

Part C

Environmental Impact Assessment Methodology





TABLE OF CONTENTS

	Page
C. ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGY	C-1
C.1 INTRODUCTION	C-1
C.2 ENVIRONMENTAL IMPACT ASSESSMENT CONSIDERATIONS	C-2
C.2.1 Environmental Impact Assessment Requirements.....	C-2
C.2.2 Environmental Impact Assessment Definitions.....	C-2
C.2.3 Project Description Document and EIA Terms of Reference.....	C-3
C.2.4 Scope of Assessment.....	C-4
C.2.5 Steps in the Environmental Impact Assessment Process	C-13
C.2.6 Follow-up and Monitoring.....	C-21
C.3 APPLICATION OF THE METHODOLOGY	C-22

List of Tables

	Page
Table C.2.4-1 Definitions of Spatial and Temporal Boundaries.....	C-7
Table C.2.4-2 List of Existing, Approved and Planned (Reasonably Foreseeable) Projects.....	C-8
Table C.2.4-3 Steps Used to Conduct the Environmental Impact Assessment.....	C-14
Table C.2.5-1 Evaluation Criteria for Assessing the Environmental Impact.....	C-18
Table C.2.5-2 Example Summary of Impact Rating on Valued Environmental Components (VECs)	C-20

List of Figures

Figure C.2.4-1 Local Study Areas (LSA) Used for the Environmental Impact Assessment
Figure C.2.4-2 Regional Study Areas (RSA) Used for the Environmental Impact Assessment
Figure C.2.4-3 Existing and Planned Projects within the Vicinity of the Proposed Project



C. ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGY

C.1 INTRODUCTION

This section provides an outline of the methodology that Pengrowth Energy Corporation (Pengrowth) used to carry out the Environmental Impact Assessment (EIA) for the Lindbergh SAGD Expansion Project (the Project).

Environmental Impact Assessment is a process, and not a document or report. An EIA Report (Alberta Environment and Sustainable Resource Development [ESRD] 2013a) is only one part of the EIA process. Beanlands and Duinker (1983) define an environmental impact assessment as a “*process or set of activities designed to contribute pertinent environmental information to project or program decision-making. In doing so, it attempts to predict or measure the environmental effects of specific human activities or do both, and to investigate and propose means of ameliorating those effects.*”

Five steps within the EIA process are recognized:

- STEP 1. The Project and EIA screening phase (*i.e.*, does the Project meet EIA thresholds?).
- STEP 2. The scoping phase (*i.e.*, the preparation and finalization of the Terms of Reference – in general defining what environmental and social features will be evaluated, the spatial and temporal scale of evaluation, how features will be evaluated, and who will be involved).
- STEP 3. The environmental baseline study phase.
- STEP 4. The interpretive, predictive, mitigative and evaluative phase (*i.e.*, the preparation and review of an environmental assessment report).
- STEP 5. The post-construction assessment phase (*i.e.*, monitoring and/or follow-up, and compliance).

For the Project, the EIA process is currently in the midst of the fourth step. Baseline environmental studies, as well as the Proponent’s interpretation, prediction and evaluation of environmental and social impacts of the Project, have been completed. This report forms the latter stages of the fourth step of the EIA process; that is, the government and public review of Pengrowth’s EIA Report. Should the proposed Project be approved, monitoring and/or follow-up during steam assisted gravity drainage (SAGD) construction and operations will constitute the fifth and final step of the EIA process.

The EIA methodology used for the Project has been adopted from several sources (*e.g.*, ESRD 2013a; Morris and Therivel 2009; Noble 2006; Hanna 2005; Alberta Environment, Energy and Utilities Board, and Natural Resources Conservation Board 2000; Barnes *et al.*, 1994; Beanlands and Duinker 1983; FEARO 1990; FEARO 1994; Hegmann *et al.*, 1995; Hegmann *et al.*, 1999;



Roots 1994) and has been used in the environmental evaluation of many resource and industrial projects. The methodology is practical, is technically sound, is familiar to both Alberta and Federal Government Review Agencies, and has received acceptance by the Federal Court of Canada. Pengrowth is of the view that the EIA carried out under this methodology for the Project is appropriate for allowing the decision-makers to make judgment as to whether the Project is acceptable, should be approved, and is in the public interest.

C.2 ENVIRONMENTAL IMPACT ASSESSMENT CONSIDERATIONS

C.2.1 ENVIRONMENTAL IMPACT ASSESSMENT REQUIREMENTS

The requirements to carry out an EIA are outlined in both provincial and federal legislation. The Project application has been prepared to address EIA requirements under both Provincial and Federal legislation.

Provincial Legislation

Provincial regulatory requirements are outlined in Sections 39 through 59 of the *Alberta Environmental Protection and Enhancement Act* (EPEA). Pengrowth has been advised by ESRD that the Project is a mandatory activity pursuant to Schedule 1(j) of the *Environmental Assessment (Mandatory and Exempted Activities) Regulation*. In accordance with Section 44(1) of the EPEA, Pengrowth was instructed to prepare and submit an EIA Report for the Project pursuant to the provisions of Part 2, Division 1 of the Act.

Federal Legislation

Federal EIA requirements are noted in Sections 13 and 14 of the *Canadian Environmental Assessment Act, 2012* (CEAA). At the time of application submission, the Project does not include any physical activities included in the Regulations Designating Physical Activities and therefore the Project does not require an environmental assessment in accordance with the *Canadian Environmental Assessment Act, 2012*.

C.2.2 ENVIRONMENTAL IMPACT ASSESSMENT DEFINITIONS

As outlined by Beanlands and Duinker (1983), without a clear definition of terms used in an EIA document, the report can become subject to a wide range of interpretation by reviewers. To avoid any confusion in interpreting the information presented in this application by government and public reviewers, Pengrowth has provided a glossary of terms and abbreviations used in this report. For example:

Project-specific effects are changes that are predicted to occur to the biophysical or social environment caused solely by the Project as a result of the proposed activities included in the scope of the Project.



Cumulative effects are changes that are predicted to occur to the natural or social environment that are caused by the interaction of residual effects of the Project (*i.e.*, an effect remaining after the application of mitigation) with residual effects of other past, present and planned projects or activities.

The glossary of terms and abbreviations used in this report are presented in [Appendix 3](#) of the Application.

C.2.3 PROJECT DESCRIPTION DOCUMENT AND EIA TERMS OF REFERENCE

In August 2013, Pengrowth prepared a proposed Terms of Reference (pTOR) for the Project. This document marked the first step in the regulatory process for the Project. The pTOR identifies the information that is required by government agencies to be considered and addressed in the preparation and submission of an EIA report for the Project. A Project Summary Table, Project Location Map, Project Description (Plain Language Document) and First Nation Consultation Plan were also included with the intent to provide regulators, stakeholders and the public with information about the Project and the anticipated Project development timelines.

The pTOR for the Project was prepared with notice of its availability being publicly advertised in the Edmonton Journal, Calgary Herald, Cold Lake Sun, St. Paul Journal, Bonnyville Nouvelle, Elk Point Review and the Windspeaker in September/October 2013. Responses to the advertisement were requested by November 15, 2013.

Following the public comment period, and with input from the Federal Government, final Terms of Reference (fTOR) for the EIA were formally issued by ESRD, pursuant to Section 48 of EPEA, on December 13, 2013.

In accordance with Section 49(n) of EPEA, a copy of the fTOR for the Project is provided in [Appendix 1](#) in the form of a concordance table, showing where each fTOR item is addressed in the EIA Report. The EIA fTOR outlines the environmental assessment overview and expected outcomes from the process and states:

SCOPE OF THE EIA REPORT

The Proponent 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, policies 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 the Proponent's application to the Alberta Energy Regulator (AER). An EIA report summary will also be included as part of the AER Application.



The Proponent shall refer to the Guide to Preparing Environmental Impact Assessment Reports in Alberta published by Alberta Environment and Sustainable Resource Development (the 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.

The Application and EIA Report has been prepared to fulfil the requirements specified in the fTOR, as well as the environmental information requirements prescribed under the EPEA and Regulations, the *Oil Sands Conservation Act* (OSCA) and federal legislation which applies to the Project. However, consistent with the iterative nature of EIA, this Application and EIA Report also address issues identified by government review agencies and directly-affected stakeholders during the collection of baseline environmental information and preparation of the EIA Report.

C.2.4 SCOPE OF ASSESSMENT

C.2.4.1 Scope of the Project

The scope of the Project for the purposes of the EIA includes all phases (construction, operation, decommissioning and reclamation) of the in situ SAGD operations and the associated facilities and infrastructure required to carry out these activities. Specifically, the scope of the Project includes:

- construction, operation and abandonment of a number of well pads and associated infrastructure (e.g., well pairs, access roads, power lines and pipelines) so that the bitumen can be extracted from the oil sands reservoir and transferred to the central processing facility (CPF);
- construction, operation and abandonment of the CPF, where the bitumen is subjected to a number of processes, cleaning and primary upgrading before it is sent off site, via a pipeline, to a broad spectrum of domestic and international refineries to be refined into petroleum products;
- construction, operation and abandonment of a camp, established to house the Project's workforce; and
- construction, operation and abandonment of water management facilities that include domestic sewage treatment, settling impoundments, sumps, and ditches.

C.2.4.2 Valued Environmental Components

The EIA report has addressed impact concerns by identifying Valued Environmental Components (VECs). VECs for the Project are those environmental attributes associated with the proposed project development, which have been identified to be of concern either by directly-affected stakeholders, government or the professional community. In many cases, key indicators or parameters, are developed that allow for the quantification of impacts of the proposed Project upon the VEC. VECs consider both biophysical (i.e., ecosystem) and socio-economic attributes because of the broad-based definition of environmental effect as outlined both in federal and provincial legislation.



In the Alberta EPEA, environmental effects must include an evaluation of the environmental, social, economic and cultural consequences of a project. Positive and negative impacts are to be assessed with an indication of plans the proponent will implement to manage negative impacts.

In the CEAA, an environmental effect refers to any change that the Project may cause to the environment. This includes the effect of any such change on health and socio-economic conditions, on physical and cultural heritage, on the current use of lands and resources for traditional purposes by aboriginal persons, or on any structure, site or thing that is of historical, archaeological, paleontological or architectural significance. In contrast to the EPEA, only negative effects are analysed as per the CEAA.

For each VEC, measurable parameters were selected, where possible and appropriate, to facilitate quantitative or qualitative measurement of potential Project effects and cumulative effects. Measurable parameters provide a means to determine the level or amount of change in a VEC. For example, a measure of total suspended solids might be chosen as the measurable parameter for sedimentation effects in watercourses and on fish habitat and condition. Each environmental discipline was responsible for identifying and defining measurable parameters for their respective VECs. The degree of change in these measurable parameters was used to help characterize Project-specific and cumulative effects and evaluate the residual effects. Thresholds or standards were identified, where possible and appropriate, for each measurable parameter.

A list of the VECs identified for the Project and the rationale for their selection is presented in [Part D](#), Environmental Impact Assessment and the respective Consultant Reports in the Application. The VECs were selected based upon regulatory requirements, consultation, and their presence within the Project Area as well as the likelihood that they would interact with the Project.

C.2.4.3 Assessment Boundaries

Section 3.1 of Alberta Environment and Sustainable Resource Developments' *Guide to Preparing Environmental Impact Assessment Reports* (ESRD 2013a) gives guidance to establishing spatial boundaries, stating:

“The Study Area for an EIA report includes the Project Area, all of the Local Study Areas (LSA) and Regional Study Areas (RSA) assessed by the Proponent. The size and shape of the Project Area, Local Study Area and Regional Study Area should not be restricted by political boundaries.”

The guidance on temporal boundaries is less prescriptive, simply recognizing that temporal scales vary based on project type and activities (ESRD 2013a). Scientific rationale for the selection of temporal scale is to be provided by the Proponent.



The establishment of the boundaries for each of the disciplines studied represented a compromise involving limitations such as economic realities and the time and space scales over which natural systems operate. Beanlands and Duinker (1983) recognize five types of boundaries that should be considered in an EIA. These five types of boundaries have been assessed for the Project and are presented below:

- **Project Boundaries** are defined by the physical activities proposed by Pengrowth. For the Project, spatial limitations are confined to activities associated with development of in situ SAGD operation and related infrastructure, including access and utility corridors. The Alberta Energy Regulator (AER) Project Area includes all lands subject to subsurface reservoir development and all surface disturbance from the Project and associated infrastructure, and is approximately 11,132 ha (Figure A.3.2-1). The EIA Project Area, as described in the *Guide to Preparing Environmental Impact Assessment Reports in Alberta* (ESRD 2013a), includes all lands subject to direct disturbance from the project and associated infrastructure, and is approximately 188,523 ha (Figure A.3.2-1). Each EIA discipline has established study areas to assess the impacts of the Project both locally and regionally (Figures C.2.4-1 and C.2.4-2)
- **Temporal Boundaries** last approximately 25 years, concomitant with the life of the Project and in some cases extend to the amount of time it takes for lands to reach equivalent capability post-decommissioning. Segments of the temporal boundaries include the duration of construction, operation, and abandonment phases of the Project.
- **Administrative Boundaries** are defined for administrative or economic reasons. The Project Area lies within the Province of Alberta and therefore the resources that will be affected by the Project are subject to the jurisdiction of Provincial and Municipal Governments (County of St. Paul No. 19 and Municipal District of Bonnyville No. 87). In case a federal department identifies a “trigger” mechanism during the review of this Project, the application was prepared in compliance with federal legislation.
- **Ecological/Socio-economic Boundaries** are the most problematic boundaries to define for the impact assessment. This is due to the fact that there are both temporal and spatial considerations over which biological, social and economic systems function (Beanlands and Duinker 1983). These will vary widely among species depending upon factors such as transport mechanisms, population cycles, and recovery rates to pre-impact site conditions. Temporal and spatial boundaries vary by discipline.
- **Technical Boundaries** are defined by time and space considerations to evaluate or measure change. For example where time and space limitations precluded the collection of quantitative information, impact predictions were assessed on the basis of evaluations of professional judgment and/or experience from existing Pengrowth operations.

Based on the aforementioned criteria, Table C.2.4-1 was prepared to assist in establishing the spatial and temporal dimensions for the study areas for each of the disciplines studied during the EIA.



Table C.2.4-1 Definitions of Spatial and Temporal Boundaries

Spatial Boundaries	Temporal Boundaries
INTERNATIONAL: Impact could extend to international level	YEAR ROUND: Significant throughout the year
NATIONAL: Impact could extend to national level	SEASONAL: Significant on a seasonal basis, depending on nature of VEC
PROVINCIAL: Impact could extend to Provincial level	OCCASIONAL: Significance is intermittent
REGIONAL: Impact could extend to the region surrounding proposed Project development area	CYCLICAL: Importance varies with cyclical changes over time
LOCAL: Impact limited to the local area in close proximity to the PDA	PERIODIC: Importance limited by period of Project development

(adapted from Barnes *et al.*, 1993)

The Local Study Area (LSA) is established based on the zone of the Project influence, beyond which the potential environmental, cultural and socio-economic effects of the Project are expected to be non-detectable. The Regional Study Area (RSA) is established based on the extent to which it would be expected that the interaction of residual effects of the Project with the residual effects of other projects would be detectable. It is also the area in which socio-economic effects are expected to be detectable (Alberta Environment 2010a). VEC-specific boundaries are established for both the LSA, for Project-specific effects, and the RSA, for cumulative effects. Potential impacts are also assessed at the spatial scale of the Project footprint (*i.e.*, the Project Area) for those VECs that have impacts more directly tied to the footprint of the Project.

The Study Area boundaries of each discipline are shown in [Figure C.2.4-1](#) (LSA) and [Figure C.2.4-2](#) (RSA). Temporal boundaries range from the life of the Project (25 years) to well beyond (50⁺ yrs). The specific LSA and RSA spatial and temporal dimensions for each discipline are discussed in [Part D](#), and in the respective Consultant Reports.

C.2.4.4 Assessment Cases

The Project considers the following assessment scenarios, as per the fToR and the *Guideline for Preparing EIA Reports* (ESRD 2013b):

- a) **Baseline Case** - includes existing environmental conditions and existing and “approved” projects or activities.
- b) **Application Case** - includes the Baseline Case and the Project.
- c) **Planned Development Case** (Cumulative Effects) - includes the Application Case plus anticipated future environmental conditions and reasonably foreseeable projects or activities.



For the purposes of defining assessment scenarios, “approved” means approved by any federal, provincial or municipal regulatory authority, and “planned” means any project or activity that has been publicly disclosed up to six months prior to the submission of the Application and EIA Report

Existing, approved and planned projects and activities considered in the assessment are listed in [Table C.2.4-2](#) and are shown on [Figure C.2.4-3](#). This list was generated to capture all projects found within the air quality RSA ([Figure C.2.4-2](#)). Local and Regional Study Areas vary in size for each of the VECs due to the variability of the spatial scale of various environmental and social systems, as discussed in [Section C.2.4.3](#). Therefore not all projects captured within the air quality RSA are captured within the study areas of other VECs ([Figure C.2.4-3](#)). Existing project footprints were captured from June-July 2013 satellite imagery, while planned project footprints were captured from publically available maps, for example those found within regulatory applications.

Table C.2.4-2 List of Existing, Approved and Planned (Reasonably Foreseeable) Projects				
Company	Project	Existing & Approved Activity	Project Only	Planned Activity (Reasonably Foreseeable)
		(Baseline Case)	(Application Case)	(Planned Development Case)
AltaGas Ltd.	Alexander Compressor Station	☑		
	Bonnyville South Compressor Station	☑		
	Charlotte & Reita Gas Battery	☑		
	Cold Lake Compressor Station	☑		
	East Angling Compressor Station	☑		
	Jessie Lake Compressor Station	☑		
	John Lake North Compressor Station	☑		
	Kehiwin Compressor Station	☑		
	Lindbergh Compressor Station	☑		
	Moonshine Compressor Station	☑		
	Moose Mountain Compressor Station	☑		
	Muriel Lake South Compressor Station	☑		
	Sage Compressor Station	☑		
	Soars Compressor Station	☑		
	South Angling Compressor Station	☑		
Southward Compressor Station	☑			
Thompson Compressor Station	☑			



Table C.2.4-2 List of Existing, Approved and Planned (Reasonably Foreseeable) Projects

Company	Project	Existing & Approved Activity	Project Only	Planned Activity (Reasonably Foreseeable)
		(Baseline Case)	(Application Case)	(Planned Development Case)
ATCO Gas and Pipelines Ltd.	Wildwood (SE-28-053-09-W5)	<input checked="" type="checkbox"/>		
Baytex Energy Corp.	Celtic 13-20-51-23W3	<input checked="" type="checkbox"/>		
	Celtic HZ 6A2-17-3A-10-8-52-23W	<input checked="" type="checkbox"/>		
	Celtic 02-36-50-23W3	<input checked="" type="checkbox"/>		
	Celtic 02-36-50-23W3	<input checked="" type="checkbox"/>		
	Celtic 10-20-51-22W3	<input checked="" type="checkbox"/>		
	Gemini Pilot and Commercial	<input checked="" type="checkbox"/>		
	Greenstreet 13-30-52-26W3	<input checked="" type="checkbox"/>		
	Tangleflags Compressor A12-33-050-27W3	<input checked="" type="checkbox"/>		
	Tangleflags A07-34-050-25W3	<input checked="" type="checkbox"/>		
	Tangleflags Compressor Station A06-30-050-24W3	<input checked="" type="checkbox"/>		
	Tangleflags 11-32-050-25W3	<input checked="" type="checkbox"/>		
	Tangleflags A13-24-050-25W3	<input checked="" type="checkbox"/>		
	Tangleflags A14-32-050-25W3	<input checked="" type="checkbox"/>		
	Tangleflags Oil Well 111 /10-34-050-25W3/03	<input checked="" type="checkbox"/>		
	Tangleflags 06-34-050-25W3	<input checked="" type="checkbox"/>		
Tangleflags 16-32-050-25W3	<input checked="" type="checkbox"/>			
Tangleflags 03-34-050-25W3	<input checked="" type="checkbox"/>			
Big Coulee Resources Ltd.	Conserve Marie Lake 12-32-065-2W4 Compressor Station	<input checked="" type="checkbox"/>		
	Conserve Marie Lake 4-11-66-4 W4 Compressor Station	<input checked="" type="checkbox"/>		
	Conserve Wolf Lake 9-22-65-7-W4 Compressor Station	<input checked="" type="checkbox"/>		
Birchwood Resources Inc.	Sage Pilot			<input checked="" type="checkbox"/>



Table C.2.4-2 List of Existing, Approved and Planned (Reasonably Foreseeable) Projects

Company	Project	Existing & Approved Activity	Project Only	Planned Activity (Reasonably Foreseeable)
		(Baseline Case)	(Application Case)	(Planned Development Case)
Bonavista Energy Corp.	Beacon Hill North 13-23, Beacon Hill SE 7-19-60-23W3 and Bronson 12-36-57-27W3	☑		
	Kent 10-01	☑		
	Reita Lake 07-26	☑		
Border Paving	Portable Plant 020011	☑		
BP Canada Energy Co.	11-07-063-08 W4 Kirby Leismer Amoco St. Lina North Compressor Station	☑		
	15-23-62-9W4 Compressor Station	☑		
	8-17-63-9W4 Compressor Station	☑		
Canadian Natural Resources Ltd.	Amoco AEC Moore Ex SWD10-5	☑		
	Ardmore 05-21	☑		
	Burnt Lake	☑		
	Elkpoint 05-34	☑		
	Frenchman Butte 10-06	☑		
	Frog Lake	☑		
	John Lake 12-26	☑		
	Kehewin 11-19 Compressor Station	☑		
	Moose Hills	☑		
	Near Wolf Lake and Primrose Plant	☑		
	North Tangleflags In-Situ Oilsands Facility	☑		
	PCL Lindbergh 5P-33 05-33-055-04W4	☑		
	Primrose East Plant , Primrose North and Primrose South Thermal	☑		
	Saddle Lake 09-09	☑		
	St. Lina South	☑		
Tangleflags 15-12	☑			
Wolf Lake Thermal	☑			



Table C.2.4-2 List of Existing, Approved and Planned (Reasonably Foreseeable) Projects

Company	Project	Existing & Approved Activity	Project Only	Planned Activity (Reasonably Foreseeable)
		(Baseline Case)	(Application Case)	(Planned Development Case)
Cargill Ltd.	Cargill AgHorizons, Vermilion east	<input checked="" type="checkbox"/>		
Cenovus Energy Inc.	Caribou 07-31	<input checked="" type="checkbox"/>		
	Fisher Compressor Station 07-25, Fisher Compressor Station 08-11 and Fisher Gas Battery 11-14	<input checked="" type="checkbox"/>		
	Foster Creek Phase A to H	<input checked="" type="checkbox"/>		
	Foster Creek Phase J			<input checked="" type="checkbox"/>
	Primrose Compressor Station 05-19	<input checked="" type="checkbox"/>		
	Primrose 01-04, Primrose 09-26	<input checked="" type="checkbox"/>		
Crescent Point Energy	Trust Cold Lake 16-35, John Lake 6-32 and Red Springs 10-13 Comp. Station	<input checked="" type="checkbox"/>		
Devon Canada Corp.	Forsyth 06-26, Frenman 11-21	<input checked="" type="checkbox"/>		
	John Lake 13-16 (13-16-055-01-W4)	<input checked="" type="checkbox"/>		
	Walleye Phase1			<input checked="" type="checkbox"/>
E Construction Ltd.	P-09 Bonnyville	<input checked="" type="checkbox"/>		
	P-01 Cold Lake Plant	<input checked="" type="checkbox"/>		
	P-24 Mobile Plant	<input checked="" type="checkbox"/>		
Encana Oil & Gas Co. Ltd	Caribou Gas Battery 05-16	<input checked="" type="checkbox"/>		
	Caribou 02-21, 04-05, 05-20, 05-35, 06-21, 06-22, 06-32, 07-17, 07-18, 08-12, 10-08, 10-27, 13-15, 16-16 Gas Plants	<input checked="" type="checkbox"/>		
	Primrose 09-02 and 10-13	<input checked="" type="checkbox"/>		
	Caribou Comp. Station 06-15	<input checked="" type="checkbox"/>		
	Moore Comp. Station 08-13	<input checked="" type="checkbox"/>		
EOG Resources Canada Inc.	Firetower Comp Station 09-25	<input checked="" type="checkbox"/>		
	Whelan Gas Battery 02-22	<input checked="" type="checkbox"/>		



Table C.2.4-2 List of Existing, Approved and Planned (Reasonably Foreseeable) Projects

Company	Project	Existing & Approved Activity	Project Only	Planned Activity (Reasonably Foreseeable)
		(Baseline Case)	(Application Case)	(Planned Development Case)
Husky Energy Inc.	Bolney O.B	<input checked="" type="checkbox"/>		
	Caribou Lake Thermal Demonstration	<input checked="" type="checkbox"/>		
	Tucker Thermal Phase 1	<input checked="" type="checkbox"/>		
Imperial Oil Resources Ventures Ltd.	10-6-56-27 W3M	<input checked="" type="checkbox"/>		
	Cold Lake Thermal Plant (including Leming Plant, Mahihkan Plant, Makhese Plant, Maskwa Plant and Nabiye Plant)	<input checked="" type="checkbox"/>		
Keyera Energy Ltd	Greenstreet Gas Plant	<input checked="" type="checkbox"/>		
	Greenstreet 11-27 and Greenstreet 11-28	<input checked="" type="checkbox"/>		
Northstar Energy Corp.	Frenman Lake Compressor Station	<input checked="" type="checkbox"/>		
NuVista Energy Ltd.	Beacon Colony D Camp Station 10-03 and Beacon Colony A Camp Station 01-13	<input checked="" type="checkbox"/>		
	Beacon Hill Camp Station 13-23	<input checked="" type="checkbox"/>		
	Fort Pitt Comp Station 11-31	<input checked="" type="checkbox"/>		
	Greenstreet 11-28 & 11-27 Compressors	<input checked="" type="checkbox"/>		
	Primrose Comp Station 05-26 and Primrose Comp Station 07-30	<input checked="" type="checkbox"/>		
	Makwa Lake Gas Battery 15-04	<input checked="" type="checkbox"/>		
	North Bronson Comp Station 12-36	<input checked="" type="checkbox"/>		
South Bronson Comp Station 07-34	<input checked="" type="checkbox"/>			
Osum Oil Sands Corp.	Taiga	<input checked="" type="checkbox"/>		
Pengrowth Energy Corporation	Lindbergh SAGD Project	<input checked="" type="checkbox"/>		
	Lindbergh SAGD Expansion Project		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Pennwest Petroleum	Sugden 3-16-61-8W4	<input checked="" type="checkbox"/>		
Royal Dutch Shell	plc Orion Phase 1 and 2	<input checked="" type="checkbox"/>		



Table C.2.4-2 List of Existing, Approved and Planned (Reasonably Foreseeable) Projects

Company	Project	Existing & Approved Activity	Project Only	Planned Activity (Reasonably Foreseeable)
		(Baseline Case)	(Application Case)	(Planned Development Case)
Sinopec Daylight Energy Ltd.	Fort Kent	☑		
Talisman	Compressor Station	☑		
The Canadian Salt Company	Lindbergh Facility	☑		
True Energy	Trust Keyano 14-12 Comp. Station	☑		

C.2.4.5 Cumulative Effects

Cumulative effects are defined as “changes to the environment that are caused by a project in combination with other past, present, and planned projects in the region” (Alberta Environment, 2010a). The requirement to assess cumulative effects is legislated under both EPEA [Section 49(d)] and the CEAA [Section 19(1)(a)]. The AER/ESRD/NRCB Information Letter “Cumulative Effects Assessment in Environmental Impact Assessment Reports under the Alberta Environmental Protection and Enhancement Act,” (June 2000) provides additional guidance with respect to cumulative effects assessments.

Pengrowth identified the cumulative effects resulting from the Project when combined with those of other existing, approved and planned projects in the region. As outlined in [Section C.2.4.3](#), the cumulative environmental effects assessment boundaries vary for each discipline. Existing, approved and planned projects in the region considered in the cumulative effects assessment are listed in [Table C.2.4-2](#).

C.2.5 STEPS IN THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The steps used to conduct the EIA for the Project are shown in [Table C.2.4-3](#) and described in this Section.



Table C.2.4-3 Steps Used to Conduct the Environmental Impact Assessment

Step	Task
1. Scoping	Identify local and regional issues of concern
	Select local and regional VECs
	Identify spatial and temporal boundaries for each resource discipline to encompass the respective VECs
	Identify potential impacts (Project and cumulative) due to actions and possible effects
2. Analysis of Effects and Identification of Mitigation	Complete the collection of local and regional baseline data
	Assess effects of proposed Project action and other cumulative actions on selected VECs
	Recommend mitigation measures
3. Impact Rating	Characterize residual effects
	Compare results against defined thresholds, such as standards, guidelines, land use objectives and trends, or other defined thresholds
	Determine impact rating of Project and cumulative effects on selected VECs
4. Follow-up and Monitoring	Recommend monitoring and effect management

C.2.5.1 Scoping

The purpose of the scoping exercise was to:

- define the Project;
- identify local and regional issues of concern;
- identify VECs (and their associated study area boundaries); and
- identify potential Project and cumulative impacts.

Issues of concern were based on:

- concerns expressed by government, the professional community, and directly-affected stakeholders;
- the EIA fToR;
- a review of legislation;
- consideration of available reference material and literature;
- previous assessment experience including proposed developments in the Project study areas; and
- issues and concerns related to resources traditionally used by indigenous peoples.

Based on the evaluation of these issues, VECs for the Project were identified. Throughout the EIA process, new VECs were identified and grouped into the appropriate resource discipline. Generally, Project VECs were selected for analyses based on the extent of the interaction



between the Project and the issue of concern. For some VECs, key questions were also developed to focus the assessment.

Spatial and temporal boundaries for each resource discipline were established to encompass the respective VECs. Potential Project and cumulative activities for each VEC were identified. The VECs identified for each environmental discipline are presented in [Part D](#) and in the respective Consultant Reports. The rationale for the selection of the respective VECs is presented in the relevant Consultant Reports.

C.2.5.2 Analysis of Effects and Identification of Mitigation

Baseline conditions for each VEC were described based on existing information and Project-specific investigations. Once baseline conditions for the resource were determined and Project activities were defined, an evaluation was carried out to determine whether environmental protection measures were required to mitigate impacts on the VEC.

The assessment of effects for the Project involved the prediction and evaluation of changes to VECs arising directly from the Project (*i.e.*, Project Effects), as well as effects arising from the Project in combination with past, present and planned projects or activities (*i.e.*, Cumulative Effects).

The assessment of the effects of interactions between the Project and environment for each VEC is presented in tabular form for each discipline in [Table C.2.5-1](#). Assessment of potential Project-specific effects on the environment was based on a combination of objective (measurable) and subjective (deduced) evaluations that were specific to the VEC being considered. The evaluation considered those protection or mitigation measures which would be required to meet either regulatory, company or public acceptance during routine planning/design, construction, operation and/or abandonment phases of the Project. In addition, likely accidents and/or malfunctions were considered in the assessment. Professional judgement is heavily relied upon, especially in cases where no regulatory thresholds are available.

Alberta Environment and Sustainable Resource Development defines mitigation as “*the elimination, reduction or control of the adverse environmental effects of the project. Mitigation includes restitution for any damage to the environment caused by such effects through replacement, restoration, compensation or any other means.*” (Alberta Environment 2010a).

Mitigation is often achieved through iterative project design, for example through site selection to avoid sensitive areas and application of best practices during construction. Additional mitigation measures, over and above mitigation integrated into Project design, were identified for each effect, as required. Types of mitigation measures that were considered included:

- environmental protection measures and protocols;
- site-specific measures (*i.e.*, timing of activities to avoid biologically sensitive periods, site-specific mitigation design measures); and
- contingency measures to address the possibility of accidental events that could affect the environment.



C.2.5.3 Impact Rating

Impact assessments are based upon ESRD's *Guideline for Preparing EIA Reports* (ESRD 2013a) and measured, estimated, or reasonably expected changes in some attributes of a selected receptor. These receptors or key resources are considered representative of the larger environment, with the assumption that if little to no impact to the receptor is identified, the broader environment will not be impacted. The identification of receptors is dependent upon scientific understanding of the respective ecological components and their interactions in the overall environment within which the Project will be developed. Work activity is guided both by issues identified during the course of impact assessment and in response to the fToR for the Project.

For each identified receptor, an assessment of the potential impact is made using the attributes of direction, geographic extent, magnitude, duration, likelihood, reversibility, and confidence in the relationships between cause and effect. An overall impact assessment rating for each receptor is derived based upon the individual attributes.

A residual project impact is defined as an effect that remains after mitigation has been applied (Alberta Environment 2010a). Thus, the quantification and description of a residual project impact, by definition, includes consideration of available mitigation procedures and opportunities. Impacts discussed in this EIA include those occurring due to the maximum disturbance scenario (*e.g.*, all Project components developed and operating at one time) and those impacts remaining after mitigation and reclamation activities have been completed (*i.e.*, the residual Project impacts).

The definition of the attributes used in the assessment is described below and in [Table C.2.5-1](#). Some specific definitions and certain attributes that pertain to a specific component are included in that component.

These attributes include:

- magnitude;
- geographic extent;
- duration;
- frequency;
- reversibility; and
- ecological context.

Alberta Environment and Sustainable Development and the CEAA provide additional guidance regarding these criteria as follows:

- **Magnitude of the Impact:** ESRD defines magnitude as “*a measure of how adverse or beneficial an effect may be*” (Alberta Environment 2010a). Guidance on magnitude from the Canadian Environmental Assessment (CEA) Agency is as follows: “*Magnitude refers to the severity of the adverse environmental effects. Minor or inconsequential effects may*



not be significant. On the other hand, if the effects are major or catastrophic, the adverse environmental effects will be significant. When using this criterion, it is important to consider the extent to which the project could trigger or contribute to any cumulative environmental effects.” (FEARO 1994)

- **Geographic Extent:** ESRD defines geographic extent as “*spatial boundaries within which an effect of a defined magnitude occurs*” (Alberta Environment 2010a). Guidance on geographic extent from the CEA Agency is as follows: “*Localized adverse environmental effects may not be significant. Alternatively, widespread effects may be significant. When considering this criterion, it will be important to take into account the extent to which adverse environmental effects caused by the project may occur in areas far removed from it (e.g., acid rain and the long-range transportation of atmospheric pollutants), as well as contribute to any cumulative environmental effects.*” (FEARO 1994)
- **Duration and Frequency:** ESRD defines duration as “the period of time in which an effect on a valued ecosystem component may exist or remain detectable” and defines frequency as “*the number of times during the life of the project that the effect may occur*” (Alberta Environment 2010a). Guidance on duration and frequency from the CEA Agency is as follows: “Long term and/or frequent adverse environmental effects may be significant. Future adverse environmental effects should also be taken into account. For example, many human cancers associated with exposure to ionizing radiation have long latency periods of up to 30 years. Obviously when considering future adverse environmental effects, the question of their likelihood becomes very important.” (FEARO 1994)
- **Degree to which the Effects are Reversible or Irreversible:** ESRD defines reversibility as “*capability of the environment to return to a capacity or condition equivalent to the baseline after the impact ceases*” (Alberta Environment 2010a). Guidance on reversibility from the CEA Agency is as follows: “*Reversible adverse environmental effects may be less significant than adverse environmental effects that are irreversible. In practice, it can be difficult to know whether the adverse environmental effects of a project will be irreversible or not. It will be important to consider any planned decommissioning activities that may influence the degree to which the adverse environmental effects are reversible or irreversible.*” (FEARO 1994)
- **Ecological Context:** Guidance on ecological context from the CEA Agency is as follows: “*The adverse environmental effects of projects may be significant if they occur in areas or regions that:*
 - have already been adversely affected by human activities; and/or
 - *are ecologically fragile and have little resilience to imposed stresses.*” (FEARO 1994).
- **Environmental Standards, Guidelines, or Objectives:** Guidance on environmental standards, guidelines and objectives from the CEA Agency is as follows: “*If the level of an adverse environmental effect is less than the standard, guideline, or objective, it may be insignificant. If, on the other hand, it exceeds the standard, guideline, or objective it may be significant.*” (FEARO 1994).



Table C.2.5-1 Evaluation Criteria for Assessing the Environmental Impact

Criteria	Criteria Definition ¹	
Magnitude	Nil	No change from background conditions anticipated after mitigation.
	Low	Disturbance predicted to be somewhat above typical background conditions, but well within established or accepted protective standards and normal socio-economic fluctuations, or to cause no detectable change in ecological, social or economic parameters.
	Moderate	Disturbance predicted to be considerably above background conditions but within scientific and socio-economic effects thresholds, or to cause a detectable change in ecological, social or economic parameters within range of natural variability.
	High	Disturbance predicted to exceed established criteria or scientific and socio-economic effects thresholds associated with potential adverse effect, or to cause a detectable change in ecological, social or economic parameters beyond the range of natural variability.
Geographic Extent	Local	Effects occurring mainly within or close proximity to the proposed development area.
	Regional	Effects extending outside of the Project boundary to regional surroundings.
	Provincial	Effects extending outside of the regional surroundings, but within provincial boundary.
	National	Effects extending outside of the provincial surroundings, but within national boundary
	Global	Effects extending outside of national boundary.
Duration	Short	Effects occurring within development phase
	Long	Effects occurring after development and during operation of facility
	Extended	Effects occurring after facility closes but diminishing with time.
	Residual	Effects persisting after facility closes for a long period of time.
Frequency	Continuous	Effects occurring continually over assessment periods.
	Isolated	Effects confined to a specified period (<i>e.g.</i> , construction)
	Periodic	Effects occurring intermittently but repeatedly over assessment period (<i>e.g.</i> , routine maintenance activities).
	Occasional	Effects occurring intermittently and sporadically over assessment period
Reversibility	Reversible in short-term	Effects which are reversible and diminish upon cessation of activities.
	Reversible in long-term	Effects which remain after cessation of activities but diminish with time.
	Irreversible	Effects which are not reversible and do not diminish upon cessation of activities and do not diminish with time.
Project Contribution	Neutral	No net benefit or loss to the resource, communities, region or province.
	Positive	Net benefit to the resource, community, region or province.
	Negative	Net loss to the resource, community, region or province.



Table C.2.5-1 Evaluation Criteria for Assessing the Environmental Impact		
Criteria	Criteria Definition ¹	
Confidence Rating	Low	Based on incomplete understanding of cause-effect relationships and incomplete data pertinent to study area.
	Moderate	Based on good understanding of cause-effect relationships using data from elsewhere or incompletely understood cause-effect relationship using data pertinent to study area.
	High	Based on good understanding of cause-effect relationships and data pertinent to study.
Probability of Occurrence Ecological Context	Low	Unlikely
	Medium	Possible or probable
	High	Certain
Impact Rating	No Impact	No adverse effects are predicted.
	Low Impact	Effects are predicted to be within the range of natural variability and below guideline or threshold levels.
	Moderate Impact	Effects may exceed natural variability and/or guideline or threshold levels during phases of the Project but recovery or restoration is considered feasible.
	High Impact	Effects of the Project are predicted to cause irreversible changes to the sustainability or integrity of a population or resource.

¹ Criteria provide general direction for the environmental assessment, some modification of definitions may occur within individual disciplines

In all attributes there are both objective and subjective considerations. Objective considerations include quantitative comparisons between predicted residual Project impacts and established quantitative limits such as ambient air objectives and water quality guidelines, regional environmental objectives, and forestry harvest quotas. Subjective considerations, or professional judgements, are required when impacts cannot be predicted quantitatively due to limited data availability or when there are no benchmarks against which to compare predicted quantitative impacts.

For each VEC that was assessed, a final impact rating of no impact, low, moderate, or high is stated. This is based upon the integration of quantitative analysis (where possible) and professional judgement that takes into account the various rankings for each attribute (direction, magnitude, geographic extent, duration, likelihood, reversibility, and confidence). This is applied to both the Project-specific impact and cumulative effects assessments. The assessment of the residual and cumulative effects of interactions between the Project and environment for each VEC have been summarized in this application for each discipline and an example is shown in [Table C.2.5-2](#).



Table C.2.5-2 Example Summary of Impact Rating on Valued Environmental Components (VECs)

VEC	Nature of Potential Impact or Effect	Mitigation/Protection Plan	Type of Impact or Effect	Geographical Extent ¹	Duration ²	Frequency ³	Reversibility ⁴	Magnitude ⁵	Project Contribution ⁶	Confidence Rating ⁷	Probability of Occurrence ⁸	Impact Rating ⁹
1. List the VEC												
			Application									
			Cumulative									
2. List the VEC												
			Application									
			Cumulative									
3. List the VEC												
			Application									
			Cumulative									
4. List the VEC												
			Application									
			Cumulative									
5 List the VEC												
			Application									
			Cumulative									

- 1. Local, Regional, Provincial, National, Global
- 2. Short, Long, Extended, Residual
- 3. Continuous, Isolated, Periodic, Occasional
- 4. Reversible in short term, Reversible in long term, Irreversible
- 5. Nil, Low, Moderate, High
- 6. Neutral, Positive, Negative
- 7. Low, Moderate, High
- 8. Low, Medium, High
- 9. No Impact, Low Impact, Moderate Impact, High Impact



C.2.6 FOLLOW-UP AND MONITORING

Once residual Project-specific environmental effects and their contribution to cumulative effects have been assessed, a follow-up program or monitoring program might be necessary. Follow-up programs are a federal requirement. ESRD defines follow-up programs as a program for verifying the “...accuracy of the Environmental Assessment of a project and/or to determine the effectiveness of any measures taken to mitigate the adverse environmental effects of the project” (Alberta Environment 2010a).

Follow-up programs might be warranted when:

- there is a need to address Project-related issues of concern;
- there is a need to test the accuracy of the predictions of the environmental assessment;
- there is a need to verify that mitigation measures were effective or successful;
- environmental effects of a project were assessed using new or unproven analytical or modelling techniques or the proposed project involves technology or mitigation measures that are new or unproven;
- there is limited experience implementing the type of project being proposed in the environmental setting under consideration; or
- scientific knowledge used to predict the environmental effects of the proposed project is limited.

Follow-up programs can be time and resource intensive and are only required where there is an identified need for a program based on the criteria set out above. In some instances, a monitoring program might adequately address issues and ensure the environment is protected.

Monitoring typically refers to a program designed to:

- confirm the effectiveness of a broad range of approved mitigation techniques;
- determine whether increased or different approved mitigation techniques are required to achieve mitigation or reclamation goals; and
- identify and address actual effects that were not predicted.

Recommended follow-up and monitoring programs are identified for specific disciplines in [Part D](#) and in the respective Consultant Reports. If a follow-up or monitoring program is recommended, recommendations are provided with respect to:

- parameters to be measured;
- methods and equipment to be used;
- location and timing of surveys; and
- how results of the follow-up or monitoring program will be applied, including consideration of an adaptive management approach.



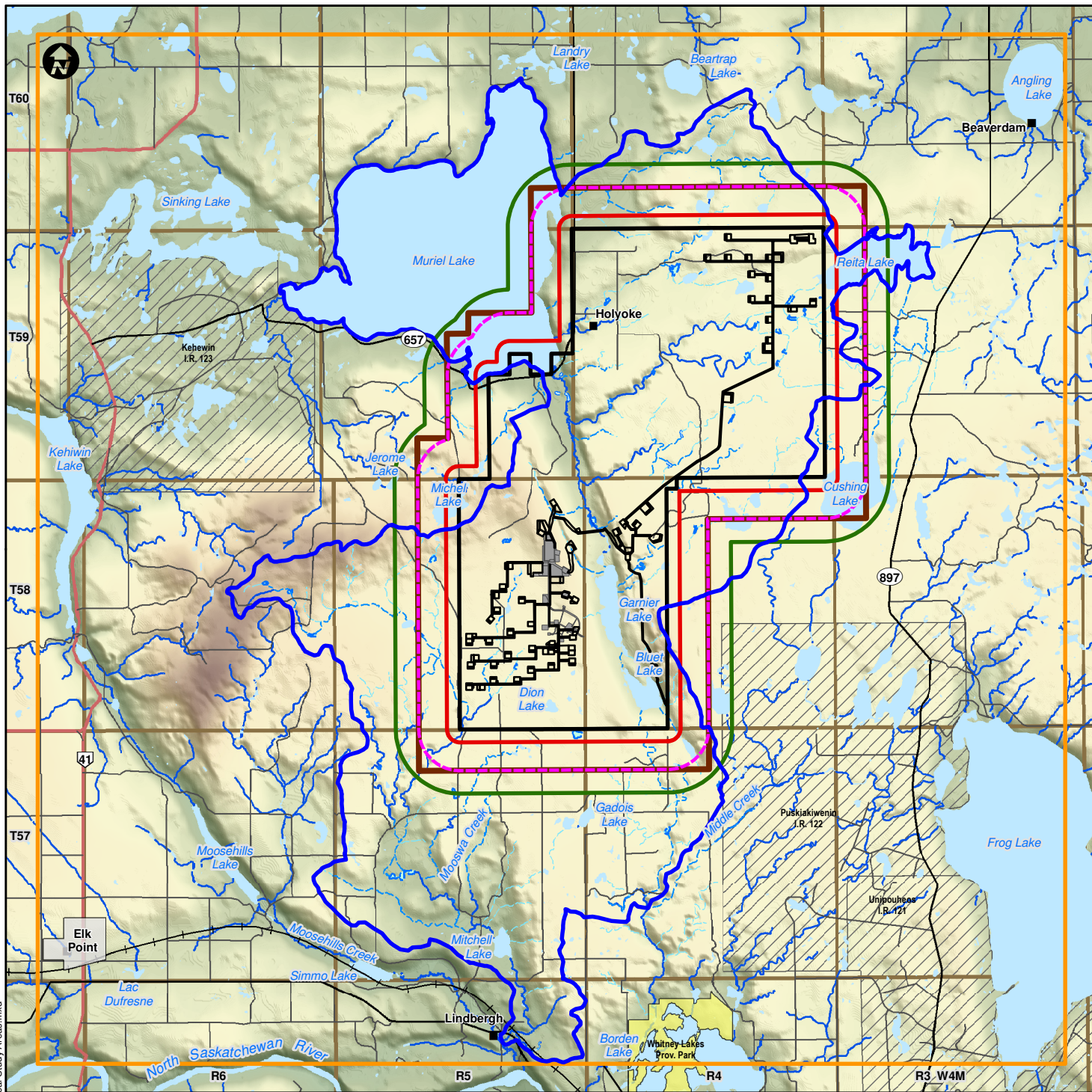
C.3 APPLICATION OF THE METHODOLOGY

Based on the above-described methodology, the EIA for the Project focused on the effects that the Project would have on the identified VECs in combination with other activities in the region over the anticipated 25 year economic life of the Project.

Based on the input received during the public consultation program, advice from regulatory agencies, and the professional community participants that worked on the Project, Pengrowth is confident that the methodology and approach used to conduct the EIA has enabled a comprehensive and accurate assessment of the effects of the Project.



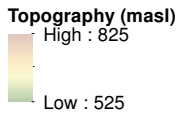
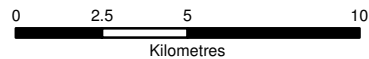
FIGURES



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Legend

- Air Quality, Human Health LSA
- Aquatic Resources, Hydrology LSA
- Historical Resources, Soils LSA
- Hydrogeology LSA
- Land Use LSA
- Noise LSA
- Vegetation, Wildlife LSA
- Development Footprint
- Existing and Approved Development
- Primary Highway
- Secondary Highway
- Railway
- First Nations
- Provincial Park

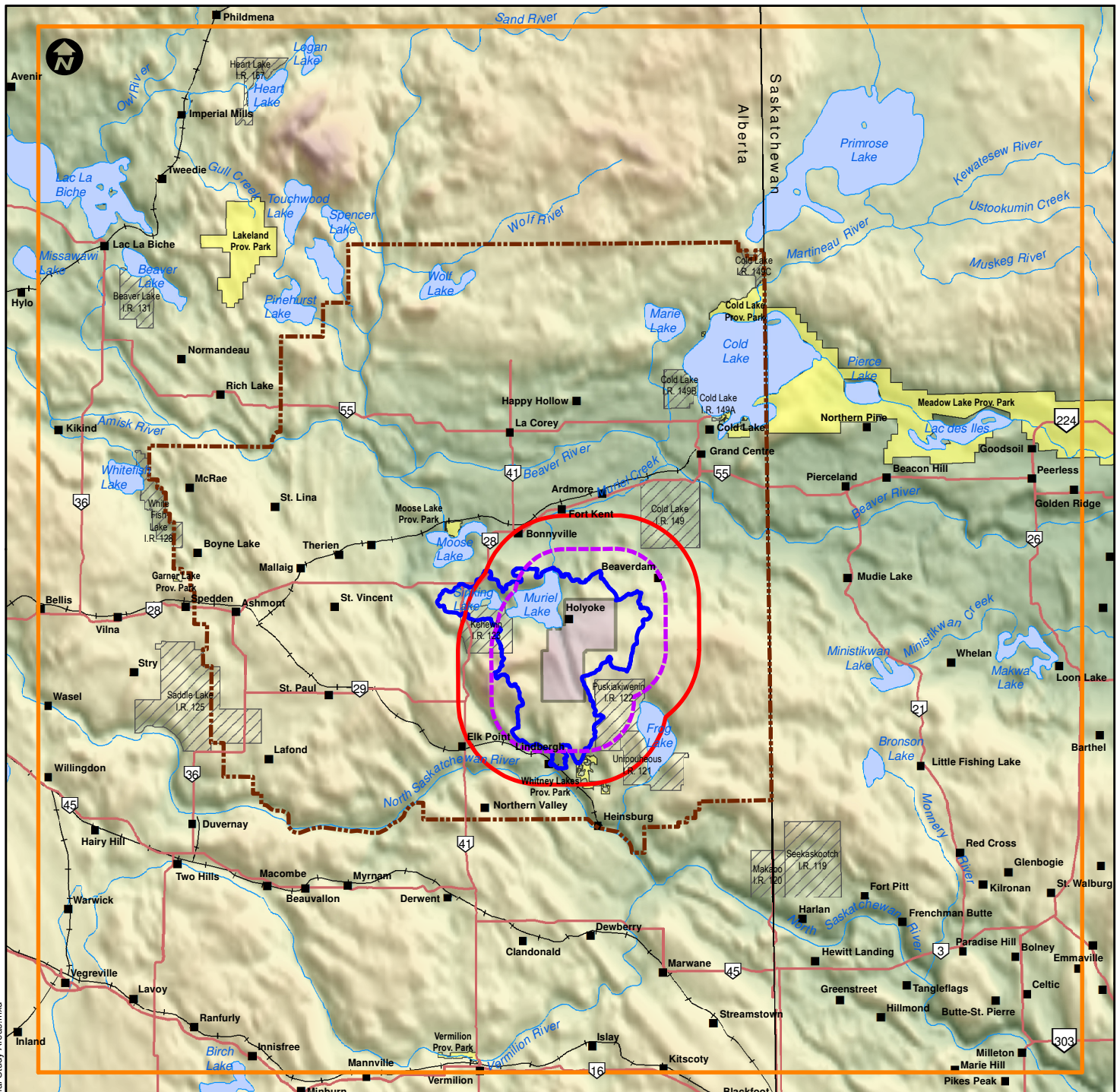


PROJECT: **Lindbergh SAGD Expansion Project**

TITLE: **Local Study Areas (LSA) Used for the Environmental Impact Assessment**

DRAWN: SL	FIGURE:
CHECKED: KK	C.2.4-1
DATE: Dec 12/13	
PROJECT: 11-033	

REF: Drifter Projects Ltd., EIA Footprint REV 3.dwg; Geobase, 2010; NCH hydrology Oct 2013.

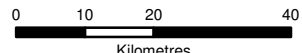


Legend

- Air Quality, Human Health RSA
- Aquatic Resources, Hydrology RSA
- Hydrogeology RSA
- Socio-Economic RSA
- Soils, Vegetation, Wildlife RSA
- Project Location
- Primary Highway
- Railway
- First Nations
- Provincial Park

Topography (masl)

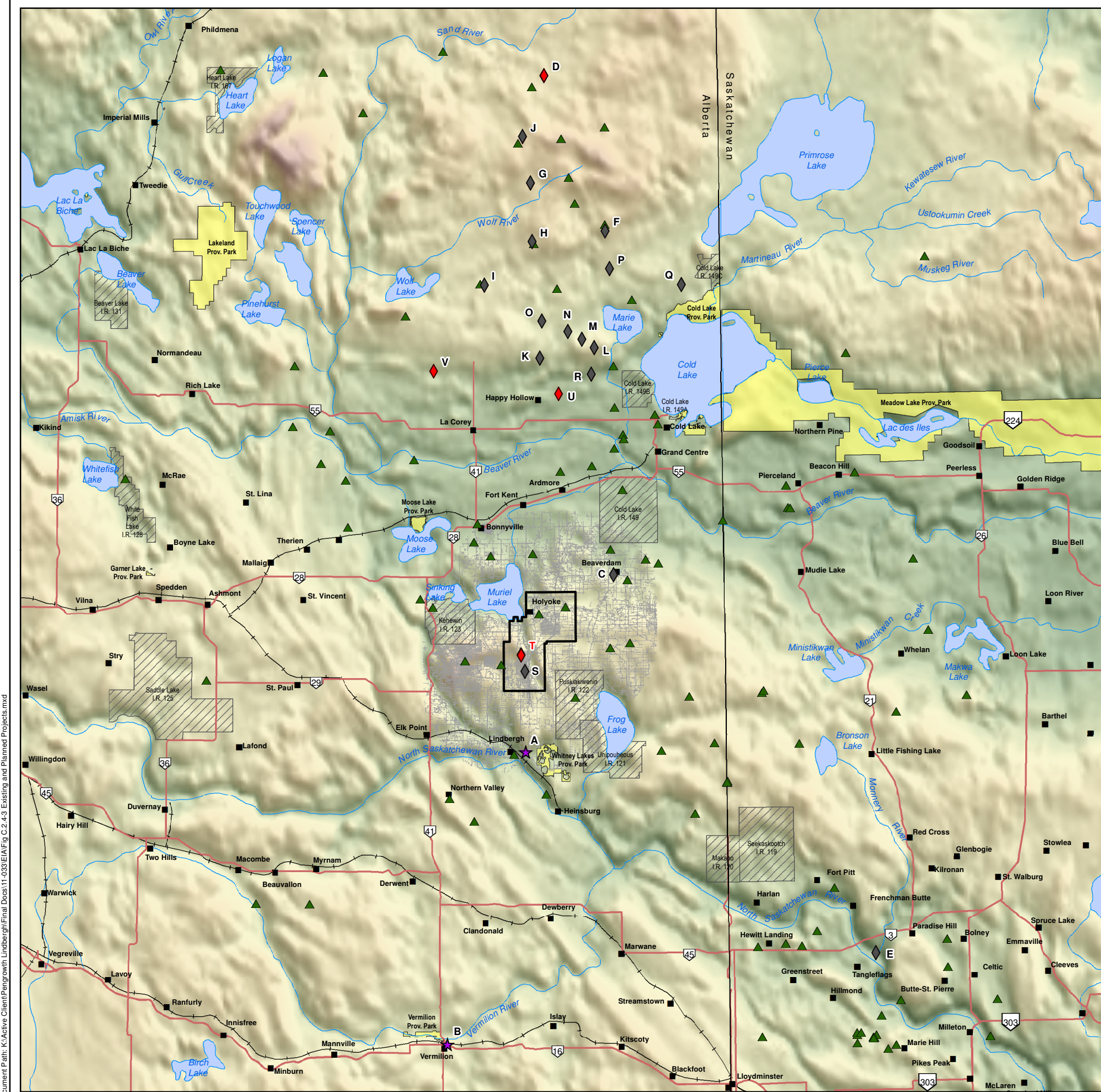
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- Low : 525



PROJECT: **PENGROWTH** Lindbergh SAGD Expansion Project

TITLE: **Regional Study Areas (RSA) Used for the Environmental Impact Assessment**

DRAWN: SL	FIGURE: C.2.4-2
CHECKED: KK	
DATE: Dec 12/13	
PROJECT: 11-033	



Legend

- Existing and Approved**
 - ▲ Compressor Station
 - ★ Industrial Facility
 - ◆ Oil Sands Facility
- Planned**
 - ◆ Oil Sands Facility
- Project Location
- Existing Human Use (within 16km of EIA Project Area)
- First Nations
- Provincial Park
- Primary Highway
- Railway
- Topography (masl)**
 - High : 825
 - Low : 525

Existing and Approved Projects

Label	Facility
A	Canadian Salt Company Lindbergh Facility
B	Cargill Limited Cargill AgHorizons Vermilion East
C	Baytex Energy Corp. Gemini Pilot and Commercial
D	Cenowus Energy Inc. Foster Creek (Phase A-J)
E	Canadian Natural Resources Ltd. North Tangleflags In-Situ Oilsands Facility
F	Canadian Natural Resources Ltd. Primrose East Plant
G	Canadian Natural Resources Ltd. Primrose North Plant
H	Canadian Natural Resources Ltd. Primrose South Plant
I	Canadian Natural Resources Ltd. Wolf Lake Thermal
J	Husky Energy Inc. Caribou Lake Thermal Demonstration Project
K	Husky Energy Inc. Tucker Thermal Project Phase1
L	Imperial Oil Resources Ventures Ltd Cold Lake Makhese Plant
M	Imperial Oil Resources Ventures Ltd Cold Lake Leming Plant
N	Imperial Oil Resources Ventures Ltd Cold Lake Maskwa Plant
O	Imperial Oil Resources Ventures Ltd Cold Lake Mahihkan Plant
P	Imperial Oil Resources Ventures Ltd Cold Lake Nabiye Plant
Q	Osum Oil Sands Corp. Taiga
R	Royal Dutch Shell Orion
S	Pengrowth Energy Corp. Lindbergh Pilot Project

Planned Projects

T	Pengrowth Energy Corp. Lindbergh SAGD Expansion Project
U	Birchwood Resources Inc. Sage Pilot
V	Devon Canada Corporation Walleye Phase 1



REF: Drifter Projects Ltd., EIA Footprint REV 3.dwg; Geobase, 2010.

PROJECT: **Lindbergh SAGD Expansion Project**

TITLE: **Existing and Planned Projects within the Vicinity of the Proposed Project**

DRAWN: SL	FIGURE:
CHECKED: KK	C.2.4-3
DATE: Dec 12/13	
PROJECT: 11-033	

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