PHASED ENVIRONMENTAL IMPACT ASSESSMENT

PHASE III: NATURAL GAS EXPLORATION AT ELGIN SUB-BASIN ELGIN, NEW BRUNSWICK

FINAL REPORT

Submitted to:

Corridor Resources Inc.
Halifax, Nova Scotia

Submitted by:

AMEC Environment & Infrastructure,

A Division of AMEC Americas Limited
Fredericton, New Brunswick

March 2014

TE131057

EXECUTIVE SUMMARY

In Phase III of the Elgin Sub-basin exploration, Corridor Resources Inc. (Corridor) proposes to continue its appraisal of the formation's natural gas resource potential using liquid propane gas (LPG) fracture stimulations in one to three of the existing wells on the Green Road and Will de Mille well pads. The Project is considered an undertaking and is subject to approval under the Environmental Impact Assessment (EIA) Regulation of the New Brunswick *Clean Environment Act* and is further subject to the requirements as described in the *Rules for Industry for the Responsible Environmental Management of Oil and Natural Gas Activities in NB (Rules for Industry)* (New Brunswick Natural Gas Group (NBNGG), 2013). Future phases of this Elgin Sub-basin EIA may include any oil and gas-related exploration, development or production at existing or new well pads or areas within this section of the Frederick Brook formation.

Corridor has retained the services of AMEC Environment & Infrastructure, a division of AMEC Americas Limited (AMEC) to prepare this Phase III EIA report in support of the registration of the Project under the EIA process.

A description of the environment within which the Project activities will occur, or potentially have an influence on, was developed from existing information. Potential positive and negative interactions between Project activities and the environment were identified. Where negative interactions were anticipated, and potential effects were a concern, methods for mitigating the effects have been proposed.

A description of the existing environment in the Study Area has been presented (see Section 4.0) based on available information, including results of field surveys conducted by AMEC from 2008 to 2011. The Valued Environmental Components (VECs) identified by issue scoping and pathway analysis (see Section 5.0) for which potential effects may be a concern include:

- ambient air quality;
- hydrology / hydrogeology;
- Species at Risk;
- migratory birds; and
- recreational land use.

No floral or faunal Species at Risk or critical / limiting habitat was identified, by desktop studies or field investigation, to occur in the proposed Project Footprint. Other Project effects are minimal and will be localized and temporary. This report also identifies measures intended to mitigate potential environmental concerns, and provides a discussion of potential residual effects resulting from the proposed Project.

Based on this Study, and given the proposed mitigation, no significant adverse residual effects are anticipated as a result of the Project.

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LIST OF ACRONYMS

ACCDC	Atlantic Canada Conservation Data Centre
AFRL	Archaeological Field Research License
AMEC	AMEC Environment & Infrastructure, a division of AMEC Americas Limited
ARD	Acid rock drainage
ARM	Air Resources Manager
ATV	All-terrain Vehicle
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CCME	Canadian Council of Ministers of the Environment
CO	Carbon monoxide
CO_2	Carbon dioxide
Corridor	Corridor Resources Inc.
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWS	Canada Wide Standards
ECC	Environmental Components of Concern
EIA	Environmental Impact Assessment
ESA	Environmentally Significant Area
GCDWQ	Guidelines for Canadian Drinking Water Quality
GHG	Greenhouse Gas
H_2S	Hydrogen sulphide
HRIA	Heritage Resource Impact Assessment
HSE	Health, Safety and Environment
IHRM	Intolerant hardwood/red maple mix
IHTH	Intolerant hardwood/tolerant hardwood mix
LPG	Liquid Propane Gas
LSD	Local Service Districts
MBBA	Maritime Breeding Bird Atlas
MBCA	*Migratory Birds Convention Act*
MN	Magnitude
NB	New Brunswick
NBDAAF	New Brunswick Department of Agriculture, Aquaculture and Fisheries
NBAQOs	New Brunswick Air Quality Objectives
NBDELG	New Brunswick Department of Environment and Local Government
NBDEM	New Brunswick Department of Energy and Mines
NBDNR	New Brunswick Department of Natural Resources
NBDNRE	New Brunswick Department of Natural Resources and Energy
NBENV	New Brunswick Department of the Environment
NBNGG	New Brunswick Natural Gas Group
NBSRA	*New Brunswick Species at Risk Act*
NO	Nitric oxide
NO_2	Nitrogen dioxide
NTNB	Nature Trust of New Brunswick Inc.
NYSDEC	New York State Department of Environmental Conservation

O_3	Ozone
OSFH	Old Spruce-Fir Habitat
PAR	Parish
PID	Property Identification Number
PIHW	Pine/hardwood mix
PM	Particulate Matter
POHW	Hardwood with over 50% poplar
RCMP	Royal Canadian Mounted Police
Rules for Industry	*Responsible Environmental Management of Oil and Natural Gas Activities in NB Rules for Industry* (NBNGG, 2013)
SARA	*Canadian Species at Risk Act*
SARPR	Species at Risk Public Registry
SO_2	Sulphur Dioxide
TDG	Transportation of Dangerous Goods
the Agency	Canadian Environmental Assessment Agency
TPH	Total Petroleum Hydrocarbon
TRS	Total Reduced Sulphur
TVD	Total Vertical Depth
UNFCCC	United Nations Framework Convention on Climate Change
VECs	Valued Environmental Components
WAWA	Watercourse and Wetland Alteration
WL	Wireline
WPSW	Softwood with over 50% pine

LIST OF UNITS

dBA	decibels
kPa	kilopascal
km	kilometre
km^2	square kilometre
L	Litre
Leq	energy equivalent sound level
m	metre
m^2	square metres
m^3	cubic metres
mm	millimetre
mt	metric tonne
Mt	Mega tonne
PM_{10}	Particulate Matter less than 10 microns
$PM_{2.5}$	Particulate Matter less than 2.5 microns
ppb	parts per billion
ppm	parts per million
$\mu g/m^3$	microgram per cubic metres (same as ppb)
µm	micrometre

1.0 INTRODUCTION

Corridor Resources Inc. (Corridor) is engaged in an exploration program to further evaluate New Brunswick's (NB) Frederick Brook Shale Formation as an unconventional reservoir capable of natural gas production. The initial phase (Phase I) of exploration entailed the upgrading and expansion of the Will de Mille well pad and the drilling of one vertical well, O-59, from that well pad (Corridor, 2011). Phase II entailed the recovery of tools from the B-41 wellbore on the Green Road well pad and a limited flow test of the well to determine production potential of the well.

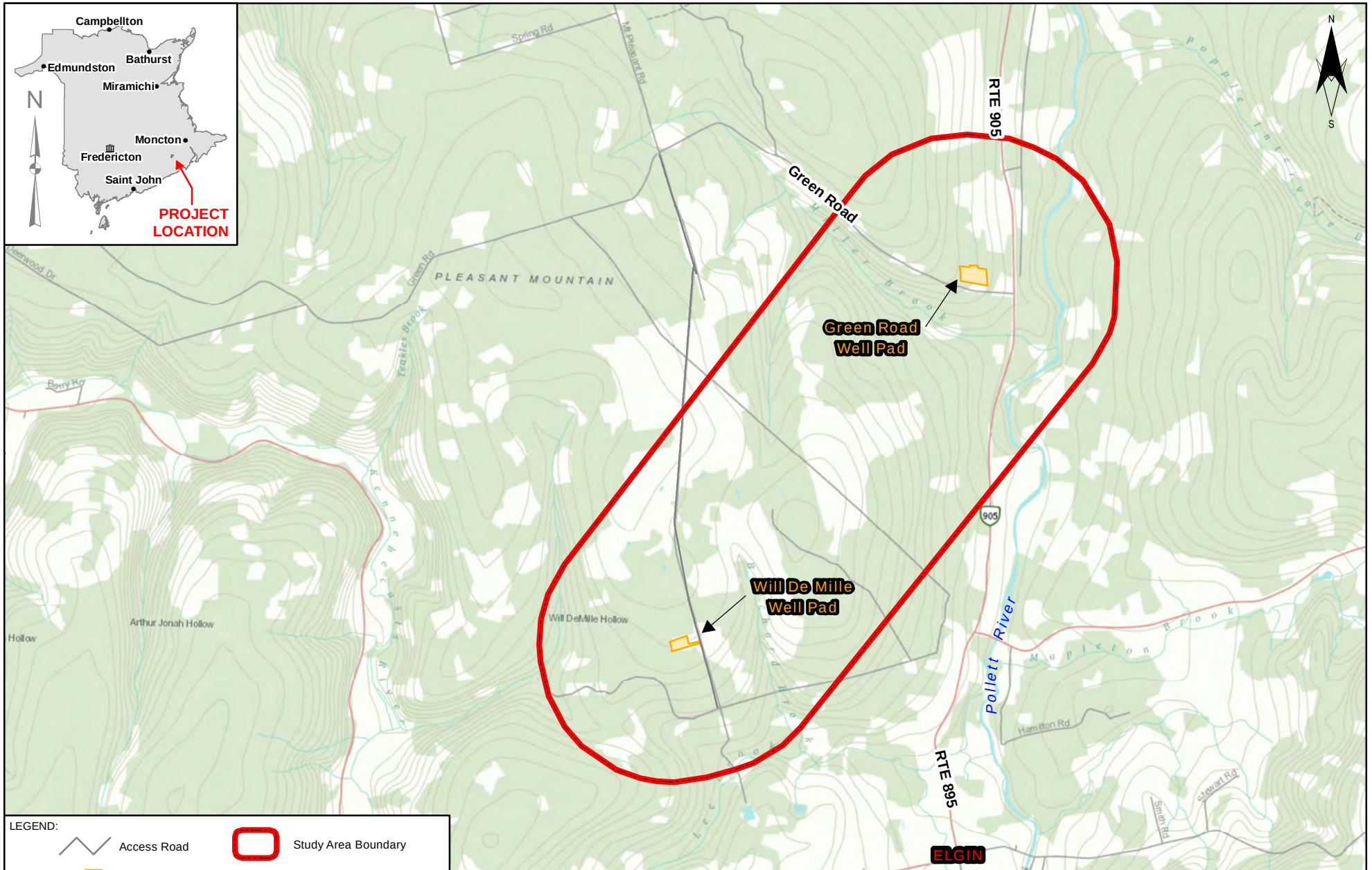
In Phase III of the Elgin Sub-basin exploration, Corridor proposes to continue its appraisal of the formation's natural gas resource potential using fracture stimulations in at least one to potentially all three of the existing wells on the Green Road and Will de Mille well pads over a period of three (3) to five (5) years. The Project is considered an undertaking and is subject to approval under the Environmental Impact Assessment (EIA) Regulation of the NB *Clean Environment Act* and is further subject to the requirements as described in the *Rules for Industry for the Responsible Environmental Management of Oil and Natural Gas Activities in NB* (*Rules for Industry*) (New Brunswick Natural Gas Group (NBNGG), 2013).

Depending on the well test results, Corridor may seek approval for additional activities and will submit at that time the next Phase of the EIA. Corridor is currently seeking a broad-based approval for fracture stimulation at these two well pads, Will de Mille and Green Road. Corridor will outline in this submission a detailed program for work in 2014 making use of liquid propane gas (LPG) as the fracture stimulation fluid. Corridor is investigating the use of water as the fracture treatment fluid for work in 2015 and beyond and will continue to use knowledge gained from all Frederick Brook fracture treatments to determine the optimal fracture design for each reservoir. For 2014, however, Corridor will only use LPG for fracture treatments. For fracture stimulation work beyond 2014, Corridor will submit detailed and specific information in advance of the work as conditions of the Certificate of Determination.

AMEC Environment & Infrastructure, a division of AMEC Americas Limited (AMEC) was retained by Corridor to provide environmental consulting services and to prepare this Phase III EIA report in support of the requirements under the NB EIA process.

1.1 Background

As part of Corridor's ongoing exploration activities, several wells have been drilled outside the McCully field in the Elgin area by Corridor and a previous partner. Corridor plans to continue exploration in the Elgin area, which is illustrated in Figure 1.1. The well pads and infrastructure are illustrated in Figures 1.2 and 1.3.



LEGEND:

- Access Road
- Well Pad
- Study Area Boundary

CLIENT: corridor resources inc.

500 250 0 500 1,000 Metres

DATUM: NAD83

PROJECTION: NB Stereographic

PROJECT NO: TE131057

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT: NATURAL GAS EXPLORATION AT ELGIN SUB-BASIN

TITLE: OVERVIEW PROJECT AREA

DWN BY: JT

DATE: Feb 18, 2014

CHK'D BY: CT

REV. NO:

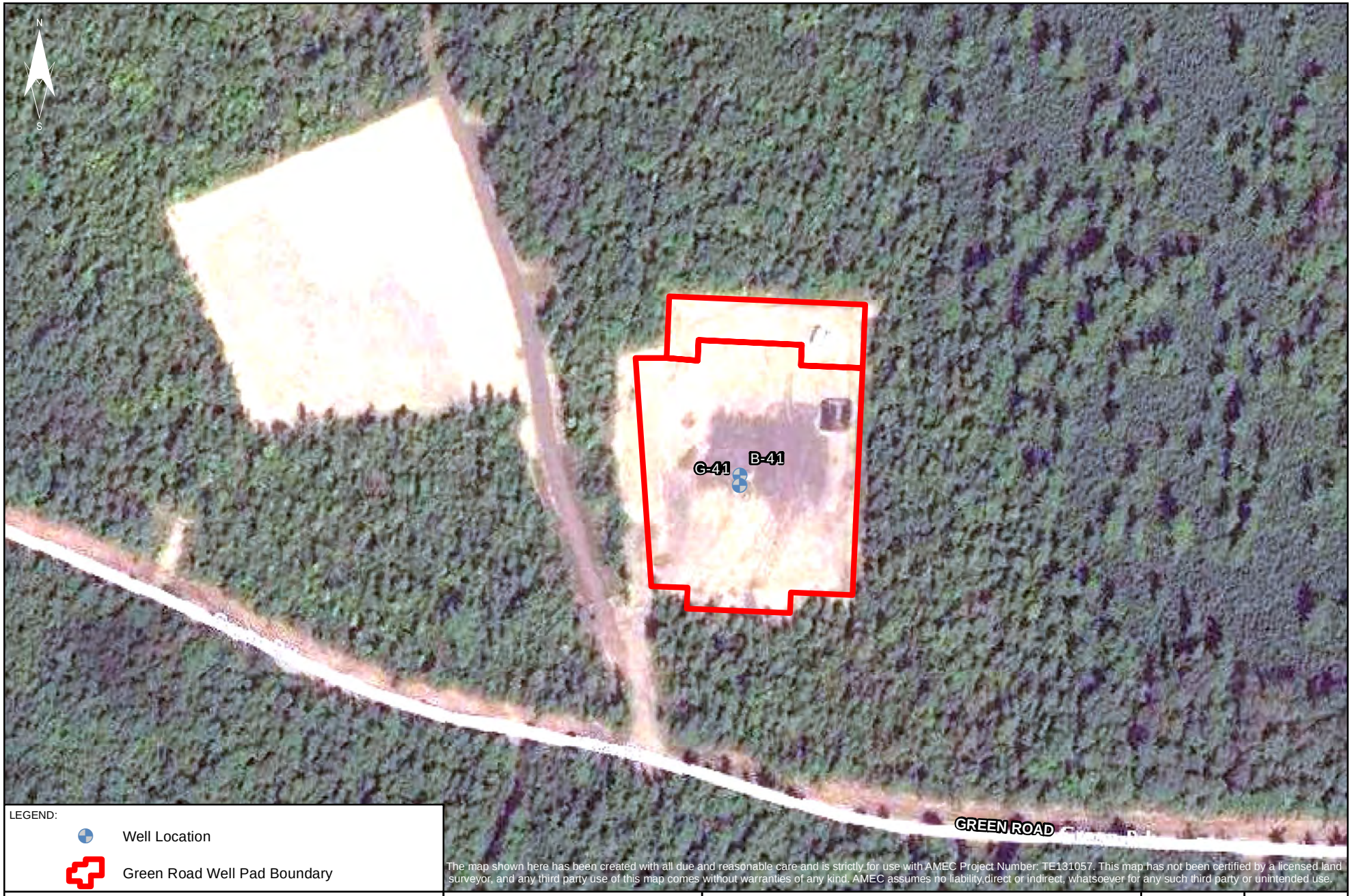
SCALE: 1:40,000

FIGURE NO: 1.1

AMEC Environment & Infrastructure,
a Division of AMEC Americas Limited
Suite 1 - 495 Prospect Street
Fredericton, NB E3B 9M4
Tel. 506-458-1000 Fax 506-450-0829 www.amec.com

Path: G:\GIS\PROJECTS\TE131057_Corridor_Well_EIA\MXD\20140218_OverviewProjectArea_Fig1_1.mxd User: jonathan.thornton Date: 18/02/2014

SOURCE: ESRI ArcGis MapService - Topographic



LEGEND:

Well Location

Green Road Well Pad Boundary

CLIENT: corridor resources inc.

20 10 0 20 40 60 Metres

DATUM: NAD83

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT: NATURAL GAS EXPLORATION AT ELGIN SUB-BASIN

DWN BY: TM

DATE: Feb 18, 2014

CHK'D BY: CT

REV. NO:

AMEC Environment & Infrastructure,
a Division of AMEC Americas Limited
Suite 1 - 495 Prospect Street
Fredericton, NB E3B 9M4
Tel. 506-458-1000 Fax 506-450-0829 www.amec.com

PROJECTION: UTM 20 North

PROJECT NO: TE131057

TITLE: GREEN ROAD WELL PAD PROJECT SITE DESCRIPTION

SCALE: 1:2,500

FIGURE NO: 1.2

Path: G:\GIS\PROJECTS\TE131057_Corridor_Well_EIA\MXD\20140218_GreenRoadWellPad_Fig1_2.mxd User: jonathan.thornton Date: 19/02/2014

SOURCE: Bing Map Service - Topographic

LEGEND:

Well Location

Will De Mille Well Pad Boundary

CLIENT: corridor resources inc.

20 10 0 20 40 60 Metres

DATUM: NAD83

PROJECT: **ENVIRONMENTAL IMPACT ASSESSMENT: NATURAL GAS EXPLORATION AT ELGIN SUB-BASIN**

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AMEC Environment & Infrastructure,
a Division of AMEC Americas Limited
Suite 1 - 495 Prospect Street
Fredericton, NB E3B 9M4
Tel. 506-458-1000 Fax 506-450-0829 www.amec.com

PROJECTION: UTM 20 North

PROJECT NO: TE131057

TITLE: **WILL DE MILLE WELL PAD PROJECT SITE DESCRIPTION**

SCALE: 1:2,500

FIGURE NO: 1.3

Path: G:\GIS\PROJECTS\TE131057_Corridor_Well_EIA\MXD\20140218_WillDeMilleWellPad_Fig1_3.mxd User: jonathan.thornton Date: 19/02/2014

SOURCE: ESRI ArcGis MapService - Topographic

In order for Corridor to make a determination regarding the production potential and the scope of possible future activities in the Elgin area, further data gathering is required. Corridor is therefore proposing an exploratory program that will involve LPG fracture stimulation of one or more of the following existing wells:

- B-41 well at the Green Road well pad;
- G-41 well at the Green Road well pad; and/or
- O-59 at the Will de Mille well pad.

Future fracture stimulation and completion operations may occur at any one of these three wells; G-41 or B-41 (on Green Road well pad) and O-59 (on Will De Mille well pad) in 2015 or a later fracture stimulation program.

Corridor will obtain all necessary approvals for the activities in the area. These approvals will be requested from the various agencies as required for the specific activity. Corridor also will continue to operate to the highest safety and environmental standards as outlined in the Corridor Corporate Health, Safety and Environment (HSE) Management System document and in accordance with all the federal and NB regulations and requirements.

1.2 Project Rationale

The purpose of the 2014 Project is to use LPG fracture stimulation of existing gas wells at the Elgin sub-basin to further assess the gas potential at this section of the formation. Use of existing well pads and wells will minimize environmental effects in comparison to new construction and drilling. The use of LPG will minimize the use of water and the production of wastewater for disposal during the fracture stimulation process. The increased use of natural gas for energy consumption was recently recommended by the NB Energy Commission as an alternative resource to electricity (NB Energy Commission, 2011).

1.3 Regulatory Framework

The operation, maintenance, and ultimate decommissioning of the Project will be undertaken in accordance with all applicable legislation, regulatory approvals, and relevant guidelines. Table 1.1 provides a list of environmental legislation, approvals, and guidelines which may be applicable to the proposed Project.

Table 1.1 Environmental Legislation and Guidelines which may be Applicable to the Corridor Project

Acts or Regulations	Section	Requirement	Department or Agency
1. Provincial – Approvals, Regulations and Guidelines			
(i) Responsible Environmental Management of Oil and Natural Gas Activities in New Brunswick, *Rules for Industry* (NBNGG, 2013)		Adherence to specific assessment and monitoring stipulations specifically for oil and gas activities in NB that are not covered by other provincial legislation.	NB Department of the Environment and Local Government (NBDELG); NB Department of Energy and Mines (NBDEM)
(ii) *Clean Environment Act*	S.5.3(1)	Authority or permission required under Act or Legislation to release waste or contaminant.	NBDELG
(iii) Regulation 87-83 under the *Clean Environment Act* – Environmental Impact Assessment Regulation	S.4	Authority or permission required prior to carrying out an undertaking (as defined in Schedule A of the Regulation).	NBDELG
(iv) Regulation 82-126 under the *Clean Environment Act* – Water Quality Regulation	S.3(1)	Approval required to release contaminants that may cause water pollution.	NBDELG
(v) *Clean Water Act*	S.12(1)	Authority or permission under Act or Legislation required for release of contaminant in watercourse.	NBDELG
(vi) *Clean Air Act* and Regulation 97-133 under the *Clean Air Act*	S.6(2) S.3(1)	Permission or authority required for the release of contaminant into the air.	NBDELG
(vii) *Community Planning Act*	S.81	Development Officer must approve any development where any community development scheme is in effect.	NBDELG
(viii)*New Brunswick Species at Risk Act* (NBSRA) –Regulation 96-26	S.3	Compliance with established prohibitions on persons in terms of impacts on specific endangered species of flora and fauna and their habitat.	NB Department of Natural Resources (NBDNR)
	S1.5	Designates species of flora and fauna that are subject to prohibitions within the NBSRA.	NBDNR
(ix) *Oil & Gas Act*		Requires Lease or License to Search for Approval for Exploration Activities.	NBDEM
		Well License for Approval to Drill / Operate a Well.	NBDEM
(xi) *Transportation of Dangerous Goods Act*	S.4(1)	Permit required for the transportation of dangerous goods.	NB Department of Public Safety
(xii) Motor Vehicle Act	S.261	Permit required for vehicles carrying excess of maximum load under the *Act*.	NB Department of Public Safety
(xiii) Highway Act	S.36(7)	Special permit under subsection 13 required to operate a vehicle exceeding road weight restriction.	NB Department of Transportation and Infrastructure

Acts or Regulations	Section	Requirement	Department or Agency
Federal Acts / Regulations			
(i) *Migratory Birds Convention Act* (MBCA)	S 6	Prohibits activities that will result in negative effects on migratory birds (listed under the MBCA) or their eggs, nests and young.	Environment Canada
	S 5.1	Prohibition of deposit of a deleterious substance into migratory bird habitat.	Environment Canada
(ii) *Species at Risk Act* (SARA)		Prohibits activities that will result in negative effects on Species at Risk (listed in Schedule 1 of SARA) or their Critical Habitat (as identified in a species recovery plan).	Environment Canada

1.4 Report Organization

This report describes:

- baseline environmental conditions within the Study Area;
- Project-related activities and potential impacts on the receiving environment; and
- mitigative measures to be used during operations to minimize or eliminate potential impacts.

The EIA report consists of the following sections:

- Section 1.0 - Introduction;
- Section 2.0 - Project Description;
- Section 3.0 - Approach and Methodology;
- Section 4.0 - Environmental and Socio-Economic Setting;
- Section 5.0 - Environmental Impacts and Associated Mitigation;
- Section 6.0 - Environmental Management;
- Section 7.0 - Public Consultation; and
- Section 8.0 - Conclusion.

2.0 PROJECT DESCRIPTION

2.1 Phase III Overview

This Phase of the Project will consist of fracture stimulation using LPG for 2014 activities, flow testing and well suspension of the O-59 well at the Will De Mille well pad and/or the G-41 well and/or the B-41 well at the G-41 (Green Road) well pad.

Prior to the Phased EIA approach implemented by the NBDELG, regulatory approvals were obtained for drilling the G-41 well. Well G-41 was drilled and completed to a measured depth of 2,422 m in January 2009. Two fracture treatments using LPG were placed in two separate zones with the Frederick Brook Shale in November of 2009. The well is currently suspended and there remains potential for further fracture treatment in the Frederick Brook Shale. Under Corridor's former partner's (Apache Canada Ltd.) Approval to Operate I-7183, the B-41 well was drilled, fracture stimulated and tested in 2010. Initial and subsequent production tests were less than satisfactory. The well is currently suspended and there remains potential for a further fracture treatment in an upper Frederick Brook Shale zone.

During Phase I of the Corridor Elgin EIA, the O-59 well was drilled vertically to a total measured depth of 3188 metres (m) (3099.44 m true vertical depth (TVD)). The well was cased and cemented, but has not yet been tested or completed. During Phase II of the Corridor Elgin EIA, tools were recovered from the B-41 wellbore on the Green Road well pad and a limited flow test of the well was conducted to determine its production potential.

During Phase III, the following activities are expected to take place :

- site preparation activities;
- well preparation activities;
- fracture treatment(s), using LPG for 2014 activities;
- well test and production evaluation; and
- well suspension activities.

NOTE: There are no plans to extend the depth of the existing wellbores.

2.2 Site Preparation Activities

Both potential worksites are existing well pads and these pads are adequate in size to accommodate the planned work so expansion will not be necessary. Both well pads are located off of the Green Road in the Elgin area of Albert County, NB (Figure 1.1).

The Will De Mille well pad was constructed in 1999 to drill the first well which was unsuccessful and abandoned. The well pad was upgraded and expanded in 2011 to an area of 26839 square metres (m^2) to drill the O-59 well. The Green Road well pad was constructed in 2008 to drill the Corridor Green Road G-41 well and was later expanded in 2010 for the drilling of the B-41 well, for which Corridor currently has ownership and operatorship. The current area of the Green Road well pad is 14826 m^2.

Site preparation at each well pad will consist of:

- smoothing and grading access roads;
- construction of secondary containment berms for miscellaneous tankage;
- move in and set up well site office trailers;
- move in and set up portable toilet facilities; and
- move in and set up portable light towers.

Access options to the Project Footprints are as follows:

- Route 895 to Portage Vale, then east on Green Road (and south on Mount Pleasant Road for Will de Mille well pad);
- Route 905 from Petitcodiac, then west on Green Road (and south on Mount Pleasant Road for Will de Mille well pad); and
- Route 895 to Mount Pleasant Road (and east on Green Road for Green Road well pad).

2.3 Well Preparation

Phase III will include the following activities:

- The 2014 Program, employing LPG fracture stimulation for four to five weeks in August/September 2014, involving one to three existing wells on the two Elgin well pads as follows:
  - Up to 10 treatments in O-59 on the Will de Mille well pad; and
  - 1 treatment in B-41 and/or G41 on the Green Road well pad.
- Additional programs involving fracture stimulation over the following three to five years on these well pads.

During the 2014 Program, up to ten (10) Frederick Brook LPG fracture treatments may be required to stimulate the O-59 well and one may be conducted at the B-41 and/or G-41 wells at the Green Road well pad. Fracture stimulation will be conducted at vertical depths of 2000 m to 3100 m. This stage of the Project will take approximately four (4) to five (5) weeks to complete during August to September of 2014.

Well preparation activities include:

- wellbore pressure testing;
- wellhead preparation and ‘frac’ valve and frac tree installation and testing;
- casing scraper and wellbore blow down; and
- wireline (WL) perforation.

Prior to WL perforation, well B-41 would also require running of a WL set bridge to isolate lower, previously tested intervals.

2.3.1 Wellbore Pressure Testing

Prior to fracture treatment activities, the wellbore is pressure tested to confirm the integrity of the completion components. This will confirm that the casing, as well as other wellbore components, can withstand the pressures expected during fracture stimulation operations, completion and production (should this occur) stages in the lifetime of the well. Following sound oilfield best practices and guidelines set forth in the Province's *Rules for Industry* (Section 2.21: Pressure Testing the Well Casing and Surface Equipment) and the Oil and Natural Gas Operating Standards (Section 31: Hydraulic Fracturing – Pressure Testing the Well Bore and Surface Equipment), the wellbore is pressure tested to 3,500 kilopascals (kPa) greater than the anticipated maximum working pressure (NBNGG, 2013).

2.3.2 Wellhead Preparation and 'Frac' Valve Installation and Testing

The wellhead 'Christmas Tree' is removed and full opening 'frac' valves are installed. The 'frac' valves provide pressure barrier protection during the completion operations and offer full internal diameter access to the well bore for down-hole tools. External equipment can be connected to the wellhead by flanged connection.

2.3.3 Casing Scraper and Wellbore Blow Down

A casing scraper is a down-hole tool, incorporating a blade assembly that is used to remove scale and debris from the internal surface of the production casing. This is run-on coiled tubing which will ensure that the wellbore is clean prior to commencing completion operations where it will be necessary to install and remove equipment from the wellbore. Once the casing scraper operation is complete, the wellbore fluids are purged from the well with nitrogen gas. The well is then ready for perforating.

2.3.4 Frac Tree Surface Pressure Control Equipment

Once the integrity of the production casing has been established, a "frac tree" will be installed on top of the wellhead. The frac tree is a series of valves and piping that will facilitate connecting the fracture stimulating pump equipment to the wellbore and permitting the flow of fracture stimulation fluids at high rates and high pressures into the wellbore and onward into the formation. It will also facilitate flow back of the fracture stimulation fluids to surface once the fracture treatment is complete. The frac tree has the same or greater internal diameter as the production casing string, which will facilitate movement of 'full bore' equipment from the surface into the wellbore. Once this equipment has been installed, it will be pressure tested as described in Section 2.2.1.1.

2.3.5 Wireline Perforating

Perforating is the process whereby holes are pierced in the production casing to connect the wellbore to the reservoir or the section of the formation desired for production. Perforations are typically performed by running perforating guns (a string of shaped charges) into the wellbore and firing them to perforate the casing. For this work, perforating guns will be conveyed into the wellbore by electric WL that will provide depth and pressure control as well as a means to fire the guns. A perforating gun will carry many charges and may be designed to shoot the guns in different orientations to optimize the connection to the reservoir rock behind the casing. Once

the casing has been perforated and the wellbore is connected to the reservoir rock, the rock may be fracture stimulated.

2.4 Fracture Stimulation Treatment

Unconventional gas reservoirs made up of tight sands or shales have very low natural permeability to flow and fracture stimulation is needed to produce hydrocarbons at commercial rates. Fracture treatment is the process of initiating and subsequently propagating a fracture in reservoir rock, using the pressure of a fluid as the source of energy. Fractures that are created in the reservoir rock are extended by internal fluid pressure that opens the fracture and causes it to extend through the rock. The fracture width is typically maintained after the treatment by including a proppant in the injected fluid. Proppant is usually composed of grains of natural or ceramic sand that will prevent the fractures from closing under sub-surface pressure once the injection has been stopped.

Fracture stimulation activities for O-59 would include the following steps:

- LPG fracture treatment;
- run WL and set bridge plug;
- repeat perforation, fracture treatment and plug set for all zones; and
- coil tubing drill-out of all bridge plugs.

B-41 and G-41 would require only the first step, LPG fracture treatment, since only one treatment would be required for these wells.

Components to be used on-site during fracture stimulation operations may consist of:

- portable lighting;
- First aid and medical trailer;
- office and security trailers;
- restroom facilities;
- wellhead and frac tree;
- electric WL equipment (perforating and setting plugs);
- frac equipment (pump units, sand trucks, chemical add unit(s), Iron truck, and blender(s));
- frac job data monitoring and recording unit;
- LPG storage tanks (nominal 80 m^3 each) and transport equipment (350 cubic metres (m^3) to 600 m^3 per frac (15 to 20 trucks);
- sand storage and transport equipment (50 to 100 metric tonne (mt) per frac (2 to 3 trucks));
- fire protection equipment;
- coiled tubing equipment;
- nitrogen pumping equipment;
- fracture fluid additives (gellant, activator, and breaker);

- steel flow back tank(s) (up to two, 60 to 80 m^3);
- pressure vessel / test separator(s);
- surface transfer and treatment piping;
- heaters; and
- flare stack.

The descriptions provided previously for LPG fracture stimulations are similar to those for a water-based fracture treatment. The wellbore preparation and perforating is unchanged. The difference would be in the details of the fracture design itself; which will be developed if and when a water fracture stimulation program is planned beyond 2014.

2.4.1 Treatment Fluid and Additives

Corridor intends to use LPG as a fluid for this program during 2014. The LPG will use only three chemical additives: a gellant; an activator; and a breaker in small dosages (4 to 10 litres (L) / 1000 L).

A gellant is used to increase fracture treatment fluid viscosity, allowing the fluid to carry more proppant into the fractures (New York State Department of Environmental Conservation (NYSDEC), 2011). An activator is an additive that works with the gellant as a catalyst to create additional viscosity. After the fracture treatment is complete and the proppant has been placed in the fractures, the breaker is used to reduce the viscosity of the fluid to its original value in order to permit carrier fluid to flow back while leaving the proppant in the fractures, which enhances the recovery of the fracture treatment fluid (NYSDEC, 2011). A disclosure summary on chemical breakdown and health information of the fracture fluid LPG and additives as provided by GasFrac can be found in Appendix A. As per Section 11.3 and Appendix 19 of the *Rules for Industry* (NBNGG, 2013), Corridor will submit more detailed information and a risk assessment of fracture fluid additives prior to the start of operations.

Fracture stimulation operations involve many pieces of equipment and a number of activities for each zone of interest. See Figure 2.1 for a typical layout of fracture stimulation equipment on a Corridor location in NB.

This equipment is transported to the work site via road on wheeled trucks. With the exception of material delivery trucks, this equipment typically travels to and from the location a single time for the treatment or series of treatments.

Figure 2.1 Typical Layout of Fracture Stimulation Equipment in NB

The fracture treatment fluid (in this case LPG) and proppant as well as liquid nitrogen will be delivered to the work site via road by wheeled trucks. It is anticipated that the following will be required for each fracture treatment:

- Liquid Propane; 350 to 600 m^3 per fracture treatment, for an estimated 6000 m^3 total;
- Proppant (frac sand): 50 to 100 mt per fracture treatment, for an estimated 1000 mt total; and
- Liquid Nitrogen: 5,000 L (1 truck).

GasFrac's closed-loop system and on-site storage will contain approximately 600 m^3 of LPG (GasFrac, 2013).

2.4.2 Methodology

The fracture stimulation process consists of a number of defined steps:

- pump a minifrac;
- pump the fracture pad;
- proppant stages; and
- displacement.

The following subsections provide a description of each step.

Pump a Minifrac

The minifrac is a small fracture treatment that is performed before the main treatment to acquire critical job design and execution data and to confirm the response of the treatment zone to fluid injection. A small volume of the actual treatment fluid is pumped into the wellbore and the resultant pressure response and subsequent pressure decline are recorded and analyzed. The final job procedures and treatment parameters are refined according to the results of the minifrac analysis.

Pump the Fracture Pad

The fracture pad is the initial part of the treatment that is injected into the formation at full fracture rate and pressure. The purpose of the pad is to create the fracture geometry. The pad contains no proppant.

Proppant Stages

The pad is followed by several stages of proppant (sand) laden fluid that carries the proppant into the fractures that have been created. Once placed in the fracture network, the proppant will 'prop' open the fracture and prevent it from closing once the applied pressure has been released. The proppant is mixed on a continuous basis with the carrier fluid into a slurry that is pumped down hole and into the perforations. The proppant is typically staged, beginning with low concentrations of small grained material and working up to higher concentrations of larger grained material. A gellant is added to the fracture treatment fluid to suspend the proppant particles so that it can be pumped and a breaker is added to 'break' the gel once the proppant is

in place and to allow the fluid to be easily flowed-back for recovery and well bore cleanup after the treatment is complete.

Please note that the use of radioactive tracer in the proppant is not planned for this work or any other work in the foreseeable future.

Displacement

Once the entire programmed volume of fluid and sand has been pumped into the wellbore at the surface, it is displaced to the perforations. The pump rate is stepped down during the final stages of the displacement. Subsequent analysis of how the pressure responds to the changes in fluid rate will assist in understanding the formation for optimization of treatments in the future. After the displacement is complete, the pumps are shut down and preparations are made to release the pressure and to flow the well in order to recover the fracture treatment fluid.

Wireline Frac Isolation Plug Placement

If several zones are to be fractured stimulated in a single wellbore, the treatments are placed in sequence from the deepest to the shallowest zone. There are several methods whereby this may be accomplished but, in each case, the zone that has been fractured must be isolated before the next zone is perforated and fractured.

For the Green Road wells, it is expected that a bridge plug, made of composite material, will be placed above the zone that has been treated in order to isolate it from the fluids and pressures applied to the next zone in sequence. The composite bridge plugs will be conveyed to the wellbore by electric WL that will provide depth and pressure control as well as a means to set the plugs.

Repeat the Process

Once the frac plug has been set to the desired depth and the lower zone isolated, the next zone is perforated and fractured as described above.

2.5 Well Completion and Production

2.5.1 Coiled Tubing Drilling of Frac Isolation Plugs

Once all of the zones of interest have been fracture stimulated, the composite frac plugs are drilled out with water or a light cycle oil to allow the stimulation fluid to be recovered and to permit all of the zones to be tested for production potential. These plugs are made of a composite material which allows them to be easily drilled, using a coiled tubing unit with a down hole motor and bit.

2.5.2 Flow Back and Production Testing

Corridor intends to flow back the fracture fluid LPG and production test each well through surface test equipment consisting of flow back piping and manifolds and test separation tanks. Flammable fluids and gases will be flowed to a flare stack and flared during initial clean-up of each well bore. Any produced water will be separated and shipped to a flow back tank on

location for future characterization. The flow back water would subsequently be transported by truck off-site for disposal by a third party waste management company.

During the flow back and test stage of the activities, wellbore pressures will be monitored. Flow rates to the flare will be continuously monitored and adjusted to limit light, noise and smoke emission.

When flowing back LPG, there are several considerations that affect equipment specification and layout:

- A choke is placed before the line heater. The LPG is cooled with the pressure drop which improves line heater efficiency.
- The line heater is used to heat returns in order to maintain the separator temperature within the gas region.
- A sand catcher is placed upstream of the choke and line heater to protect them from potential recovered proppant erosion.
- All liquids are collected in a Pressure Tank vented to the flare.

2.6 Well Suspension

Once fracturing treatments and well testing is complete, the frac tree will be removed from the wellhead and the 'Christmas Tree' reinstalled and tested. The valves will be closed, chained and locked and security fencing will be erected around the wellhead. All equipment and material will be removed and the entrance gate to the well pad will be closed and locked.

2.7 Project Schedule

The Project activities have been scheduled as follows:

Phase III 2014 Program:

- LPG fracture treatments and testing of O-59: August and/or September, 2014, for an estimated three weeks; and/or
- LPG fracture treatments and testing of B-41 or G-41: August and/or September 2014, for an estimated two weeks.

The fracture treatments would take place sequentially on the two pads with possible flow test operations occurring simultaneously once the fracture treatments have been completed.

3.0 APPROACH AND METHODOLOGY

To facilitate the review of identified issues, an understanding and description of the environment within which the activities will occur, or potentially have an influence on, was developed from a review of existing information. Potential positive and negative interactions between Project activities and the environment were identified. Where negative interactions were anticipated and potential effects were a concern, methods for mitigating the potential effects were proposed. For the purposes of impact assessment, the interactions (effects) between Project outputs, or activities, and Valued Environmental Components (VECs) are described as either positive or negative, their significance of potential interactions is determined, and the likelihood of the interactions also considered.

Generally, the literature presents the EIA as a complete process, which should begin at the earliest stages of planning and remain in force throughout the life of a project, moving through a series of stages:

- describing the project and establishing environmental baseline conditions;
- scoping the issues and establishing the boundaries of the assessment;
- assessing the potential environmental effects of the project, including residual and cumulative effects;
- identifying potential mitigative measures to eliminate or minimize potential adverse effects; and
- monitoring and follow-up programs.

Issues are identified during development of the EIA document and comments received from regulatory bodies and members of the public. The concerns of the public potentially affected by the Project are identified, including concerns expressed by the public at large, community groups and stakeholders, scientific community, and governments during Public Consultation and previous projects of similar nature. As a result of this "social scoping" effort (Beanlands and Duinker, 1983), environmental issues or Environmental Components of Concern (ECC) that may be affected by the Project are identified, by professionals in the field and by the public, and pathways between the ECCs and Project activities are identified. Where pathways cannot be identified, the ECC or issue is deemed not to be affected by the Project and, therefore, is no longer part of the analysis. Elements of the environment that could be affected by the Project and are protected by legislation or regulation are included as VECs. A definition of each VEC is developed, including its scope (spatial and temporal boundaries), a description of linkages (or pathways) of effect with the Project and with other components of the environment.

This impact assessment focuses then on the evaluation of potential interactions between Project components and activities and VECs that were identified through an issues scoping process. Issues scoping was used to identify important issues of the development and focuses the EIA on high-priority issues (Kennedy and Ross, 1992). As suggested by Beanlands and Duinker (1983), VECs were determined on the basis of perceived public concerns related to

social, cultural, economic, or aesthetic values. They were also chosen to reflect the scientific concerns of the professional community.

Issues were derived from recent experience with comparable projects, consultation with the public, scientific community and individuals knowledgeable about the Study Area, and the professional expertise of the Study Team.

3.1 Approach to the Selection of VECs

A critical element of the EIA was the delineation of the Project through identification of spatial and temporal bounds. The approach to identification of VECs and the approach to bounding are described.

Consideration was given to the possibility of Project activities to interact with each VEC. The determination that significant effects may be possible was based on regulatory requirements, previous experience, and our professional judgment.

Two approaches were taken for identifying VECs, upon which the assessment focuses. First, those parameters for which Provincial and Federal Regulations are in place were identified. Second, a scoping exercise was conducted, based upon previous EIA experience with similar Project components, consultation, and available information related to the environment near the Project site.

3.1.1 Approach to Bounding

Temporal bounds delineate the time period(s) over which project-related impacts / effects can be expected. Spatial bounds delineate the physical area(s) in which VECs may be affected by Project activities.

For the purposes of this Assessment, the temporal bounds have been categorized as fracture stimulation, well testing and well suspension over the next three to five years.

Spatial bounds for the Project effects on most VECs include the immediate environs of the Project Footprint, the access roads, and areas potentially affected by down-gradient movement of groundwater, surface water, and air. For socio-economic components of the environment, bounding extends to communities that have a stake in the potential effects resulting from the proposed Project.

3.1.2 Approach to Determination of Significance

The assessment or determination of the significance of potential effects is based on the framework/criteria provided in the guidance document Responsible Authority's Guide (Canadian Environmental Assessment Agency (the Agency), 1994) which summarizes the requirements that have been applied to similar projects in the past, and which have been widely accepted by government and regulatory agencies in Canada.

The Reference Guide entitled *Determining Whether A Project Is Likely To Cause Significant Adverse Environmental Effects*, included in the Responsible Authority's Guide (the Agency, 1994) was used as the basis for determining the significance of identified potential effects. This determination consists of the following steps:

- determine whether the environmental effect is adverse;
- determine whether the adverse environmental effect is significant; and
- determine whether the significant environmental effect is likely.

For the purposes of the EIA, an effect is defined as the change effected on a VEC(s) as a result of project activities. A project induced change may affect specific groups, populations, or species, resulting in modification of the VEC(s) in terms of an increase or decrease in its nature (characteristics), abundance, or distribution. Effects will be categorized as either negative (adverse) or positive. Any adverse effects will be determined to be significant or non-significant in consideration of assessment criteria discussed above. The Assessment will focus on those interactions between the VECs and project activities which are likely.

4.0 ENVIRONMENTAL AND SOCIO-ECONOMIC SETTING

This section provides a description of the environmental and the socio-economic setting for the Project, and includes those components of the environment potentially affected by the proposed Project. The Project location and the surrounding area (the Study Area) are depicted in Figure 4.1.

The description of the environmental setting typically encompasses the 1 kilometre (km) Study Area surrounding the Project. This description has been prepared to provide information on environmental and socio-economic components which may potentially be affected by the Project, or which may influence or place constraints on the execution of project-related activities.

The following subsections describe the components of the environmental (bio-physical) setting of the Project, including the atmospheric environment, its physiography and geology, hydrology and hydrogeology, wetland resources, mineral resources, flora, fauna, archaeological and heritage resources, designated areas and other critical habitat features.

4.1 Study Area Definition

The Study Area was based on:

- location, proximity and sizes of the Green Road and Will de Mille well pads;
- the access roads; and
- biophysical setting.

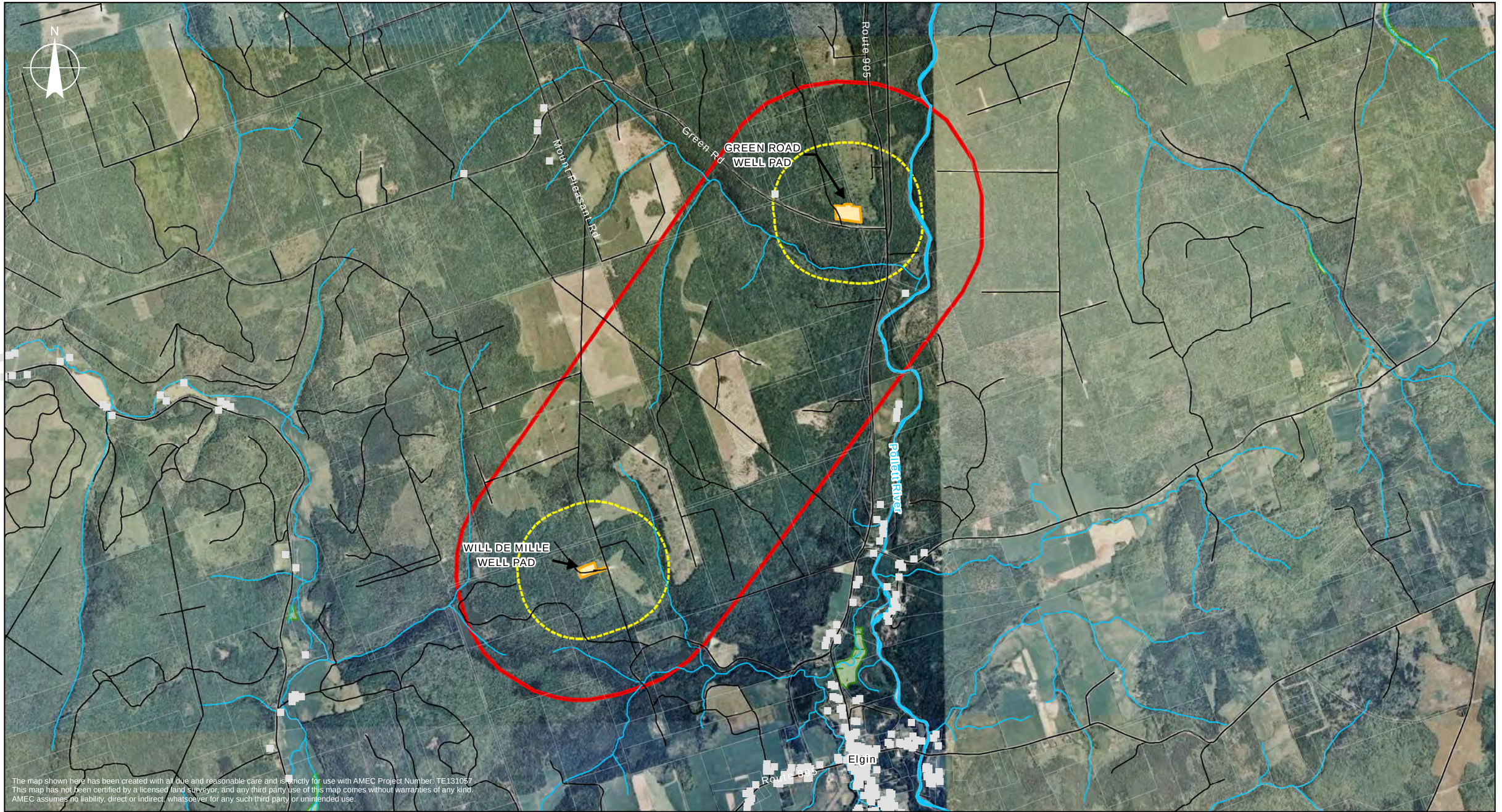
The Study Area takes into consideration the Project Footprints as defined by the Will de Mille well pad (26839 m^2) and the Green Road well pad (14826 m^2), the existing access roads and the area between the two, traversed by Mount Pleasant Road (a secondary logging road). In addition, a minimum buffer of 1 km around the Will de Mille and Green Road well pads was incorporated. Downstream areas of the air shed and watershed are also included, with increasing priority placed on those areas in close proximity to the Project.

4.2 Atmospheric Environment

Air quality is influenced by the concentrations of air contaminants in the atmosphere. Air contaminants are emitted by both natural and anthropogenic sources and are transported, dispersed, or concentrated by meteorological and topographical conditions.

4.2.1 Ambient Air Quality

Air quality in NB is routinely monitored by the Provincial and Federal Governments at various stations, usually located in or near population centres. The Province has established Air Quality Objectives (NBAQOs) for Carbon monoxide (CO), Hydrogen sulphide (H_2S), Nitrogen dioxide (NO_2) and Sulphur dioxide (SO_2). Ozone (O_3) levels and particulate (PM) matter, influenced mostly from sources outside the Province, are recorded and compared against the national objectives.



The map shown here has been created with all due and reasonable care and is strictly for use with AMEC Project Number: TE131057
This map has not been certified by a licensed land surveyor, and any third party use of this map comes without warranties of any kind.
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LEGEND:

- NB DNR Transportation
- NB DNR Waterbody
- NB DNR Watercourse
- NB DNR Wetland
- Study Area Boundary
- 500m Well Water Quality Survey Buffer
- Well Pad
- Building

CLIENT: corridor resources inc.

AMEC Environment & Infrastructure, a Division of AMEC Americas Ltd.
495 Prospect St., Suite 1
Fredericton, NB E3B 9M4
Tel, 506-458-1000 Fax 506-450-0829
www.amec.com

PROJECT No: TE131057
DATUM: NAD83
PROJECTION: NB Stereographic
SCALE: 500 250 0 500 Metres 1:30,000

PROJECT: ENVIRONMENTAL IMPACT ASSESSMENT: NATURAL GAS EXPLORATION AT ELGIN SUB-BASIN

TITLE: PROJECT STUDY AREA

DWN BY: TM
CHK'D BY: CT
DATE: Feb 18, 2014
REV NO:
FIGURE: 4-1

Path: G:\GIS\PROJECTS\TE131057_Corridor_Well_EIA\MXD\20140218_TE131057_StudyArea_Fig4_1.mxd User: jonathan.thornton, Date: 19/02/2014

SOURCE: NBDNR Aerial Photography

Table 4.1 lists the Air Quality Standards from Schedule B of the national *Clean Air Act* in addition to the NBAQOs established under the Provincial *Clean Air Act*.

Table 4.1 Air Quality Guidelines in New Brunswick

Pollutant	Averaging Period							
	1-hour		8-hour		24-hour		1 year	
	Clean Air Act	**NBAQO**	***Clean Air Act***	**NBAQO**	***Clean Air Act***	**NBAQO**	***Clean Air Act***	**NBAQO**
CO	35,000 ppb*	30,000 ppb	15,000 ppb	13,000 ppb				
H_2S	15 ppb	11 ppb			5 ppb	3.5 ppb		
NO_2	400 ppb	210 ppb			200 ppb	105 ppb		52 ppb
SO_2**	900 ppb	339 ppb			200 ppb	113 ppb		23 ppb
Total Suspended Particulate					120 ppb	120 ppb		70 ppb

Notes:
* ppb – parts per billion (µg/m^3 (micrograms per m^3).
** The standards for sulphur dioxide are 50% lower in Saint John, Charlotte, and Kings counties.

In 2009, the New Brunswick Department of Environment (NBENV) commissioned the use of a data acquisition software called the Envista Air Resources Manager (ARM), which now allows the Province to collect accurate real time data in a format that can be easily analysed by computer desktop applications. Most monitoring sites are electronically connected to a system in Fredericton which communicates with each station at least hourly to obtain the latest readings. This system's frequency of data capture and archiving capability allows the Province to issue a regional Air Quality Health Index to the public and identify abatement initiative requirements (NBENV, 2011).

According to the latest results published by the NBDELG in 2012, there were no exceedances of NO_2 or CO anywhere in the Province in 2010. Exceedances of SO_2 were detected only in Saint John, and these levels have been steadily decreasing since 1992. Objectives for O_3 and PM remain below national objectives (NBDELG, 2012). The following subsections describe each component for which NBAQOs and / or Canadian Standards are set and the most recent results, published in 2011, for the nearest air monitoring stations, located in Moncton and St. Andrews, NB in 2010.

- **Carbon Monoxide (CO)**

CO is formed from the incomplete combustion of carbon compounds. The NBDELG has set an air quality guideline for CO of 30 parts per million (ppm), for a 1-hour averaging period. Due to the relatively small size and density of the population in NB, there were no exceedances of NBAQOs for CO in Moncton or any of the other provincial monitoring sites in 2010.

- **Hydrogen Sulphide (H_2S)**

This component is used by the Provincial mobile air quality trailer to measure total reduced sulphur (TRS) in industrial areas such as Saint John and the AV Nackawic Mill, where TRS odour is a concern. TRS is not monitored in areas like Moncton where the odour is not produced.

- **Nitrogen Oxides (NO and NO_2)**

Nitric oxide (NO) is released in the exhaust of internal combustion engines and furnaces. NO is an unstable compound and is readily converted to NO_2, which contributes to the formation of acid rain and is a primary precursor pollutant in the formation of smog. NBDELG has set NBAQOs of 210 ppb and 105 ppb per 1 hour and 24 hour averaging periods, respectively. No exceedances of hourly or 24-hour standards for NO_2 were recorded during 2010 in Moncton, nor since monitoring began at this location in 1998 (NBDELG, 2012). There were no exceedances of the NBAQOs for NO_2 at any monitoring station in the Province in 2010.

- **Sulphur Dioxide (SO_2)**

SO_2 is produced by burning oil and coal for energy production and space heating; each containing sulphur as an impurity in various concentrations. Other potential sources of SO_2 to the environment include oil refineries, pulp and paper mills, and vehicles. Industries in NB are responding by using lower or near-zero sulphur fuels as well as reducing production and electricity-generating rates. NBDELG has established an episode control program in Saint John, which requires SO_2 to be monitored by some industries as part of their Approval to Operate. This component is not monitored in Moncton, or other NB locations that do not have heavy industry. Exceedances were very infrequent throughout the Province in 2010 (NBDELG, 2012).

- **Particulate Matter (PM)**

PM refers to those particulates in the air, such as smoke, soot, and dust that do not settle readily and thereby remain suspended. PM is a broad class of chemically and physically diverse substances that can either be in a solid or liquid state, or a combination of the two. PM greater than 10 micrometres (µm) in size creates problems such as visibility reduction, soiling, material damage, and vegetation damage.

Particulate matter becomes a potential human health hazard when the particle size is equal to or less than 10 µm in diameter (PM_{10}) (NBDELG, 2001). These particles are typically dust granules that are invisible to the naked eye as individual specks. Such particles are commonly generated from building materials, combustion, human activities, and outdoor sources, including atmospheric dust and combustion emissions from mobile and stationary sources. PM_{10} data for Moncton is not monitored.

Particles of 2.5 µm or less ($PM_{2.5}$) are small enough to inhale into the lungs and are believed to cause respiratory and cardiovascular problems. These particles are visible as clouds of smoke and are typically high in sulphates, nitrates, carbon and heavy metals, being produced by fossil fuel combustion, vehicle exhaust and industrial emissions (NBDELG, 2001).

In 2000, the Canadian Council of Ministers of the Environment (CCME) developed the Canada-Wide Standards (CWS) for PM and O_3 in response to the agreement signed by both the Canadian and NB governments in an effort to significantly reduce these pollutants by 2010. The $PM_{2.5}$ target value is 30 µg/m^3 over a 24-hour averaging period. In 2010, the annual average $PM_{2.5}$ concentration in both Moncton and St. Andrews was 5.1 µg/m^3, with no exceedances.

4.2.2 Climatology

The climate of the Study Area is described below. The information is based upon climate normals using the latest data gathered from 1981 to 2010 at the Environment Canada weather station nearest the Study Area, Sussex, NB (71-2000).

The climate of NB is typically continental. This is due to the westerly air flows, dominant in the region, having passed over the interior of the continent and not over a temperature-moderating ocean (Hinds, 2000). During the winter, the airmass is cold and unaltered with a January daily mean temperature of -8.5^{o}C and, in the summer, the airmass is predominantly warm continental, with a July daily mean temperature of 19.2^{o}C. The extreme maximum and minimum temperatures recorded were +37.2 and -38.9^{o}C, respectively (Environment Canada, 2013a). These values all match that of the data recorded for the 1971-2000 Climate Normal Data for this Town, with the exception of the extreme minimum temperature which is 5.5 ^{o}C higher than the previously recorded -44.4^{o}C.

The coastal areas of NB experience a large amount of fog that often moves far inland as a result of the abutment of the warm Gulf Stream with the cold Labrador Current. The average annual precipitation in the Study Area is 1170 millimetres (mm), of which 79% is in the form of rain (Environment Canada, 2013a).

CO_2 is a chemical compound present in the Earth's atmosphere, best known as a greenhouse gas (GHG). It is projected to account for approximately half of the anticipated world temperature increase. Major contributors of CO_2 are stationary sources (such as power plants) and mobile sources (particularly vehicles that burn fossil fuels, specifically oil, gasoline, and diesel). About 80% of all global CO_2 emissions are generated as a result of human activity. The majority of the remainder stems from the burning and decay of vegetation related to deforestation (Clean Fuels Consulting Inc., 1994).

Canada is committed to reducing its emissions to 6% below 1990 levels by 2012. As a signatory to the United Nations Framework Convention on Climate Change (UNFCCC), Canada is required on an annual basis to prepare and submit a national inventory of anthropogenic GHG emissions from sources (e.g. fuel combustion, industrial processes) and removals of GHG emissions by sinks (e.g. growing plants and trees). The Government of Canada submitted its latest National Inventory in 2013, showing results up to the year 2011 (Environment Canada, 2013b). Although GHG emissions have decreased by 4.8% since 2005, emissions increased during 2010 by 0.14% to a level of 702 mega tonnes (Mt). CO_2 is not generally considered a "traditional pollutant" and its cycle and movement pattern is relatively unknown. This parameter is therefore not monitored regionally, but globally (NBDELG, 2001).

4.3 Physiography and Geography

The Study Area lies within the Anagance Ridges sub-division of the Caledonian Highlands physiographic division (Rampton *et al*., 1984). The following sections describe the visual aesthetics, geology, the potential to encounter seismic activity or acid-generating bedrock, as well as regional subsidence and soils.

4.3.1 Visual Landscape

The Project will be conducted on existing Corridor well pads on Green Road and on a logging road accessed by Green Road. Both well pads are located within a mixed wood forest, not visible from public roads or surrounding areas. The Green Road wells are located approximately 350 m from Route 905; the well pad is hidden from the road by a belt of mixed wood trees and shrubbery. In addition, these wells are located over 100 m from the unpaved Green Road. The Will de Mille well pad is located deeper in the woods, approximately 3.5 m southwest of the Green Road well pad.

4.3.2 Bedrock Geology

The bedrock underlying the Study Area is comprised of Early Carboniferous formations of the Mabou Group and Late Carboniferous formations of the Cumberland Group (New Brunswick Department of Natural Resources and Energy (NBDNRE), 2000). The Mabou Group is an undivided, reddish brown to red polymetric conglomerate, quartzo-feldspathic sandstone, and mudstone with locally well-developed calcrete. The Cumberland Group is a red to red-brown and lesser blue-grey silty mudstone, siltstone and very fine-grained sandstone alternating with sandstone-conglomerate units that are typically about 5 m thick.

4.3.2.1 Potential for Acid-generating Bedrock

Acid-generating rocks are a group of mineralized geologic materials that contain various sulphides. When these minerals are disturbed and come into contact with water, oxygen, and iron reducing bacteria, the sulphide minerals become oxidized and acid is generated in the process. The presence of iron-reducing bacteria serves as a catalyst which accelerates acid production and the potential for generation of Acid Rock Drainage (ARD). Carbonate minerals, where present, serve to buffer acid generation. The Study Area bedrock, having well-developed calcrete, raises the pH and thus prevents the occurrence of acid generation.

4.3.3 Potential for Seismic Activity

NB is in an area of low to moderate seismicity, with values ranging from 1.0 to 6.0 on the Richter Scale (average approximately 3.0). The two largest recordings were 4.0 in Bathurst (1962) and 5.7 in Miramichi (1982). There are a number of old geologic fault lines associated with the Kingston Uplift, whose last movement is estimated at approximately 300 million years ago. In summary, the potential for seismic activity in the Study Area is low.

Elgin lies within the Northern Appalachians seismic zone, which includes most of the Province. Several earthquakes have been recorded in this zone to reach Magnitudes (MN) of 5 to 6. Epicentres are clustered in the Moncton and Passamoquody Bay regions, where the most recently “felt” earthquake occurred in August 2012, registering at 2.6 MN near St. Andrews

(Natural Resources Canada, 2014). NB can also feel the effects from more distant earthquakes centered in Quebec and the Grand Banks. Seismic activity in NB is believed to be related to the regional stress fields, with the earthquakes concentrated in regions of crustal weakness.

4.3.4 Mineral Occurrences, Mining Claims, and Aggregate Resources

The main economic minerals occurring in the region are “potash” (potassium) and salt. Potassium is one of the world’s most important fertilizers used in modern agricultural practices. Salt is used mainly for de-icing roads in winter but can also be refined for the purpose of consumption.

4.3.5 Soils

Soils in the Study Area are classed as Podzolic (Agriculture Canada, 1989). The forest soil classification is a rapidly to well drained Sunbury unit. The parent rocks of this soil unit are non-metamorphosed grey sandstones, which lack calcium and contain high proportions of lithic and quartz fragments. The parent material is usually yellowish-brown, friable, rapidly permeable sandy loam to loamy sand. In this case, the A and B horizons are typically a sandy to silty loam over a more coarse sandy to sandy-loam C horizon (Colpitts et al., 1995).

The region of the Study Area is covered by a non-compact glacial till of varying thickness, texture, and stoniness, which is occasionally overlain by a thin (<0.5 m) veneer of marine silt and clay. The overburden depth varies greatly, even over short distances, but is generally greater than 2 m (Rampton et. al., 1984).

Water Erosion Risk mapping produced by Agriculture Canada (1992), indicates severe risk of erosion on bare soils in the Study Area. Protection from water erosion provided by usual crop management is excellent.

4.4 Hydrology and Hydrogeology

The following sections describe the hydrological and hydrogeological conditions of the Study Area, including water quality for both surface and groundwater resources.

4.4.1 Surface Water Quantity

The Study Area falls within the hydrometric subdivision 1BU as defined by Environment Canada (1986). Miller Brook drains from Mount Pleasant eastwards to the Pollett River, which is located east of the Study Area and drains north into the Petitcodiac River. Provincial mapping also indicates tributaries south of each well pad draining eastwards into the Pollett River (the nearest to either well pad being approximately 480 m away) (GeoNB, 2014). The Pollett River has a drainage area of 314 square kilometres (km^2) (Petitcodiac Watershed Alliance, 2013). There are no protected watersheds located within the Study Area, the nearest being the Turtle Creek watershed located approximately 60 km from the Green Road well pad (NBDELG, 2013a).

NBDELG requires a permit under the Watercourse and Wetland Alteration (WAWA) Regulation for any alteration within 30 m of the bank of a watercourse or wetland. The *Rules for Industry* require that well heads be located a minimum of 100 m from watercourses and wetlands and that neither well pads or access roads are to be located within 30 m of a watercourse or wetland (NBNGG, 2013). All of the stipulations above for surface water setbacks have been met for this Program, as detailed fully in the following subsections. Surface water monitoring is required for watercourses located within 150 m of a well pad, of which there are none. It is important to note that all wells subject to activity under Phase III are existing facilities that have been in place for a number of years.

4.4.2 Surface Water Quality

Surface water quality in the Study Area is dependent primarily on geology, watershed size, topography and vegetation. The Pollett River is described as having physical habitat comparable to those found in the Miramichi River, with excellent water quality having natural influences (Petitcodiac Watershed Alliance, 2013).

4.4.3 Watercourses

The Pollett River is separated from the Study Area by Route 905, although a number of small, unnamed tributaries are detected on the GeoNB mapping as draining from the area into the River. Field surveys conducted in 2010 and 2011 by AMEC did not detect watercourses within 30 m of either the Green Road or Will de Mille well pads. The Provincially-mapped watercourses nearest the Project are approximately 480 m from the Green Road well heads and over 500 m from the O-59 well head at Will de Mille.

4.4.4 Wetland Resources

Wetlands in NB have been given specific protection under the *Clean Environment Act* and the *Clean Water Act*. The NB EIA Regulation requires registration of “all enterprises, activities, projects, structures, works, or programs affecting two hectares or more of bog, marsh, swamp, or other wetland”.

Based on biological field surveys conducted in the summers of 2010 and 2011 by qualified AMEC personnel, there are no provincially mapped or unmapped wetlands observed in or within 30 m of the Project Footprint. The Provincially-mapped wetlands nearest the Project are over 2 km from either well pad (Figure 4.1).

4.4.5 Groundwater Quantity

There are no wellfield protection areas located within the Study Area; the nearest being the Springdale wellfield located approximately 13 km from the Will de Mille well pad (NBDELG, 2013b). Stand-alone groundwater wells have been developed in and around the Study Area for other public or private uses such as farms, industrial, and commercial establishments. Private wells for domestic uses are most common. There are no domestic wells within 500 m of either well pad.

4.4.6 Groundwater Quality

Mandatory testing for water quality of all newly drilled or redrilled domestic water wells in NB was introduced under the "Potable Water Regulation" of the *Clean Water Act* in September of 1994. The standard tests required under the "Potable Water Regulation" analyse the water for both inorganic and bacteriological substances using the *I analytical package at the NBDELG Analytical Services Laboratory.

The Province maintains a database of these results and has used 10,500 samples analysed between 1994 and 2007 to produce the NB Groundwater Chemistry Atlas (NBENV, 2008). The database can also be searched for these results, and more current results, by region in NB using the Online Well Log (OWL) System. The water quality test results provided are in aggregate form and do not identify the individual well from which the sample was taken, but queries can be submitted to view results for specific areas. Using the property identification (PID) numbers on which the well pads are located (01083518 for Green Road and 01083484 for Will de Mille), a search of the database was unable to display records at 500 m or 1000 m for either location as a result of a limited number of records for the locations. Using a radius of 2 km for Green Road and 2.5 km for Will de Mille, the OWL system returned 8 records for each radius for wells drilled between 1994 and 2010 (NBDELG, 2014).

The NB Department of Health has adopted the Guidelines for Canadian Drinking Water Quality (GCDWQ) established by Health Canada (Health Canada, 2012) to assess groundwater quality (New Brunswick Department of Health, 2013). Groundwater quality in NB for domestic consumption is generally good with the exception of isolated aquifers that have naturally occurring and / or anthropogenic water quality problems. Groundwater quality data available for NB as well as a combination of the records located for both well pads is presented in Table 4.2.

Comparison of Study Area results against those for the Province as a whole show similar trends, though arsenic iron, pH and zinc may be more problematic. Drill reports for the 16 records in total show well depths ranging from 15.2 to 88.4 m. Average bedrock level is 2.4 m and bore records list shale, hardpan, topsoil, rock, conglomerate, wackie, clay, overburden, and sandstone, as being encountered in the Study Area (NBDELG, 2014).

In 2006, NBENV launched a program called “Know Your H_2O” to promote drinking water quality awareness. During the period of July 2006 to November 2007, all private well owners could submit a water test for total coliform bacteria and *E.coli* at no cost. It was determined during this program that one third (35.6%) of the private wells sampled were contaminated with coliform while 4.4% had *E.coli* (NBENV, 2009). According to OWL reports for the total of sixteen wells within 2 km of Green Road and 2.5 km of Wille de Mille well pads, 18% of the newly drilled wells had Total Coliform but none of them had *E.coli*.

Prior to the commencement of Phase III activities, baseline water quality analysis would be conducted for all drinking water wells within 500 m of the edge of each well pad as per the *Rules for Industry*. There are, however, no domestic water wells within 500 m of either the Green Road or Will de Mille well pads; the closest permanent residences are approximately 700

m from the Green Road well pad and another being over 1 km from the Will de Mille well pad (Figure 4.1).

Table 4.2 Summary of Selected Groundwater Quality Parameters

Parameter	Percentage Samples in Compliance in NB*	Percentage Samples in Compliance Within Elgin Area**
Arsenic	94.1	90
Barium	98.6	100
Cadmium	99.9	100
Chromium	99.8	100
Fluoride	95	100
Lead	97.3	99.3
Nitrate	99.4	98.9
Selenium	98.9	100
Uranium	97.9	100
Chloride	96.7	100
Iron	71.2	45
Manganese	60.2	63.6
pH	86.3	73
Sodium	96.6	100
Zinc	99.9	91

Sources:
*NBENV, 2008
**NBDELG, 2014

4.5 Biological Environment (Flora and Fauna)

Southern NB supports a variety of flora and fauna. Rowe (1972) identifies most of southeastern NB, where the Study Area is located, as being within the Eastern Lowland Forest Region. In this region, level land and impeded drainage are widespread, encompassing stands of black spruce (*Picea mariana*), red spruce (*Picea rubens*) and balsam fir (*Abies balsamea*), or mixed-woods, in which these species are associated with eastern white pine (*Pinus strobus*), red maple (*Acer rubrum*), sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*) and white birch (*Betula papyrifera*). In areas of poorly drained terrain, open peat bogs are interspersed with predominantly black spruce and tamarack (*Larix laricina*) forests. The majority of the Study Area is comprised of edge and mixed forest and the Project Footprints are existing natural gas well pads whose dimensions will not be altered during Phase III (Figure 4.1).

A site visit was conducted at the Will de Mille well pad by AMEC Biologists on July 6, 2011 during sunny, calm conditions. The site is located on a steep slope (10 to 15%) on shallow, sandy soil over sandstone. The hillside is well drained and very dry and hot (south facing), with no indication of surface drainage or wetland areas. In general, the vegetation diversity is very low, consisting of those few species which can tolerate the acid, low nutrient, and dry soil conditions. Observed signs of wildlife included deer tracks, bear tracks, and rabbit scat.

There is a relatively new clear cut immediately northeast, north, west, and south of the well pad. The new clear cut has been replanted with red spruce and white pine saplings (shrub height at time of survey). The native vegetation is a mix of low forest herbs that remain from the former mixed forest habitat; which is becoming overgrown by newer weedy species that are more suited to open canopy exposed sites. The old clear cut includes the area immediately east of the well pad. The old clear cut has not been replanted, but is regenerating a natural mixed forest that is currently in the sapling to early immature age class. The tree species included red maple, striped maple, white birch, beech, trembling aspen, large toothed aspen; all (with the exception of beech) are early forest succession species that colonize disturbed sites. The herb layer is fully shaded, supporting a more diverse community including Lady's Slipper (*Cypripedium acaule*), wild strawberry (*Fragaria virginiana*), blueberry (*Vaccinium sp*.), and trilliums (*Trillium sp*.).

A site visit was conducted at the Green Road well pad on April 29, 2010. The surrounding forest habitat is composed of a mixed forest with white pine and balsam fir (*Abies balsamea*) as dominant species for the softwoods in addition to maple and American beech (*Fagus grandifolia*) trees for the hardwoods. The understory is composed of beaked hazelnut (*Corylus cornuta*) and wild raisin (*Viburnum nudum cassanoides*) shrubs with bracken ferns (*Pteridium aquilinum*), bunchberry (*Cornus canadensis*) and Prince's-pine (*Chimaphila umbellata*). Evidence of historic and active forestry in the areas included the presence of active dirt logging roads, old trails, cut stumps and slash lying on the ground.

There are no areas designated as Old Spruce Fir Habitat (OSFH) located within the Study Area and the nearest permanent forest sample plot is approximately 2 km northwest of the Will de Mille well pad.

Bird mortality is reported to be greatest during the first year of life. Therefore, breeding and fledgling populations are considered to be the life stages most sensitive to potential disturbance. Erskine (1992) summarizes the results of breeding bird surveys conducted in NB to the date of publication. According to this reference, a total of 110 species of birds have been reported to potentially use breeding habitat within and adjacent to the Study Area.

4.6 Species at Risk

The following section focuses on Species at Risk (i.e., endangered, threatened, of special concern, and rare species), which are of concern due to potential disturbance as a result of Project development. Available information on the known occurrence of floral and faunal Species at Risk in the Study Area was compiled and reviewed to determine their presence relative to the proposed Project. Sources included published and unpublished listings of occurrences of such species and these are described below.

Under the federal SARA, the listing process begins with a species assessment that is conducted by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). SARA uses the COSEWIC scientific assessment when making the listing decision. Once a species is added to Schedule 1 it benefits from all the legal protection afforded, and the mandatory recovery

planning required under SARA. The Act provides federal legislation to prevent wildlife species from becoming extinct and to provide for their recovery. The status of species protected under SARA can be found at the Species at Risk Public Registry (SARPR) online at http://www.registrelep-sararegistry.gc.ca (SARPR, 2013).

The Province of NB provides additional species protection through its own NBSRA, which has been adapted from the repealed *Endangered Species Act* in 2012. Under this Act, an endangered species (or sub-species) is any indigenous fauna or flora threatened with imminent extinction or extirpation throughout all, or a significant portion of, its range and designated by regulation as endangered. This Act prohibits the killing of, or interference with any member of an endangered species, or the habitat of an endangered or regionally endangered species.

The Atlantic Canada Conservation Data Centre (ACCDC) is part of the NatureServe network, a non-government agency which maintains conservation data for the Atlantic Provinces. An information request was submitted to the ACCDC December 13, 2013 for a list of occurrences of rare and endangered flora and fauna within a 5 km radius of either the Green Road or Will de Mille well pads (Appendix B). S1, S2, and S3 ranked species are considered to be extremely rare to uncommon within its range in the Province. S4 and S5 ranked species are considered to be widespread and their occurrences are fairly common to abundant. The response to this request and explanations of the S-Ranks are included in Appendix B.

4.6.1 Plant Species at Risk

The ACCDC (Appendix B) identifies the following regionally rare or uncommon plant species as occurring within a 5 km radius of the Project (Table 4.3).

Table 4.3 Plant Species of Conservation Concern Occurring within a 5 km Radius of the Green Road and Will de Mille Well Pads

Common Name	Scientific Name	ACCDC Rank*	Habitat**
Vasey's Rush	*Juncus vaseyi*	S2	Variety of wetlands with sandy soils
Pennsylvania Blackberry	*Rubus pensilvanicus*	S2?	Clearings and roadside, mainly in southern NB
Hyssop-leaved Fleabane	*Erigeron hyssopifolius*	S3	Calcareous ledges and shores
Spotted Coralroot	*Corallorhiza maculata*	S3S4	Mature, dry forest with sparse ground vegetation

Sources:
*ACCDC, 2013.
**Hinds, 2000

None of these four plant species are listed by COSEWIC, SARA, or the NBSRA (SARPR, 2013; NBDNR, 2014). Most are wetland species, found at Gordon Falls, south of Elgin. The Project Footprints themselves exist as cleared areas within recently disturbed mixed woods. The nearest mapped wetland is over 2 km from either Footprint, therefore none of the species listed above as S2 (rare in its Provincial range) or S3 (uncommon in its Provincial range) are expected to exist in the affected area. No further clearing will be required during Phase III.

4.6.2 Mammal Species at Risk

The ACCDC has listed the Eastern cougar (*Puma concolor pop. 1*) as being SU, SH (unrankable and historical, perhaps not being verifiably observed within the past 20 to 70 years) but observed once within 2 km of the Project. The Eastern Cougar was listed under the NB *Endangered Species Act* but has not been included on the NBSRA. Controversy has ensued over the years regarding the existence of the Eastern cougar, as well as its distinction as a subspecies since DNA testing of those captured proved to be that of cats that had escaped from captivity (Hinterland Who's Who, 2013). COSEWIC also lists the Eastern cougar as "Data Deficient".

The NBSRA lists the Canada lynx (*Lynx canadensis*) as Regionally Endangered within the Province, although the ACCDC has not identified its presence as observed within 5 km of the Project or in range maps and COSEWIC lists this species as "Not At Risk" (SARPR, 2013). The Study Area is not known to represent limiting or critical habitat for either the cougar, which prefers large tracts of undisturbed land, nor the lynx who follows snowshoe rabbit (Hinterland Who's Who, 2013). The Project will be conducted on existing well pads and access roads, thereby leaving existing habitat unaltered.

4.6.3 Bird Species at Risk

Table 4.4 lists the ACCDC (Appendix B) bird Species at Risk identified as occurring within a radius of 5 km of both Green Road and Will de Mille well pads.

In NB, migratory birds typically nest during the "sensitive nesting window" of May 1 to August 31, and begin migration in late September (J. Mailhiot, pers. comm., 2013).

Table 4.4 Potential Bird Species of Conservation Concern Occurring within a 5 km Radius of the Project Area

Common Name	Scientific Name	ACCDC Rank*	Other Protection / Listing
American Three-toed Woodpecker	*Picoides dorsalis*	S3?	
Cliff Swallow	*Petrochelidon pyrrhonota*	S3S4 (Breeding)	
Red Crossbill	*Loxia curvirostra*	S3	
Wood Thrush	*Hylocichla mustelina*	S1S2 (Breeding)	COSEWIC: Threatened

Source:
*ACCDC 2013, Appendix B

All four of the birds listed in Table 4.4 are migratory birds. Those that breed in the region do so within the sensitive nesting window. Further discussion regarding the regional migratory birds is presented in Section 4.7.

The wood thrush, listed by COSEWIC as "Threatened" in 2012 is a forest-nesting species prone to nest-predation by the cowbird in the region's fragmented habitats (COSEWIC, 2013). They breed in deciduous or mixed forest habitats with deciduous understories late May to mid-July (Natureserve, 2013).

The NBSRA designates the harlequin duck (*Histrionicus histrionicus*), peregrine falcon (*Falco peregrinus anatum*), and piping plover (*Charadrius melodus melodus*) as Endangered and the bald eagle (*Haliaetus leucocephalus*) as Regionally Endangered in NB. The bald eagle is listed by COSEWIC as "Not At Risk" and the peregrine falcon is listed by SARA Schedule 1 as "Special Concern" (SARPR, 2013).

The Study Area, being located inland, would not contain limiting habitat for raptor and coastal species. Although the proposed Project will be conducted entirely on existing well pads and access roads, the wood thrush may be present in the surrounding area.

4.6.4 Herpetile Species at Risk

In an effort to prevent commercial exploitation, ACCDC reports no longer include observational information for the wood turtle. Wood turtle populations are threatened by human capture, as well as nest destruction by road traffic and use of recreational vehicles such as snowmobiles and all-terrain vehicles (ATVs) in otherwise inaccessible areas (SARPR, 2013) such as the Study Area. It is not a species listed under the NBSRA. Wood turtles are colonial and gather in large numbers when nesting next to water on open sandy areas, such as high riverbanks, roadsides, rail embankments, and in wetlands – none of which are present within 100 m of the Project Footprints.

4.7 Migratory Birds

Migratory birds are protected under the federal MBCA. Under this Act, no person shall deposit or permit to be deposited oil, oil wastes or any other substance harmful to migratory birds in any waters or any area frequented by migratory birds, and no person shall possess, buy, sell, exchange or give a migratory bird or nest or make it the subject of a commercial transaction, without lawful excuse, and no person shall disturb, destroy or take a nest, egg, nest shelter, eider duck shelter, or duck box of a migratory bird without a permit. In NB, migratory birds typically nest during the "sensitive nesting window" of May 1 to August 31, and begin migration in late September. Migratory routes are dependent on several factors including: origin, species, and time of day that migration occurs.

The following literature and information sources were reviewed and / or contacted:

- Maritime Breeding Bird Atlas (2nd Atlas, 2011);
- ACCDC (Appendix B); and
- NBDNR.

Once the above sources were consulted, all of the bird species that could potentially occur in the Study Area were compiled in a species list. Within the MBBA 2nd Atlas (MBBA, 2011), which was compiled over the period of 2006 to 2010, the Study Area lies within Region #13, Petitcodiac, and more specifically in Square #20LR37 (Elgin). There were 153 bird species identified in the Petitcodiac area. Within the Elgin square, 45 were identified as possible, probable or confirmed breeders – 33 of these being migratory birds protected under the MBCA. Most of these species nest within the sensitive nesting window.

Seven of these species protected under the MBCA have been known to breed outside the sensitive breeding window as shown in Table 4.5.

Table 4.5 Migratory Bird Species Potentially Breeding in the Study Area Outside the Sensitive Nesting Window

Species	Nesting Habitat*	Breeding Dates**
Ruffed grouse	Base of tree, bush or stump in forests or woodlands	Late Apr – Late Aug
American woodcock	Young, second-growth hardwoods in edge areas	Early Apr – Late July
Mourning dove	Varies among trees, shrubs, stumps and ground	Mid-May – Late Sept
Red-eyed vireo	Shrubs or low trees with thick canopy	Early June – Mid-Sept
Barn swallow	Inside or beneath eaves of man-made structures	Mid-May – Early Sept
American robin	Branches of trees or shrubs in a variety of settings	Early May – Late Sept
American goldfinch	Small trees or shrubs in open edge areas	Late June – Late Sept

Sources:
*NatureServe, 2013
**MBBA, 2011.

The barn swallow is designated as “Threatened” under COSEWIC, although it has not been identified by the ACCDC as being a rare species located within the Study Area. During a survey conducted in July 2011, crows and black-capped chickadees were observed. No other migratory birds or bird nests were noted.

The Project will be conducted on existing well pads and access roads. Migratory bird habitat, therefore, will not be altered during Phase III.

4.8 Designated Areas and Other Critical Habitat Features

A number of natural areas within the Province of NB have been either formally protected or inventoried as sites of potential significance, and are recommended for protection as Conservation Areas or Significant Natural Areas. The areas identified below are referred to as “Designated Areas” in this report.

Categories under the heading Significant Natural Areas include:

- Environmentally Significant Areas (ESAs);
- critical natural areas;
- nature reserves; and
- national and provincial parks.

All of the types of Conservation Areas and Significant Natural Areas listed above have been identified by Federal and / or Provincial regulatory authorities as areas for consideration and protection.

4.8.1 Environmentally Significant Areas (ESAs)

Environmental Significant Areas in NB are designated by Nature Trust of New Brunswick Inc. (NTNB) as having at least one of the following characteristics (NTNB, 2011):

- natural areas that are considered to be ecologically fragile with respect to human activities;
- areas that provide habitat for rare / endangered species;
- areas that have unique, or especially distinctive, natural features of biological, ecological, geological, or aesthetic value; or
- areas that have been enhanced through implementation of specific habitat management strategies aimed at specific species and / or ecosystems.

There are no ESA's located within 500 m of the Study Area. The nearest ESA to the Study Area is Gordon/Gibson Falls, located on the Pollett River south of the Study Area near Elgin (Appendix B). The falls are a popular gathering area for the local community. The nearest park is the Fundy National Park, located 40 km east of the Study Area.

4.9 Socio-economic Setting

The following sections describe the socio-economic setting of the Study Area.

4.9.1 Population and Labour Force

The proposed Project is located in the community and parish of Elgin in Albert County, NB. This region comprises the Study Area's socio-economic component of the EIA. The total area encompassed by the Parish is 519 km^2.

The major commercial centres nearest Elgin are Sussex Corner and Sussex, approximately 30 and 31 km southwest of the Study Area, respectively. The smaller Village of Petitcodiac is located approximately 11 km northeast of the Study Area and provides some commercial needs, but not to the extent that Sussex does. Table 4.6 shows the population of Elgin Parish (PAR), as well as the Towns of Petitcodiac and Sussex (Statistics Canada, 2011) as per the 2011 census.

Table 4.6 Census Population by Study Area Municipality

Municipality	Area (km^2)	2006	2011	% Change
Elgin (PAR)	519.4	973	968	-0.5
Petitcodiac (Village)	17.22	1368	1429	4.3
Sussex (Town)	9.03	4241	4312	1.6
Albert (County)	1806.5	27,562	28,846	4.7

Source: Statistics Canada, 2011 Canadian Census.

Elgin PAR experienced a slight population decline between 2006 and 2011 (Statistics Canada, 2006). The Town of Sussex showed a moderate increase between 2001 and 2006 (1.4%) and again by 2011 (1.6%). The Town of Petitcodiac, however, experienced a significant population decline of 5.3% between 2001 and 2006, contrary to the moderate increase that occurred between 2006 and 2011 (4.3%).

4.9.2 Local Economy

Sussex is the main industrial and commercial centre for the area. The Town is centrally located amongst the three major cities in NB – Saint John, Moncton, and Fredericton. In the areas adjacent to the Study Area, there is little in terms of industry and commerce compared to the nearby urban centres. Therefore, it is expected that a large number of people in this region commute to work.

4.9.3 Existing Land Use

4.9.3.1 Industrial

Major industry in the region includes Potash Corporation of Saskatchewan Inc. – New Brunswick Division which is a commercial producer of nitrogen, phosphate, and potash in Canada. The Penobsquis operation is an underground mining operation that produces sylvite (potash) and halite (salt). Cargill Limited is one of Canada's largest agricultural merchandisers and processors, with interests ranging from meat to grain processing. Corridor, also present in the vicinity of the Study Area, is an Eastern Canadian oil and natural gas exploration and development company that collects, processes and supplies natural gas to New England markets via the Maritimes and Northeast Pipeline. Corridor operates a natural gas processing plant and a natural gas gathering system in the region.

4.9.3.2 Commercial

Commercial land use is concentrated in the nearby urban centres. There are, however, a few commercial establishments scattered throughout the Study Area, such as a country market and a corner store located in Elgin.

4.9.3.3 Residential

The Elgin Local Service District (LSD) is rural in nature. As such, it is predominantly comprised of forested area, agricultural land and scattered rural homes. The residential areas are concentrated along transportation routes. The nearest building is a camp on Green Road, approximately 500 m west of the Green Road well (Figure 4.1). The residence nearest the Will de Mille well pad is approximately 1.9 km away.

4.9.3.4 Forestry

Field surveys were conducted by AMEC Biologists April 29, 2010, prior to the Green Road well pad expansion and Will de Mille well pad construction (AMEC, 2010a). According to the NBDNR forestry inventory mapping, the Green Road well pad forest habitat was composed of three main categories: IHTH (intolerant hardwood/tolerant hardwood mix), PIHW (Pine/ hardwood mix), and IHRM (intolerant hardwood/red maple mix). The Will de Mille well pad forest habitat was composed of two main categories: POHW (hardwood forest with over 50%

poplar) and WPSW (softwood forest with over 40% pine species). Evidence of historic and active forestry in the areas included the presence of active dirt logging roads, old trails, cut stumps and slash lying on the ground. The survey showed that Mount Pleasant Road was being actively used for logging operations.

4.9.3.5 Cultural / Institutional

Cultural/institutional land uses may include hospitals and nursing homes, churches, educational facilities, museums, and theatres. In general, the Town of Sussex serves as the cultural and institutional centres for this area.

There are three places of worship within the region. There are 12 churches in Sussex.

There is one elementary school in Elgin. Older children commute by bus to the Regional school in Petitcodiac or to one of the schools in Sussex. In Sussex, there are two elementary schools (one of which is located in Sussex Corner), a middle school, a Regional High School, and the Sussex Christian School which accommodates pre-school aged children to Grade 12.

Post secondary schools in Sussex include extension courses in the Town offered by the University of New Brunswick, the New Brunswick Community College, and Kingswood University which offers B.A. and B.Sc. degrees in Christian Education.

There are no cultural or institutional land uses in the form of hospitals, museums, or theatres in the Study Area. There is, however, one seniors centre. Petitcodiac has a medical health centre with four doctors, and Sussex has a hospital that serves the larger rural region as well as the nearby Towns.

4.9.3.6 Recreational

The Study Area is rural, and there is not the population base to support recreational facilities such as ball fields, ice rinks, etc. Being that Elgin has a large proportion of natural forest, as well as several streams, local residents utilize these resources for recreational activities such as hiking, four wheeling, snowmobiling (winter), and fishing. There are many such trails in the Study Area.

4.9.3.7 Agricultural Land

There are traditional farming communities within a small portion of the Study Area and surrounding region. One business in Elgin, Bridges Bros. Ltd. relates to farming and farming supply sales.

4.9.3.8 Traffic Circulation

The following transportation corridors are located within or near the Study Area:

- **Highway**

The Study Area is accessed using Green Road, which is a gravel road that runs westwards off Route 905 north of Elgin. The Green Road well heads are located approximately 355 m west from Route 905 and 110 m from Green Road. The Will de Mille well pad is accessed via a logging road branching southwards from Green Road, Mount Pleasant Road, which is approximately 2 km west of Route 905.

- **Air**

There is a local airport in Havelock. The facility is a civil airport, open to public use, with an unpaved runway and is, therefore, suitable only for lighter aircraft. The nearest airport serving domestic and international commercial passenger and cargo flights is in Moncton.

4.9.3.9 Utility Corridors

There are no electrical generating facilities in or near the Study Area. There is one NB Power corridor located approximately 10 km northwest of the Project. Water and sewer needs for the area are provided by individual domestic water wells and septic systems. Neither the Green Road nor Will de Mille well pads are connected to the Corridor Gathering Line.

4.9.4 Emergency and Medical Services

The Atlantic Health Sciences Corporation administers the overall health services for Region 2 of the NB Department of Health, which includes the Study Area. The Sussex Health Centre is a 25-bed facility providing ambulatory clinics as well as emergency care and ambulance service to the Saint John Regional Hospital 24 hours/day, 7 days/week (Horizon Health Network, 2013).

Closer to the Study Area, Petitcodiac has a health care centre, which provides the services of local doctors. In addition, the Greater Moncton area has two hospitals, the Moncton Regional Hospital and the Dr. Georges L. Dumont Hospital, both located in the City of Moncton. These facilities serve as referral centres for patients from other parts of the Province.

Emergency services for the Study Area are provided through the 911-service. Elgin has a Fire Department that serves the Study Area. This department is small and, therefore, in situations where additional help is required, the Petitcodiac Volunteer Fire Brigade and the Sussex Fire Department are called. Police Protection is provided by the Royal Canadian Mounted Police (RCMP).

4.10 Heritage and Archaeological Resources

The following is a brief summary of the results of the heritage and archaeological investigations conducted prior to the construction of these well pads.

A heritage resources desktop review was conducted by AMEC for the present location of the Will de Mille and Green Road well pad areas as part of the Heritage Resources Impact Assessment (HRIA) for a proposed Elgin Natural Gas Lateral Pipeline in 2008 under Archaeological Field Research License (AFRL) 2008NB45 (AMEC 2010b). A complete desktop review and visual field survey was conducted for these areas by an AMEC licensed archaeologist with assistance from an archaeological survey crew.

As indicated in the HRIA report for the Elgin Natural Gas Lateral Pipeline (Ibid.), these impact areas were assessed as having low potential for archaeological and heritage resources. The 2008 research did not identify any heritage resources in the vicinity of the Will de Mille or Green Road well pads. A review of both present day and historical mapping (and the 2008 visual survey) indicated that there are no watercourses in the immediate vicinity of these development footprints. There are no historic transportation routes in close proximity of either of these well pads. While there are dirt trails near the well pads, none of these trails are apparent in the 1945 aerial photographs and appear to be of relatively recent manufacture. The 1945 aerial photographs indicate that the areas at that time were completely wooded with no clearings in the vicinity of the well pads. The areas in the immediate vicinity of both the Will de Mille and Green Road well pads were assessed in 2008 to have low potential for unidentified heritage resources.

Since there will be no impacts to subsurface materials (within potential cultural layers), heritage/archaeology is not considered to be a VEC for this activity.

5.0 ENVIRONMENTAL IMPACTS AND ASSOCIATED MITIGATION

During the scoping phase of the Study (refer to Sections 3.0 and 4.0), a preliminary issues list containing ECCs was developed, from which VECs were selected. The approach to assessment of potential effects involved an initial evaluation to determine the likelihood of an interaction between ECCs and Project activities. Where linkages between ECCs and Project activities existed, and potential effects were of concern, these components were selected as the VECs (Table 5.1), on which the EIA focuses. Where a linkage between proposed Project activities and VECs was absent or was deemed unlikely to result in an effect, no further analysis was required.

The Phase III Project Sites are limited to existing well pads and access roads. Spatial bounds for the Project are a 1 km border around each site and the area between. Temporal bounds are limited to the time of well re-entry and fracture stimulation, which could occur within the next three years.

Phase III will include the following activities:

- The 2014 Program, employing LPG fracture stimulation for four to five weeks in August/September 2014, involving one to three existing wells on the two Elgin well pads as follows:
  - Up to 10 treatments in O-59 on the Will de Mille well pad; and
  - 1 treatment in B-41 and/or G41 on the Green Road well pad.
- Additional programs involving fracture stimulation over the following three years on these well pads.

There are no wetlands and or watercourses within 100 m of the Phase III Project well heads, B-41, G-41 or O-59. There are no dwellings, schools, hospitals or nursing homes within 250 m of any of these three well heads and both well pads are located more than 100 m from any other permanent building, railway, pipeline, or public road. No unique or critical habitat for migratory birds or raptors was observed or reported. A summary of the potential environmental impacts and the associated mitigation to address any potential impacts is provided in Table 5.2.

Corridor will conduct its operations in accordance with all applicable regulations and guidelines prescribed by NBDNR, NBDEM and the NBDELG, including the *Rules for Industry* (NBNGG, 2013). Key requirements are outlined in the Approval to Operate and the Certificate of Determination for the Phased EIA issued by NBDELG.

Table 5.1 Issues Scoping/Pathway Analysis Summary Matrix - Valued Environmental Components (VECs): Natural Gas Exploration at Elgin Sub-basin

Environmental Resources	Environmental Components of Concern (Biophysical and Socio-Economic)	Pathway of Concern		Possible Pathway	VEC		Project Activity	
		Yes	No		Yes	No	Fracture Stimulation	Rationale for Inclusion/Exclusion as VEC
Atmospheric Environment	Ambient Air Quality	X		• Overburden disturbance. • Accidental release of hazardous materials.	X		X	Included as a VEC – Protected by statute/regulation.
	Climatology		X	No possible pathway identified.		X		Excluded as a VEC – No pathway of concern identified.
Terrestrial Environment	Physiography and Geology	X		• Temporary alteration in visual aesthetics.	X		X	Included as a VEC – Protected by statute/regulation.
	Hydrology and Hydrogeology	X		• Fracture stimulation activities. • Accidental release of hazardous materials.	X		X	Included as a VEC – Protected by statute/regulation.
	Wetland/Watercourse Resources		X	Avoided during site selection.		X		Excluded as a VEC – No pathway of concern identified.
	Mineral Resources		X	No possible pathway identified.		X		Excluded as a VEC – No pathway of concern identified.
Biological Environment	Species at Risk	X		• Habitat or population disturbance. • Accidental release of hazardous materials. • Noise. • Lighting.	X		X	Included as a VEC – Protected by statute/regulation.
	Wildlife	X		• Habitat or population disturbance. • Accidental release of hazardous materials. • Noise. • Lighting.		X		Excluded as a VEC – Temporal boundaries preclude significant effects.
	Migratory Birds	X		• Habitat or population disturbance. • Accidental release of hazardous materials. • Noise. • Lighting.	X		X	Included as a VEC – Protected by statute/regulation.
	Fish, Fish Habitat, and Fishery Resources		X	Avoided during site selection.		X		Excluded as a VEC – No possible pathway.
	Designated Areas and Other Critical Habitat Features		X	Avoided during site selection.		X		Excluded as a VEC – No possible pathway.
	Population and Labour Force		X	Size of project precludes a significant impact to labour force.		X		Excluded as a VEC – No pathway of concern identified.
Socio-Economic Setting	Industry and Commerce		X	Avoided during site selection.		X		Excluded as a VEC – No pathway of concern identified.
	Residential		X	Avoided during site selection.		X		Excluded as a VEC – No pathway of concern identified.
	Existing Land Use: • Recreation • Forestry	X		Trucking traffic may temporarily impact recreation and logging activity.	X		X	Included as a VEC – Mitigation Required.
	Community and Emergency Services	X		• Limited size and duration of Project.		X		Excluded as a VEC – No pathway of concern identified.
	Heritage and Archaeological Resources		X	• Avoided during site selection.		X		Excluded as a VEC – No pathway of concern identified.

Table 5.2 Summary of Potential Environmental Effects and Mitigation

Environmental Components of Concern (ECC)	Possible Pathway	Potential Impact	Mitigation
Air Quality	Overburden disturbance Equipment Operation Flaring	Reduction in localized air quality Noise	• Control dust with the use of water. • Cover piles of soil to prevent particulate release. • Maintain equipment to limit particulate exhaust releases. • Control speed of vehicles. • Corridor will prepare emissions management documents as per Section 7.0 of the *Rules for Industry* document and Regulator consultation (NBNGG, 2013). See Section 6.0 of this EIA. • Corridor will employ mitigation measures for emission reduction for petroleum facilities, such as those listed in Appendix 11 of the *Rules for Industry* document (NBNGG, 2013). • Corridor will adhere to noise regulations in the *Rules for Industry* and employ mitigation techniques for noise impacts, such as the examples listed in Appendix 15 of the *Rules for Industry* document (NBNGG, 2013). • Plan to conduct work activities that are likely to result in an increase in noise emissions during daytime hours (7am to 7pm) wherever possible, as described in Section 6.0 of this EIA. • Minimize heavy truck traffic and associated noise where possible. • If a noise complaint is received, Corridor will report the complaint to the Regulator as per the *Rules for Industry* Section 9.5 (NBNGG, 2013).
Physiography	Heavy equipment and increased truck traffic	Visual Aesthetics	• Existing well pads and access roads will be used. • Natural terrain will not be altered. • Mitigatory measures, such as those examples provided in Appendix 16: Visual Impact Mitigation Measures of the *Rules for Industry* document (NBNGG, 2013) will be implemented. See Section 6.0 of this EIA.

Environmental Components of Concern (ECC)	Possible Pathway	Potential Impact	Mitigation
Hydrology/Hydrogeology	Use of freshwater	Effects on groundwater quantity	• Develop Water Management Plan as described in the *Rules for Industry* document Section 6.0 (NBNGG, 2013).
Migratory Birds	Equipment presence Presence of people	Noise / physical disturbance of breeding or nesting birds Behavioural changes Mortality	• Report the discovery of any nests encountered during construction to the Canadian Wildlife Service, Sackville, NB. • Corridor will employ mitigation techniques for noise such as those examples listed in Appendix 15 of the *Rules for Industry* document (NBNGG, 2013). See Section 6.0 of this EIA. • Corridor will employ mitigation techniques for Project lighting, such as those examples listed in Appendix 14 of the *Rules for Industry* document (NBNGG, 2013) and Section 6.0 of this EIA.
Species at Risk	Equipment presence Presence of people	Noise / physical disturbance of birds or wildlife Behavioural changes Mortality	• Report the discovery of any ground nests of Threatened species encountered during activities. • No on-site employees will harass wildlife. • Corridor will employ mitigation techniques for noise such as those examples listed in Appendix 15 of the *Rules for Industry* document (NBNGG, 2013). See Section 6.0 of this EIA. • Corridor will employ mitigation techniques for Project lighting, such as those examples listed in Appendix 14 of the *Rules for Industry* document and Section 6.0 of this EIA.
Land Use: Recreational	On-site activities Equipment/product transportation	Noise Traffic	• Corridor will employ mitigation techniques for noise such as those examples listed in Appendix 15 of the *Rules for Industry* document (NBNGG, 2013). See Section 6.0 of this EIA. • Corridor will employ mitigation techniques for traffic such as those examples listed in Appendix 14 of the *Rules for Industry* document (NBNGG, 2013).

Environmental Components of Concern (ECC)	Possible Pathway	Potential Impact	Mitigation
Accidental Spills and Malfunctions	Accidental release of hazardous materials and contaminant migration	Contamination of local and downstream environment	• Adherence to maintenance schedules and daily pre-work inspection for vehicles and equipment on-site. • Adequate training must be provided for personnel responsible for transportation, storage, handling, or use of hazardous materials. • Mobile equipment must be serviced and refuelled at dedicated refuelling / service stations. • Appropriately sized spill kits must be available on-site for clean-up efforts. • Adherence to contingency plans developed by Corridor.

Corridor has developed a comprehensive HSE Management System that includes the following manuals: Health and Safety Manual; Waste Management Manual; Environmental Management Manual; and an Emergency Response Manual. Corridor will also develop other Management Plans described in the *Rules for Industry* document in consultation with NBDELG. Corridor requires that all its well site personnel (employees, vendors and visitors) adhere to the health, safety and environmental policies and procedures outlined in these Manuals. The Corridor site supervisor has a copy of these manuals on-site and key contractors will also be provided with a copy of these manuals.

In addition to the mitigation outlined in Table 5.2, the following are standard mitigation measures that Corridor utilizes for all its programs:

- All personnel entering a Corridor well site must receive a Field HSE Orientation each calendar year. In addition, Corridor ensures that adequate environmental training is provided for personnel who will be responsible for transportation, storage, handling, or use of any hazardous materials. This training includes spill prevention and response and covers proper clean-up procedures for accidental spills to minimize the extent and magnitude of adverse effects to the environment.
- A sign will be posted to notify all visitors and contractors or personnel new to the site that they must immediately check-in at the Corridor on-site security building, located at the entrance, upon arrival at the location. This is to ensure that only authorized personnel are on-site and that each person receives a site-specific Corridor Field HSE Orientation.
- Corridor will notify nearby residents and NBDELG, if there is a significant event which could result in environmental impacts or disturbance.
- In the event that Corridor receives a complaint from the public regarding unfavourable environmental impacts, Corridor will investigate the complaint, take corrective action, and report the complaint to the NBDELG within one business day of receiving the complaint.

Based on the nature of the Phase III activities, the planned mitigation outlined in Table 5.2 and the application of the management plans that will be developed as per the *Rules for Industry* (NBNGG, 2013), no significant adverse interaction with any environmental component is anticipated.

6.0 ENVIRONMENTAL MANAGEMENT

6.1 Ground Water

6.1.1 Ground Water Monitoring

Ground water monitoring will not be required as per the *Rules for Industry* (NBNGG, 2013), Section 5.1: Water Well Testing and Appendix 9: Water Well Testing for Oil and Gas Activities, given there are no domestic water wells within 500 m of either well pad, Green Road or Will de Mille, that could be affected.

6.1.2 Water Quantity Requirements

The following total water requirements have been estimated for each stage of the Project:

- Fracture Stimulation: While LPG will be the primary stimulation fluid, there will be a requirement for 200 to 300 m³ of freshwater, although produced water from the nearby Corridor Gas Processing Facility may be considered. This water will be required to provide a stand-by source of water for the fire-fighting foam units, emergency showers, general work site use, dust control, etc. Fresh water or brine (that has a higher hydrostatic gradient than LPG) may also be required to fill the well bore in advance of the LPG to provide additional hydrostatic pressure to assist in creating the initial fracture in the formation rock.

Fresh Water will be delivered to the work site via road by wheeled trucks and water for fire-fighting foam will be stored on location in 80 m³ tanks. An additional 80 m³ storage tank will be located on-site to store water for any additional requirements during the program.

6.2 Surface Water Monitoring

The *Rules for Industry* document outlines surface water quality monitoring requirements in Section 5.2 and Appendix 10 for watercourses within 150 m of well pads (NBNGG, 2013). There are no mapped watercourses within 150 m of either the Green Road or Will de Mille well pads.

6.3 Air Quality Monitoring

6.3.1 Emissions Inventory

Air emissions will generally include CO and CO_2 emissions from equipment and truck exhaust (*eg.,* heavy equipment, trucks, etc.) and fugitive dust from the well pad. Accidental releases of materials are another source of potential air emissions.

Flaring of excess LPG and produced natural gas will take place during fracture stimulation operations and during flow testing of the wells.

Using practices for the assessment of other industrial sources of air emissions and the requirements specified in the *Rules for Industry*, Section 7.0: Addressing Air Emissions Including GHG, Corridor shall conduct a program of assessment for the Project to include:

- Preparation and submittal of an emissions inventory that describes:
  - predicted emission rates; and
  - predicted annual tonnage releases for all emission sources.
- Screening level emission dispersion modeling using accepted computer-based model.
- Preparation of a report for submission to the Regulator.

Based on the data and findings of the above and/or based on complaints related to air quality, Corridor may be required to conduct Air Quality Monitoring at Source and Ambient Air Quality Monitoring as per Section 7.0 of the Rules for Industry.

Corridor will also prepare and adopt a Fugitive Emissions Management and GHG Emission Reduction Plan for the Project that will be submitted to the Regulator for approval. The Plan will describe the emission mitigation measures that will be employed.

6.3.2 Noise Monitoring

Generally, in rural settings, typical noise levels are 40 to 55 dBA (decibels) Leq (energy equivalent sound level) at night time, depending on the dwelling density and proximity of dwellings to highways and railways. The *Rules for Industry* have set maximum limits for noise measured at the outer wall of the nearest receptor (a dwelling or other noise-sensitive building) of 50 dBA Leq for the daytime period (7 am to 7 pm) and 40 dBA Leq for night activities (7pm to 7am).

The majority of noise emissions will be associated with the operation of fracture stimulation, and related activities. As per Sections 9.4 and 9.5 in the *Rules for Industry*, baseline noise monitoring will be conducted for a minimum of 48 hours at a point no further than 1500 m from the well pad centre, or at the external wall of the closest permanent building/residence if one lies within 1500 m. The nearest noise receptors include a camp 500 m west of the Green Road well pad, a residence located approximately 0.7 km from the edge of the Green Road well pad and another nearly 2 km from the Will de Mille well pad. Noise monitoring will, therefore, be conducted at the external wall of the residence located 700 m from the Green Road well pad. A review of existing noise sources indicates that the Green Road well pad has similar existing noise sources; baseline noise measurements should therefore be representative of those present at the Will de Mille well pad. Sound level data will also be collected over a 24 hour (day time and night time) period during fracture stimulation. Monitoring is expected to be conducted in the spring of 2014.

Corridor will ensure that noise levels associated with normal activities will not cause the measured noise level to be above the applicable noise levels established in the *Rules for Industry*. Corridor will be sensitive to noise generated during the overnight hours and shall schedule activities accordingly.

Activities will be undertaken in keeping with the following:

- Use natural barriers (or alternative materials where appropriate, such as storage tanks and vessels) where possible to dampen noise.
- Plan to conduct work activities that are likely to result in an increase in noise emissions during daytime hours (7am to 7pm) wherever possible (within constraints for those operations that are 24/7).
- Minimize heavy truck traffic and associated noise where possible.

All noise impact monitoring and mitigation measures will be documented in a Noise Impact Assessment and Mitigation Plan that will be submitted to the Regulator for review and approval prior to commencement of operations.

If a noise complaint is received, Corridor will report the complaint to the Regulator and investigate the complaint, perform noise testing to determine the actual levels and implement noise abatement measures if required.

6.3.3 Visual Aesthetics

Phase III will be conducted on existing Corridor well pads on Green Road and on a logging road accessed by Green Road. Both well pads are located within a mixed wood forest, not visible from public roads or surrounding areas. The Green Road wells are located approximately 350 m from Route 905; the well pad itself is hidden from the road by a belt of mixed wood trees and shrubbery. In addition, these wells are located over 100 m from the unpaved Green Road. The Will de Mille well pad is located deeper in the woods, approximately 3.5 m southwest of the Green Road well pad.

For four to five weeks during August/September of 2014, fracture stimulation activities will be conducted at one or both well pads, which will temporarily affect the visual landscape of the Study Area with the presence of components shown in Figure 2.1 such as:

- flare stacks;
- well servicing, fracture stimulation truck mounted equipment;
- lighting towers;
- personnel trailers;
- restroom facilities;
- storage tanks;
- above-ground piping and separators; and
- trucks, transporting LPG, water or wastewater.

None of these structures will be permanent. Once fracture stimulation has been completed and the wells have been suspended, all equipment will be removed, leaving both well pads unchanged in appearance.

During the course of the Project, however, mitigation measures, such as the examples provided in Appendix 16 of the *Rules for Industry* document (NBNGG, 2013) will be implemented in order to minimize visual impacts to the landscape - particularly in regards to the use of light towers which may disrupt people, birds and wildlife. Lighting fixtures must be set up in a manner which ensures worker safety, but will also be:

- directed downwards and internally as much as possible;
- directed so that bulbs are not openly visible;
- directed so as not to be cast towards the road or housing; and
- motion-activated if light is for the purposes of security.

6.4 Waste Management

Solid and liquid wastes generated from normal operations of the Project will be managed in accordance with the Corridor Waste Management Plan and the requirements of the *Rules for Industry* (NBNGG, 2013), Section 4.0: Managing Wastes and Preventing Potential Contaminants from Escaping the Well Pad and Appendix 5: Waste Management.

All wastes, hazardous or not, will be tracked by a Transportation of Dangerous Goods (TDG) Shipping Document/Waste Manifest completed and signed by the Corridor Well Site Supervisor for each waste shipment from the work site. A summary of all wastes will be recorded on a Waste Reporting Sheet, which will be the basis of waste information submission in the quarterly report to NBDELG.

Corridor will ensure that all waste is properly stored, handled, transported, treated, recycled or disposed of at Provincially-approved disposal facilities in accordance with Corridor's Waste Management Plan and the *Rules for Industry* (NBNGG, 2013).

6.4.1 Sewage

During typical fracture treatment operations, there will be no personnel living on location. The office and work site trailers on location will not be equipped with bathroom facilities and will not require sewage storage facilities. Portable toilets will be used on-site for the bathroom requirements of personnel. Waste removal from the portable toilets will be undertaken by the vendor, a certified Sewage Disposal Company. At the end of Phase III, all portable toilets will be removed from the work site.

6.4.2 Solid Waste

All garbage is placed in appropriate garbage containers and transported off location to an approved landfill or recycling facility. General waste from normal operations will include empty sacks, rags, plastic, food waste, pails, pallet wood, etc.

6.4.3 Petroleum, Oils, and Lubricants

Used oils, used oil filters, oily rags/absorbent pads are collected in separate containers and sent for recycling. Combustible waste, such as oily rags and paint cans, are placed in hazardous materials containers for appropriate disposal at an approved facility.

6.4.4 Flow Back Fluid and Produced Water

Corridor plans to conduct fracture stimulation treatments using LPG as fluid in 2014 and, as a result, does not anticipate significant amounts of liquid waste (flow back fluid and produced water) in the flow back of the stimulated wells.

Should any water be produced from the wells, it will be piped from the well to temporary 80 m^3 storage tanks that will be on-site during flow back and production testing activities. Produced wastewater will be sampled and analyzed in accordance with the Corridor Waste Management Plan and in compliance with the *Rules for Industry* (NBNGG, 2013) prior removal from the site by a third party waste management company for disposal at a licensed treatment facility. Transfer of wastewater from on-site storage tanks to tanker trucks will be carried out in compliance with applicable Regulations and standard oil field best practices and procedures.

7.0 PUBLIC CONSULTATION

Corridor is committed to stakeholder consultation and community and public engagement. As per the NB EIA Regulation, the availability of this Phased EIA for review will be advertised in the Times & Transcript and the Kings County Record, as well as posted in local public areas such as the Elgin Post Office, the Town of Sussex Office, the Village of Petitcodiac Office, and both the Fredericton and Moncton NBDELG Offices. The EIA will also be available at the Corridor Office and company website. Corridor will work with NBDELG to determine the appropriate publications and timing.

In addition, Corridor will take a personalized approach to engaging the property owners within an 1800 m radius of the Green Road and Will de Mille well pads as per the *Rules for Industry*. Corridor representatives will explain the proposed activities and program as a whole, listen to their concerns and answer questions they may have regarding the Project. Information sheets with contact information for any future questions or concerns they may have will be left during these visits and Corridor representatives will make every reasonable effort to make themselves available to every property owner. Corridor will also make contact with the local fire department and Project and contact information will be sent to the Albert County MLA.

Corridor's Public Engagement Strategy also includes:

- Distribution of the Corridor Newsletter which will include an overview of planned activities, as well as contact information. Additional updates will be provided in future newsletters in advance of the Program.
- An update of planned Elgin Program activities on the Corridor Website, as well as a mechanism for submitting questions and concerns directly to Corridor through the website.

The Will de Mille well pad is on two parcels of Crown land and another eleven parcels are within 1800 m. The Green Road is not on Crown land, but there are 6 parcels within an 1800 m radius. Corridor will comply with any additional requirements for activities that are conducted on Crown lands as well as any that result from the NBDELG review of the Phase III document.

8.0 CONCLUSION

This EIA has been prepared for the proposed Phase III activities to be conducted at the Elgin sub-basin. This assessment consisted of a consideration of potential effects on the environment resulting from activities as described in Section 2.0. A description of the existing environment in the Study Area has been presented (Section 4.0) based on available information and results of field surveys conducted from 2008 to 2011. The VECs identified by issues scoping and pathway analysis (Section 5.0) for which potential effects may be a concern included:

- Ambient air quality;
- Hydrology / hydrogeology;
- SAR;
- Migratory birds; and
- Recreational land use.

The potential for environmental effects has been discussed in Section 6.0. Significant adverse residual effects are not anticipated for Phase III based on:

- available mapping information and results of previous field investigations in the Study Area presented in Section 4.0;
- previous projects of this nature conducted in NB, as described in Section 2.0;
- observation of the *Rules for Industry* for Responsible Environmental Management of Oil and Natural Gas Activities in New Brunswick (NBNGG, 2013), including the baseline and environmental monitoring and management plans that will be developed and conducted, some of which are discussed in Section 6.0 of this document;
- Corridor's existing HSE Management System;
- the Public Engagement Strategy described in Section 7.0; and
- the mitigation measures outlined in this EIA.

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Contact List

Contact Name	Organization/Agency	Contacted Regarding
Mailhiot, Joshua	Environment Canada – Canadian Wildlife Service	Migratory Birds

APPENDIX A
LPG Fracture Fluid and Additives
Disclosure Provided by GasFrac

LPG AND ADDITIVES DISCLOSURE

The following is a disclosure summary of the chemical breakdown and health information of the fracture stimulation fluid to be utilized as provided by the manufacturer, GasFrac (GasFrac, 2013). A risk assessment and more detailed information will be provided prior to the start of operations, as required by the Rules for Industry (NBNGG, 2013).

65% to 75% of the fracture stimulation fluid will be composed of LPG which consists of primarily propane (with less than 5% v/v of ethane, butane, and propylene (propene)) including additives, as outlined below, at concentrations of less than 5%. The remainder of the fluid is made up of proppant that is added to the fracturing fluid in increasing concentrations up to 400 – 800 kg/m^3 as it is pumped into the well.

Liquid Petroleum Gas

LPG has the following general health information:

- Not expected to have carcinogenic, mutagenic or reproductive effects;
- Health (National Fire Protection Association (NFPA)) rating: 2 warning, may be harmful if inhaled or absorbed;
- Flammability: 4 danger, flammable gas;
- Chronic effects: asphyxiant, displaces oxygen primarily in enclosed spaces;
- Bioaccumulation and biodegradation not determined; and
- Ecotoxicity unexpected: does not contain any Class I or II Ozone depleting compounds.

Gellant – GELLP-10

The gellant to be utilized is GELLP-10 and is composed of mixed alkyl phosphate ester and phosphoric acid.

GELLP-10 has the following general health information:

- Contains no carcinogens, reproductive or chronic hazards (>0.1%);
- Biodegradable;
- No Environmental Protection Agency (EPA) Hazardous Air Pollutants (HAP) (>0.1%);
- Health Hazardous Materials Information System (HMIS) rating: 3 warning, may cause skin and eye burns;
- Flammability (HMIS): 2 warning, moderate hazard, flash point 151 °F (NFPA); and
- Ecotoxicity and bioaccumulation capacity not determined.

Activator XL-105

Activator XL-105 is composed of ferric sulfate, 2-butoxyethanol, fatty acids, coconut acid diethanolamide and non-hazardous components.

Activator XL-105 has the following general health information:

- IARC evaluates the substance coconut acid, diethanolamide in Group 2B (possibly carcinogenic to humans);
- Biodegradable;
- Health (HMIS) rating: 3 serious. Chronic Effects;
- Flammability (HMIS): 2 moderate. warning, serious hazard, flash point below 100°F (NFPA); and
- Ecotoxicity and bioaccumulation capacity not determined.

Breaker BRKLP-10

The breaker to be utilized is Breaker BRKLP-10 and is composed of magnesium oxide (MgO) and petroleum distillates.

Breaker BRKLP-10 has the following general health information:

- Not expected to have carcinogenic, chronic or reproductive effects (WHMIS); MgO not classifiable as a human carcinogen;
- Excessive exposure may cause neurological problems (Occupational Safety and Health Association (OSHA);
- Health (HMIS) rating: 2 moderate hazard, minor injury may occur;
- Flammability (HMIS): 1 slight hazard, material must be preheated for ignition to occur;
- LD-50 estimated at 7905 mg/kg with rats via oral ingestion (practically non-toxic, probable lethal dose for man – 1 L); and
- Ecotoxicity unexpected but not determined.

GasFrac LPG has developed a zero-oxygen, waterless, closed system which increases worker safety, eliminates post-job clean-up, requires only minimal flaring and facilitates recovery of the LPG fluid post-fracture stimulation, which can be recaptured and re-used, as much as possible, at the nearby Corridor Gas Treatment Facility (GasFrac, 2013).

APPENDIX B
ACCDC Data Response
and
Part I. Conservation Data Centre Subnational Rarity Ranks

DATA DICTIONARY: revised May 4, 2012

I. Observation Records

The following fields of data may be included (and may or may not be populated) in occurrence records.
Text field lengths given as TXT+ are 255 char max. (and may truncate text).

TAXONOMY	*type*	*definition*
MCODE	TXT 8	8 character 'Museum Code' (1 to 4 = genus, 5 to 8 = sp+ssp)
ELCODE	TXT 10-12	Unique IIdentifier of taxon[1]
SCINAME	TXT+	Global Scientific Name of taxon[1]
COMNAME	TXT+	English Common Name of taxon[1]
NOMCOMMUN	TXT+	French Common Name

LOCATION

SURVEYSITE	TXT+	General locality of occurrence (not necessarily protected)
DIRECTIONS	TXT+	Specific locality: e.g. bearings and distance from enduring landmark
SUBNAT	TXT 2	Province/State: 2 character ISO code
COCODE	TXT 6	County Code (2 chars for province + 4 chars for county name)
MAPCODE	TXT 7	Map number: NTS identifier in Canada
UTME20	NUM 6	UTM[3] Easting reprojected as Zone 20
UTMN20	NUM 7	UTM[3] Northing reprojected as Zone 20
LONDEC	DEC 12,6	Decimal Longitude (6 decimal places, negative for west of Greenwich)
LATDEC	DEC 12,6	Decimal Latitude (6 decimal places)
LOCUNCM	NUM 5	Precision in meters, i.e. geospatial resolution or lack thereof
PREC	DEC 3,1	Precision in meters by power of 10 (e.g. 3 = 10 to the 3rd = 1000m = 1km)

prec	*common speech*	*example*	*unit size*	*literal range (m)*
6.0	within province	province	1000.0km	562.3 - 1778.3
5.7	in part of province	'NW NB'	500.0km	281.2 - 889.1
5.0	within in county	county	100.0km	56.2 - 177.8
4.7	within 50s of kilometers		50.0km	28.1 - 88.9
4.0	within 10s of kilometers	BBA grid	10.0km	5.6 - 17.8
3.7	within 5s of kilometers		5.0km	2.8 - 8.9
3.0	within kilometers	topo grid	1.0km	0.6 - 1.8
2.7	within 500s of meters		500.0m	281.2 - 889.1
2.0	within 100s of meters	ball field	100.0m	56.2 - 177.8
1.7	within 50s of meters		50.0m	28.1 - 88.9
1.0	within 10s of meters	boxcar	10.0m	5.6 - 17.8
0.7	within 5s of meters		5.0m	2.8 - 8.9
0.0	within meters ***NOT USED***	pace	1.0m	0.6 - 1.8
-1.0	within 10s of centimeters	fingernail	0.1m	0.1 - 0.2

RARITY STATUS

NRANK	TXT 5	National Rarity Rank of taxon (in Canada)[1]
NPROT	TXT+	National Protection Status of taxon (= COSEWIC in Canada)

code	*rank and short definition*
X	Extinct in Canada and elsewhere
XT	Extirpated in Canada but surviving elsewhere
E	Endangered in Canada
T	Threatened in Canada
V	Vulnerable in Canada
SC	Special Concern in Canada
DD	Data Deficient: data inadequate for assessment
NAR	Not At Risk in Canada

SRANK** TXT 5 Subnational (Provincial) Rarity Rank of taxon[1]

code	*rank and short definition*
SX	Extinct or extirpated in province
SH	Historically occuring but currently undetected in province
S1	Extremely rare in province
S2	Rare in province
S3	Uncommon in province
S4	Widespread, common and apparently secure in province
S5	Widespread, abundant and demonstrably secure in province
SE	Exotic in province
SA	Accidental, infrequent and outside of range within province
SNA	Ranking not applicable in province
SNR	Not yet assessed in province

SPROT** TXT+ Provincial rank/status of taxon; cf provincial websites

DATASENS	TXT 5	Data sensitivity index; indicates blurred[2] export coordinates
IUCN	TXT+	International Union of Conservation Naturalists rarity rank; cf IUCN website

code	*rank and short definition*
EX	Extinct: no individuals remaining
EW	Extinct in the Wild: only captive or naturalised survivors
CR	Critically Endangered: extreme risk of extinction in wild
EN	Endangered: high risk of extinction in wild
VU	Vulnerable: high risk of endangerment in wild
NT	Near Threatened: likely to become endangered soon
LC	Least Concern: lowest risk, widespread and abundant
DD	Data Deficient: data inadequate for assessment
NE	Not Evaluated, not yet assessed against criteria

OBSERVATION

OBSERVER	TXT+	Person or persons collecting specimen, in bibliographic form
OBDATE	TXT 10	Date of specimen collection as YYYY MM DD
OBDATA	TXT+	Concatenation of fields below, relating to specimen (EODATAEVID, EODATACNT etc)
OBEVID	TXT+	Type of evidence (specimen, photo etc)
OBCOUNT	TXT+	Number of individuals at location
OBABUN	TXT+	Relative rarity of taxon at location, e.g. 'common', 'scattered'
OBSIZE	TXT+	Size of specimen
SIZE	TXT+	Size of occurrence 'patch' (in m2, ha or acres)
OBDESC	TXT+	Details of specimen appearance
OBPHEN	TXT+	Lifestage of specimen (bud, flowering etc)
OBSEX	TXT+	Male/female if relevant
OBACTIV	TXT+	Activity of taxon when observed (nesting, crossing road etc)
OBASSP	TXT+	Other taxa associated with specimen
NOTETAX	TXT+	Identifier's note on taxonomic issues
GENDESC	TXT+	Concatenation of fields below, relating to site (HABITAT, ECOL etc)
HABITAT	TXT+	Habitat characterisation of location
ECODIST	NUM 4	National Ecological Framework EcoDistrict identifier
WSCODE	TXT 10	Quaternary Watershed identifier
GCOM	TXT+	General Comments: concatenation of Notes (NOTE1, NOTE2, NOTE3)

COLLECTION

OWNER	TXT+	Landowner or owner type (Federal, Provincial, Private, etc)
ACCNUM	TXT+	Museum/Herbarium Accession number
COLLNUM	TXT+	Collectors' number
COLLECTION	TXT+	Herbarium acronym(s) with specimen
CITATION	TXT+	Primary source of data

DATA MANAGEMENT

IDNUM	TXT+	Field Office Number: Internal ACCDC record reference (not the EONUM)
EDITION	TXT 14	Last editor's initials and date as YYYY MM DD
OB	TXT 2	Mapping shape: PN=polygon, BF=buffer, LN=line, PT=point
DB	TXT 2	Database, e.g. Ob=observations, Ff=freshwater fish, Bp=birds, pelagic
IN	TXT 2	GIS search flag for observation within buffer
IX	TXT 2	GIS search flag for observation intersects buffer
EONUMLAST	NUM 3	Map labeling flag for most recent taxon observation in area
RARENS	NUM 1	Inclusion flag for extraprovincial records in NS 100km GIS scans

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Notes:

[1] Methodology of NatureServe, Arlington, VA

[2] Easting and Northing rounded to 5, 10 or 50km grid location.

[3] Universal Transverse Mercator.

** Field name followed by 2-character ISO provincial abbreviation.

II. Managed or Special Areas

The following fields of data may be included (and may or may not be populated) for Protected Areas and Ecologically Significant Areas.

IDENTITY

MACODE	TXT 14	Unique identifier for Managed Area[1] with some level of protection
SACODE	TXT 14	Unique identifier for Ecologically Special Area[1] with or without protection
MANAME	TXT+	Name of Protected Area containing occurrence
SANAME	TXT+	Name of Ecologically Special Area containing occurrence
SITECODE	TXT+	External agency site identity code

JURISDICTION / OWNERSHIP

LOCALJURIS	TXT+	Abbreviation for mandated agency
OWNER	TXT+	Short name or category of title holder
OWNERCOM	TXT+	Short detail of multiparty arrangements
OWNERCODE	TXT+	Canadian Conservation Area DB ownercodes (modified)

group	*code*	*designation*
Owner	GN	government, national (federal)
	GS	government, subnational (prov., state)
	GM	government, municipal
	IN	international
	NG	non-governmental organisation
	OR	organisational
	CO	corporate
	PR	private

CLASSIFICATION

PROTSTAT	TXT+	Activities permitted or restricted (when known)
LEGALACT	TXT+	Short title of enabling legislation
LEGALDATE	TXT+	Year of enabling legislation
ESTABDATE	TXT+	Year of site designation
IBP	TXT+	International Biological Program identity number (Y=unknown)
IBPSTATUS	TXT+	International Biological Program status: proposed or declared
IUCN	TXT+	IUCN protection level, e.g. I very restricted, VI few restrictions
LEVEL1	TXT 3	Canadian Conservation Area DB type
LEVEL2	TXT+	Canadian Conservation Area DB subtype(s)

group	*code*	*designation*
Conservation	CEP	Conservation Easement Property
	ESA	Environmentally Sensitive Area
	NAC	Nature Conservancy
	NAT	Natural Area
	NCA	NCC Conservation Land
	PCA	Private Conservation Area
	PRA	Protected Area
	PRB	Protected Beach
	RER	Representative Area Ecological Reserve
	TRA	Nature Trail
Heritage	ARS	Archaeological Site
	HEA	Heritage Area or Park
	HEC	Heritage Canal
	HEP	Heritage Park
	HER	Heritage River
	HIA	Historic Area or Park
	NHP	National Historic Park
	NHS	National Historic Site
	PEP	Provincial Heritage Property
	PHP	Provincial Historic/Heritage Park
	PHS	Provincial Heritage Site
	WHS	World Heritage Site
Parks	CMG	Campground
	CMP	Community Park
	DUP	Day Use Park
	MUP	Municipal Park
	NAP	National Park
	NEP	Natural Environment Park
	NTP	Nature Park
	PKW	Parkway
	PNS	Picnic Site
	PVP	Provincial Park
	WAP	Wayside Park

group	*code*	*designation*
Wilderness	ECR	Ecological Reserve
	NTA	Nature Trust Area
	NTR	Nature Reserve
	SES	Significant Ecological Area
	WDA	Wilderness Area
	WDR	Wilderness Reserve
Wildlife	BSR	Bird Sanctuary
	EHJ	Eastern Habitat Joint Venture
	GAS	Game Sanctuary
	MBS	Migratory Bird Sanctuary
	NWA	National Wildlife Area
	PWA	Provincial Wildlife Area
	SBS	Sea Bird Sanctuary
	WHR	Western Hemispheric Shorebird Reserve
	WLP	Wildlife Park
	WLR	Wildlife Reserve
	WLS	Wildlife Sanctuary
	WMA	Wildlife Management Area
	WPA	Wildlife Protection Area
	WRF	Wildlife Refuge
Other	AGF	Agreement Forest
	ASI	Area of Scientific Interest
	DUN	Ducks Unlimited Canada
	EDA	Education Area
	FCP	Federal Community Pasture
	IBP	International Biological Program
	NCC	National Capital Commission
	NSA	Natural Scenic Area
	PLS	Palaeontological Site
	PSL	Public Safety Lands: watershed protection
	RAM	Ramsar Wetland Site
	RTA	Research and Teaching Area
NS SigHab	380	wetland habitat
	381	saltmarsh habitat
	382	deer/moose wintering
	383	other significant habitats

Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada Atlantique

DATA REPORT 5162: Sussex, NB

Prepared 19 December, 2013
by J. Churchill, Data Manager

CONTENTS OF REPORT

1.0 PREFACE

The Atlantic Canada Conservation Data Centre (ACCDC) is part of a network of NatureServe data centres and heritage programs serving 50 states in the U.S.A, 10 provinces and 1 territory in Canada, plus several Central and South American countries. The NatureServe network is more than 30 years old and shares a common conservation data methodology. The ACCDC was founded in 1997, and maintains data for the jurisdictions of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador. Although a non-governmental agency, the ACCDC is supported by 6 federal agencies and 4 provincial governments, as well as through outside grants and data processing fees. URL: www.ACCDC.com.

Upon request and for a fee, the ACCDC queries its database and produces customized reports of the rare and endangered flora and fauna known to occur in or near a specified study area. As a supplement to that data, the ACCDC includes locations of managed areas with some level of protection, and known sites of ecological interest or sensitivity.

1.1 DATA LIST

Included datasets:

Filename	Contents
SussexNB_5162ob.xls	Rare and legally protected *Flora and Fauna* in your study area
SussexNB_5162ff.xls	Rare and common *Freshwater Fish* in your study area (DFO database)
SussexNB_5162sa.xls	All *Significant Natural Areas* in your study area

1.2 RESTRICTIONS

The ACCDC makes a strong effort to verify the accuracy of all the data that it manages, but it shall not be held responsible for any inaccuracies in data that it provides. By accepting ACCDC data, recipients assent to the following limits of use:

a) Data is restricted to use by trained personnel who are sensitive to landowner interests and to potential threats to rare and/or endangered flora and fauna posed by the information provided.
b) Data is restricted to use by the specified Data User; any third party requiring data must make its own data request.
c) The ACCDC requires Data Users to cease using and delete data 12 months after receipt, and to make a new request for updated data if necessary at that time.
d) ACCDC data responses are restricted to the data in our Data System at the time of the data request.
e) Locations given for rare species records may be deliberately imprecise. Each record has an estimate of locational uncertainty, which must be referenced in order to understand the record's relevance to a particular location. Please see attached Data Dictionary for details.
f) ACCDC data responses are not to be construed as exhaustive inventories of taxa in an area.
g) The absence of a taxon cannot be inferred by its absence in an ACCDC data response.

1.3 ADDITIONAL INFORMATION

The attached file DataDictionary 2.1.pdf provides metadata for the data provided.

Please direct any additional questions about ACCDC data to the following individuals:

Plants, Lichens, Ranking Methods
Sean Blaney, Botanist
Tel: (506) 364-2658
sblaney@mta.ca

Animals (Fauna)
John Klymko, Zoologist
Tel: (506) 364-2660
jklymko@mta.ca

Plant Communities
Sarah Robinson , Community Ecologist
Tel: (506) 364-2664
srobinson@mta.ca

Data Management, GIS
James Churchill, Data Manager
Tel: (902) 679-6146
jlchurchill@mta.ca

Billing
Cindy Spicer
Tel: (506) 364-2665
cspicer@mta.ca

All other Inquiries
R.A. Lautenschlager
Tel: (506) 364-2661
rlautenschlager@mta.ca

Questions on the biology of Federal Species at Risk can be directed to ACCDC: (506) 364-2657, with questions on Species at Risk regulations to: Samara Eaton, Canadian Wildlife Service (NB and PE): (506) 364-5060 or Julie McKnight, Canadian Wildlife Service (NS): (902) 426-4196.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in New Brunswick, please contact Stewart Lusk, Natural Resources: (506) 453-7110.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in Nova Scotia, please contact Sherman Boates, NSDNR: (902) 679-6146.

For provincial information about rare taxa and protected areas, or information about game animals, fish habitat etc., in Prince Edward Island, please contact Rosemary Curley, PEI Dept. of Agriculture and Forestry: (902) 368-4807.

2.0 RARE AND ENDANGERED SPECIES

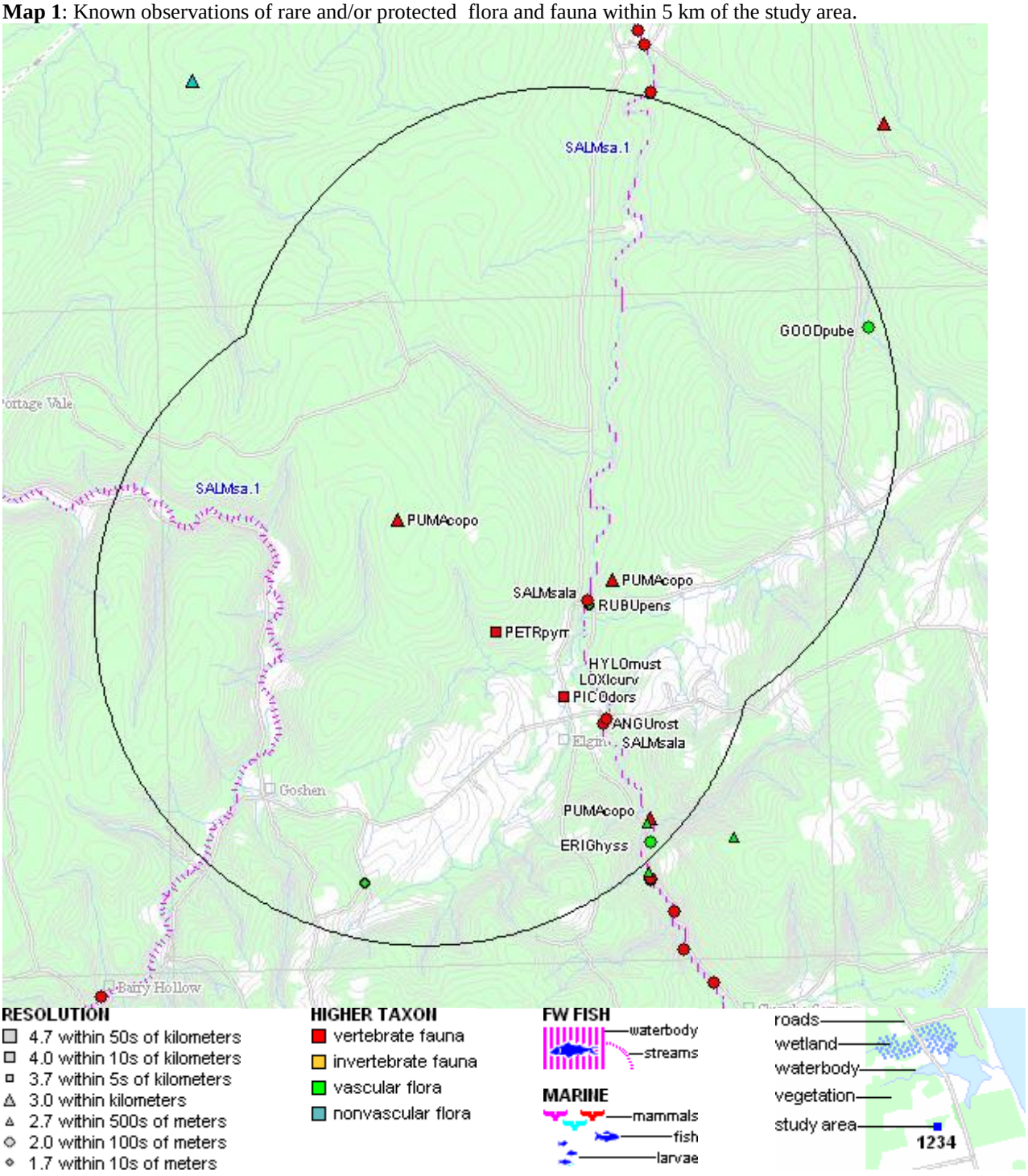
2.1 FLORA

A 5 km buffer around the study area contains 5 records of 5 vascular, 0 records of nonvascular flora (Map 1 and attached: *ob.xls).

2.2 FAUNA

A 5 km buffer around the study area contains 15 records of 8 vertebrate, no records of invertebrate fauna (Map 1 and attached data files - see 1.1 Data List). Sensitive data: Records indicate Wood Turtle may be present in the study area but concerns about commercial exploitation preclude inclusion of relevant data in this report. See attached file WOTU.pdf for general species information.

Map 1: Known observations of rare and/or protected flora and fauna within 5 km of the study area.

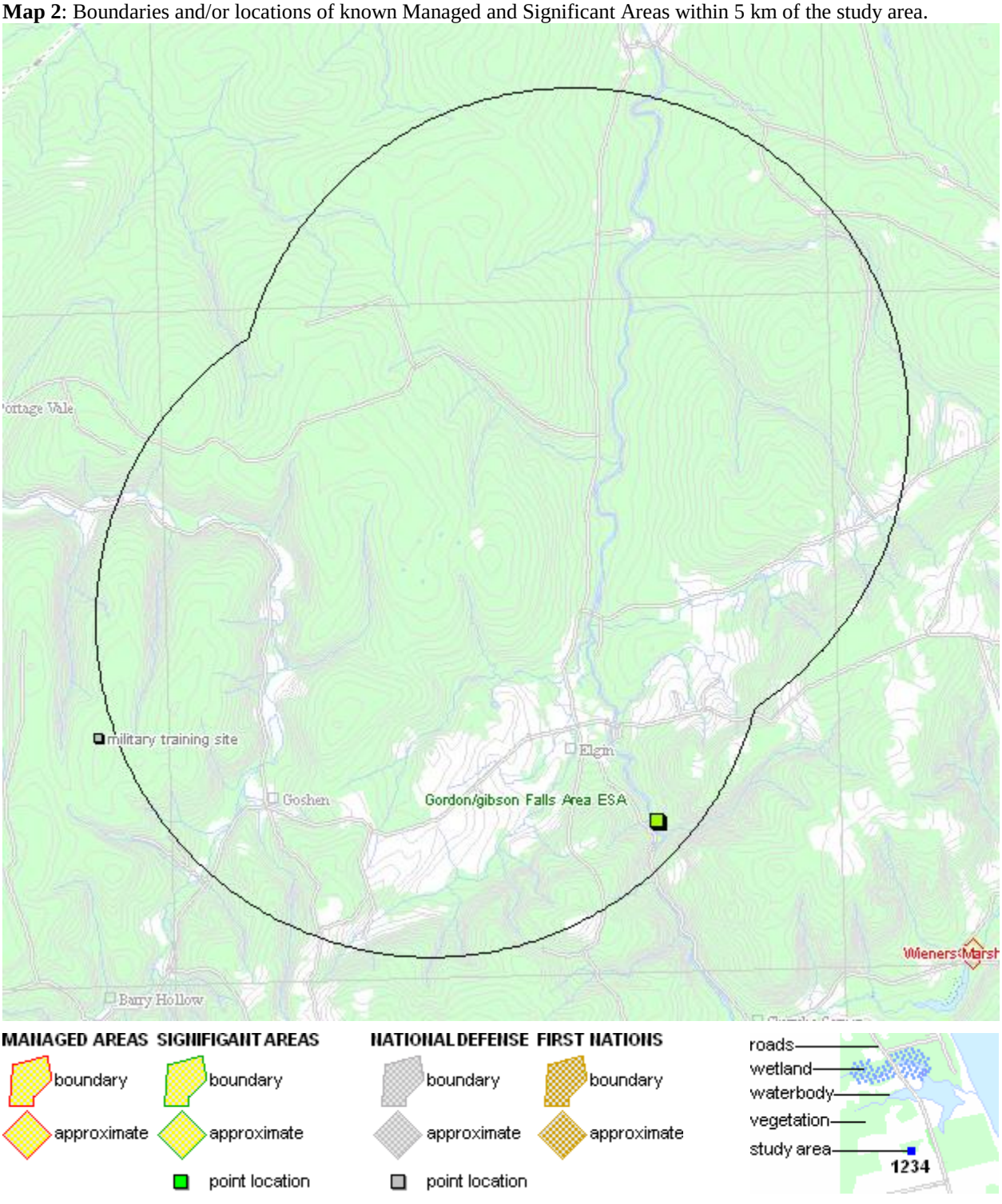


3.0 SPECIAL AREAS

3.1 MANAGED AREAS
The GIS scan identified no managed areas in the vicinity of the study area (Map)

3.2 SIGNIFICANT AREAS
The GIS scan identified 1 biologically significant site in the vicinity of the study area (Map 2 and attached file: *sa*.xls)

Map 2: Boundaries and/or locations of known Managed and Significant Areas within 5 km of the study area.



4.0 RARE SPECIES LISTS

Rare and/or endangered taxa within the buffered area listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation. [P] = vascular plant, [N] = nonvascular plant, [A] = vertebrate animal, [I]= invertebrate animal, [C] = community.

4.1 FLORA

	Scientific Name	Common Name	COSEWIC	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
P	*Goodyera pubescens*	Downy Rattlesnake-Plantain			S1	May Be At Risk	1	6.2 ± 0.1
P	*Juncus vaseyi*	Vasey Rush			S2	Sensitive	1	5.2 ± 0.1
P	*Rubus pensilvanicus*	Pennsylvania Blackberry			S2?	Secure	1	1.7 ± 0.03
P	*Erigeron hyssopifolius*	Hyssop-leaved Fleabane			S3	Secure	1	4.9 ± 0.5
P	*Corallorhiza maculata*	Spotted Coralroot			S3S4	Sensitive	1	5.7 ± 0.01

4.2 FAUNA

	Scientific Name	Common Name	COSEWIC	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
A	*Salmo salar pop. 1*	Atlantic Salmon - Inner Bay of Fundy pop.	Endangered		S2	May Be At Risk	1	1.3 ± 0
A	*Salmo salar pop. 7*	Atlantic Salmon - Outer Bay of Fundy pop.	Endangered		S2	May Be At Risk	2	3.5 ± 0
A	*Hylocichla mustelina*	Wood Thrush	Threatened		S1S2B	May Be At Risk	1	2.7 ± 5.0
A	*Anguilla rostrata*	American Eel	Threatened		S5	Secure	1	3.3 ± 0.1
A	*Puma concolor pop. 1*	Cougar - Eastern pop.	Data Deficient	Endangered	SU,SH	Undetermined	3	1.7 ± 1.0
A	*Salmo salar*	Atlantic Salmon			S2	May Be At Risk	4	1.6 ± 0.1
A	*Loxia curvirostra*	Red Crossbill			S3	Secure	1	2.7 ± 5.0
A	*Picoides dorsalis*	American Three-toed Woodpecker			S3?	Sensitive	1	2.7 ± 5.0
A	*Petrochelidon pyrrhonota*	Cliff Swallow			S3S4B	Sensitive	1	1.6 ± 5.0

5.0 SOURCE BIBLIOGRAPHY

The recipient of this data shall acknowledge the ACCDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

# recs	CITATION
5	Epworth, W. 2012. Species at Risk records, 2009-11. Fort Folly Habitat Recovery Program, 162 recs.
4	Erskine, A.J. 1992. Maritime Breeding Bird Atlas Database. NS Museum & Nimbus Publ., Halifax, 82,125 recs.
3	Scott, Fred W. 1998. Updated Status Report on the Cougar (Puma Concolor couguar) [Eastern population]. Committee on the Status of Endangered Wildlife in Canada, 298 recs.
1	Basquill, S.P. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre, Sackville NB, 69 recs.
1	Benedict, B. Connell Herbarium Specimen Database Download 2004. Connell Memorial Herbarium, University of New Brunswick. 2004.
1	Benedict, B. Connell Herbarium Specimens (Data) . University New Brunswick, Fredericton. 2003.
1	Blaney, C.S.; Spicer, C.D.; Mazerolle, D.M. 2005. Fieldwork 2005. Atlantic Canada Conservation Data Centre. Sackville NB, 2333 recs.
1	Steeves, R. 2004. Goodyera pubescens occurrence from Colpitts Brook, Albert Co. , Pers. comm. to C.S. Blaney. 1 rec.
1	Cowie, F. 2007. Electrofishing Population Estimates 1979-98. Canadian Rivers Institute, 2698 recs.
1	Dept of Fisheris & Oceans. 2001. Atlantic Salmon Maritime provinces overview for 2000. DFO.
1	Cowie, F. 2007. Electrofishing Population Estimates 1979-98. Canadian Rivers Institute, 2698 recs.