of samples on data quality. Duplicate samples were used to evaluate the precision of the sampling method and laboratory results. All excess sample materials were archived by the labs for future reference.

Upon receipt of the laboratory results, Component Leads reviewed the datasets. Concentrations in blank samples greater than five times the analytical detection limit in the field blanks were considered to indicate the possibility of contamination. Duplicate measurements with a difference greater than 20% were considered to signal a possible error in analysis. In these instances sample re-runs were requested, or potential errors were considered when interpreting the data.

4 DOCUMENTATION

4.1 DATA MANAGEMENT

At the end of each program, data sheets were reviewed and checked for completeness by the relevant Component Lead or designate. Prior to data entry, analysis and output requirements were reviewed to ensure the database conformed to the necessary specifications. After entry into the database was completed, data entries were checked against the original data sheets. Ten percent of the data entries, or a minimum of one hundred entries were checked for every dataset.

A management system for data control and filing was used for the Project. This system ensured that the most current information was stored in a single location for use by team members. This practice ensured efficient QA/QC procedures and was available to other components and Cenovus as required.

Each component was assigned an electronic project directory. Subdirectories were named by the task code number and title. Data files within the subdirectories were named according to content and date of revision. Files were archived as they became either outdated or redundant to ensure that all files were current.

4.2 DOCUMENT CONTROL

The Project produced large quantities of written material, including correspondence, field data, data reports from laboratories, documentation of analysis and reports. The document control system operated as follows:

- Field records, materials and reports received or produced in-house were dated, coded and filed according to the relevant task.
- Copies of documents transferred to Cenovus were photocopied along with the accompanying transmittal and were stored in the Project master files.
- Documents received from external parties were logged in an incoming documents ledger and filed in the Project master files.

- The Project master files were maintained by the Project Management Team and located in a locked file with restricted access. Draft Project reports and application sections were completed by Component Leads and reviewed by a Senior Reviewer in the relevant discipline before submission to the Project Management Team for the final review process.

4.3 FINAL REVIEW AND DOCUMENTATION PROCESS

The final Project application is a compilation of several independent sections, reports and appendices. As stated above, each section was reviewed first by the Component Lead and then by a Senior Reviewer before it was submitted to the Project Management Team. Once received by the Project Management Team, each document underwent an extensive review and documentation process including:

- complete document format to ensure correct headings and page layouts;
- technical review of each section for consistency and compliance with Project-specific conventions;
- complete check of references, cross-references, tables and figures;
- complete review by the Project Manager and Project Director as appropriate;
- review by Cenovus representatives;
- review of all comments and edits received from Cenovus representatives with document authors to ensure technical content was not compromised; and all questions and comments were addressed; and
- final review and approval by the Project Manager, Project Director and Cenovus representatives.

This review process was managed and documented by the Project Coordinator. Electronic and paper copies of each report were archived as they were superseded and a single current version was made available for each step of the process. A QA/QC check of the edits and changes incorporated was completed at each stage of the process. A tracking sheet was completed for each document stating the dates each step was completed and by whom.

5 ABBREVIATIONS

%	Percent
CAEAL	Canadian Association for Environmental Analytical Laboratories
COC	Chain-of-Custody
e.g.	For example
EIA	Environmental Impact Assessment
Cenovus	Cenovus Energy Inc.
Golder	Golder Associates Ltd.
HASP	Health and Safety Plan
i.e.	That is
QA/QC	Quality Assurance/Quality Control
SWI	Specific Work Instructions
UTM	Universal Transverse Mercator

APPENDIX 2-V

MONITORING PROGRAMS

TABLE OF CONTENTS

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LIST OF TABLES

1 INTRODUCTION

Cenovus Energy Inc. (Cenovus) has committed to undertaking numerous monitoring programs in relation to the Pelican Lake Grand Rapids Project (the Project). Monitoring programs will be implemented for aspects of the Project that have been predicted to have an effect on the environmental and social resources in the Project Area, including air quality, aquatic resources, terrestrial resources and social resources.

Cenovus has a comprehensive suite of monitoring programs currently in place for its other project facilities. These monitoring programs will be introduced, as necessary, to the Project. Cenovus will complete regular analyses of the data from monitoring programs to evaluate their success and determine if any changes or adjustments to the monitoring programs are required. Cenovus will work with Alberta Environment (AENV) to design updated monitoring programs as necessary.

2 AIR QUALITY

Cenovus is committed to ensuring regional air quality objectives are achieved through careful monitoring and regional management. Cenovus will monitor Project emission sources and ambient ground-level concentrations as required by the Alberta *Environmental Protection and Enhancement Act* (EPEA) approval. The predicted ambient air quality concentrations will be considered in the design of an appropriate monitoring program and the development of mitigation and adaptive management strategies. These programs and strategies are intended to minimize emissions from the Project and their effects. The monitoring program and mitigation and adaptive management strategy will include the following components:

- scope of the program;
- goals of the program;
- air quality monitoring program;
- emissions monitoring program;
- response planning describing strategies for responding to events of significant emission rates or air quality effects (including the development of thresholds that would elicit a response depending on the severity); and
- annual report describing procedures for the preparation of annual reports and their ancillary components, (e.g., references, glossary, concordance tables).

Detailed management plans and monitoring program will be provided if the Project progresses to the permitting stage.

3 AQUATIC RESOURCES

3.1 HYDROGEOLOGY

The groundwater monitoring programs for the Project will be designed to validate the predictions from the effects assessments. The programs will be flexible so that adjustments can be made as new information becomes available.

3.1.1 Plant Site Monitoring Program

The central processing facility will be developed in three phases. Shallow groundwater monitoring will be carried out at the plant site to allow early detection of an effect on groundwater quality. The monitoring program will include the installation of groundwater monitoring wells, the monitoring of the water levels in the wells and the collection of groundwater samples for chemical analysis. A comprehensive proposal for the monitoring program will be submitted to AENV following Project approval. Key aspects of the monitoring program are as follows.

The primary fluids at the plant site that have the potential to affect the chemical quality of the shallow groundwater are bitumen, produced water, and process-related chemicals. As a result, the groundwater samples collected from the monitoring wells will be analyzed for the parameters listed in Table 3.1-1. At the time of sample collection, field parameters (pH, temperature and electrical conductivity) will be measured. Sampling and analytical Quality Assurance/Quality Control protocols will be followed to ensure the quality of the monitoring data.

Table 3.1-1 Analytical Parameters for Plant Site Groundwater Samples

Parameter Group	Parameters
Field Parameters	Electrical Conductivity, pH, Temperature
Major Water Quality Parameters	Total Dissolved Solids (TDS), Total Suspended Solids (TSS), pH, Electrical Conductivity, Hardness ($CaCO_3$), Alkalinity (PP as $CaCO_3$), Alkalinity (Total as $CaCO_3$), Ion Balance
Major Cations	Calcium, Magnesium, Sodium, Potassium
Major Anions	Carbonate, Sulphate, Chloride, Hydroxide, Bicarbonate
Miscellaneous Inorganics	Dissolved Nitrate (N), Dissolved Nitrite (N), Nitrate plus Nitrite (N), Total Ammonia, Total Phosphate
Dissolved Metals	Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Lithium, Manganese, Molybdenum, Nickel, Phosphorus, Selenium, Silicon, Silver, Strontium, Sulphur, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc
Volatile Hydrocarbons	Benzene, Toluene, Ethylbenzene, Xylenes, F1 Fraction, F2 Fraction
Miscellaneous Organics	Total Organic Carbon, Dissolved Organic Carbon, Total Phenols, Ethylene Glycol, Diethylene Glycol, Triethylene Glycol, Tetraethylene Glycol, Propylene Glycol

The first set of groundwater samples will be collected at the time the monitoring wells are installed prior to the start of operations. Groundwater samples will then be collected on a bi-monthly basis during the first year of operation and on a semi-annual basis thereafter. Reporting to AENV will be on an annual basis. The annual report will include all monitoring results for the current year and the results for all previous years.

3.1.2 Groundwater Withdrawal Monitoring Program

Cenovus will manage groundwater withdrawal from the Grand Rapids 'A' aquifer as per the terms and conditions of the licences to be issued under the *Water Act*. The groundwater withdrawal monitoring program will include:

- monitoring the water levels in the water source wells on a regular (e.g., hourly) basis;
- monitoring groundwater production (flow rates and volumes) from the wells on a regular (e.g., daily) basis; and
- collecting groundwater samples from the wells for chemical analysis on a regular (e.g., quarterly) basis.

Results of the monitoring program will be provided to AENV using AENV's Water Use Reporting System and in any annual groundwater monitoring report issued during the temporary time period when groundwater is being diverted as make-up water for steam generation.

Monitoring and reporting for the groundwater withdrawal from the Quaternary aquifer for utility purposes will also be undertaken according to the terms and conditions of the *Water Act* licence.

3.1.3 Well Pad Monitoring Program

Shallow groundwater monitoring will be carried out at select well pads for the purposes of assessing groundwater temperature and chemical quality. The monitoring program will include the installation of groundwater monitoring wells, the monitoring of the water levels in the wells and the collection of groundwater samples for chemical analysis. The program will include the collection of samples from watercourses or waterbodies located in close proximity to a well pad where warranted. A proposal for the monitoring program will be included with the proposal document for the plant site monitoring program.

Potential changes in groundwater quality due to thermal effects have been identified as a potential concern. A monitoring program to address this concern will be designed and implemented. The program, which will be developed in consultation with AENV, will document pre-development conditions and monitor potential changes in temperature and groundwater quality. If the monitoring results indicate that effects to groundwater quality are approaching established targets, a groundwater response plan will be initiated.

3.1.4 Non-saline Groundwater in Direct Contact with Bitumen Monitoring Program

The Grand Rapids 'A' lean zone is a non-saline aquifer directly overlying the bitumen reservoir. The Grand Rapids 'B' aquifer underlies a shale unit that separates this aquifer from the reservoir. Due to the non-saline characteristics of these two aquifers, the requirements specified in the draft "Guidelines for the Assessment and Management of Non-saline Groundwater in Direct Contact with Bitumen for In Situ Oil Sands Operations" (AENV 2009) are applicable.

The Grand Rapids 'A' lean zone aquifer and the Grand Rapids 'B' aquifer represent groundwater management units (GMUs) as defined in AENV (2009). The Quaternary aquifers, the Quaternary/Tertiary aquifer and the Viking aquifer are also defined as GMUs. A proposed groundwater monitoring program was submitted to AENV for the steam-assisted gravity drainage (SAGD) Well Pair Test Project that includes the five GMUs and addresses the requirements in the draft guidelines (Westwater 2011). The proposed program was accepted and it is currently underway in accordance with Section 4.5 of Approval No. 269241-00-00. A proposal to expand the program for the Project will be submitted to AENV once Project approval has been issued.

The current groundwater monitoring program for the SAGD Well Pair Test Project includes a network of groundwater monitoring wells installed in the five GMUs. The monitoring well network will be expanded for the Project. The rationale for the locations of the proposed wells is:

- Quaternary (or Tertiary) aquifer: two proposed wells will be added for spatial coverage and to determine the hydraulic gradient; one proposed well will determine the types and thicknesses of the geologic materials at the planned site for the central processing facility.
- Viking aquifer: two proposed wells will be added for spatial coverage.
- Grand Rapids 'B' aquifer: three proposed wells will be added for spatial coverage and to determine the hydraulic gradient.

Additional groundwater monitoring wells will be installed in subsequent phases of project development and/or as warranted.

Groundwater samples collected from the proposed monitoring wells will be analyzed for the same parameters as for the existing wells (Table 3.1-2). This analyte list includes all primary and secondary parameters listed in Section 1.1.1 of AENV (2009).

3.1.5 Groundwater Response Plan

A groundwater response plan will be included in the monitoring program proposal for the plant site and well pad monitoring programs. The groundwater response plan will be implemented in the event an unexpected change in the temperature or chemical quality of the groundwater in a monitoring well is detected. The response plan will include the following actions:

- re-sampling the monitoring well at which the change in temperature or chemical quality was identified to confirm a change has occurred;
- for the plant site program, determining the source of the change and implementing mitigation measures to minimize or halt further effects; and
- determining the magnitude and likely extent of the effect and taking appropriate actions involving remediation, risk assessment, and/or risk management.

The remediation option most appropriate for an adverse effect will depend on the depth and extent of the affected groundwater, the types of surface and geologic materials in the affected zone, the complexity of the situation, and the type of chemical. Remediation options could include soil excavation, recovery trenches, recovery wells and monitored natural attenuation. The selected option would be based on technical applicability. The remediation program would be modified or expanded as necessary as remediation proceeds.

Table 3.1-2 Analytical Parameters for Quaternary/Tertiary and Bedrock Groundwater Samples

Parameter Group	Parameters
Field Parameters	Electrical Conductivity, pH, Temperature
Major Water Quality Parameters	Total Dissolved Solids, Total Suspended Solids, pH, Electrical Conductivity, Hardness ($CaCO_3$), Alkalinity (PP as $CaCO_3$), Alkalinity (Total as $CaCO_3$), Ion Balance
Major Cations	Calcium, Magnesium, Sodium, Potassium
Major Anions	Carbonate, Sulphate, Chloride, Hydroxide, Bicarbonate
Miscellaneous Inorganics	Dissolved Nitrate (N), Dissolved Nitrite (N), Nitrate plus Nitrite (N), Total Ammonia, Sulphide, Fluoride
Dissolved Metals	Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Lithium, Manganese, Mercury, Molybdenum, Nickel, Phosphorus, Selenium, Silicon, Silver, Strontium, Sulphur, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc
Volatile Hydrocarbons	Benzene, Toluene, Ethylbenzene, Xylenes, F1 Fraction, F2 Fraction, Fraction 1: C6 to C10 minus BTEX
Polycyclic Aromatics	23 Parameter Suite
Miscellaneous Organics	Total Organic Carbon, Dissolved Organic Carbon, Total Phenols, Naphthenic Acids

3.2 HYDROLOGY

3.2.1 Surface Disturbances

An integral part of Project operations will be the development of a surface water monitoring program that includes remedial maintenance and adaptive management practices undertaken and the timing and locations of these activities. This program will continue until Project decommissioning and will include the following activities:

- Regular monitoring of the storm water ponds to confirm adequate storage capacity is available to mitigate uncontrolled releases from the plant sites and well pad drainage systems. The downstream drainage path from the slow release lines will also be inspected annually to confirm that the terrain is absorbing the water with no apparent vegetation stress and that no downstream channel development or erosion is occurring.
- If required, culvert installations at road crossings and wetlands areas will be monitored regularly, particularly during or following high runoff periods. Excessive sedimentation, debris or ice accumulation will be removed to maintain the flow capacity of the culvert. Screens or other deterrents may be added to culvert inlets to prevent blockage in areas of potential beaver activity.
- Re-graded areas will be inspected for evidence of erosion or instability, and repaired or stabilized as required. Revegetation efforts will be monitored and maintained to allow growth and survival. Replanting will occur if survival of vegetation is inadequate.
- Drainage courses disturbed during construction will be inspected to confirm that riparian vegetation and stable drainage conditions have been re-established.

3.2.2 Watercourse Crossings

A monitoring program will be implemented so that sediment generation caused by construction and operation of watercourse crossings will be a minimum. The monitoring program will include the following activities:

- If required, culvert operations at road crossings will be monitored, particularly during or following high runoff periods. Excessive sedimentation, debris or ice accumulation will be removed to maintain the flow capacity of the culvert. Screens and other deterrents may be added to culvert inlets to prevent blockage in areas of potential beaver activity.
- Watercourse crossings will be inspected to confirm that properly installed sediment control measures are in place during and following construction.
- Post-construction inspection will be done to verify that affected streambed profiles and bank disturbances have been appropriately reclaimed.

3.3 WATER QUALITY

Water quality monitoring will be an integral component of the Project operations.

Storm water ponds will be tested before release to the surrounding environment to verify acceptability of release waters for parameters defined under the EPEA approval for the Project. For example, the EPEA Approval No. 48522-00-09 for the Cenovus Christina Lake Thermal Project (CLTP) includes sampling for pH, chloride and oil and grease (Table 3.3-1).

Table 3.3-1 Water Quality Limits and Monitoring Parameters for an Industrial Runoff Control System at the Cenovus Christina Lake Thermal Project

Parameter	Concentration Limit	Frequency		Reporting
		Before Release	During Release	
Discharge volume (in cubic metres)	-	-	once/day	Industrial wastewater and runoff report (on or before February 14 of the year following the year in which the information was collected.
pH	6.0 to 9.5 pH unit	once	once/day	
Oil and grease	No visible sheen	once	once/day	
Chloride in mg/L	500 mg/L	once	once/day	

- = Not applicable.
Source: AENV 2003.

Treated domestic wastewaters will be sampled and tested on a regular basis to ensure that the effluent quality is within specified limits for treated wastewater discharge. For example, the current EPEA Approval for the Cenovus CLTP specifies monitoring at a minimum frequency of three times per week and limits of 25 mg/L carbonaceous biochemical oxygen demand and 25 mg/L TSS.

3.4 FISH AND FISH HABITAT

Based on the results of the analysis completed for Fish and Fish Habitat, monitoring programs are not planned outside those identified for groundwater, hydrology and water quality components. Should results of these monitoring programs indicate monitoring of aquatic biota is warranted, a program will be developed in consultation with regulators.

4 TERRESTRIAL RESOURCES

Project effects will be monitored by Cenovus to provide feedback on the effects of development and mitigation activities on Terrestrial Resources. The monitoring programs will include assessments of the effects of development on wetlands and wildlife, as well as on the success of achieving reclamation goals for soils, vegetation, wildlife and biodiversity. These programs will be integrated into existing monitoring programs that are currently being implemented; both programs being conducted by Cenovus and regional monitoring programs that may be implemented in the future.

Cenovus will participate in relevant regional working groups and research programs to resolve uncertainties associated with developments in the area. Residual mitigation activities that may be recommended by these research programs will be reviewed for appropriateness regarding inclusion in the Project.

Final design of the monitoring programs will be completed in consultation with AENV, Alberta Sustainable Resource Development (ASRD) and other relevant regulatory authorities. Prior to the implementation of any monitoring program the program objectives and design will be approved by the appropriate regulatory authorities.

4.1 SOIL AND RECLAMATION

Future soils, vegetation and wetlands, wildlife habitats and biodiversity cannot be accurately predicted because the performance of the terrestrial ecosystem in the Far Future will depend on many factors (e.g., climate and management). The conceptual Conservation and Reclamation (C&R) Plan provides an estimate of the Far Future scenario as described in the post-reclamation mapping (Volume 1, Section 12). The plan includes upland and transitional wetlands reclamation procedures and starting vegetation planting prescriptions for the targeted post-reclamation ecosite phases. The objectives of the C&R monitoring program are to evaluate the success of the reclamation procedures and planting prescriptions in achieving the targeted ends, over time, and to adjust or modify these measures where necessary to ensure the following:

- erosion control and slope stability;
- revegetation and sustainability of all disturbed areas;
- weed control;
- re-establishment of wildlife habitat;

- restoration of biodiversity; and
- reclamation certification.

The monitoring objectives will be met through regular site inspections, additional reclamation efforts over time (if necessary), evaluation of the monitoring program results on all reclaimed areas, and extrapolation of data from other projects. Reclamation monitoring will be integrated with other relevant monitoring programs.

Cenovus will produce an annual C&R report summarizing the previous year's activities, which includes some or all of the following:

- completed reclamation activities;
- completed assessments conducted on proposed facility areas to be constructed in the following year (i.e., Pre-Disturbance Assessments);
- results of reclamation monitoring; and
- planned activities for the following year.

This report will be submitted to AENV in accordance with the terms and conditions of the Project approval.

4.2 TERRESTRIAL VEGETATION, WETLANDS AND FOREST RESOURCES

Cenovus will implement a wetlands monitoring program similar to what has been developed and implemented for the Cenovus CLTP. Given that wetlands represent a significant proportion of the Project Area, potential effects resulting from Project activities may alter water flow conditions and potentially alter wetlands plant community structure and function as indicated by changes in plant species composition, abundance and vigour (health). The purpose of the wetlands program is to determine if Project infrastructure is having an effect on wetlands plant community structure and function.

Cenovus will consult with AENV and ASRD to ensure the proposed program meets the terms and conditions of the EPEA approval for the Project. All of Cenovus' monitoring information will be provided to ASRD to support regional terrestrial vegetation, wetlands and forest resources management efforts.

4.3 WILDLIFE

Cenovus will implement a wildlife monitoring program associated with the Project. The monitoring program will include surveys to assess wildlife effects from the Project and the effectiveness of mitigation strategies, with a focus on sensitive species occurring within the local study area (e.g., woodland caribou).

A wildlife log and sighting cards will be maintained at the plant sites and the camp to allow staff to record wildlife observations (e.g., sighting, call, nest, den, interactions with storm water pond or facilities). The wildlife log will also be used to record any potential nuisance wildlife problems related to beavers and bears, and will be reported to ASRD. Personnel will be required to report all vehicle-wildlife collisions. Records will be summarized annually.

To assess the effects of barriers to wildlife movement, monitoring will include surveys of wildlife tracks and wildlife presence in relation to aboveground pipeline crossing structures to evaluate if movements are being affected and to determine the effectiveness of the mitigation measures employed. Roads will be monitored during winter to ensure that snow berms are not too high and that gaps are left to facilitate wildlife movement at regular intervals. Roads will also be monitored for wildlife road kill. Mortality logs will be kept to check for trends. Any woodland caribou deaths or injuries will be reported to ASRD.

Cenovus is working collaboratively with other in-situ operators to develop a coordinated approach to wildlife monitoring in the region. The basis for this approach is that the various companies have similar project EPEA approval conditions related to wildlife monitoring and there is value in coordinating the monitoring efforts.

As part of this coordinated approach, Cenovus anticipates there will be full sharing of information amongst all in-situ operators concerning their local, project-specific wildlife monitoring, as well as coordination of regional wildlife monitoring efforts. Cenovus will work collaboratively with other in-situ operators west of the Athabasca River to develop a coordinated approach to wildlife monitoring in the region.

Cenovus will consult with AENV and ASRD to ensure the proposed program meets the terms and conditions of the EPEA approval for the Project. All of Cenovus' monitoring information will be provided to ASRD to support regional wildlife management efforts.

4.4 BIODIVERSITY

Soils, vegetation and wildlife tend to be assessed separately rather than in an integrated manner (AENV 1999). However, ecosystems are connected through a steady flow of energy, nutrients and species (Noss 1983). Therefore, it is also important to assess integrated effects to biodiversity at the landscape and other levels to encompass key interactions between organisms and ecosystems.

A biodiversity monitoring program will be developed to monitor the success of reclamation and establishment of biodiversity by integrating different ecosystem components for the Project based, in part, on the framework described in *Evaluation of the Alberta Biodiversity Monitoring Institute for Monitoring Reclaimed Oil Sands Sites* (Golder 2007). The monitoring approach will consider protocols established by the Alberta Biodiversity Monitoring Institute (ABMI; formerly Alberta Biodiversity Monitoring Program [ABMP]) to evaluate biodiversity in the province, with modifications to address Project-specific requirements (Golder 2007). Biodiversity monitoring protocols might include winter track counts, breeding bird surveys, vegetation surveys and incidental wildlife observations (ABMP 2006). Plot design for surveys will be consistent with the ABMI where those protocols are recommended. The Reclamation Working Group of Cumulative Environmental Management Association is in the process of evaluating methods, including methods similar to those of ABMI, for the development of a monitoring program to assess the re-establishment of biodiversity on reclaimed landscapes in the region (Kirk et al. 2009).

Biodiversity indicators, as assessed in the Environmental Impact Assessment, could be measured and compared to reference sites within the region to determine whether these goals are being met. The goal for using established monitoring protocols is consistency and replicability over time within the Project LSA. Cenovus will work with other oil and gas and government partners in evaluating, and potentially conducting research and monitoring of, cumulative environmental effects of oil and gas development in the region. In addition, Cenovus provided funding to the ABMI in 2010 and 2011.

5 SOCIO-ECONOMIC

No quantitative socio-economic monitoring programs are proposed for the Project. Cenovus will monitor the effects of its operations continually through ongoing effective engagement and consultation with stakeholders and Aboriginal groups, so that the information can be used to adjust policies, procedures, mitigation and enhancement measures and behaviours where deemed necessary. Cenovus's use of local community relations advisors who reside in the area has been successful in monitoring issues and service shortfalls in other primarily Aboriginal communities where it operates. The local advisor is able to review and respond to issues in real time. Results of monitoring will also be discussed with nearby populations, as part of ongoing consultation and information exchange on the Project. In addition, Cenovus will co-operate with community stakeholders, other developers in the Municipal District of Opportunity area, and the Royal Canadian Mounted Police to monitor the traffic situation on Local Highways 813 and 754.

Adaptive management strategies aimed at addressing emerging issues throughout Project construction and operations will be employed. These strategies will be informed by ongoing evaluation of the effectiveness of mitigation and benefit enhancement measures. Cenovus plans to conduct stakeholder surveys every two years to gather feedback regarding areas of strength and potential areas of improvement relating to Cenovus's relationship with local stakeholders. These surveys will inform adaptive management strategies over time.

Cenovus will also be working with industry partners in the Wabasca area to understand if there are industry wide trends and issues that need to be addressed either through additional mitigations or by government agencies.

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7 ABBREVIATIONS

ABMI	Alberta Biodiversity Monitoring Institute (formerly the ABMP)
ABMP	Alberta Biodiversity Monitoring Program
AENV	Alberta Environment and Water
ASRD	Alberta Sustainable Resource Development
BTEX	Benzene, toluene, ethylbenzene, xylene
C&R	Conservation and Reclamation
$CaCO_3$	Calcium carbonate
Cenovus	Cenovus Energy Inc.
CLTP	Christina Lake Thermal Project
e.g.	For example
EPEA	Alberta *Environmental Protection and Enhancement Act*
GMU	Groundwater Management Unit
Golder	Golder Associates Ltd.
i.e.	That is
mg/L	Milligrams per litre
the Project	Pelican Lake Grand Rapids Project
SAGD	Steam-Assisted Gravity Drainage
TDS	Total Dissolved Solids
TSS	Total Suspended Solids

8 GLOSSARY

Alberta Environment (AENV)

Alberta Environment and Water (AEW): Provincial ministry that establishes policies, legislation, plans, guidelines and standards for environmental management and protection; allocates resources through approvals, dispositions and licenses, and enforces those decisions; ensure water infrastructure and equipment are maintained and operated effectively; and prevents, reduces and mitigates floods, droughts, emergency spills and other pollution-related incidents.

Alberta Sustainable Resource Development (ASRD)

Alberta Sustainable Resource Development (ASRD) is one of the Alberta Ministries whose mission is to encourage balanced and responsible use of Alberta's natural resources through the application of leading practices in management, science and stewardship. ASRD works with Albertans across the province to ensure a balance between the economic, environmental and social values of our province. They fight forest fires, manage fish and wildlife, oversee the development of Alberta's forests and manage the use of public lands.

Aquifer

A body of rock or soil that contains sufficient amounts of saturated permeable material to yield economic quantities of water to wells or springs.
Any water-saturated body of geological material from which enough water can be drawn at a reasonable cost for the purpose required. An aquifer in an arid prairie area required to supply water to a single farm may be adequate if it can supply 1 m^3/d. This would not be considered an aquifer by any industry looking for cooling water in volumes of 10,000 m^3/d. A common usage of the term aquifer is to indicate the water-bearing material in any area from which water is most easily extracted.

Biodiversity

The variety of plant and animal life in a particular habitat (e.g., plant community or a country). It includes all levels of organization, from genes to landscapes, and the ecological processes through which these levels are connected.

Bitumen

A highly viscous, tarry, black hydrocarbon material having an API gravity of about 9 (specific gravity about 1.0). It is a complex mixture of organic compounds. Carbon accounts for 80 to 85% of the elemental composition of bitumen, hydrogen 10%, sulphur 5%, and nitrogen, oxygen and trace elements form the remainder.

Bog	Sphagnum or forest peat materials formed in an ombrotrophic environment due to the slightly elevated nature of the bog, which tends to disassociate it from the nutrient-rich groundwater or surrounding mineral soils. Characterized by a level, raised or sloping peat surface with hollows and hummocks. Mineral-poor, acidic and peat-forming wetlands that receives water only from precipitation.
Ecosite	Ecological units that develop under similar environmental influences (climate, moisture and nutrient regime). Ecosites are groups of one or more ecosite phases that occur within the same portion of the moisture/nutrient grid. Ecosite is a functional unit defined by the moisture and nutrient regime. It is not tied to specific landforms or plant communities, but is based on the combined interaction of biophysical factors that together dictate the availability of moisture and nutrients for plant growth.
Ecosite Phase	A subdivision of the ecosite based on the dominant tree species in the canopy. On some sites where the tree canopy is lacking, the tallest structural vegetation layer determines the ecosite phase.
Ecosystem	An integrated and stable association of living and non-living resources functioning within a defined physical location. A community of organisms and its environment functioning as an ecological unit. For the purposes of assessment, the ecosystem must be defined according to a particular unit and scale.
Electrical Conductivity	The capability of a solution to transmit an electrical current. A capability closely related to the concentration of salts in soils.
Erosion	The process by which material, such as rock or soil, is worn away or removed by wind or water.
Fen	Sedge peat materials derived primarily from sedges with inclusions of partially decayed stems of shrubs formed in a eutrophic environment due to the close association of the material with mineral rich waters. Minerotropic peat-forming wetlands that receive surface moisture from precipitation and groundwater. Fens are less acidic than bogs, deriving most of their water from groundwater rich in calcium and magnesium.
Groundwater	That part of the subsurface water that occurs beneath the water table, in soils and geologic formations that are fully saturated.

Habitat	The place or environment where a plant or animal naturally or normally lives or occurs.
Hydraulic Gradient	A measure of the force of moving groundwater through soil or rock. It is measured as the rate of change in total head per unit distance of flow in a given direction. Hydraulic gradient is commonly shown as being dimensionless, since its units are metres/metre.
Hydrogeology	The study of the factors that deal with subsurface water (groundwater) and the related geologic aspects of surface water. Groundwater as used here includes all water in the zone of saturation beneath the earth's surface, except water chemically combined in minerals.
Hydrology	The science of waters of the earth, their occurrence, distribution and circulation; their physical and chemical properties; and their reaction with the environment, including living beings.
In-Situ	Also known as "in place". Refers to methods of extracting deep deposits of oil sands without removing the groundcover. The in-situ technology in oil sands uses underground wells to recover the resources with less effect to the land, air and water than for oil sands mining.
Local Study Area (LSA)	Defines the spatial extent directly or indirectly affected by the Project.
Marsh	A non-peat-forming, nutrient-rich wetlands characterized by frequent flooding and fluctuating water levels.
pH	The degree of acidity (or alkalinity) of soil or solution. The pH scale is generally presented from 1 (most acidic) to 14 (most alkaline). A difference of one pH unit represents a ten-fold change in hydrogen ion concentration.
Riparian	Refers to terrain, vegetation or simply a position next to or associated with a stream, floodplain or standing waterbody.

Risk	The likelihood or probability that the toxic effects associated with a chemical or physical agent will be produced in populations of individuals under their actual conditions of exposure. Risk is usually expressed as the probability of occurrence of an adverse effect, i.e., the expected ratio between the number of individuals that would experience an adverse effect at a given time and the total number of individuals exposed to the factor. Risk is expressed as a fraction without units and takes values from 0 (absolute certainty that there is no risk, which can never be shown) to 1.0, where there is absolute certainty that a risk will occur.
Runoff	The portion of water from rain and snow that flows over land to streams, ponds or other surface waterbodies. It is the portion of water from precipitation that does not infiltrate into the ground, or evaporate.
Sediment	Solid material that is transported by, suspended in, or deposited from water. It originates mostly from disintegrated rocks; it also includes chemical and biochemical precipitates and decomposed organic material, such as humus. The quantity, characteristics and cause of the occurrence of sediment in streams are influenced by environmental factors. Some major factors are degree of slope, length of slope soil characteristics, land usage and quantity and intensity of precipitation.
Sedimentation	The process of subsidence and deposition of suspended matter carried by water, wastewater or other liquids, by gravity. It is usually accomplished by reducing the velocity of the liquid below the point at which it can transport the suspended material.
Soil	The naturally occurring, unconsolidated mineral or organic material at least 10 cm thick that occurs at the earth's surface and is capable of supporting plant growth.
Species	A group of organisms that actually or potentially interbreed and are reproductively isolated from all other such groups; a taxonomic grouping of genetically and morphologically similar individuals; the category below genus.
Steam-Assisted Gravity Drainage (SAGD)	An in-situ oil sands recovery technique that involves the use of two horizontal wells, one to inject steam and a second to produce the bitumen.

Swamp	Land having soils that are saturated with water for at least part of the year and which usually occur next to waterbodies or in areas in association with fluctuating water levels such as along peatland margins.
Total Dissolved Solids (TDS)	The total concentration of all dissolved compounds solids found in a water sample. See filterable residue.
Total Suspended Solids (TSS)	The amount of suspended substances in a water sample. Solids, found in wastewater or in a stream, which can be removed by filtration. The origin of suspended matter may be artificial or anthropogenic wastes or natural sources such as silt.
Upland	Areas that have typical ground slopes of 1 to 3% and are better-drainage.
Water Table	The shallowest saturated ground below ground level - technically, that surface of a body of unconfined groundwater in which the pressure is equal to atmospheric pressure.
Watercourse	A general term that refers to riverine systems such as creeks, brooks, streams and rivers.
Weed	Plants that are defined as controlled weeds, nuisance weeds, or noxious weeds by the *Weed Control Act*, as amended.
Wetlands	Wetlands are land where the water table is at, near or above the surface or which is saturated for a long enough period to promote such features as wet-altered soils and water tolerant vegetation. Wetlands include organic wetlands or “peatlands,” and mineral wetlands or mineral soil areas that are influenced by excess water but produce little or no peat.
Wildlife	Under the *Species at Risk Act*, wildlife is defined as a species, subspecies, variety or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus that is wild by nature and is native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.

APPENDIX 2-VI

CO-OPERATIVE EFFORTS

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1 CO-OPERATIVE EFFORTS

Cenovus participates in co-operative efforts to address industry issues where it determines that such endeavours are effective. Cenovus re-visits its participation in such co-operative effort on an ongoing basis.

While the Pelican Lake Grand Rapids Project is in the Municipal District of Opportunity No. 17, Cenovus will use learnings from its participation in other regional associations (as below) to enhance the value of this project.

Oil Sands Developers Group (OSDG) – This organization was formerly called the Regional Issues Working Group (RIWG). Cenovus currently provides support and staff participation to the OSDG. Cenovus participates as a member and is also represented on its Board of Directors. The OSDG is funded through industry members and works with various other organizations to assess environment, social and economic effects of oil sands developments.

Southern Athabasca Oil Sands Producers (SAOP) – This is a committee of the OSDG. Its mandate is to provide a forum for open discussion of issues facing oil sands producers with projects located in the southern portion of the Athabasca Oil Sands Deposit.

Cumulative Environmental Management Association (CEMA) – This multi-stakeholder organization includes government, industry and non-government agencies active in the Regional Municipality of Wood Buffalo. All decisions made are based on consensus.

Cenovus is an active participant in CEMA as well as its working groups who complete scientific and technical work related to the environment. The mandate and focus of CEMA is as follows (CEMA 2010):

> *"CEMA's mandate is to study the cumulative environmental effects of industrial development in the region and produce guidelines and management frameworks. Since its inception CEMA has produced hundreds of reports and 8 Management Frameworks.*
>
> *A multi-stakeholder organization, CEMA is governed by 44 members representing all levels of government, industry, regulatory bodies, environmental groups, Aboriginal groups and*

the local health authority, which have an interest in protecting the environment in the Wood Buffalo region:

- *Governments and agencies that regulate and oversee oil sands development.*
- *Aboriginal communities that ensure traditional lifestyle, culture and environmental knowledge is respected and upheld.*
- *Industry that is committed to corporate responsibility, the orderly development of resources and economic growth and opportunity.*
- *Health agencies that are focused on promoting public wellness and preserving public safety.*
- *Environmental non-government organizations that are concerned with guarding and promoting environmental sustainability."*

Sustainable Ecosystems Working Group (SEWG) – This is a working group of CEMA. Its mandate is to address issues on wildlife, biodiversity and sustainable ecosystems. Cenovus is an active participant in this working group.

Alberta Chamber of Resources (ACR) – Cenovus is a financial supporter and an active participant in the ACR, having a seat on the board of directors as well as participating in its Integrated Landscape Management (ILM) program. As stated by ACR, (ACR 2010):

> *"The Integrated Landscape Management (ILM) program represents the first large scale Canadian effort to proactively address the cumulative impacts of resource-based land use."*

Alberta Biodiversity Monitoring Institute (ABMI) – Cenovus is a financial supporter and an active participant in the ABMI. This organization is establishing a province-wide biodiversity monitoring program. As stated by ABMI (ABMI 2010):

> *"The Alberta Biodiversity Monitoring Institute (ABMI) conducts world-class monitoring of the changing state of Alberta's species, habitats and ecosystems. The goal of the ABMI is to support natural resource decision-making by providing relevant, timely, and credible scientific knowledge on the state of provincial biodiversity."*

Athabasca River Watershed Planning and Advisory Council (WPAC) – Though this group is in its development phase Cenovus has pledged to participate as a member.

Development plans for the Project will consider the existing Cenovus Wabiskaw Operations; where synergies exist to minimize surface land disturbance, those synergies will be utilized. It is anticipated that 20% to 25% of the Grand Rapids Project development will utilize existing surface disturbances in the Greater Pelican Region. Some of the key synergies that account for this reduced impact are road and pipeline corridors.