MCCULLY
PHASED ENVIRONMENTAL IMPACT ASSESSMENT

PHASES I AND II: NATURAL GAS EXPLORATION AND DEVELOPMENT AT WELL PAD F-67

Submitted to:

Corridor Resources Inc.
Halifax, Nova Scotia

Submitted by:

AMEC Environment & Infrastructure,

A Division of AMEC Americas Limited
Fredericton, New Brunswick

October 2013

TE131040

EXECUTIVE SUMMARY

Under a Phased Environmental Impact Assessment (EIA), Corridor Resources Inc. (Corridor) is proposing to conduct natural gas exploration and development in the McCully Field at an existing natural gas well pad, F-67, in two consecutive Phases: expansion of the well pad to its previous 2007 expansion size (Phase I) and subsequently conduct drilling, fracture stimulation, and production activities at that location (Phase II). The Project is considered an undertaking subject to phased approval under the EIA Regulation of the *Clean Environment Act*. The Project activities are also subject to the *Rules for Industry for the Responsible Environmental Management of Oil and Natural Gas Activities in New Brunswick*. Corridor has retained the services of AMEC Environment & Infrastructure (E&I), a division of AMEC Americas Limited (AMEC) to prepare this Phase I and II EIA report in support of the registration of the Project under the EIA process. Future phases of this McCully EIA could include any oil and gas related exploration, development and production at existing or new well pads or areas within the McCully Field.

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 in 2006 and 2007. The Valued Environmental Components (VECs) identified by issue scoping and pathway analysis (see Section 5.0) for which potential effects may be a concern included:

- Ambient air quality;
- Hydrology / hydrogeology;
- Species at Risk and wildlife;
- Migratory birds;
- Residential land use; and
- Heritage and archaeological resources.

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 identified measures intended to mitigate potential environmental concerns, and provided a discussion of potential residual effects resulting from the proposed Project.

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

TABLE OF CONTENTS

PAGE

PAGE

LIST OF TABLES

TABLE OF CONTENTS (cont'd)

PAGE

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ACRONYMS

ACCDC	Atlantic Canada Conservation Data Centre
AMEC	AMEC Environment & Infrastructure, a division of AMEC Americas Limited
AQOs	Air Quality Objectives
ARD	Acid Rock Drainage
ARM	Air Resources Manager
ASNB	Archaeological Services New Brunswick
CAPP	Canadian Association of Petroleum Producers
CCME	Canadian Council of Ministers of the Environment
CDWQ	Canadian Drinking Water Quality
CIHB	Canadian Inventory of Historic Buildings
CLC	Community Liaison Committee
CNR	Canadian National Railway
CO	Carbon monoxide
CO_2	Carbon dioxide
Corridor	Corridor Resources Inc.
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
ECC	Environmental Components of Concern
EEM	Environmental Effects Monitoring
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
ESAs	Environmentally Significant Areas
FUNA	Forest Unit Name
GHG	Greenhouse Gas
GIS	Geographic Information System
GPS	Global Positioning System
HRIA	Heritage Resource Impact Assessment
HSE	Health, Safety and Environment
LPG	Liquid Propane Gas
LSD	Local Service Districts
MBCA	*Migratory Birds Convention Act*
MgO	Magnesium oxide
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
NBENV	New Brunswick Department of the Environment
NBEUB	New Brunswick Energy and Utilities Board
NBNGG	New Brunswick Natural Gas Group
NBOHSA	*New Brunswick Occupational Health and Safety Act*
NBSRA	*New Brunswick Species at Risk Act*
NFPA	National Fire Protection Association
NO	Nitric oxide

NO_2	Nitrogen dioxide
NRCan	Natural Resources Canada
O_3	Ozone
OSFH	Old Spruce-Fir Habitat
OSHA	Occupational Safety and Health Association
OHSA	New Brunswick *Occupational Health and Safety Act*
OWL	Online Well Log
PID	Property Identification Number
PM	Particulate Matter
POL	Petroleum, Oil, Lubricants
PotashCorp	Potash Corporation of Saskatchewan Inc. – New Brunswick Division
RCMP	Royal Canadian Mounted Police
RKB	Rotary Kelly Bushing
SARA	*Canadian Species at Risk Act*
SARPR	Species at Risk Public Registry
SBM	Synthetic oil-based drilling fluid
SO_2	Sulphur Dioxide
TD	Total Depth
TDS	Total Dissolved Solids
the Agency	Canadian Environmental Assessment Agency
UNBI	Union of New Brunswick Indians
VECs	Valued Environmental Components
WBM	Water-based drilling fluid
WHMIS	Workplace Hazardous Materials Information System
WL	Wireline

LIST OF UNITS

cm	Centimetre
dBA	Decibels
ha	Hectares
km	Kilometre
km^2	square kilometres
L	Litres
Leq	energy equivalent sound level
m	Metre
m^2	square metres
m^3	cubic metres
mg/L	milligrams per litre
mm	Millimetre
mt	metric tonne
Mt	Megatonne
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

In 2006, Corridor Resources Inc. (Corridor), an Eastern Canada company, submitted a Stage 2 Development Plan for the McCully Field as a whole. Under that Plan and subsequent updates to it, Corridor is proposing to conduct exploration and development within the McCully Field (the Project). The Project is considered an undertaking and is subject to approval under the *Environmental Impact Assessment Regulation* of the New Brunswick *Clean Environment Act* and is further subject to the requirements as described in the Rules for Industry under the Responsible Environmental Management of Oil and Natural Gas Activities in NB (Rules for Industry).

This ongoing McCully Project will be conducted under a phased Environmental Impact Assessment (EIA) process, the first two of which have been assessed within this document. The Phases are described as follows:

- Phase I: Expand the existing well pad, F-67, by approximately 5260 square metres (m^2) to the size of its previous 2007 expansion.
- Phase II: Drill a new exploration/development well, conduct work-overs, fracture stimulate both the new well and an existing well (E-67B) on that well pad using Liquid Propane Gas (LPG), tie both wells into the existing gathering system and flow propane into the gathering system.
- Additional Phases: Depending on the results of Phase II, other oil and gas exploration, development and production activities may be conducted in the future within the McCully Field.

AMEC Environment & Infrastructure (E&I), a division of AMEC Americas Limited (AMEC) was retained by Corridor to provide environmental and engineering consulting services and to prepare this Environmental Impact Assessment (EIA) report in support of the registration of the Project under the NB EIA process.

1.1 Background

Corridor has been producing natural gas from the McCully Field since 2003 to its partner Potash Corporation of Saskatchewan, New Brunswick Division (PotashCorp). In addition, Corridor has submitted a Stage 2 Development Plan for the McCully Field as a whole in 2006. In June 2007, after undergoing EIA and Energy and Utility Board (EUB) processes and following construction of a field gathering system, a gas plant, and a pipeline lateral, the McCully Field was connected to markets through the Maritimes and Northeast Pipeline. Over time other wells were developed and tied into the gathering system, with each new well/well pad tie-in and section of gathering system undergoing EIA and EUB review and approvals.

Corridor is in the early stages of assessing the commercial potential for shale gas development in the Sussex and Elgin sub-basins. In addition, Corridor has contingent resources and discovered shale gas resources in Elgin, NB. Several McCully wells have been drilled to varying depths within the Frederick Brook Shale formation to evaluate its potential as a future

source of natural gas production. A significant amount of technical information has been gathered for the shale sections penetrated to date in these wells. Expansion of the F-67 well pad would enable Corridor to further enhance production through activities such as in-fill drilling, exploration drilling, and fracture stimulation, within both the Hiram Brook Sands and the Frederick Brook Shale formations at one location.

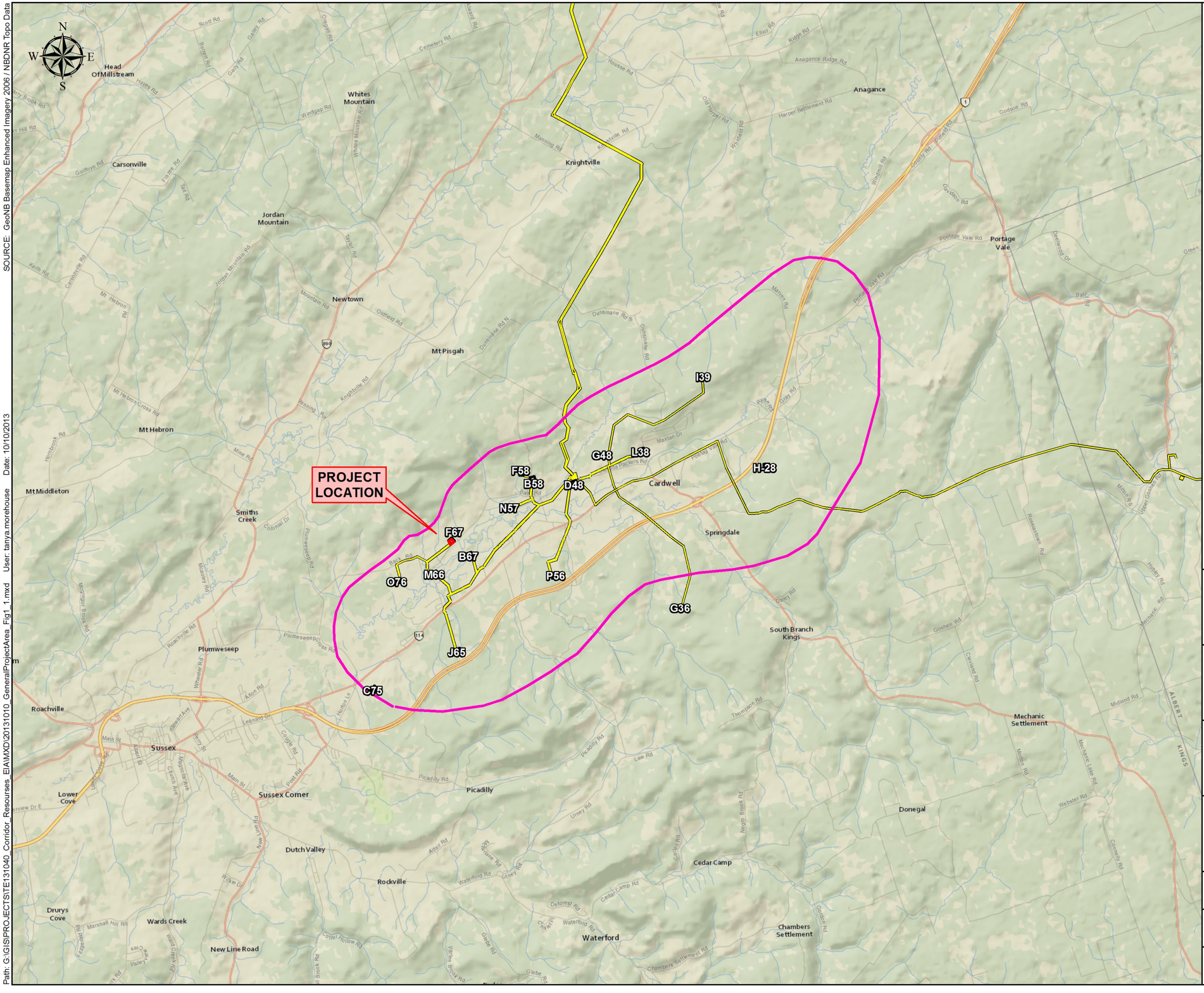
The F-67 well pad is located within the McCully Field, on Back Road in Penobsquis, Kings County, New Brunswick (NB) (Figure 1.1). The well pad was constructed in 2005, expanded in 2007, and reduced to its original and current size in 2008. Downsizing of the well pad was conducted, whereby a portion of the property, approximately 5260 m^2 on the west, was remediated and released back to the property owner. The F-67 well pad has four existing drilled wells (J-67, G-67, E-67B, and C-67) on it. Three of these wells, J-67, G-67 and C-67, are currently connected to the gathering system and ultimately the Maritimes and Northeast Pipeline.

The current Project for which Corridor has prepared this Phase I and II EIA, will entail the following: Phase I - expansion of the F-67 well pad to its previously expanded 2007 dimensions (see Figure 1.2); and Phase II - drilling of a new well, work-over of E-67B, LPG fracture stimulation of both the new well and the existing E-67B, tie-in of E-67B and the new well to the existing gathering system and flow of some propane into the pipeline.

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 Project is to expand an existing well pad to make it suitable for further access to explore both the Hiram Brook Sands and the Frederick Brook shale formations, as well as to access an additional gas supply for Corridor and PotashCorp. Expanding an existing well pad onto an area that was already once used as a well pad will minimize effects in comparison to new construction. The increased use of natural gas was recently recommended by the NB Energy Board as an alternative resource to electricity (Canadian Press, 2011). The use of LPG will minimize the use of water and the production of wastewater for disposal during the fracture stimulation process.



Path: G:\GIS\PROJECTS\TE131040_Corridor_Resourses_EIA\MXD\20131010_GeneralProjectArea_Fig1_1.mxd User: tanya.morehouse Date: 10/10/2013

SOURCE: GeoNB Basemap Enhanced Imagery 2006 / NBDNR Topo Data

LEGEND:

McCully Field Closure Boundary

F-67 Well Pad

2,000 1,000 0 2,000 4,000 Meters

1 cm = 1,000 metres

The map shown here has been created with all due and reasonable care and is strictly for use with AMEC Project Number: Corridor Resources 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. AMEC assumes no liability, direct or indirect, whatsoever for any such third party or unintended use.

CLIENT:

CORRIDOR RESOURCES

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:

ENVIRONMENTAL IMPACT ASSESSMENT:
NATURAL GAS EXPLORATION AT F-67

TITLE:

WELL PAD F-67
OVERVIEW PROJECT AREA

DATUM:	DWN BY:	DATE:
NAD 83 CSRS	TM	Oct 10, 2013
PROJECTION:	CHK'D BY:	SCALE:
New Brunswick Stereographic	CT / JB	1:100,000
PROJECT NO:	REV NO:	FIGURE NO:
TE131040		1.1

LEGEND:

- Existing Well
- Gathering System
- Existing Well Pad Footprint
- Proposed Well Pad Footprint Expansion

N
W E
S

20 10 0 20 40 Meters

1 cm = 10 metres

The map shown here has been created with all due and reasonable care and is strictly for use with AMEC Project Number: Corridor Resources 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. AMEC assumes no liability, direct or indirect, whatsoever for any such third party or unintended use.

CLIENT:

CORRIDOR RESOURCES

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:

ENVIRONMENTAL IMPACT ASSESSMENT:
NATURAL GAS EXPLORATION AT F-67

TITLE:

WELL PAD F-67
PROJECT SITE DESCRIPTION

DATUM:	DWN BY:	DATE:
NAD 83 CSRS	TM	Sept 26, 2013
PROJECTION:	CHK'D BY:	SCALE:
New Brunswick Stereographic	CT / JB	1:1,000
PROJECT NO:	REV NO:	FIGURE NO:
TE131040		1.2

Path: G:\GIS\PROJECTS\TE131040_Corridor_Resourses_EIA\MXD\20130926_ProjectSiteDescripton_Fig1_2.mxd User: tanya.morehouse Date: 26/09/2013

SOURCE: GeoNB Basemap Enhanced Imagery 2006 / NBDNR Topo Data

1.3 Regulatory Framework

The construction, 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.

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 construction and operation 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.

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 (NB Natural Gas Group (NBNGG), 2013)		Rules to support NB's ongoing management of oil and gas activities in an environmentally responsible manner.	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 97--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)*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
(x) *Topsoil Preservation Act* – Regulation 95-66 under *Topsoil Preservation Act*	S.3 (1) (Reg)	Permit required for removal of topsoil from a site.	Minister of the Department of Agriculture and Aquaculture and Fisheries (NBDAAF)
(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 *Act*.	NB Department of Public Safety

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

Acts or Regulations	Section	Requirement	Department or Agency
(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
(xiv) *Pipeline Act, 2005*	29.1-29.6 30.1-30.4	Take all necessary precautions for ground disturbance over or near pipeline. Pipeline will require inspection by NBEUB.	NB Energy and Utilities Board (NBEUB)
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

2.0 PROJECT DESCRIPTION

2.1 Phase I: F-67 Well Pad Expansion Activities

The existing F-67 well pad will be expanded from 14844 m^2 to 21619 m^2 to accommodate planned 2014 and future operations. The expansion by an approximate 5086.7 m^2 area will return the well pad to its 2007 expanded size in order to accommodate planned 2014 and future operations. Corridor anticipates expanding the well pad in the October 2013 timeframe so that earthworks may be completed before frost is established in the ground.

The well site was previously constructed in 2005 on privately-owned land, property identification number (PID) 00132571. It was then expanded in 2007 to 21619 m^2. The expansion area was remediated and returned to the landowner in 2008.

The F-67 well pad is located on agricultural land, outside the floodplain. In order to build the well pad to the required dimensions, the expansion area will be topped up with fill and leveled with heavy equipment, such as bulldozers and excavators to match the height and stability of the existing pad. If the native soil is not sufficient to handle heavy loads, additional gravel will be brought to location to provide support for the loads. As per the new Rules for Industry, Corridor will submit the proposed design of the well pad for approval prior to well pad expansion.

The F-67 well site has an existing access road off Back Road which will not require modification. The main route to get to the well pad is to take Exit 211 (Fundy Park Road) off Highway 1, then McCully Station Road to Back Road. This stage of the Project will take approximately two weeks to complete.

2.2 Phase II: Drilling, Completion, Fracture Stimulation, Tie-in and Production at F-67

2.2.1 Drilling of New Natural Gas Well Activities

An infill well (yet unnamed) will be drilled and completed on the F-67 well pad. The well will be drilled into the upper Frederick Brook Shale formation in order to obtain better understanding of the shale's long term production potential and to provide a new and sustainable gas supply for Corridor and PotashCorp.

The process of drilling a well is done in sections. Each section of the well starts with the drilling of a hole to a predetermined depth as indicated in Table 2.1. Once this depth has been reached, a steel pipe (casing) is placed in the wellbore and cemented in place. The next section of the well will start with a smaller size hole and casing will be installed when the total depth is reached. This will continue until the final depth of the well is reached, with each successive casing string cemented in place.

The sections for the planned well and anticipated depths are listed in Table 2.1.

Table 2.1 Description of Hole and Casing Sizes

Hole Section	Hole Size (mm)	Casing Size (mm)	Setting Depth (m RKB)	Drilling Fluid Type	Top of Cement
Conductor	660	473	+/- 30	Fresh Water	Cemented to surface
Surface Hole	444.5	339.7	+/- 250	Fresh Water Gel (Bentonite)	Cemented to surface
Intermediate Hole	311.2	244.5	+/- 2500	Synthetic Oil Based Drilling Fluid	Cemented to surface
Main Hole	216	139.7	+/- 3450	Synthetic Oil Based Drilling Fluid	50 m + above intermediate casing shoe

Note: RKB = Rotary Kelly Bushing point of reference for depth measurements

A drill bit on the end of a string of threaded drill pipe is used to cut the formation rock, creating a well bore. Drilling fluid is circulated down the drill pipe and through the drill bit. The fluid returns to the surface via the annulus between the drill pipe and the well bore wall, carrying with it the drill cuttings, as illustrated in Figure 2.1.

The cuttings are removed from the drilling fluid in a series of successive separation stages that may use shakers and/or centrifuges. The cuttings are usually then mixed with wood chips to absorb any remaining drilling fluid. The cuttings and wood chip mixture is loaded onto a truck to be transported to an approved offsite disposal facility. Drilling fluid is recovered and reconditioned for reuse in the closed loop system as much as possible. All cuttings and drilling fluid are contained on location within temporary steel tanks until sent for disposal. Water-based drilling fluid (WBM) can be reused on several wells before being recycled. Synthetic oil-based drilling fluid (SBM) can be reused on many wells.

For the planned well, WBM is planned for the surface hole and SBM is planned for the main hole sections. The surface hole uses WBM, which contains materials similar to those that a conventional water well driller would use, such as fresh water and bentonite clay for viscosity. This system is used to protect the groundwater aquifers while drilling through them. The surface hole section will be cased and cemented prior to drilling the main sections. SBM will be used on the main sections to reduced torque and drag, improve well bore stability and obtain better hole cleaning.

The total volume of cuttings and fluids for this well will be dependent upon the wellbore depth and drilling conditions encountered. The anticipated volumes for the planned well are:

- WBM drill cuttings – 150 m³
- SBM drill cuttings – 1,000 m³

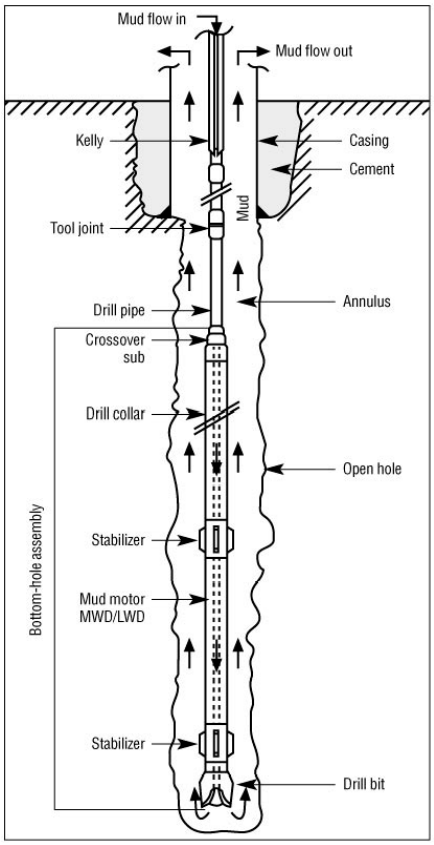


Figure 2.1 Well Diagram Showing Drilling Fluid and Cuttings Returns (Source: Canadian Association of Petroleum Producers (CAPP) 2001)

Flaring is not planned while drilling. However, flaring may be necessary, if there are small amounts of gas in the rock that is drilled in the wellbore (trip gas) or in the case of a well control event.

Planned activities will consist of:

- move in and rig up drilling rig and ancillary equipment;
- drill surface hole;
- run and cement surface casing;
- drill out and perform formation integrity test;
- drill intermediate hole;
- run and cement intermediate casing;

- evaluate cement placement behind intermediate casing;
- drill out and perform formation integrity test;
- drill production hole;
- wireline (WL) evaluation logging;
- run and cement production casing;
- evaluate cement placement behind production casing; and
- rig down and move rig.

General site components will consist of:

- drilling rig, including pipe racks and drilling fluids storage;
- blow out preventers;
- wellhead;
- drill bits and miscellaneous tools;
- pipe and pipe storage;
- Security / First Aid trailer at site entrance;
- portable toilet facilities;
- portable light towers;
- three (3) to four (4) wellsite office trailers;
- cement storage and mix water tanks; and
- other typical Contractor equipment as and when required (cementing unit, logging unit, etc).

2.2.2 Re-entry and Re-completion of E-67B Well

Once the new infill well (yet unnamed) has been drilled, the drilling rig will be moved to the E-67B well. The existing E-67B well was drilled vertically to 4130 m in 2008, of which 2709 m was cased and cemented to isolate the B sand. After perforation, drilling fluid recovery and testing, the well was suspended in January 2009. The activities that are expected to take place during this stage of the work are as outlined below:

Planned activities will consist of:

- move in and rig up drilling rig and ancillary equipment;
- run in with bit to Total Depth (TD) to condition well bore;
- run and cement production casing;
- evaluate cement placement behind production casing; and
- rig down and move rig.

NOTE: There is no plan to extend the depth of the existing wellbore.

General site components will consist of:

- drilling rig including pipe racks and drilling fluids storage;
- blow out preventers;
- wellhead;

- drill bits and miscellaneous tools;
- pipe and pipe storage;
- Security / First Aid trailer at site entrance;
- portable toilet facilities;
- portable light towers;
- three (3) to four (4) wellsite office trailers;
- cement storage and mix water tanks; and
- other typical Contractor equipment as and when needed.

2.2.3 Well Preparation

Completion and well preparation activities commence after the well has been drilled to its planned depth and the drilling rig has been removed from location. Two Hiram Brook and three Frederick Brook LPG fracture treatments are planned in order to stimulate the new well. Five (5) LPG fracture treatments are to be conducted in the existing E-67B well. Fracture stimulation will be conducted at vertical depths of 2400 m to 3400 m. This stage of the Project will take approximately one and a half months to complete during July and the first half of August, 2014.

Completion activities include:

- wellbore pressure testing;
- wellhead preparation and 'frac' valve and frac tree installation and testing;
- casing scraper and wellbore blow down with coiled tubing and nitrogen;
- WL perforation;
- 'frac' tree installation and testing;
- LPG fracture treatment;
- run WL set bridge plug;
- repeat perforation, fracture treatment, plug set for all zones;
- coiled tubing drill out of all bridge plugs;
- flow test the well to recover LPG and to evaluate the effectiveness of the treatments;
- run production tubing; and
- install wellhead and tie in well to production facilities.

2.2.3.1 Wellbore Pressure Testing

After the well has been drilled, cased and cemented, 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 hydraulic 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 kPa greater than the anticipated maximum working pressure.

2.2.3.2 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.

2.2.3.3 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 circulated from the well with nitrogen gas. The well is then ready for perforating.

2.2.3.4 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 to 3,500 kPa greater than the maximum expected pressure that is anticipated to be reached during hydraulic fracture stimulation operations.

2.2.3.5 Wireline Perforating

Perforating is the process where 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 hydraulically fracture stimulated.

2.2.4 Fracture Stimulation Treatment

Well stimulation will be conducted using the method of hydraulic fracture treatments, whereby the process of initiating and subsequently propagating a fracture in reservoir rock employs the pressure of a fluid as the source of energy. Fractures that are hydraulically 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 grains of natural or ceramic sand

that will prevent the fractures from closing under sub-surface pressure once the injection is stopped.

Unconventional gas reservoirs made up of tight sands or shales have very low natural permeability to flow and hydraulic fracture stimulation is needed to produce hydrocarbons at commercial rates.

Components to be used during hydraulic fracture stimulation operations 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 ea) and transport equipment (350 m^3 to 600 m^3 per frac (15 to 20 trucks)
- sand storage and transport equipment (50 - 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 - 80 m^3);
- pressure vessel / test separator(s);
- surface transfer and treatment piping;
- heaters; and
- flare stack.

2.2.4.1 Treatment Fluid and Additives

Corridor intends to use LPG as a fluid for this program. The LPG will use only three chemical additives: a gellant; an activator; and a breaker in small dosages (4 – 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.

Hydraulic fracture stimulation operations involve many pieces of equipment and a number of activities for each zone of interest. See Figure 2.2 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.

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 m^3 - 600 m^3 per fracture treatment, for an estimated 6000 m^3 total.
- Proppant (frac sand): 50 - 100 mt per fracture treatment, for an estimated 800 mt total; and
- Liquid Nitrogen: 2,000 L (1 truck).

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

2.2.4.2 Methodology

The hydraulic fracture stimulation 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.

<u>Pump a Minifrac</u>

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.

Figure 2.2 Typical Layout of Fracture Stimulation Equipment in NB

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.

Displacement

Once the entire programmed volume of fluid and sand has been pumped into the wellbore at 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 hydraulically fractured 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 this Project, 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.

2.2.5 Well Completion and Production

2.2.5.1 Coiled Tubing Drilling of Frac Isolation Plugs

After all of the zones of interest have been fracture stimulated, the composite frac plugs are drilled out to allow the stimulation fluid to be recovered and to permit all of the zones to be tested for production potential.

The plugs are made of a composite material that allows them to be easily drilled, using a coiled tubing unit with a down hole motor and bit.

2.2.5.2 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 and disposal. As soon as practical, all well production will be directed inline to Corridor's gas plant for processing and sales.

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 pollution. Any produced water is to be collected and trucked offsite for disposal by third party waste management company.

When flowing back LPG, there are several considerations that effect 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 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.

2.2.5.3 Well Completion - Snub Production Tubing

After production testing has been completed, production tubing will be installed in the wellbore with a hydraulic snubbing unit if required. The frac valves / tree will be removed and replaced with a permanent wellhead top section.

2.2.5.4 Well Completion - Production Tie-in

The E-67B well and the new well will be tied-in to produce natural gas to the field gathering system. The wells, as with every well in production, will be equipped with necessary safety devices to properly and safely operate the well; and comply with all applicable codes and standards outlined through the New Brunswick Energy and Utilities Board (NBEUB). The wells will be equipped with individual emergency shut-offs and metering devices as part of the production tie-in. To minimize flaring during testing, temporary tie-in from the production testing package will be connected to the existing gathering system until permanent production lines can be installed. The construction of the tie-in piping, equipment, and installation is subject to NBEUB inspection prior to commencing production into the existing gathering system.

2.2.6 Project Schedule

The Project activities have been scheduled as follows:

Phase I:

- Re-expansion of F-67 well pad: October 2013, for an estimated two weeks.

Phase II:

- Drilling of new well: Mid-March to Mid-June, 2014, for an estimated three months;
- Re-entry, run and cement production casing on E-67B: Mid-to-Late June 2014, for an estimated two weeks;
- LPG Fracture Treatments of E-67B and the new well: Early July to Mid-August, 2014, for an estimated one and a half months
- Run production tubing and complete well: Late August to Mid-September 2014, for an estimated two weeks; and
- Construct and tie-in to field production gathering system: expected to be completed during the month of October 2014, for an estimated four to six weeks.

2.2.7 Decommissioning and Abandonment Activities

The decommissioning and abandonment of the well site will take place when the site is no longer required for oil and gas exploration and production. This will be included in a future Phase of the EIA. The site will be restored in such a manner that its capability to support different land uses is similar to its pre-construction capability.

Prior to commencement of the well pad expansion, a pre-construction site assessment will be carried out to provide a baseline assessment of the landscape, soils, and vegetation and to provide a guide and measure for future restoration.

Specific activities related to the decommissioning and abandonment of the well site will be managed in accordance with the requirements of the Rules for Industry (NBNGG, 2013), Section 9.12: Site Restoration, Section 9.13: Site Remediation Standards for Contaminants, and the New Brunswick Oil and Natural Gas Operating Standards for Well Exploration, Development and Production: Part IX – Abandonment of Wells.

Site decommissioning will comply with that described by Appendix 17 of the Rules for Industry (NBNGG, 2013) and other legislative standards to ensure that the site will be left clean and safe. Where necessary, groundwater and/or soils testing will be undertaken to ensure that the site is free of contamination from exploratory activities. If related activity contamination is discovered, the site will be remediated to meet all applicable regulatory requirements.

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 are 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.

The impact assessment focused 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 Study, the temporal bounds have been categorized as two Phases:

- Phase I: well pad expansion; and
- Phase II: drilling and completion, fracture stimulation, tie-in and production.

Spatial bounds for the Project effects on most VECs typically include the immediate environs of the Project Footprint, the access road, 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 Agency guidance document Responsible Authority's Guide (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 and size of the well pad; and
- biophysical setting.

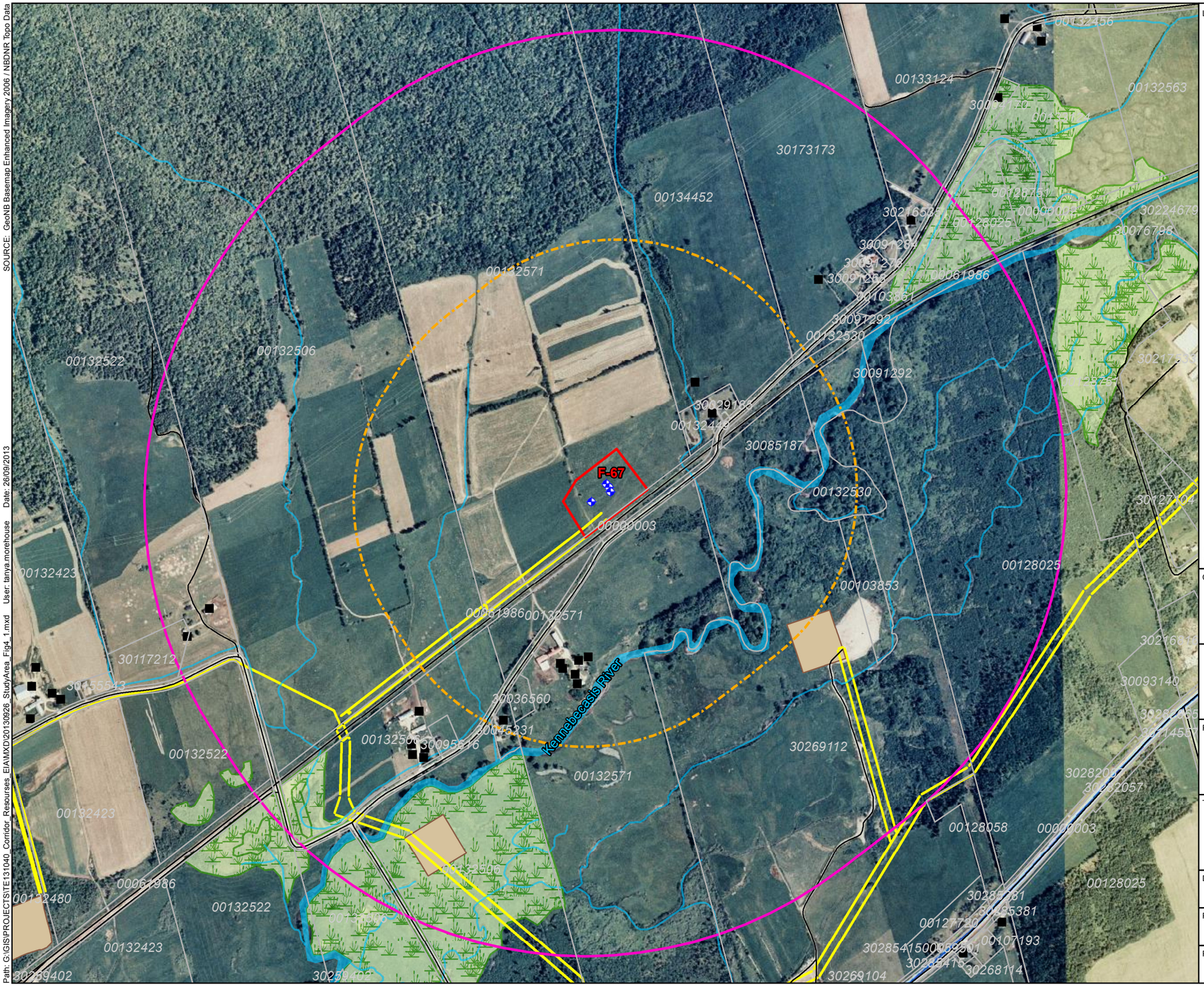
The Study Area takes into consideration the area covered by the Project Footprint as well as a 1 km buffer around it (Figure 4.1). Downstream areas of the airshed and watershed are also included, with increasing priority placed on those areas in close proximity to the Project.

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, 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.



LEGEND:

- Existing Well
- Buildings
- F-76 Well Pad 1km Study Area
- F-67 Well Pad 500m Well Water Quality Survey Buffer
- Gathering System
- NB DNR Transportation
- NB DNR Watercourse
- NB DNR Waterbody
- NB DNR Wetland
- Proposed F-67 Well Pad Footprint
- Corridor Well Pads
- SNB Property Boundary
  Kings County

N W E S

100 50 0 100 200 300 Meters

1 cm = 90 metres

CLIENT:

CORRIDOR RESOURCES

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:

ENVIRONMENTAL IMPACT ASSESSMENT:
NATURAL GAS EXPLORATION AT F-67

TITLE:

WELL PAD F-67
PROJECT STUDY AREA

DATUM:	DWN BY:	DATE:
NAD 83 CSRS	TM	Sept 26, 2013
PROJECTION:	CHK'D BY:	SCALE:
New Brunswick Stereographic	CT / JB	1:9,000
PROJECT NO:	REV NO:	FIGURE NO:
TE91043		4.1

SOURCE: GeoNB Basemap Enhanced Imagery 2006 / NBDNR Topo Data Date: 26/09/2013 User: tanya.morehouse Path: C:\GIS\PROJECTS\TE131040_Corridor_Resources_EIA\MXD\20130926_StudyArea_Fig4_1.mxd

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 *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**
Carbon monoxide (CO)	35,000 ppb**	30,000 ppb	15,000 ppb	13,000 ppb				
Hydrogen sulphide	15 ppb	11 ppb			5 ppb	3.5 ppb		
Nitrogen dioxide (NO_2)	400 ppb	210 ppb			200 ppb	105 ppb		52 ppb
Sulphur dioxide (SO_2)***	900 ppb	339 ppb			200 ppb	113 ppb		23 ppb
Total Suspended Particulate					120 ppb	120 ppb		70 ppb

*NBAQO – New Brunswick Air Quality Objectives.
** ppb – parts per billion ($\mu g/m^3$ (micrograms per cubic metres).
*** 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 in Saint John are electronically connected to a system in Fredericton which communicates with each station at least hourly to obtain 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 for the nearest air monitoring station, located in Moncton and St. Andrews, NB.

- **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 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 carbon monoxide 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 an air quality guideline of 210 ppb and 105 ppb per 1 hour and 24 hour averaging periods, respectively. No exceedances of hourly or 24-hour standards for nitrogen dioxide 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)**

Sulphur dioxide 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 is 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)**

Particulate matter 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 in a combination of these two states. 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 micrometres (µm) in diameter (PM_{10}) (NBDELG, 2001). These particles are typical of 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 micrograms per cubic metre (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, 2013). 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 mm, of which 79% is in the form of rain (Environment Canada, 2013).

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 greenhouse gas (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 annual report on GHG emissions in 2009, which showed a decrease of 2.1 percent in Canada's total emissions from 2007 to 2008. This decrease is attributed to both Canada's efforts to use greater amounts of clean energy power generation targeting GHG production, and to the slow-down in economic growth at the end of 2008 (Environment Canada, 2009). 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).

In 2009 Canada signed the Copenhagen Accord, committing to reduce GHG emissions to 607 megatonnes (Mt) by 2020. This represents a 17% decrease from 2005 levels of 731 Mt, which accounted for approximately 2% of the total global GHG presence. Examination of 2010 technical modelling resulted in a 2011 Environment Canada report which projected the 2020 GHG emission level to reach 785 Mt, given existing fuel efficiency regulations for light-duty vehicles, renewable fuels standards and the Emissions Performance Standard for coal-fired electricity. Canada plans to initiate further measures under its Climate Change Plan (Environment Canada, 2012).

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). This area is located within the Kennebecasis River flood plain between long parallel ridges. The following sections describe the visual aesthetics, geology, the potential to encounter seismic activity, areas with acid-generating bedrock; areas of subsidence and soils.

4.3.1 Visual Landscape

The Project will be conducted on an existing Corridor well pad, F-67, which lies in an agricultural field in a low-lying area at the bottom of Mount Pisgah. The well pad is surrounded on all four sides by an earthen berm, and is separated from Back Road by a CNR railway track and a belt of mixed wood trees and shrubbery. An NB Power Corridor runs southwesterly, approximately 400 m north of the Footprint (Figure 4.2).

4.3.2 Bedrock Geology

The bedrock underlying the Study Area is composed of Early Carboniferous formations of the Mabou Group. The Mabou Group is an undivided, reddish brown to red polymetric conglomerate, quartzo-feldspathic sandstone, and mudstone with locally well-developed calcrete. It also consists of minor greenish grey mudstone and sandstone (McLeod and Johnson, 1999).

4.3.3 Potential for Seismic Activity

NB is in an area of low to moderate seismicity, with values ranging from 1.0-6.0 on the Richter Scale (average ~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 are estimated at approximately 300 million years ago. In summary, the potential for seismic activity in the Study Area is low.

Figure 4.2 Existing F-67 Well Pad

Penobsquis 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 recent "felt" earthquake occurred in August 2012, registering at 2.6 MN near St. Andrews (Natural Resources Canada, 2013). 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 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.

Bedrock underlying the Study Area, which is composed mainly of sandstone and conglomerate, has generally low acid-generating potential but may contain small amounts of coal and sulphides of limited area (M. McLeod, pers. comm., 2007). Areas underlain by limestone bedrock have very low acid producing potential.

4.3.5 Mineral Occurrences, Mining Claims, and Aggregate Resources

The main economic minerals occurring in the Study Area 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 cooking purposes. The Project occurs within the PotashCorp Mining Lease.

4.3.6 Soils

Soils in the Study Area are classed as Podzolic (Agriculture Canada, 1989). The majority of the Study Area is covered by a 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 Kennebecasis River lies in a broad floodplain composed of alluvial sand and gravel. There are also some local areas of glacially deposited sand and gravel called “kames” (Rampton *et al.*, 1984). The overburden depth varies greatly, even over short distances, but is generally greater than 2 m (Rampton *et al.*, 1984).

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 1AP as defined by Environment Canada (1986). All surface runoff from this subdivision drains into the Kennebecasis River, which eventually drains into the Saint John River and then into the Bay of Fundy. There are no protected watersheds located within the Study Area (NBDELG, 2013a).

The average annual precipitation in the Study Area as measured in Sussex is 1160.1 mm, of which approximately 245 mm (water equivalence) is in the form of snowfall (Environment Canada, 2011). High seasonal water flows are generally experienced in April and May as a result of snowmelt and groundwater discharge. The stream flow typically decreases through the summer as a result of high evaporation and depleting groundwater storage. Flow typically increases in the fall due to lower temperature and reduced evaporation.

4.4.2 Surface Water Quality

Surface water quality in the Study Area is dependent primarily on geology, watershed size, topography and vegetation. The chemical quality of watercourses in NB is generally excellent for human consumption. Calcium bicarbonate-type waters predominate, although mixed chemical influences are known to occur in the Province (Environment Canada, 1989). Total Dissolved Solids (TDS) concentrations in the lower Saint John River Basin are typically low to moderate, ranging from 17 to 115 milligrams per litre (mg/L) (Environment Canada, 1989). The headwaters of the Kennebecasis River are characterized as low in calcium carbonate.

4.4.3 Watercourses

The proposed site is loosely bounded to the east and west by two mapped watercourses that flow from Mount Pisgah south to the Kennebecasis River (Figure 4.1). The western watercourse was assessed in 2006 for the Gathering Line EIA and given the designation of WC-64 (AMEC, 2006). At that time, it was determined that no channel was present.

The tributary to the east of the Project Footprint, which runs southwards towards Back Road, is located approximately 200 m from the western edge of the existing F-67 well pad lease, whose border will not be changed during well pad expansion on the east (Figure 1.2). Upon reaching the north side of Back Road, the watercourse channel takes a sharp turn east, following a man-made diversion along the CNR railway ditch to reach the culvert running beneath Back Road. This diversion east brings the watercourse channel within approximately 130 m of the eastern border of the lease before resuming its path southwards beneath Back Road and into McLeod Brook. This watercourse is ephemeral in nature and monitoring possibilities may be dependent on the quantity of water present at any given time of year.

4.4.4 Groundwater Quantity

There are no wellfield protection areas located within the Study Area; the nearest presently being the Penobsquis Wellfield on Fundy Park Road (NBDELG, 2013b), approximately 7 km from the Project. 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. The Penobsquis Wellfield is the source for a municipal supply that was developed and commissioned in 2009. The source is a 60 gpm well located adjacent to an existing artesian spring along the Fundy Park Road, which became a protected wellfield under the *Clean Water Act* in 2012 (schedule A.37) (NBDELG, 2013b). The Penobsquis Regional Water System extends along Route 114 to the mouth of McCully Station Road (J. Russell, 2013).

4.4.5 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 PID number on which the Project Footprint is located (00132571) a search of the database displays records for 12 wells drilled within the 1 km Study Area between 1994 and 2010, though only 7 of these display sample analysis results (NBDELG, 2013c). According to the OWL, there were 3 newly drilled

wells recorded since 1994 within 500 m of the longitude / latitude point central to the Project Footprint (45.772091, 65.413761) for which specific sample analysis results are not available.

The NB Department of Health has adopted the Guidelines for Canadian Drinking Water Quality (CDWQ) 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 the 1 km Study Area is presented in Table 4.2.

Table 4.2 Summary of Selected Groundwater Quality Parameters

Parameter	*Percentage Samples in Compliance in NB	**Percentage Samples in Compliance Within Study Area
Arsenic	94.1	100
Barium	98.6	100
Cadmium	99.9	100
Chromium	99.8	100
Fluoride	95	100
Lead	97.3	100
Nitrate	99.4	100
Selenium	98.9	100
Uranium	97.9	100
Chloride	96.7	71
Iron	71.2	57.1
Manganese	60.2	57.1
pH	86.3	85.7
Sodium	96.6	85.7
Zinc	99.9	100

*NBENV, 2008.
**NBDELG, 2013c

Comparison of Study Area results against those for the Province as a whole show similar trends, though iron and chloride may be more problematic. Drill reports for the 12 records show well depths ranging from 25.9 to 189 m. Average bedrock level is 5.8 m and bore records list shale, conglomerate, fill, granite, clay, rock, overburden, sandstone, siltstone and course gravel as being encountered in the Study Area (NBDELG, 2013c).

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 for the seven wells within the 1 km Study Area, 57% of the newly drilled wells had Total Coliform but none of them had *E.coli*.

Prior to the commencement of Project activities, further baseline water quality analysis will be conducted for all drinking water wells within 500 m of the edge of well pad F-67. Collection and analysis will be performed as described in Appendix 9 in the Rules for Industry document.

Analysis will be conducted by the NBDELG Analytical Services Laboratory in Fredericton, NB, and will include the parameters listed under the "Drilling and Completions Water Well Testing Parameter List" (Appendix B).

4.4.6 Wetland Resources

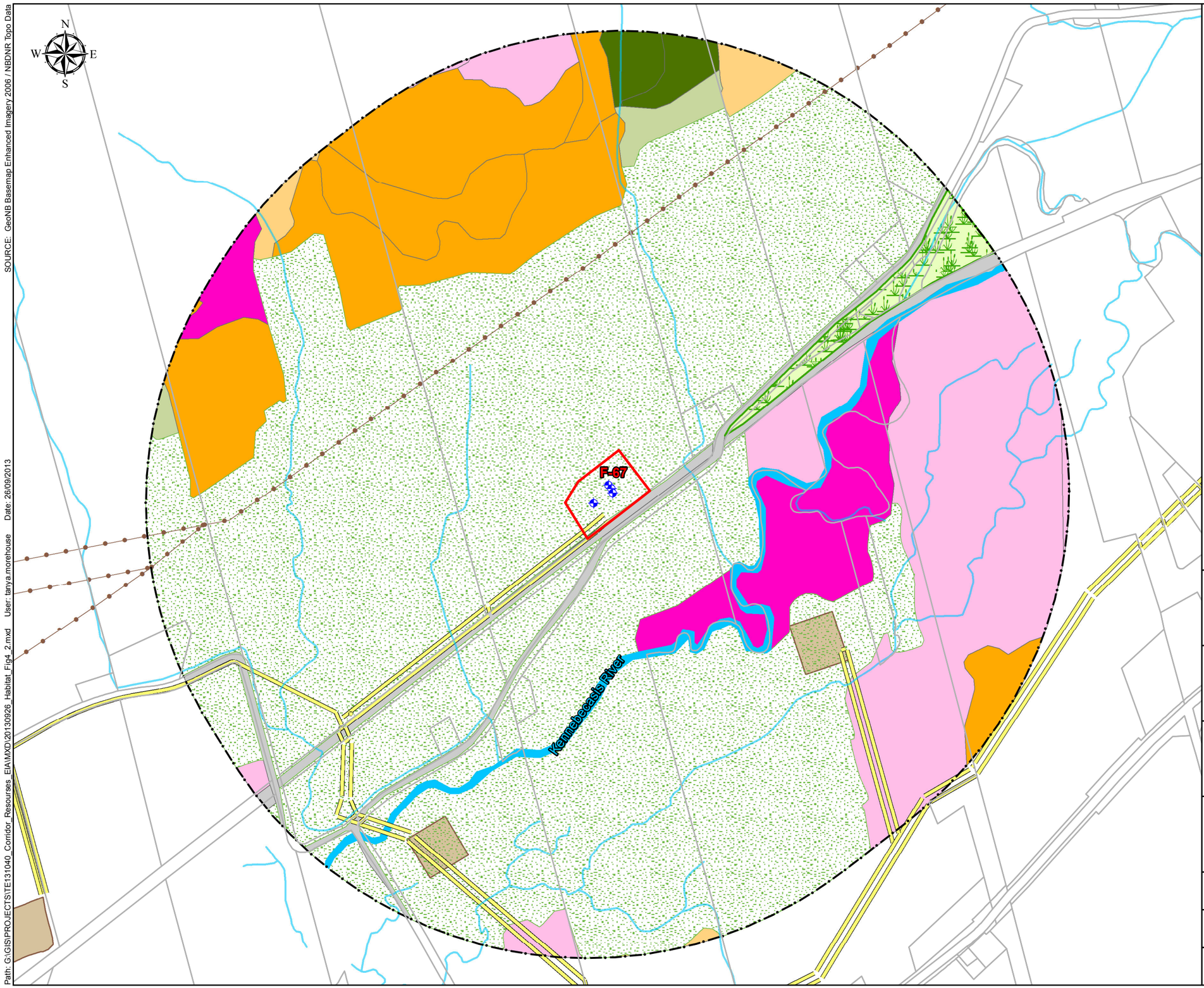
Wetlands in NB have been given specific protection under the *Clean Environment Act* and the *Clean Water Act*. The NB EIA Regulation requires registration of "all enterprises, activities, projects, structures, works, or programs affecting two ha or more of bog, marsh, swamp, or other wetland". NBDELG requires a permit under the WAWA Regulation for any alteration within 30 m of the bank of a watercourse or wetland.

There are two provincially-mapped wetlands present in the Study Area; one being approximately 750 m east and another 550 m west of the proposed extent of the well pad (Figure 4.3).

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 agricultural lands and the Project Footprint is located on an existing natural gas wellpad which was built within a field previously cleared by agricultural activities of the landowner (Figure 4.3).

There are no areas designated as Old Spruce Fir Habitat (OSFH) located within the Study Area. Two permanent forest sample plots are within 4 km of the Footprint: one of intolerant hardwood (ID #39076) and one of pine (ID #39054) (NBDNR, 2007). There are 57 known native species of mammals (Dilworth, 1984), approximately 350 resident and migratory bird species (Squires, 1976), and 25 species of amphibians and reptiles, including various species of salamanders, frogs, turtles, and snakes (Gorham, 1970) that inhabit NB. Vegetative communities are the main determinant of habitat for most area wildlife species.



SOURCE: GeoNB Basemap Enhanced Imagery 2006 / NBDNR Topo Data

Date: 26/09/2013

User: tanya.morehouse

Path: G:\GIS\PROJECTS\TE131040_Corridor_Resources_EIA\MXD\20130926_Habitat_Fig4_2.mxd

LEGEND:

- Existing Well
- F-76 Well Pad 1km Study Area
- NB DNR Watercourse
- Gathering System
- Utility
- Corridor Well Pads
- Proposed F-67 Well Pad Footprint
- SNB Property Boundary Kings County
- NB DNR Wetland
- NB DNR Waterbody

Non Forest Habitat Type

- Edge
- Field

Forest Habitat Type

- Hardwood
- Mixedwood
- Old Hardwood
- Old Mixedwood
- Old Softwood
- Softwood

Meters
100 50 0 100 200 300
1 cm = 90 metres

CLIENT:

CORRIDOR RESOURCES

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:

ENVIRONMENTAL IMPACT ASSESSMENT:
NATURAL GAS EXPLORATION AT F-67

TITLE:

WELL PAD F-67
HABITAT MAP

DATUM:	DWN BY:	DATE:
NAD 83 CSRS	TM	Sept 26, 2013
PROJECTION:	CHK'D BY:	SCALE:
New Brunswick Stereographic	CT / JB	1:9,000
PROJECT NO:	REV NO:	FIGURE NO:
TE131040		4.3

Approximately 350 resident and migratory bird species have been reported in NB (Squires, 1976). Bird species diversity in temperate regions is, in part, a function of foliage height diversity (i.e., the greater the height diversity, the greater the number of species using that habitat) (MacArthur and MacArthur, 1961). This is particularly true in deciduous forest stands. Species diversity is also related to floral species diversity (Morrison, 1991). Thus, grasslands would support limited species diversity, while a successional deciduous forest may support relatively higher species diversity.

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 infrastructure. Sources included published and unpublished listings of occurrences of such species and these are described below.

Under the federal *Species at Risk Act* (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.

The Province of NB provides additional species protection through its own *Species at Risk Act* (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 species of fauna or flora threatened with imminent extinction or imminent 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 September 3, 2013 for a list of occurrences of rare and endangered flora and fauna within and near the proposed Study Area (Appendix C). 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 C.

4.6.1 Plant Species at Risk

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

Table 4.3 Plant Species of Conservation Concern Occurring within a 5 km Radius of the F-67 Well Pad

Common Name	Scientific Name	ACCDC Rank	Habitat
Rough Hawthorn	*Crataegus scabrida*	S2	Thicket.
Field Sedge	*Carex conoidea*	S3	Edge of low meadow and dirt road.
Tender Sedge	*Carex tenera*	S3	Edge of salt springs.
Salt Grass	*Distichlis spicata*	S3,S4	Coastal, salt-marsh.

ACCDC, 2013.

None of these five plant species are listed by COSEWIC, SARA, or the NBSRA (SARPR, 2013; NBDNR, 2013). The Project Footprint itself and the surrounding area is cleared agricultural land, 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 Study Area.

4.6.2 Mammal Species at Risk

The ACCDC has listed the Eastern cougar (*Puma concolor pop. 1*) as being SH,SU (unrankable and historical, perhaps not being verifiably observed within the past 20 – 70 years) but observed once within 5 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 as 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 ACCDC range maps also indicate the presence of Southern flying squirrel (*Glaucomys volans*) (S2,S3) as possibly occurring in the area according to provincial distribution. The Southern flying squirrel was re-assessed by COSEWIC in 2006 and reassigned as "Not at Risk" and it is not listed under the NBSRA. This species uses forests as habitat and is not anticipated to be found in the Study Area.

The NBSRA lists the Canada lynx (*Lynx canadensis*) as Regionally Endangered within the Province, though 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).

4.6.3 Bird Species at Risk

Table 4.4 lists the ACCDC (Appendix C) bird Species at Risk identified as occurring within a radius of 5 km of the Study Area.

In NB, migratory birds typically nest during the “sensitive nesting window” of May 1 to August 1, and begin migration in late September.

Table 4.4 Potential Bird Species of Conservation Concern Occurring within a 5 km Radius of the Corridor F-67 Project Area

Common Name	Scientific Name	ACCDC Rank*	Other Protection / Listing
Barn Swallow	*Hirundo rustica*	S3 (Breeding)	COSEWIC: Threatened
Bank Swallow	*Riparia riparia*	S3 (Breeding)	COSEWIC: Threatened
Bobolink	*Dolichonyx oryzivorous*	S3S4 (Breeding)	COSEWIC: Threatened
Brown Thrasher	*Toxostoma rufum*	S2 (Breeding)	
Brown-headed Cowbird	*Molothrus ater*	S3 (Breeding)	
Canada Warbler	*Wilsonia Canadensis*	S3S4 (Breeding)	SARA: Threatened
Cliff Swallow	*Petrochelidon pyrrhonota*	S3S4 (Breeding)	
Eastern Kingbird	*Tyrannus tyrannus*	S3S4 (Breeding)	
Eastern Meadowlark	*Sturnella magna*	S1S2 (Breeding)	COSEWIC: Threatened
Evening Grosbeak	*Coccothraustes vespertinus*	S3S4 (Breeding)	
Horned Lark	*Eremophila alpestris*	S2 (Breeding)	
Killdeer	*Charadrius vociferous*	S3 (Breeding)	
Purple Martin	*Progne subis*	S1S2 (Breeding)	
Scarlet Tanager	*Piranga olivacea*	S3S4 (Breeding)	
Sedge Wren	*Cistothorus platensis*	S1 (Breeding)	COSEWIC: Not At Risk
Vesper Sparrow	*Pooecetes gramineus*	S2 (Breeding)	
Willow Flycatcher	*Empidonax traillii*	S1S2 (Breeding)	
Wood Thrush	*Hylocichla mustelina*	S1S2 (Breeding)	COSEWIC: Threatened

*(ACCDC 2013, Appendix C)

Many of the birds listed in Table 4.4 are migratory birds, breeding in the region within the sensitive nesting window, which will be avoided by scheduling the expansion of the well pad during the autumn of 2013, but may be breeding during the drilling of the new well and / or the fracture stimulation of the new and the existing E-67B wells. The barn swallow, killdeer and horned lark are known to breed one to two weeks outside that window. Further discussion regarding the regional migratory birds is presented in Section 4.8.

The Canada warbler inhabits areas of dense understorey of mature deciduous or mixed woodlands, shrubby areas near streams and swamps. The cause of its decline is attributed to significant loss of wintering habitat in South America (SARPR, 2013). There is no wetland habitat in the Project area, and disturbance to the nearby watercourse is not anticipated.

The birds listed by COSEWIC as "Threatened" in Table 4.4 are songbirds. Bank swallows breed as colonies, burrowing into sand or gravel banks and barn swallows in the roofing rafters of buildings and would not be anticipated to be found breeding in the Study Area. The bobolink and Eastern meadowlark, however, nest in dry grassy habitats – especially hay fields left unmown for a year or longer. There is a possibility that nests could be encountered in grassy areas of the Study Area within the sensitive nesting window (Tufts, 1986).

The ACCDC noted that, though no observations were reported in the Study Area, Barrow's goldeneye (*Bucephala islandica*) (Eastern population), the piping plover (*Charadrius melodus melodus*), and the roseate tern (*Sterna dougalli*) are linked to the area by predictive range maps. Barrow's goldeneye is listed under SARA Schedule 1 as "Special Concern".

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 almost entirely agricultural land in inland NB, would not contain limiting habitat for these raptor and coastal species.

4.6.4 Herpetile Species at Risk

The ACCDC report for the Study Area does not include any observations of amphibian or reptile species within 5 km of the Project (Appendix C).

There are no amphibian species in NB listed under SARA as Schedule 1. There are, however, two reptiles: the snapping turtle (*Chelydra serpentine*) whose status is "Special Concern" and the wood turtle (*Glyptemys insculpta*) whose status is "Threatened". The snapping turtle is the largest freshwater turtle in Canada, reaching up to 40 cm in length in addition to a tail that is almost as long as the carapace. Though numbers are decreasing in central and western Canada, the snapping turtle remains abundant in eastern Canada. The ACCDC report for the Study Area did not contain any observations of the snapping turtle (Appendix C).

Wood turtles are colonial and gather in large numbers when nesting. The species nests next to water on open sandy areas, such as high riverbanks, roadsides, rail embankments, and in wetlands. Wood turtle populations are threatened by human capture, as well as nest destruction and water contamination (SARPR, 2011). The ACCDC has reported a range rank of "1" for the wood turtle in the Study Area, which indicates a "possible occurrence" according to predictive range mapping (Appendix C).

4.6.4.1 Wood Turtle Survey

Wood turtles are most easily detected during early spring during mating season, found sun-basking and foraging along freshwater shorelines. Two watercourses are identified by Provincial mapping to occur near the Project footprint, but field surveys conducted in 2006 (AMEC, 2006) noted that the eastern one was confirmed not to be present. The western watercourse was included in a wood turtle survey, during which it was determined that there was no potential habitat.

4.6.5 Invertebrate Species at Risk

Invertebrates are typically the most diverse group of fauna present in a given ecosystem, and represent a key component of the food web. The ACCDC does not list any observations of invertebrate Species at Risk with 5 km of the Project, but has reported a range rank of "1" for the monarch butterfly in the Study Area, which indicates a "possible occurrence" according to predictive range mapping (Appendix C).

The monarch butterfly is listed on Schedule 1 of the SARA as a Species of Special Concern due to development in southern overwintering habitats. In NB, monarch butterflies utilize habitats such as meadows, wild fields, and watercourses where milkweed is present during their breeding season. The Study Area is primarily agricultural and disturbed area and does not provide critical habitat for the monarch butterfly.

Both the NBSRA and COSEWIC identify the Maritime ringlet butterfly (*Coenonympha inornata nipisiquit*) as Endangered in NB. This butterfly has an extremely restricted range, and a small population. It is threatened by loss and degradation of habitat. This butterfly is strictly limited to salt marsh habitats and is unlikely to occur within the Study Area.

4.7 Migratory Birds

Migratory birds are protected under the federal *Migratory Birds Convention Act* (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 1, 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 C); 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 #12, Saint John, and more specifically in Square #20LR17 (Penobsquis). There were 183 bird species identified in the Saint John area. Within the Penobsquis area, 76 were identified as possible, probable or confirmed breeders. Most of these species nest within the sensitive nesting window.

Three of these species protected under the MBCA have been known to breed outside the sensitive breeding window and are listed by the ACCDC as occurring in the Study Area, as shown in Table 4.5.

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

Species	***Habitat**	**[1]Breeding Dates**
Killdeer	Open fields and pastures; nests on the ground	Apr 15 – early Aug
Barn swallow	Nests inside barns or beneath overhanging structures	May 15 – Early Sept
Horned Lark	Dry grass in open fields with little to no concealment	May 15 – Early Sept

*Tufts, 1986.
[1] MBBA, 2011.

Geographic information system (GIS) digital datasets were supplied by NBDNR to derive potential habitat types (NBDNR, 2007). The criteria for habitat type were derived by combining habitat criteria used by NBDNR, reviewing the Maritime Breeding Bird Atlas (MBBA, 2011) habitat criteria, and by incorporating information related to habitat preference as detailed on the SARPR website. From available mapping, 10 broad habitat types were identified as occurring within the Study Area (Figure 4.2):

- softwood;
- old softwood;
- hardwood;
- old hardwood;
- mixedwood;
- old mixedwood;
- edge;
- field;
- waterbodies; and
- wetland.

In order to determine the amount of habitat affected by the 1 km Project Study Area, the total area in m^2 was calculated for each habitat type. The Study Area and Project Footprint within the NBDNR datasets consist of approximately 3753901.0 m^2 and 21618.8 m^2, respectively, of potential migratory bird habitat. The Project Footprint itself is comprised entirely of existing well pad and agricultural land. The Study Area is comprised of the following amounts of these habitat types as listed in Table 4.6.

From Table 4.6 it is apparent that the dominant habitat prevalent within the Study Area is field habitat (62.8%) followed by hardwood habitat (13.5%) and old mixedwood (11.4%).

The species listed in Table 4.5 nest in open fields or in manmade structures; therefore, there is some potential for migratory birds to be present within the Project Footprint, especially during the "sensitive nesting window".

Table 4.6 Migratory Bird Habitat Present in the Study Area

Habitat Type	Study Area (m^2)	Project Fooprint (m^2)
Field	2358866.92	21618.8
Edge	94144.51	
Hardwood	507881.20	
Mixedwood	31464.39	
Softwood	27043.53	
Old Hardwood	171834.39	
Old Mixedwood	428760.08	
Old Softwood	39947.16	
Waterbody	47441.00	
Wetland	46528.00	
TOTAL	3753901.00	21618.2

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 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 NBDELG 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; and
- Areas that have been enhanced through implementation of specific habitat management strategies aimed at specific species and / or ecosystems.

There are two ESA's located within 5 km of the Study Area according the ACCDC report. Located approximately 3.0 km north of the Project Footprint is the Mount Pisgah Hemlocks ESA. Established in 1995, it has forest significance as it contains small patches of hemlock along the ridges along the ridge top. Approximately 4 km southwest is the Sussex Salt Spring ESA, which is one of the only known inland salt springs with high salinity and vegetation characteristic of coastal salt marshes in NB, where salt water bubbles up from underground and is caught in a small pool (Appendix C).

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 of Penobsquis, NB in the Parish of Cardwell, Kings County. This region comprises the Study Area's socio-economic component of the EIA. The total area encompassed by the Parish is 312 square kilometres (km^2).

The major commercial centre nearest Penobsquis is Sussex Corner and Sussex, approximately 11 and 12 km southwest of the Study Area, respectively. The smaller Village of Petitcodiac is located approximately 10 km east of the Study Area and provides some commercial needs, but not to the extent that Sussex does. Table 4.7 shows the population of Cardwell PAR, and the Towns of Petitcodiac and Sussex (Statistics Canada, 2011) as per the 2011 census.

Previously Cardwell (PAR) experienced a population decline between 1996 and 2001, however a significant increase in growth (7.0%) was observed between 2001 and 2006 (Statistics Canada, 2006), and 4.4% further in 2011. The Town of Sussex also observed a reversal in declining trends with 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%).

Table 4.7 Census Population by Study Area Municipality

	Area (km^2)	2006	2011	% Change
Cardwell (PAR)	311.72	1414	1479	4.4
Petitcodiac (Village)	17.22	1368	1429	4.3
Sussex (Town)	9.03	4241	4312	1.6
Kings (CT)	3483.4	65,824	69,665	5.5

Statistics Canada, 2011 Canadian Census.

4.9.2 Local Economy

Sussex is the main industrial and commercial centre for the area. The Town is centrally located from 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 PotashCorp 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 in meat, egg, malt, and oilseed processing; livestock feed, salt manufacturing, as well as crop input products, grain handling and merchandizing. 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 also 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. However there are some commercial establishments scattered throughout the Study Area. There are three retail stores located in Penobsquis. Establishments also include retail of baked goods, antiques, and a nursery. There is one restaurant in Penobsquis, the Timberland. There are also the following services: rental storage; well servicing; construction; auto repair; and drilling contractor for the mining industry.

4.9.3.3 Residential

The Cardwell 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. There are seven (7) properties within the 1 km Study Area with residential buildings (Figure 4.1).

4.9.3.4 Cultural / Institutional

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

There are no places of worship within the Study Area. There is one church in Petitcodiac, one in Penobsquis and 12 in Sussex.

There are no schools in Penobsquis. 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 and 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 or nursing homes, museums, or theatres in the Study Area. 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.

4.9.3.5 Recreational

The Study Area is predominantly agricultural, and there is not the population base to support recreational facilities such as ball fields, ice rinks, etc.

There are three campgrounds and two motels listed in Penobsquis, many of which are close to hiking trails and have other amenities such as pools, mini golf, playgrounds, etc.

Being that Penobsquis has a large proportion of natural forest, as well as several streams, it is likely that local residents utilize these resources for recreational activities such as hiking, four wheeling, snowmobiling (winter), and fishing.

4.9.3.6 Agricultural Land

There are traditional farming communities within a small portion of the Study Area and surrounding region. Many of the businesses previously listed relate to farming and farming supply sales.

4.9.3.7 Traffic Circulation

The following transportation corridors are located within the Study Area:

- **Highway**

The Study Area contains Back Road, which connects to Route 114 via McCully Station Road. Route 114 may be accessed by Route 1 via the Fundy Park Road.

- **Rail**

Well pad F-67 is located adjacent to a section of the Canadian National (CN) rail line, separated by a fence, which extends east to west, north of Route 1.

- **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.

4.9.3.8 Utility Corridors

- **Electricity**

There are no electrical generating facilities in or near the Study Area. There is one NB Power corridor located approximately 400 m north of the Project.

- **Water / Sewer**

Sewer needs for the area are provided by individual septic systems. The Penobsquis Municipal Water System only extends as far as McCully Station Road.

- **Natural Gas**

The F-67 well pad is connected to the Corridor Gathering Line, providing natural gas to PotashCorp as well as the Corridor gas plant.

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. Penobsquis has a Volunteer 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

A Heritage Resource Impact Assessment (HRIA) is one component of an EA. The objectives of an HRIA are to identify, inventory, and evaluate all sites of archaeological, historical, and architectural significance within the Project Study Area (focusing on the Project Footprint) and to assess the potential effects of the Project on these heritage resources. AMEC has conducted numerous HRIAs within the Project Study Area associated with the Corridor development and the Potash industry (AMEC, 2005; AMEC, 2006; AMEC, 2007; AMEC, 2008a; AMEC, 2008b; AMEC, 2008c; AMEC, 2009; AMEC, 2010; AMEC, 2013). In addition, in 2007, AMEC conducted a HRIA for Corridor for the precise location of the present Project Footprint (impact area) (AMEC 2008d). Since the regulatory guidelines (ASNB 2012) have not changed with regards to the assessed potential for archaeological resources within the proposed impact area, another HRIA for this impact area is not required by the provincial regulator (Brent Suttie pers. com. 2013). However, a review of the previous research conducted in this area is required. Therefore, what follows is a brief review of the previous research conducted for both in the Project Study Area and the more specific Project impact area.

Preliminary studies, consisting of background desktop research of the Project Study Area and a field examination of the Project impact area, were conducted in 2007 (AMEC, 2008d). The well pad labelled in the present studies as “F-67” was identified during the 2007 assessment as “Well Pad A” (Ibid.). More recent desktop research has also been conducted for the Study Area, including a 2012 assessment for a proposed development only 2.25 km to the southwest (AMEC, 2013). The studies for the 2012 desktop review included the present Project impact area.

4.10.1 Background Desktop Review

Past and present transportation routes are considered to be high potential areas for heritage and archaeological resources. Watercourses were the primary transportation routes of the past, while roads are the primary transportation routes of the more recent past and present. The Kennebecasis River is a substantial New Brunswick waterway and is documented to have been used in the Prehistoric and Historic past for habitation, food procurement, and transportation for the Natives (First Nations) and European settlers.

- **Potential Prehistoric Heritage Resources**

Ganong (1899) identified a prehistoric portage route in the general vicinity of the Study Area: the Kennebecasis – Anagance[1] portage. This portage route was described as one that leaves the Anagance River ½ mile west of Anagance Station, and runs directly southwest to the Kennebecasis River – a distance of 2 miles (Ibid.). This pedestrian transportation route is located outside of the Project impact area. However, there is a documented Native site that was identified by the Kennebecasis River in the Project Study Area (AMEC, 2005; AMEC, 2006; AMEC, 2007). While this registered site (BkDi-3), located just north of the Penobsquis Loop Road (Figure 4.3), does not impact the Project, it does provide physical confirmation that there was a prehistoric Native presence along the Kennebecasis River.

There are numerous historical references to the presence of First Nations peoples in the Study Area when the Loyalists arrived in the late 1700s. The significant numbers of indigenous Maliseet in the area resulted in the New England Company opening and operating a provincial "Indian School" in Sussex Vale (present-day Sussex Corner), from the 1790s to the 1820s (University of New Brunswick Archives, 2007; Thomson, 1984). Reportedly, Native "encampments" were along the shorelines of the rivers in this area up until the late 1800s, and the Natives were known to travel up and down the waterways of the Kennebecasis, Anagance, and Petitcodiac rivers (Aiton, 1967). Therefore, there is potential for Native archaeological resources in the vicinity of the Kennebecasis River.

- **Potential Historic Heritage Resources**

The general area surrounding the Project Study Area was settled in the late 1780s by the United Empire Loyalists through land grants from King George III. Historic records indicate that the proposed Project impact area, located on (PID 00132571), is located on a 200 acre parcel of land that was granted to Samuel Taylor in 1828. This property is bounded on the south side by the Kennebecasis River, which was at that time called Salmon River.

As a result of previous investigations conducted in this area (AMEC, 2005; AMEC, 2006; AMEC, 2007), two previously unregistered historic sites were identified in the Project Study Area; sites BkDi-1 and BkDi-2. Site BkDi-1 is located near the Kennebecasis River, just north of the "T" intersection of McCully Station Road and Back Road. Site BkDi-2 is located on the north side of Back Road, approximately 1,200 m east of the intersection with McCully Station Road. Figure 4.3 indicates the location of these two known historic sites. Both of these sites have historic stone foundation features associated with them. While the age of Site BkDi-2 is unknown, BkDi-1 was confirmed through subsurface investigations to be a late 1700s to early 1800s historic habitation site.

[1] "*Anagance* is the Maliseet word for "portage" (Ganong, 1899:246).

While the Canadian Register of Historic Places (2012) identifies 21[2] historic places in Sussex and the New Brunswick Register of Historic Places (2012) identifies 22, there are no historic places registered in the Penobsquis-McCully area. The closest designated national historic site to the Project Study Area is the former Intercolonial Railway Station in Sussex. There are no provincially or nationally designated historic sites within the proposed Study Area (S. Finley, pers. comm., 2005; Parks Canada, 2012). There is one identified cemetery in the vicinity of the Study Area (Figure 4.4). This is the Pioneer Cemetery (Est.1801), which is located well outside of the Project impact area.

Historical aerial photographs of the Project Study Area indicate building structures and settlement clearings on the present-day Route 114, Picadilly Road, and Back Road. The Canadian Inventory of Historic Buildings (CIHB) indicates that there are two historic buildings southwest of Well Pad F-67 on the Back Road (CIHB # 113 and 114). However, historic mapping, aerial photographs, and the CIHB do not identify any potential historic building sites within the Project impact area. Therefore, while there is elevated potential for historic heritage resources within the Project Study Area, there is low potential for these resources within the specific Project impact area.

4.10.2 Field Examination

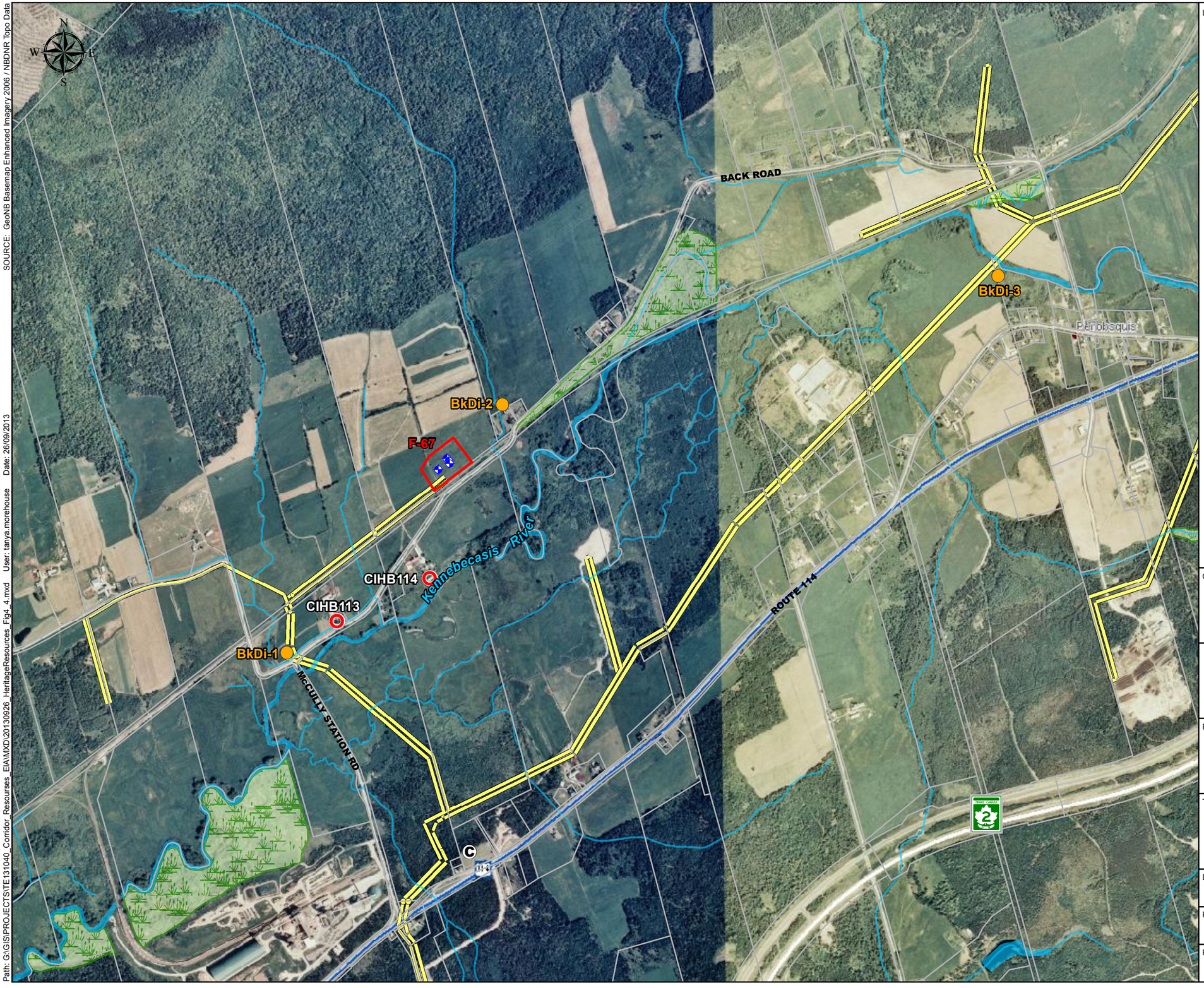
- **Local Informant Interviews**

The primary objective of informant interviews is to compile information on identified and unreported heritage resources from local people who have knowledge of the Project Study Area. These discussions can elicit a more local community-based knowledge and history of the area. Councillor John Keenan and Chief Roger Atwin, representatives of the closest Maliseet First Nation community (Oromocto First Nation), were contacted in reference to work conducted within this Project impact area (AMEC 2008d). They have not responded to date. In addition, since 2006, 10 long-time local residents of the McCully-Penobsquis area have been interviewed regarding heritage resources in this general area (and the specific Project Footprint) (AMEC 2013). None of the informants knew of any discoveries or references to prehistoric or historic heritage resources within the Project impact area.

- **Visual Field Survey**

The objective of the field examination is to obtain first-hand exposure to the Project impact area in order to aid in the early identification of potential heritage resource locations. This involves a close visual examination of the surface of the Project impact area. In July and August of 2007, AMEC archaeologists conducted the visual surface survey of the area associated with the present Project. The visual field survey involved two field workers walking abreast 15 m apart,

[2] The national register also identified two additional “Historic Places” with the word “Sussex” in their names, which are not actually located within the Sussex area.



SOURCE: GeoNB Basemap Enhanced Imagery 2006 / NBDNR Topo Data

Date: 26/09/2013

User: tanya.morehouse

Path: G:\GIS\PROJECTS\TE131040_Corridor_Resources_EIA\MXD\20130926_HeritageResources_Fig4_4.mxd

LEGEND:

- Registered Archaeological Site
- Historic Structure
- Pioneer Cemetery
- Existing Well
- Gathering System
- NB DNR Watercourse
- NB DNR Waterbody
- NB DNR Wetlands
- Proposed F-67 Well Pad Footprint
- SNB Property Boundary
  Kings County

200 100 0 200 400 600 Meters

1 cm = 150 metres

CLIENT:

CORRIDOR RESOURCES

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:

**ENVIRONMENTAL IMPACT ASSESSMENT:
NATURAL GAS EXPLORATION AT F-67**

TITLE:

**HERITAGE RESOURCES
IDENTIFIED IN THE VICINITY OF THE
PROJECT IMPACT AREA**

DATUM:	DWN BY:	DATE:
NAD 83 CSRS	TM	Sept 26, 2013
PROJECTION:	CHK'D BY:	SCALE:
New Brunswick Stereographic	DD / JB	1:15,000
PROJECT NO:	REV NO:	FIGURE NO:
TE131040		4.4

around the perimeter of the proposed well pad areas and along a number of transects within those boundaries using a field Global Positioning System (GPS) unit. The proposed Well Pad A (F-67) footprint was situated entirely within a cleared agricultural field. There were no observable indicators of heritage or archaeological resources within the proposed impact area for this well pad.

Overall, the proposed Project impact area has a low potential for heritage resources. This assessment is supported by Archaeological Services New Brunswick (ASNB) Geographic Information Systems mapping for the area (Appendix D). No further investigations are recommended for the proposed expansion of Well Pad F-67.

4.10.3 Palaeontological Resources

In order to conduct a desktop review of potential palaeontological resources within the Study Area, the Bedrock Geology of NB (NB Department of Natural Resources and Energy 2000) and the New Brunswick Fossil Database Project (2007, 2011, and 2012) were reviewed as well as other geological survey publications. In addition, Provincial Geologist Clinton St. Peter was consulted regarding the geology and potential resources within the Project Study Area (2005).

The Project Study Area is underlain by Early Carboniferous “terrestrial sediments” of the Mabou Group (NB Department of Natural Resources and Energy 2000). There are numerous recorded accounts of fossils (Plantae and Shelly) identified within a 20 km radius of the Study Area in other formations (Horton Group - Albert and Weldon formations and Sussex Group – Gautreau formation). However, there are none identified within the Project impact area (New Brunswick Fossil Database Project 2007, 2011, and 2012). No exposed fossils were observed during the field investigations of the Project impact area in 2007.

4.10.4 First Nations / Aboriginal Communities

The Project is not proposed to overlap a present day First Nations community. Geographically, the closest First Nation community is the Mi’kmaq Nation at Fort Folly. However, the Study Area is located within traditional Wolastoqiyik (Maliseet) territory. The closest Wolastoqiyik community is the Oromocto First Nation. For this Study, AMEC is committed to informational exchange relationships with a representative of the Oromocto First Nation, as well as the provincial aboriginal organizations, the Union of New Brunswick Indians (UNBI), and the New Brunswick Aboriginal Affairs Secretariat. These organizations have representation from both the Wolastoqiyik and Mi’kmaq peoples.

5.0 ENVIRONMENTAL IMPACTS AND ASSOCIATED MITIGATION

The Phase I and II Project Site is limited to a small piece of agricultural field with an existing access road. Spatial bounds for the Project are a 1 km border around the site. Temporal bounds are limited to the time of construction, drilling, fracture stimulation and tie-in to production. The anticipated Project schedule is as follows:

Phase I:

- Re-expansion of F-67 well pad: October 2013, for an estimated two weeks.

Phase II:

- Drilling of new well: Mid-March to Mid-June, 2014, for an estimated three months;
- Re-entry, run and cement production casing on E-67B: Mid-to-Late June 2014, for an estimated two weeks;
- LPG Fracture Treatments of E-67B and the new well: Early July to Mid-August, 2014, for an estimated one and a half months
- Run production tubing and complete well: Late August to Mid-September 2014, for an estimated two weeks; and
- Construct and tie-in to field production gathering system: expected to be completed during the month of October 2014, for an estimated four to six weeks.

There are no wetlands and only one ephemeral watercourse within 150 m of the Phase I and II Project area. 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 5.1.

Corridor will conduct its operations in accordance with all applicable regulations and guidelines prescribed by NBDNR, NBNGG 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.

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:

Table 5.1 Issues Scoping/Pathway Analysis Summary Matrix - Valued Environmental Components (VECs): Exploration at F-67 Well Pad

Environmental Resources	Environmental Components of Concern (Biophysical and Socio-Economic)	Pathway of Concern		Possible Pathway	VEC		Project Stage				Rationale for Inclusion/Exclusion as Valued Environmental Component (VEC)
		Yes	No		Yes	No	Construction	Drilling	Fracture Stimulation	Tie-In/Production	
Atmospheric Environment	Ambient Air Quality	X		• Overburden disturbance. • Noise • Lighting • Accidental release of hazardous materials.	X		X	X	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		• Alteration in visual aesthetics	X		X	X	X		Included as a VEC – Protected by statute/regulation.
	Hydrology and Hydrogeology	X		• Drilling and fracture stimulation activities. • Accidental release of hazardous materials.	X		X	X	X	X	Included as a VEC – Protected by statute/regulation
	Wetland Resources		X	No possible pathway identified.		X					Excluded as a VEC – No pathway of concern identified.
	Mineral Resources		X	Avoided during site selection.		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	X	X	X	Included as a VEC – Protected by statute/regulation.
	Wildlife	X		• Habitat or population disturbance. • Accidental release of hazardous materials.	X		X	X	X	X	Included as a VEC – Protected by statute/regulation.
	Migratory Birds	X		• Habitat or population disturbance. • Accidental release of hazardous materials. • Noise • Lighting	X		X	X	X	X	Included as a VEC – Protected by statute/regulation.
	Fish, Fish Habitat, and Fishery Resources		X	No possible pathway identified		X					Excluded as a VEC – No possible pathway.
	Designated Areas and Other Critical Habitat Features		X	No possible pathway identified		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		• Traffic • Noise • Lighting	X		X	X	X		
	Existing Land Use		X	No significant impact to landowner		X					Excluded as a VEC – No pathway of concern identified.
	Community and Emergency Services	X		• Project activities		X					Excluded as a VEC – No pathway of concern identified.
	Heritage and Archaeological Resources	X		• Ground disturbance activities	X		X	X			Included as a VEC – Potential impact to heritage and archaeological resources.

Table 5.2 Summary of Potential Environmental Effects

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. 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 mitigatory 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 – 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 and Geography	Heavy equipment and increased truck traffic	Visual Aesthetics	• Existing well pad 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.

Hydrology and hydrogeology	Construction work near surface water supply Disturbance of underlying aquifer	Effects on surface water quality Effects on groundwater quality	• Suspend construction activities during high water flow periods and extreme weather events. • Preserve existing vegetation to the extent possible. • Consider runoff, erosion and sediment controls in the well pad design, to be maintained for the life of the Project. • Develop Water Management Plan as described in the Rules for Industry document Section 6.0 (NBNGG, 2013). • Employ proper well casing and cementing techniques, as described in Section 2.0 of the Rules for Industry (NBNGG, 2013). • Conduct baseline water quality survey for all drinking water wells within 500m of Project Footprint as described in the Rules for Industry document's Section 5.0 (NBNGG, 2013). Conduct water quality sampling after fracture treatment process is complete. See Section 6.0 of this EIA. • Develop a surface water quality baseline and monitoring plan as per the Rules for Industry Section 5.2 and Appendix 10 (NBNGG, 2013) in consultation with NBDELG.
Wildlife	Well pad expansion Equipment presence Presence of people	Alteration / displacement of habitat Noise / physical disturbance of wildlife Behavioural changes Mortality	• Expansion scheduled to occur during periods of lowest sensitivity to wildlife. • Abide by all relevant timing constraints for wildlife as identified by regulatory agencies. • No on-site employees will harass wildlife. • Corridor will employ mitigatory techniques for noise reduction such as those examples listed in Appendix 15 of the Rules for Industry document (NBNGG, 2013). See Section 6.0 of this EIA.
Migratory Birds	Well pad expansion Equipment presence Presence of people	Alteration / displacement of habitat during breeding Noise / physical disturbance of wildlife	• Well pad construction activities will be scheduled outside of the migratory bird sensitive nesting window (May 1st to September 30th). • Report the discovery of any nests encountered during construction to the Canadian Wildlife Service, Sackville, NB.

		Behavioural changes Mortality	• Corridor will employ mitigatory 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.
Species at Risk	Well pad expansion Equipment presence Presence of people	Alteration / displacement of habitat Noise / physical disturbance of wildlife Behavioural changes Mortality	• Report the discovery of any ground nests of Threatened species encountered during activities. • Corridor will employ mitigatory 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.
Residential	Onsite activities Equipment/product transportation	Noise Lights Traffic	• Corridor will employ mitigatory 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 mitigatory techniques for traffic such as those examples listed in Appendix 14 of the Rules for Industry document (NBNGG, 2013). • Corridor will employ mitigatory techniques for Project lighting, such as those examples listed in Appendix 16 of the Rules for Industry document (NBNGG, 2013). See Section 6.0 of this EIA.

Heritage and Archaeological Resources	Well pad expansion Drilling below surface Fracture treatment below surface Tie-in construction	Destruction of artefacts Disturbance of human remains	• Archaeological procedural protocols to be adopted and followed in the event of an unexpected discovery of archaeological resources or human remains during construction. • In part, the content of the protocol addresses an incident where potential heritage resources or human remains are found during construction, operation, or maintenance of the proposed Project. Work in the area must cease and ASNB must be contacted immediately at 453-3014, as per the requirements of the *Heritage Conservation Act* (2010).
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 material. • 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.

- 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 onsite and that each person receives a site-specific Corridor Field HSE Orientation.
- Corridor will notify nearby residents, 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 activities in Phases I and II, 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 interaction with any environmental component is anticipated.

6.0 ENVIRONMENTAL MANAGEMENT

6.1 Ground Water Monitoring

Ground water will be monitored to verify that water-related safeguards are effective and to provide early warning of any problems that may affect water quality. Water well testing shall be carried out in the manner prescribed in the Rules for Industry (NBNGG, 2013), Section 5.1: Water Well Testing and Appendix 9: Water Well Testing for Oil and Gas Activities.

All private water wells within a minimum of 500 m of the well pad expansion will be included in a drinking water quality survey to be conducted by an approved third party consultant prior to commencement of well pad expansion activities in order to establish a baseline as per the Rules for Industry (NBNGG, 2013). Water samples will be collected by a third-party engineering firm and will be analysed by the NBDELG Analytical Laboratory for parameters included in their Drilling and Completions package (as per Appendix 9 in the Rules for Industry document). In addition, methane presence will be conducted as a field component and, if present, gas will be collected and submitted to Tier 2 analysis (Tier 3 if suggested by Tier 2 results). See Appendix B for the list parameters that will be analyzed in the water samples.

Water wells within a minimum of 500 m will also be re-tested at the conclusion of the fracture stimulation program.

Water quality test result reporting, report disposition, record keeping and the final report shall be carried out in a manner that follows the Rules for Industry (NBNGG, 2013), Appendix 9: Water Well Testing for Oil and Gas Activities. A third party engineering firm will be retained by Corridor to:

- prepare and mail out individual water quality results to landowners;
- assist landowners in interpretation of water quality results;
- notify landowner immediately if the water poses a significant human health risk;
- compare pre-activity test results to follow-up results;
- provide NBDELG with electronic copies of all landowner communication relating to well water quality; and
- prepare and submit to NBDELG a final report within 90 days of program completion.

6.1.1 Water Quantity Requirements

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

- Drilling: 250 m^3 for drilling fluid, 250 m^3 to mix cement, 1200 m^3 for daily rig requirements (boilers and washes).
- Fracture Stimulation: While LPG will be the primary stimulation fluid, there will be a requirement for 200 to 300 m^3 of freshwater, though 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 as a fracture spearhead to assist in breaking down the formation on the bottom-most zone where high break down pressures may be expected.

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 m^3 tanks. An additional 80 m^3 storage tank will be located on-site to store water for any additional requirements during the program. A water well will be drilled onsite to supplement the water supply.

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 is an unnamed tributary to McLeod Brook identified in Section 4.3 of this document whose channel is diverted east along the CNR ditch to reach a culvert, bringing an approximate 20 m section of the ephemeral watercourse into the 150 m buffer before it resumes its course beneath Back Road and out of the buffer (Figure 4.1).

Baseline surface water quality characterization described in the Rules for Industry include:

- Collection and testing of water samples upstream and downstream of the well pad prior to well pad construction.
- Prior to drilling, a qualified third party engineering or geosciences firm is to:
  - prepare a site plan, indicating sample collection locations at three (3) locations within the watercourse: 50 m upstream, 50 m downstream and 100 m downstream of the drilling location,
  - record site-specific information, describing components that may affect water quality such as land use, geology, vegetation, etc, for each sampling station,
  - collect in situ field tests for Tier 1 gas detection, conductivity, pH, dissolved oxygen and temperature, and
  - collect samples to be submitted to the NBDELG Analytical Services Laboratory for the Surface Water Package parameters listed in Appendix 10 of the Rules for Industry.

Monitoring requirements listed in the Rules for Industry at the three designated sites include:

- Weekly testing of conductivity, pH, dissolved oxygen and temperature;
- Monthly Collection of samples to be submitted to the NBDELG laboratory during drilling operations, up until two months after site reclamation;
- Continuation of the monthly sample collection described above during production; and
- Continuous monitoring of conductivity, pH dissolved oxygen and temperature using in-stream datasondes and dataloggers during production.

The watercourse within the 150 m buffer upon intersecting Back Road is ephemeral in nature and monitoring possibilities may be dependent on the quantity of water present at any given time of year. Corridor will consult with NBDELG to determine the surface water monitoring methods and locations appropriate for this Project.

6.3 Air Quality Monitoring

6.3.1 Emissions Inventory

During Phase I and II, air emissions will generally include Carbon Monoxide (CO) and Carbon Dioxide (CO_2) emissions from equipment and truck exhaust (*e.g.,* heavy equipment, trucks, etc.) and fugitive dust from the well pad. Accidental releases of materials are another source of potential air emissions.

Flaring is not planned while drilling. However, flaring may be necessary, if there are small amounts of gas in the rock that is drilled in the wellbore (trip gas) or in the case of a well control event. Flaring of excess LPG and produced natural gas will take place during hydraulic 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 Greenhouse Gases (GHG), Corridor shall conduct a program of assessment for the F-67 well pad 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 and
- preparation of a report for submittal 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, including:

- Compilation of calculated emissions showing total pollutant outputs in a given area.
- Ground level impact modeling, showing the potential impact on ambient air quality including potential levels of smog-forming chemicals.
- Installation of real-time multi-parameter ambient monitoring stations.
- Collection of grab samples.
- Odour monitoring;
- Upset or occurrence monitoring when odours or other unusual events occur.

Corridor will also prepare and adopt a Fugitive Emissions Management and GHG Emission Reduction Plan for the F-67 well pad that will be submitted to the Regulator for approval. The Plan will describe the emission mitigation measures that will be employed in the 2014 design, construction and operation of the F-67 well pad facilities including well drilling, well completion, fracture stimulation, production gathering and processing.

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 heavy equipment, drilling, fracture stimulation, and related activities. Baseline noise monitoring will be conducted before drilling begins. The nearest noise receptor is a residence located approximately 275 m from the centre of the F-67 well pad.

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.

Drilling activities will be undertaken in keeping with the following:

- use natural barriers (or alternative materials where appropriate) 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 – 7pm) wherever possible (within constraints for those operations that are 24/7); and
- 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 I and II will be conducted on an existing Corridor well pad, F-67, which lies in an agricultural field in a low-lying area at the bottom of Mount Pisgah. The well pad is surrounded on all four sides by an earthen berm, and is separated from Back Road by a CNR railway track and a belt of mixed wood trees and shrubbery. An NB Power Corridor runs southwesterly, approximately 400 m north of the Footprint (Figure 4.2).

The well pad expansion stage of the Project will take approximately two weeks during October of 2013, during which typical earth-moving equipment will be present on-site, such as trucks, bulldozers and excavators. For five months in the spring/summer of 2014, drilling and fracture stimulation activities will be conducted at F-67, which will temporarily affect the visual landscape of the Study Area with the presence of components shown in Figure 2.2 such as:

- a drill rig;
- a crane;
- flare stacks;
- 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 the fracture stimulation is complete, the wells may be tied-in to the gathering system, which is already present at that location. A new well head will be visible on the well pad, where there are currently four.

During the course of Phase I and II, however, mitigatory measures, such as the examples provided in Appendix 16 of the Rules for Industry document (NBNGG, 2013) must 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 various stages of the Project (well pad expansion, drilling, hydraulic fracture stimulation, completions, tie-in and production) 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 will tracked by a Bill of Lading or Manifest prepared by the Corridor Well Site Supervisor. The Bill of Lading or Manifest will accompany every waste shipment. 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.

Below is a summary of the waste management approach for drilling fluid, drill cuttings, cement, sewage, solid waste and petroleum/oils/lubricants (POLs).

6.4.1 Drill Cuttings and Drilling Fluid Disposal

Conductor and Surface Hole Section (6 - 250 m) – WBM System

Cuttings:
The cuttings out of this section are stored in a waste container. The drilling fluid is re-used in the active system until the surface section is complete.

Drilling fluid:
WBM will be collected at the end of this section.

Main Hole Section (300 - 3450m) – SBM System

Cuttings:
The SBM cuttings will be mixed with sawdust to remove any excess oil, then stored onsite in a metal waste container. The oil will be returned to the active system.

Drilling fluid:
Corridor intends to recover all of the SBM, to be reused at a later date. Any SBM which is recovered and no longer fit for purpose will be sent for disposal.

Disposal

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).

Corridor will characterize WBM and the SBM related wastes prior to disposal as per the Rules for Industry Appendix 5 (NBNGG, 2013).

6.4.2 Cement

During the construction of all oil and gas wells, there is a need to use cement. Once a well section has been drilled, the drill string is removed and a long section of pipe (casing) is inserted and cemented into place. During the cementing operations, some cement (usually 1-10 m^3) returns to the surface indicating that the casing has cement from the bottom to surface. The excess cement returns are taken off location for disposal.

6.4.3 Sewage

During typical drilling operations, anywhere from 2 to 8 personnel live on location in accommodation trailers. Most accommodation trailers do not have sewage storage facilities. As a result, temporary septic storage tanks are installed behind the trailers. These tanks are regularly pumped out by a septic truck which takes the material to a waste treatment facility. At the end of the drilling stage, all tanks are removed.

6.4.4 Solid Waste

All garbage are 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.

6.4.5 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.

6.4.6 Flowback Fluid and Produced Water

Corridor plans to conduct fracture stimulation treatments using LPG as fluid and, as a result, does not anticipate significant amounts of liquid waste (flowback 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 to being removed 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 local newspaper, the Kings County Record, and posted in public areas such as the Penobsquis Fire Hall, the NBDELG offices and the Corridor office. Corridor will work with NBDELG to determine the appropriate publications and timing.

In addition, Corridor has developed a personalized approach to engaging landowners within an 1800 m radius of the F-67 well pad. Corridor representatives will visit the approximate 65 residences within the radius to explain the proposed activities, hear their concerns and answer their questions. Information sheets with contact information will be left during these visits planned for October 2013. Corridor representatives will make every reasonable effort to make themselves available to every resident.

Corridor's Public Engagement Strategy also includes:

- Briefing of the long-standing Community Liaison Committee (CLC) in October, 2013.
- Distribution of a Corridor Newsletter Update in October, 2013, which will entail a brief 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 activities on the Corridor Website, as well as a mechanism for posting questions and concerns directly to Corridor, to become available on the date of the EIA Registering.
- Briefing of local officials to provide them with information sheets and contact information for questions and concerns.

Corridor will also comply with any additional requirements that results from the NBDELG review of the Phased EIA document.

8.0 CONCLUSION

The EIA has been conducted for the proposed Phase I and II activities to be conducted on the F-67 well pad. This assessment consisted of a consideration of potential effects on the environment resulting from the Phase I and II 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 in 2006. The VECs identified by issue scoping and pathway analysis (Section 5.0) for which potential effects may be a concern included:

- Ambient air quality;
- Hydrology / hydrogeology;
- SAR and wildlife;
- Migratory birds;
- Residential land use; and
- Heritage and archaeological resources.

The potential for environmental effects has been discussed in Section 6.0. Significant negative residual effects are not anticipated for either Phase I or II 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 Communication Strategy described in Section 7; and
- the mitigatory measures outlined in this EIA.

REFERENCES

Agriculture Canada. 1989. Soil Landscapes of Canada, Maritime Provinces. Canada Soil Inventory, Centre for Land and Biological Resources Research, Research Branch, Agriculture Canada. Contribution Number 87-18.

Aiton, G. 1967. The Story of Sussex and Vicinity. Kings County Historical Society.

AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC). 2013. Archaeological Impact Assessment, Salt Transload Facility Expansion Project, Penobsquis, Kings County, NB. Report submitted to Archaeological Services, Heritage Branch, N.B. Department of Tourism, Heritage and Culture and Sport and Potash Corporation of Saskatchewan Inc.

AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC). 2010. Final Report – Heritage Resource Impact Assessment, Corridor Resources Inc. Elgin Natural Gas Lateral Pipeline and Gathering System Development, Albert and Kings Counties, NB. Report submitted to Archaeological Services, Heritage Branch, N.B. Department of Wellness, Culture and Sport and Corridor Resources Inc.

AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC). 2009. Corridor Resources Inc. 2008 Expansion Development of the McCully Natural Gas Gathering System, Kings County, NB. Report submitted to Archaeological Services, Heritage Branch, N.B. Department of Wellness, Culture and Sport and Corridor Resources Inc.

AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC). 2008a. Heritage Resource Impact Assessment Potash Mine Expansion, Picadilly Site: Potash Corporation of Saskatchewan Inc., Penobsquis, Kings County, NB. Report submitted to Archaeological Services, Heritage Branch, N.B. Department of Wellness, Culture and Sport and Potash Corporation of Saskatchewan Inc.

AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC). 2008b. Heritage Resources Impact Assessment: Potash Corporation of Saskatchewan Inc. Brine Pipeline Development from Penobsquis to Cassidy Lake, Kings County, NB - Final Report submitted to Archaeological Services Unit, Heritage Branch, Department of Wellness, Culture and Sport, Government of New Brunswick.

AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC). 2008c. Heritage Resource Impact Assessment McCully Stage II Expansion: Two Additional Natural Gas Wells and Associated Gathering Lines, Penobsquis, Kings County, NB. Report submitted to Archaeological Services, Heritage Branch, N.B. Department of Wellness, Culture and Sport and Corridor Resources Inc.

AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC). 2008d. Heritage Resource Impact Assessment McCully Stage II Expansion: Five Additional Natural Gas Wells and Associated Gathering Lines, Penobsquis, Kings County, NB. Report submitted to Archaeological Services, Heritage Branch, N.B. Department of Wellness, Culture and Sport and Corridor Resources Inc.

AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC). 2007. Heritage Resource Impact Assessment: McCully Natural Gas System. Report submitted to Archaeological Services, Heritage Branch, N.B. Department of Wellness, Culture and Sport and Corridor Resources Inc. AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC). 2005. Environmental Impact Assessment: McCully Natural Gas System. Report submitted to Corridor resources Inc. December 2005.

AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC). 2006. Field Assessment Report: Proposed McCully Natural Gas System. Report submitted to Corridor resources Inc. July 2006.

AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC). 2005. Environmental Impact Assessment: McCully Natural Gas System. Report submitted to Corridor resources Inc. December 2005.

Beanlands, G.E. and P.N. Duinker. 1983. An ecological framework for environmental impact assessment in Canada. Institute for Resource and Environmental Studies, Dalhousie University, Halifax, Nova Scotia.

Canadian Association of Petroleum Producers (CAPP). 2001. Offshore Drilling Waste Management Review. Technical Report, 2001-0007: 268 pp.

Canadian Environmental Assessment Agency (the Agency). 1994. Responsible Authorities Guide.

Canadian Press. 2011. New Brunswick energy commission calls for increased use of natural gas. May 24, 2011. http://www.google.com/hostednews/canadianpress/article/ALeqM5gg4yxQCmUTaVtBxVLY_R2QkOqNmw?docId=6942035

Canadian Register of Historic Places. 2012. Online Database. http://www.historicplaces.ca/en/rep-reg/search-recherche.aspx.

Clean Fuels Consulting Inc. 1994. Environmental Review of Propane as an Alternative Transportation Fuel, Illinois.

Corridor Resources. 2013. Available at: www.corridor.ca

Dilworth, T. (ed). 1984. Land Mammals of New Brunswick. Unipress Ltd. 228p.

Dionne, Leo A., Dorothy M. Farmer, C. Mary Young. 1998. Critical Natural Areas in New Brunswick. New Horizons Critical Natural Area Committee, Fredericton, New Brunswick.

Environment Canada. 1986. Atlantic Provinces: Active Hydrometric Stations Reference Index. Inland Waters Directorate, Atlantic Region.

Environment Canada. 1989. Historical Overview of Water Quality in New Brunswick 1961 - 1979. Inland Waters Directorate, Atlantic Region.

Environment Canada. 1991. The Federal Policy on Wetland Conservation. Government of Canada. 14 pp.

Environment Canada. 2009. National Pollutant Release Inventory – Overview 1990-2009. Available: http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1

Environment Canada. 2009. Water Survey Branch. Hydrology of Canada. Available: www.wsc.ec.gc.ca/applications/H2O/report-eng.cfm?yearb=&yeare=&station=01AP004&report=monthly&year=2009

Environment Canada. 2013. Canadian Climate Normals 1981-2010: Sussex New Brunswick. Available: http://www.climate.weatheroffice.ec.gc.ca/climate_normals/

Environment Canada (EC). 2012. Canada's Emission Trends. Available: http://www.ec.gc.ca/Publications/default.asp?lang=En&xml=253AE6E6-5E73-4AFC-81B7-9CF440D5D2C5

Erskine, A.J. 1992. Atlas of Breeding Birds of the Maritime Provinces. The Province of Nova Scotia.

Ferguson, A.M. 2004. Guide to Heritage Resource Impact Assessment in New Brunswick. New Brunswick Manuscripts in Archaeology 35. Archaeological Services, Heritage Branch, Culture and Sport Secretariat, Government of New Brunswick: Canada.

Ganong, W.F. 1899. A Monograph of Historic Sites in the Province of New Brunswick. Royal Society of Canada, Transaction, 2nd Series, 3:213-357.

GasFrac. 2013. Accessible: http://www.gasfrac.com/

Gorham, S.W. 1970. The amphibians and reptiles of New Brunswick. Monographic series No.6. The New Brunswick Museum, Saint John, New Brunswick. 30 pp.

Health Canada, 2012. Guidelines for Canadian Drinking Water Quality. Prepared by the Federal-Provincial-Territorial Committee on Drinking Water of the Federal-Provincial-Territorial Committee on Health and the Environment. Revised December 2012.

Hinds, H. 2000. Flora of New Brunswick Second Ed. University of New Brunswick, Fredericton, New Brunswick.

Hinterland Who's Who. Accessed 2011. Available: http://www.hww.ca/index_e.asp

Horizon Health Network. 2013. Sussex Health Centre. Available: http://horizonnb.ca/home/facilities-and-services/facilities/sussex-health-centre.aspx

Kennedy, A.J. and W.A. Ross. 1992. An approach to integrate impact scoping with environmental impact assessment. Environmental Management, Vol. 16, No.4, pp. 475-484.

MacArthur, R.H. and J.W. MacArthur. 1961. On species diversity. Ecology 42: 594-598

Maritime Breeding Bird Atlas (MBBA). 2011. http://www.mba-aom.ca/

McLeod, M.J., and S.C. Johnson. 1999. Bedrock geological compilation of the Petitcodiac area (NTS 21 H/14). Kings, Westmorland and Queens counties. New Brunswick. New Brunswick Department of Natural Resources and Energy, Minerals and Energy Division. Plate 99-23.

Morrison, M.I. 1991. Bird Abundance in Forest managed for timber and wildlife resources. Biol. Conservation 60:127-134.

Natural Resources Canada (NRCan). 2013. Earthquakes Canada: The New Brunswick Area. Available: http://www.earthquakescanada.nrcan.gc.ca/index-eng.php?tpl_region=nb

Nature Trust of New Brunswick Inc. (NTNB). 2011. http://www.naturetrust.nb.ca

New Brunswick Department of Environment (NBENV). 2005. Protecting Sources of Municipal Drinking Water: An Overview of New Brunswick's Wellfield Protection Program. March. Available: gnb.ca/0009/0371/0001/wellfield-e.pdf

New Brunswick Department of Environment (NBENV). 2008. New Brunswick Groundwater Chemistry Atlas: 1994-2007. Sciences and Reporting Branch, Sciences and Planning Division, Environmental Reporting Series T2008-01. Available at: www.gnb.ca/0009/0371/0014/index-e.asp

New Brunswick Department of Environment (NBENV). 2009. Know Your H2O: Domestice Water Quality Monitoring. Environmental Reporting Series T2009-01.

New Brunswick Department of the Environment and Local Government (NBDELG). 2001. An Introduction to Air Quality in New Brunswick. Accessible: http://www.gnb.ca/0009/0355/0007/AQE.pdf

New Brunswick Department of Environment and Local Government (NBDELG). 2012. Air Quality Monitoring Results in New Brunswick for the Year 2010. Available: http://www.gnb.ca/0009/0355/0022/0001-E.pdf

New Brunswick Department of Environment and Local Government (NBDELG). 2013a. List of Designated Watersheds. http://www2.gnb.ca/content/gnb/en/departments/elg/environment/content/land_waste/content/reference_manual/watershed_protection.html. Accessed 2013:

New Brunswick Department of Environment and Local Government (NBDELG). 2013b. Designated Wellfield Protected Areas. http://www2.gnb.ca/content/gnb/en/departments/elg/environment/content/water/content/wellfield_protectionprogram/wellfield_protected_areas.html. Accessed 2013.

New Brunswick Department of Environment and Local Government (NBDELG). 2013c. Online Well Log System (OWL). Accessed 2013: http://app.elg-egl.gnb.ca/0375-0001/

New Brunswick Department of Environment (NBENV). 2011. Air Quality Monitoring Results in New Brunswick for the Year 2008. Available: http://www.gnb.ca/0009/0355/0022/0001-E.pdf

New Brunswick Department of Health. 2013. Drinking Water Quality Guidelines in New Brunswick. Available at: http://www2.gnb.ca/content/gnb/en/departments/ocmoh/healthy_environments/content/drinking_water_guidelines.htmlNew Brunswick Department of Natural Resources (NBDNR). 2007a. Permanent Sample Plot Forest Inventory Data.

New Brunswick Department of Natural Resources (NBDNR). 2013. Species At Risk. Available: http://www2.gnb.ca/content/gnb/en/departments/natural_resources/wildlife/content/SpeciesAtRisk.html

New Brunswick Department of Natural Resources. 2007. Digital Topographic Database.

New Brunswick Department of Natural Resources and Energy. 2000a. Bedrock geology of New Brunswick. Minerals and Energy Division. Map NR1 (2000 Edition). Scale 1:500 000.

New Brunswick Department of Natural Resources and Energy. 2002. New Brunswick Wetlands Conservation Policy. Produced in partnership with the New Brunswick Department of Environment and Local Government. July, 2002. 14 p.

New Brunswick Department of Health. 2013. Drinking Water Guidelines. http://www2.gnb.ca/content/gnb/en/departments/ocmoh/healthy_environments/content/drinking_water_guidelines.html

New Brunswick Fossil Database Project. 2007 & 2011. Government of New Brunswick On-line Database of Fossils in New Brunswick. http://www1.gnb.ca/0078/GeoscienceDatabase/Fossils/Fossils-e.asp. Accessed on April 17, 2007, June 23, 2011 and August 29, 2012.

New Brunswick Natural Gas Group (NBNGG). 2013. Responsible Environmental Management of Oil and Natural Gas Activities in New Brunswick: Rules for Industry.

New Brunswick Register of Historic Places. 2012. Online Database. http://www.rhp-rlp.gnb.ca/PublicSearch.aspx?blnLanguageEnglish=True.

New York State Department of Environmental Conservation (NYSDEC). 2011. Revised Draft – Supplemental Generic Environmental Impact Statement On The Oil, Gas and Solution Mining Regulatory Program. September 7, 2011.

Parks Canada. 2012. National Historic Sites of Canada - Directory of Federal Heritage Designations. Online Database. http://www.pc.gc.ca/progs/lhn-nhs/index.aspx.

Rampton V.N., R.C. Gauthier, J. Thibault and A.A. Seaman. 1984. Quaternary Geology of New Brunswick, Geological Survey of Canada, Memoir 416.

Rowe, J.S. 1972. Forest Regions of Canada. Department of the Environment, Canadian Forestry Service.

Species At Risk Public Registry (SARPR). 2013. Available at: http://www.registrelep-sararegistry.gc.ca

Squires, W.A. 1976. The Birds of New Brunswick. Second Edition. NB Museum, Monograph Series, No. 7. 221 pp.

Statistics Canada. 2006. Canadian Census.

Statistics Canada. 2011 Canadian Census. Available: http://www12.statcan.ca/census-recensement/index-eng.cfm

Thomson, W.C. 1984. Knocks at Our Door: Visitors at Salt Spring Farm Penobsquis, New Brunswick. Sackville New Brunswick: New Ireland Press.

Tufts, Robie. 1986. Birds of Nova Scotia. Online version provided by Nova Scotia Museum Natural History. Updated 1998. Available at: http://museum.gov.ns.ca/mnh/nature/nsbirds/bons.htm

University of New Brunswick Archives. 2007. The Winslow Family Papers. "Indian Schools" in New Brunswick. http://www.lib.unb.ca/winslow/schools.html

Contact List

Contact Name	Organization/Agency	Contacted Regarding
Finley, Scott	New Brunswick Department of Wellness, Culture and Sport (NBDWCS) Heritage Branch	Historic Places and Structures (2005, 2006, 2007, 2008, and 2009)
McLeod, Malcolm	NBDNR	Bedrock (2007)
Russell, Jeff	NBDELG	Penobsquis Regional Water System (2013)
St. Peter, Clinton	NBDNR	Palaeontological Resources (2005)
Suttie, Brent	ASNB	Archaeological Resources (2013)

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 of propane with less than 5% v/v of ethane, butane and propylene (propene). The remainder of the fluid is made up of proppant and additives.

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-46D / Activator XL-105

There are potentially two activators to be utilized: Activator XL-46D and Activator XL-105. Activator XL-46D is composed of ferric sulfate, isopropanolamine, ammonium citrate, ferric ammonium citrate, and non-hazardous components.

Activator XL-46D has the following general health information:

- No carcinogens, reproductive or chronic hazards (>0.1%);
- Partially biodegradable;
- No EPA HAP (>0.1%);
- Health (HMIS) rating: 3 serious, warning, corrosive or toxic. Avoid skin contact/inhalation. Harmful if swallowed;
- Flammability (HMIS): 2 moderate hazard, flash point > 200º F; and
- Bioaccumulation capacity not determined.

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
NBDELG Analytical Services Laboratory Drilling and Completions Water Well Testing Parameter List

NBDELG Analytical Laboratory Drilling and Completions
Water Well Quality Analysis Package

***I Package and:**

Additional Chemistry Parameters:
Ammonia
Total Organic Carbon (TOC)
Nickel
Silica
Tin
Total Dissolved Solids (TDS)
Total Suspended Solids (TSS)

Microbiology:
Total Coliform
E.coli

Organic (Atlantic RBCA):
Benzene, Toluene, Ethylbenzene and Total Xylenes (BTEX)
C6-C10
>C10-C16
>C16-C21
>C21-C32
Modified TPH – Tier 1

Radiological:
Total Thorium
Total Radium

Gas Analysis:
Tier 1 Presence Detection: Performed by AMEC at Residence. If present, gas is collected and submitted for Tier 2 analysis.
Tier 2: Methane, Ethane, Propane. If ratio of gas composition (methane/(ethane+propane) is less than 200, sample will be submitted for Tier 3 analysis.
Tier 3: Isotopic Analysis

NBDELG Analytical Laboratory's
*I Drinking Water Quality Analysis

General Chemistry Parameters:

Total Hardness (Calcium and Magnesium)
Alkalinity (Carbonate and Bicarbonate)
Conductivity
Nitrate
Nitrite
Nitrate/Nitrite Total
pH
Turbidity

Metals:

Aluminum
Antimony
Arsenic
Boron
Barium
Bromide
Cadmium
Calcium
Chloride
Chromium
Copper
Fluoride
Iron
Lead
Magnesium
Manganese
Potassium
Selenium
Sodium
Sulphate
Thallium
Uranium
Zinc

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

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

2004 Edition

Part I. Conservation Data Centre Subnational Rarity Ranks

Biological diversity or biodiversity can be described at a number of levels, from molecules to ecosystems. Biodiversity is a combination of species diversity (the variety of species), genetic diversity (the genetic variability among individuals of that species), and ecological diversity (the variety of ecosystems/habitats in which they live). Conservation Data Centres (CDCs), as part of The NatureServe* international network, track biodiversity at two levels: species and ecological communities. Species and ecological communities are referred to as **elements** of biodiversity. Elements are ranked in each jurisdiction (province or state) and at global and national levels in order to help prioritise conservation efforts.

NatureServe and all CDCs (called Heritage Programs in the US) use a standardised element ranking system that has evolved over some 30 years, with input from hundreds of scientists, managers and conservationists. The following material describes this element ranking system at the subnational (S) or provincial level and explains how ranks are assigned for species elements of biodiversity. (The community ranking process is slightly different.)

* Formerly known as The Nature Conservancy (TNC)

Definitions of Provincial (subnational) ranks - SRANKS

S1 Extremely rare throughout its range in the province (typically 5 or fewer occurrences or very few remaining individuals). May be especially vulnerable to extirpation.

S2 Rare throughout its range in the province (6 to 20 occurrences or few remaining individuals). May be vulnerable to extirpation due to rarity or other factors.

S3 Uncommon throughout its range in the province, or found only in a restricted range, even if abundant in at some locations. (21 to 100 occurrences).

S4 Usually widespread, fairly common throughout its range in the province, and apparently secure with many occurrences, but the Element is of long-term concern (e.g. watch list). (100+ occurrences).

S5 Demonstrably widespread, abundant, and secure throughout its range in the province, and essentially ineradicable under present conditions.

S#S# Numeric range rank: A range between two consecutive numeric ranks. Denotes range of uncertainty about the exact rarity of the Element (e.g., S1S2).

SH Historical: Element occurred historically throughout its range in the province (with expectation that it may be rediscovered), perhaps having not been verified in the past 20 - 70 years (depending on the species), and suspected to be still extant.

SU Unrankable: Possibly in peril throughout its range in the province, but status uncertain; need more information.

SX Extinct/Extirpated: Element is believed to be extirpated within the province.

S? Unranked: Element is not yet ranked.

SA Accidental: Accidental or casual in the province (i.e., infrequent and far outside usual range). Includes species (usually birds or butterflies) recorded once or twice or only at very great intervals, hundreds or even thousands of miles outside their usual range; a few of these species may even have bred on the one or two occasions they were recorded.

SE Exotic: An exotic established in the province (e.g., Purple Loosestrife or Coltsfoot); may be native in nearby regions.

SE# Exotic numeric: An exotic established in the province that has been assigned a numeric rank.

SP Potential: Potential that Element occurs in the province, but no occurrences reported.

SR Reported: Element reported in the province but without persuasive documentation which would provide a basis for either accepting or rejecting (e.g., misidentified specimen) the report.

SRF Reported falsely: Element erroneously reported in the province and the error has persisted in the literature.

SZ Zero occurrences: Not of practical conservation concern in the province, because there are no definable occurrences, although the species is native and appears regularly. An NZ rank will generally be used for long distance migrants whose occurrences during their migrations are too irregular (in terms of repeated visitation to the same locations) or transitory. In other words, the migrant regularly passes through the province, but enduring, mappable Element Occurrences cannot be defined.

Qualifiers

Breeding Status

B Breeding: Basic rank refers to the breeding population of the element in the province.

N Non-breeding: Basic rank refers to the non-breeding (usually wintering) population of the element in the province.

M Migratory: Basic rank refers to the migratory stopover population in the province.

Other Qualifiers:

? Inexact or uncertain: for numeric ranks, denotes inexactness, e.g., SE? denotes uncertainty of exotic status. (The "?" qualifies the character immediately preceding it in the SRANK)

C Captive or cultivated: Element is presently extant in the country or province only in captivity or cultivation.

Part II. The Ranking Process

To rank species elements, eight different biological criteria are assessed for each species. A letter value from A to D is assigned to each biological factor for which there is enough information. A species with all **A**s will likely be ranked S1 whereas a species with all **D**s would likely receive a S5. Where there is a mixture of letter ranks, the person doing the ranking must use their judgment to decide how much weight should be given to certain factors, depending on the biology of the species in question. The eight factors considered in assigning status ranks are described below. Following this there is a matrix (Table 1) summarizing the guidelines for scoring (A-D) the eight criteria.

Ranking Matrix Eight ranking criteria and value of letter scores for each criterion.

	MATRIX SCORE			
	A	**B**	**C**	**D**
CRITERIA				
Population size	<1000	1000-3000	3000-10,000	> 10,000
Geographic Distribution	<4% of province	4-10% of province	11-50% of province	>50% of province
Population Trend	Rapid decline (>50% in 10 yrs)	Decline (>20% in 10 yrs)	Stable (natural fluctuation)	Increasing
Distribution Trend	Rapid Decline	Decline	Stable	Increasing
Number of Element Occurrences	0-5	6-20	21-100	>100
Number of protected EOs	Believed to be none	At least one	Several	Many
Threats to population	Extreme	Moderate	Limited	None
Threats to habitat	Extreme	Moderate	Limited	None

1. Provincial Abundance

A single letter code represents the estimated provincial abundance of the species. Abundance is measured in different ways depending on the biology of the species. For animal populations it is usually measured by the number of individuals, for plants it may be measured by the area

occupied by a distinct population, and for aquatic invertebrates it may be measured by the stream length that the species occupies:

A = Fewer than 1,000 individuals *or*
Fewer than 10 miles of stream length *or*
fewer than 800 ha

B = 1,000 - 3,000 individuals *or*
10 - 50 miles of stream length *or*
800 - 4000 ha

C = 3,000 - 10,000 individuals *or*
50 - 250 miles of stream length *or*
4,000 to 20,000 ha

D = over 10,000 individuals *or*
over 250 miles of stream length *or*
over 20,000 ha

2. Provincial Range

This denotes the approximate range of the species as a percentage of the province's area. It is defined as the current area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of occurrence, but, *excluding* significant areas where the species does not occur due to unsuitable habitat. Thus the estimate of range for a species exhibiting a linear use of coastal forests or riverine habitats would not consider tracts of unsuitable habitat in the interior of the polygon.

A = Very small range, less than 3% of province
B = Narrow range, less than 10% of province
C = Moderately widespread, less than half of province
D = Widespread, more than half of province

3. Population Abundance Trend

Population Abundance Trend is an estimate of the change in the number of mature individuals over time, from long term monitoring data and historical accounts, where available. Natural fluctuations will not normally count as part of a decline. An observed decline should not be considered as part of a natural fluctuation unless there is evidence for this.

A = Declining rapidly (decrease of 50 % in the last 10 years or 3 generations, whichever is longer)
B = Declining (decrease of 20 % in the last 10 years…)
C = Stable
D = Increasing

4. Distribution Trend

A single-letter code which best characterizes the trend in the species' distribution over its provincial range:

A = Declining rapidly (decrease of 50 % in the last 20 years or 6 generations, whichever is longer)
B = Declining (decrease of 20 % in the last 20 years…)
C = Stable
D = Increasing

5. Number of Element Occurrences (EOs)

An “element occurrence” is the mapping unit of CDC methodology. It is generally defined as an area of land or water on which an “element of biodiversity” (plant and animal species or natural community) is or was present. It is a physical location important to the conservation of a species or community, an area worth preserving to insure the survival of a community or species at risk. For a species it is generally the habitat occupied by a local population, for a community it is the area containing a stand or patch. What constitutes an occurrence also varies between species (e.g. hibernacula, den sites, breeding ponds where adults, egg masses and/or larvae have been identified, breeding colonies, etc.). Some species can have more than one type of occurrence, for example breeding and wintering occurrences.

A single letter code (below) represents the number of estimated occurrences believed extant for the species in the province. When a species’ distribution is extremely limited and there are very few site occurrences, it is very susceptible to any number of ecological disturbances, both predictable and unpredictable. This criteria is therefore an important factor influencing SRANK when the number of occurrences is few. If the letter code for this field is A or B, the species usually qualifies for a rank of S1 or S2.

A = 0 - 5 occurrences
B = 6 - 20 occurrences
C = 21 - 100 occurrences
D = 101+ occurrences

6. Number of Protected Element Occurrences

The estimated number of adequately protected occurrences of the species in the province.

A = Believed to be none protected.
B = At least one protected occurrence.
C = Several protected occurrences.
D = Many protected occurrences.
U = Unknown whether any occurrence protected.

7. Threats to Population

Threats to population include observed, inferred or projected 1) direct exploitation, 2) harassment, or 3) ecological interactions with predators, competitors, pathogens or parasites - which may result in population declines. Threats may arise from natural or man-made forces.

- **A** = Very threatened in the province; threats are of high magnitude (affect more than half the population) and imminent; unmitigated.
- **B** = Moderately threatened province-wide (less than half the population); threats imminent; mitigated by some level of human protection.
- **C** = Not very threatened province-wide; threats not so imminent; threat is less significant to population viability; threats are being mitigated through protective measures.
- **D** = Unthreatened on a province-wide basis, although it may be threatened in minor portions of the province.

8. Threats to Habitat

Threats to habitat include observed, inferred or projected habitat alterations (loss, conversion, degradation or fragmentation) which may result in population declines or loss of element occurrences.

- **A** = Very threatened in the province (affects more than half the provincial range); threats are of high magnitude and imminent; unmitigated.
- **B** = Moderately threatened province-wide (affects less than half the provincial range); threats imminent; mitigated by some level of human protection.
- **C** = Not very threatened province-wide; threats not so imminent; threat is less significant to population viability; threats are being mitigated through protective measures.
- **D** = Unthreatened on a province-wide basis, although it may be threatened in minor portions of the province.

9. Other Considerations

Other considerations in determining the rank that are not apparent from the letter codes selected for the above criteria. Generally, these considerations will raise rather than lower the rank, e.g., "Never sexually reproduces" or "All occurrences are in areas under development".

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

DATA REPORT- ACCDC 5087 AMEC Project TE131040

Prepared 12 September, 2013
by M. Elliott, Data Manager

CONTENTS OF REPORT

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

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, Newfoundland and Labrador. Although a non-governmental agency, the ACCDC is supported by 6 federal agencies, 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 LISTS

Included datasets:

Filename	Contents
Filename _ob.dbf	Rare and Endangered Flora and Fauna in your study area
Filename_bb.dbf	Breeding Birds in your study area
Filename_sa.dbf	Biologically-Significant zones in your study area
Filename_ma.dbf	Managed Natural areas in your study area
Filename_xp.dbf	Expert Maps (predictive distribution) 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 CONTACT INFORMATION

Please direct questions about ACCDC data to the following individuals:

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

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

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

Data Management, GIS
Michael Elliott
Tel: (506) 364-2657
mielliott@mta.ca

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

All other Inquiries
R.A. Lautenschlager
Tel: (506) 364-2665
rlautenschlager@mta.ca

Questions on Federal Species at Risk can be directed to ACCDC: (506) 364-2657, and technical data queries 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.

2.0 RARE AND ENDANGERED TAXA

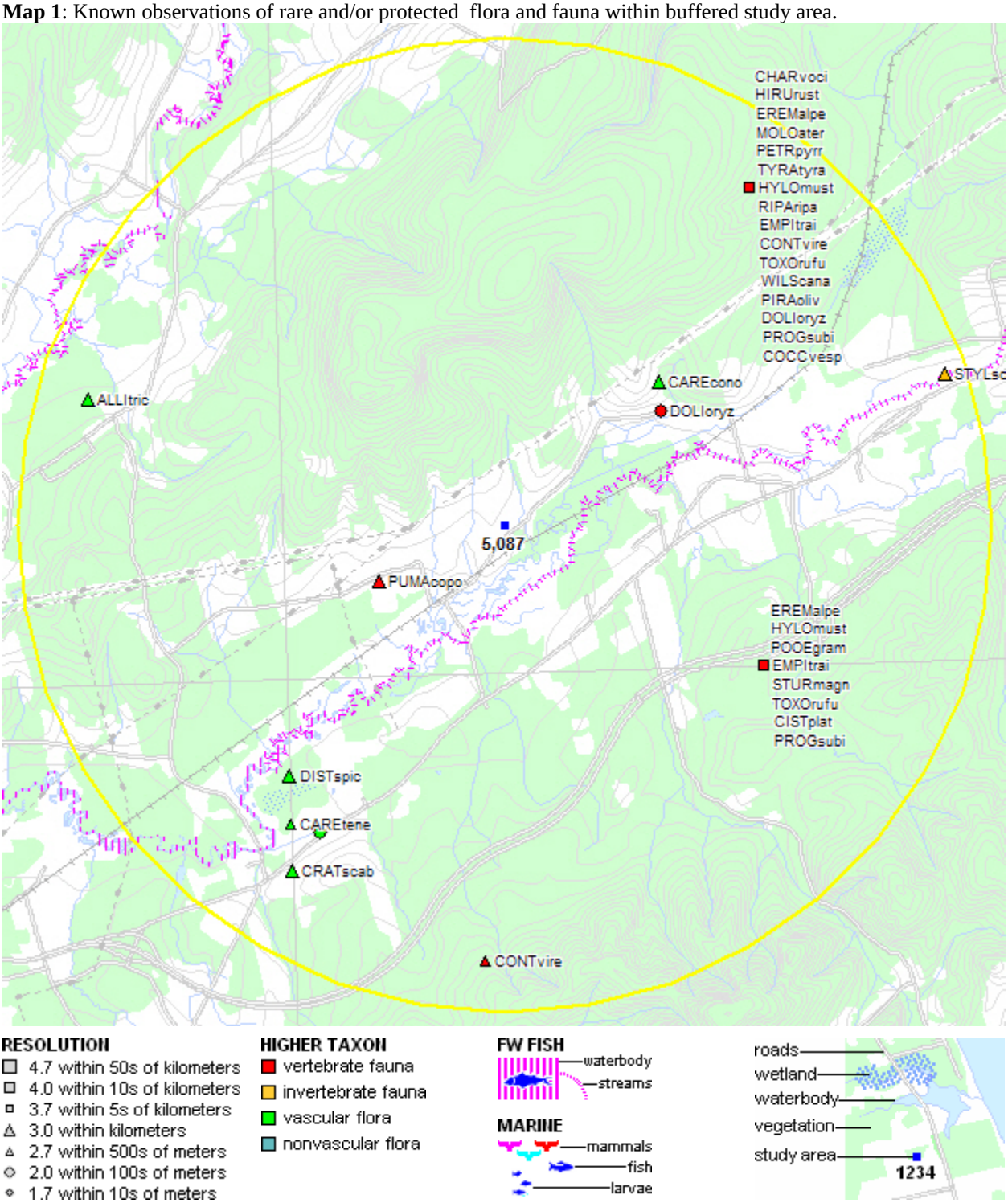
2.1 FLORA

A 5km buffer around the study area contains 7 records of 5 vascular, 0 records of nonvascular flora (see attached *ob.dbf).

2.2 FAUNA

A 5km buffer around the study area contains 206 records of 117 vertebrate, 1 record of 1 invertebrate fauna (cf attached *ob.dbf). Sensitive data: Peregrine Falcons are PRESENT in the study area (cf attached PEFA.rtf).

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



3.0 SPECIAL AREAS

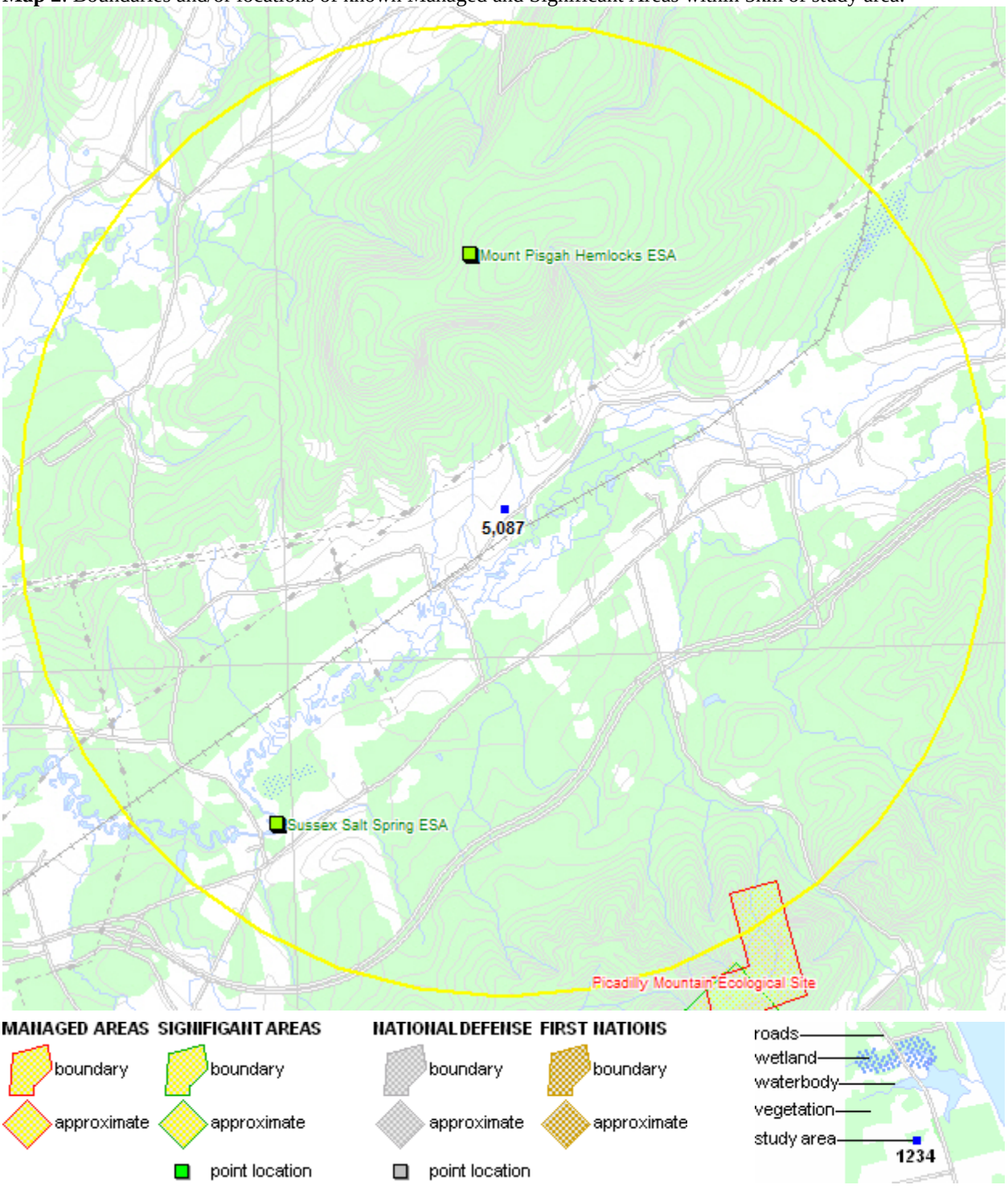
3.1 MANAGED AREAS

The GIS scan identified 1 Managed Area with some degree of protected status, in the vicinity of the study area (see attached *ma.dbf).

3.2 SIGNIFICANT AREAS

The GIS scan also identified 2 biologically significant sites in the vicinity of the study area; such sites are known for exceptional biotic richness but may or may not have legal status (see attached *sa.dbf).

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



4.0 TAXON 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 FAUNA

	Scientific Name	Common Name	Natl. Rarity	Prov. Rarity	Prov. Status	obs	Near.km
A	Charadrius vociferus	Killdeer	G5	S3B		2	4.5±5
A	Cistothorus platensis	Sedge Wren	G5	S1B		1	3.4±5
A	Coccothraustes vespertinus	Evening Grosbeak	G5	S3S4B,S4S5N		1	4.5±5
A	Dolichonyx oryzivorus	Bobolink	G5	S3S4B		7	2.3±0.1
A	Empidonax traillii	Willow Flycatcher	G5	S1S2B		3	3.4±5
A	Eremophila alpestris	Horned Lark	G5	S2B		2	3.4±5
A	Hirundo rustica	Barn Swallow	G5	S3B		2	4.5±5
A	Hylocichla mustelina	Wood Thrush	G5	S1S2B		2	3.4±5
A	Molothrus ater	Brown-headed Cowbird	G5	S3B		1	4.5±5
A	Petrochelidon pyrrhonota	Cliff Swallow	G5	S3S4B		2	4.5±5
A	Piranga olivacea	Scarlet Tanager	G5	S3S4B		1	4.5±5
A	Pooecetes gramineus	Vesper Sparrow	G5	S2B		1	3.4±5
A	Progne subis	Purple Martin	G5	S1S2B		5	3.4±5
A	Puma concolor pop. 1	Cougar - Eastern pop.	G5THQ	SU,SH	Endangered	1	1.8±1
A	Riparia riparia	Bank Swallow	G5	S3B		3	4.5±5
A	Sturnella magna	Eastern Meadowlark	G5	S1S2B		1	3.4±5
A	Toxostoma rufum	Brown Thrasher	G5	S2B		2	3.4±5
A	Tyrannus tyrannus	Eastern Kingbird	G5	S3S4B		3	4.5±5
A	Wilsonia canadensis	Canada Warbler	G5	S3S4B		1	4.5±5
P	Carex conoidea	Field Sedge	G5	S3		1	2.9±1
P	Carex tenera	Tender Sedge	G5	S3		1	3.8±0.5
P	Crataegus scabrida	Rough Hawthorn	G5?	S2		1	4.8±1
P	Distichlis spicata	Salt Grass	G5	S3S4		3	3.8±0.1

4.2 FLORA

	Scientific Name	Common Name	Natl. rarity	Prov. Rarity	Prov. Status	obs	Near.km
P	Crataegus scabrida	Rough Hawthorn	G5?	S2		1	4.8±1
P	Carex conoidea	Field Sedge	G5	S3		1	2.9±1
P	Carex tenera	Tender Sedge	G5	S3		1	3.8±0.5
P	Distichlis spicata	Salt Grass	G5	S3S4		3	3.8±0.1

4.3 RANGE MAPS

The legally protected taxa listed below are linked to the study area by predictive range maps based upon expert estimates of distribution. Taxa listed here but not in the observation data above, are unknown within the study area but perhaps present. A potential for occurrence value of 1 indicates possible occurrence, with 2 and 3 increasingly less probable.

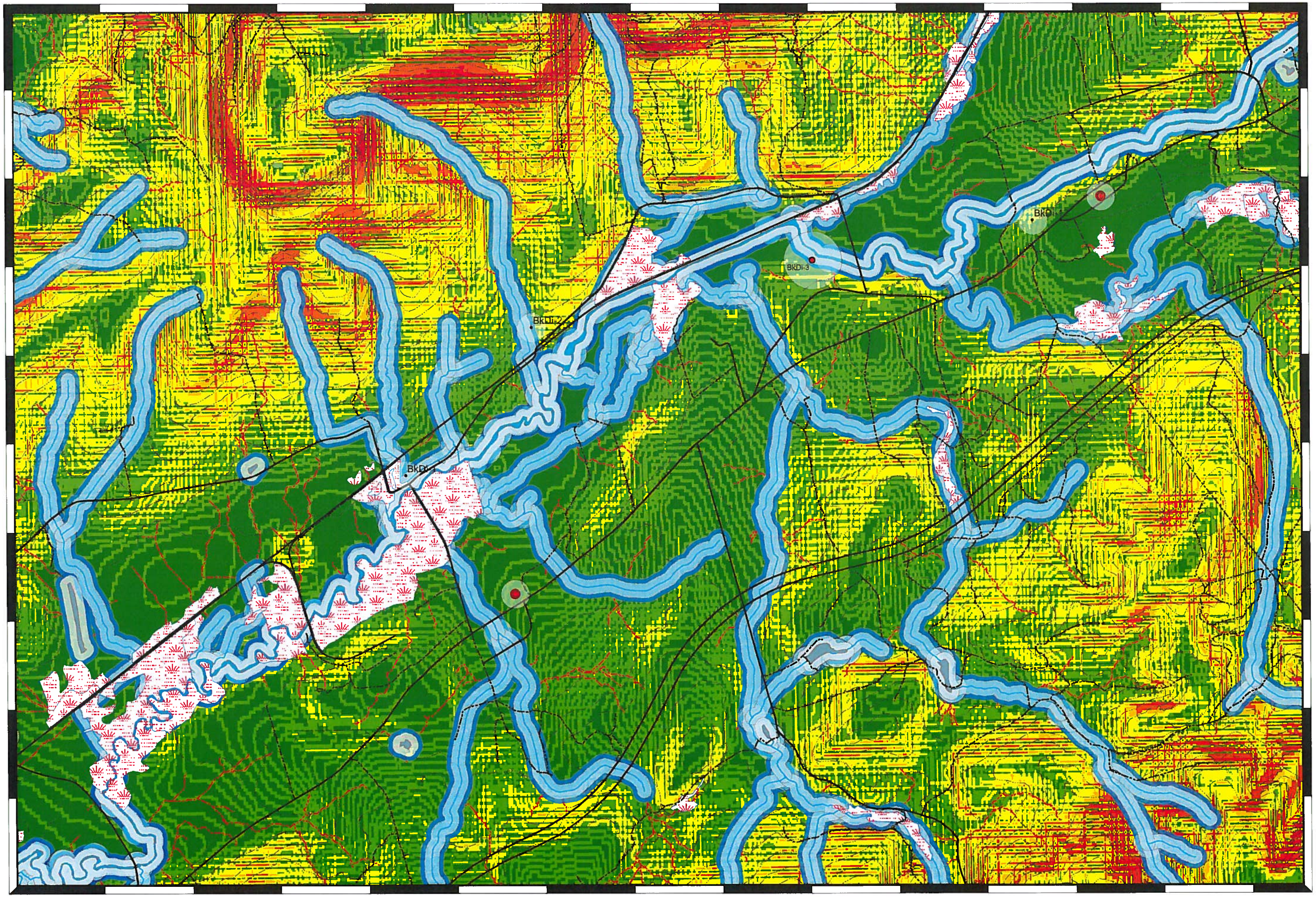
	scientific name	common name	prov. rarity	prov. status	COSEWIC	Potential
a	Glyptemys insculpta	Wood Turtle	S3	Vulnerable	T	1
p	Listera australis	Southern Twayblade	S2			1
p	Isoetes prototypus	Prototype Quillwort	S2	Vulnerable	SC	1
i	Danaus plexippus	Monarch	S2B		SC	1
a	Glaucomys volans	Southern Flying Squirrel	S2S3		NAR	1
a	Bucephala islandica	Barrow's Goldeneye (Eastern pop.)	S1N		SC	2
p	Juncus caesariensis	New Jersey Rush	S2	Vulnerable	SC	2
p	Lachnanthes caroliana	Redroot	S2	Threatened	SC	2
n	Erioderma pedicellatum	Boreal Felt Lichen (Atlantic pop.)	S1S2	Endangered	E	1
a	Charadrius melodus melodus	Piping Plover melodus ssp	S1B	Endangered	E	1
p	Hydrocotyle umbellata	Water-pennywort	S1	Endangered	T	2
p	Scirpus longii	Long's Bulrush	S2S3	Vulnerable	SC	2
p	Lilaeopsis chinensis	Eastern Lilaeopsis	S2	Vulnerable	SC	1
p	Eriocaulon parkeri	Parker's Pipewort			NAR	2
a	Sterna dougallii	Roseate Tern	S1B	Endangered	E	1

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	source
102	Erskine, A.J. 1992. Maritime Breeding Bird Atlas Database.
60	Lepage, D. 2009. Maritime Breeding Bird Atlas Database.
37	Erskine, A.J. 1992. Maritime Breeding Bird Atlas Database. NS Museum & Nimbus Publ., Halifax, 82,125 recs.
4	Lepage, D. 2009. Maritime Breeding Bird Atlas Database. Bird Studies Canada, Sackville NB, 143,498 recs.
3	Benedict, B. Connell Herbarium Specimens (Data) . University New Brunswick, Fredericton. 2003.
2	Hinds, H.R. 1986. Notes on New Brunswick plant collections. Connell Memorial Herbarium, unpubl, 739 recs.
2	Tims, J. & Craig, N. 1995. Environmentally Significant Areas in New Brunswick (NBESA). NB Dept of Environment & Nature Trust of New Brunswick Inc.
1	Tims, J. & Craig, N. 1995. Environmentally Significant Areas in New Brunswick (NBESA). NB Dept of Environment & Nature Trust of New Brunswick Inc, 6042 recs.
1	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	Downes, C. 1998-2000. Breeding Bird Survey Data. Canadian Wildlife Service, Ottawa, 111 recs.
1	Brunelle, P.-M. (compiler). 2009. ADIP/MDDS Odonata Database: data to 2006 inclusive. Atlantic Dragonfly Inventory Program (ADIP), 24200 recs.
1	Benedict, B. Connell Herbarium Specimens. University New Brunswick, Fredericton. 2003.
1	Houston, J.J. 1990. Status of the Redbreast Sunfish (Lepomis auritus) in Canada. Can. Field-Nat. 104:64-68.
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.
1	Zelazny, V. 2007. Fine Filter Protected Natural Areas digital ma

APPENDIX D
ASNB Mapping of Study Area



N
W E
S

Legend

- Cemeteries 1
- PlaneCrashApproxNov2010
- PlaneCrashNov2010
- Historic Period Sites
- Precontact Sites
- Protohistoric Sites
- Unspecified Sites
- Recorded Shipwrecks
- Suspected Shipwrecks
- New Brunswick Portage Routes
- HistoricBuffer
- PreconBuffer
- ShipwrecksBuffer
- UnknownBuffer
- wetland

waterbody
- <all other values>

WATER_CODE
- AO
- LK
- ON
- PN
- RV
- SL
- WA

watercourse
- <all other values>

WATERCOURS
- 1
- 2
- High Potential
- Medium Potential
- NewBrunswickPortageRoutes_Bu
- Predicted Flow Channel

0 0.125 0.25 0.5 0.75 1
Kilometers

New Nouveau Brunswick

Time: 11:17:47 AM
Date: 26/01/2012