Environmental Impact Assessment
Atlantic Potash Corporation
McAllister Industrial Park
Fertilizer Production Facility

Submitted to:

Atlantic Potash Corporation
Saint John, New Brunswick

Submitted by:

AMEC Environment & Infrastructure,

a division of AMEC Americas Limited
Fredericton, New Brunswick

January 2015

TE111019

EXECUTIVE SUMMARY

Atlantic Potash Corporation (APC) is proposing to construct and develop a fertilizer production facility on 100 acres of land available in McAllister Industrial Park in the City of Saint John, New Brunswick. The facility will be designed to refine and ultimately produce potassium nitrate fertilizer. An environmental assessment of the proposed Project will be necessary to meet the requirements of the Environmental Impact Assessment (EIA) Regulation of the New Brunswick *Clean Environment Act*. APC has retained the services of AMEC Environment & Infrastructure, a division of AMEC Americas Limited (AMEC), to prepare this Project Description in order to register the Project for Assessment.

The description of Project components and activities is based on a Pre-Front End Engineering Design (FEED) level of information. The description of the environment within which the Project activities will occur, or may potentially have an influence on, was developed from existing information and site visits from 2011 to 2013. Potential positive and negative interactions between Project activities and the environment have been predicted, to the extent possible, given the preliminary design stage. Where negative interactions were anticipated, and potential effects were a concern, methods for mitigating the effects have been proposed.

The Valued Environmental Components (VECs) identified by issue scoping and pathway analysis (see Section 6.0) for which potential effects may be a concern included:

air quality and climate change;
acoustic environment;
surface water;
groundwater resources;
wetland resources;
wildlife;
migratory birds;
fish, fish habitat and fishery resources;
species at risk;
designated areas;
local economy;
utility corridors;
community and emergency services; 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 construction effects are minimal and will be localized and temporary. During operation, an air quality monitoring program will be in place to ensure that air emissions are below regulated thresholds. Potential greenhouse gas (GHG) emissions from the Project during operation were calculated and all values were found to be below NB annual objectives.

Based on this Study and the mitigation and monitoring strategy proposed, the Project is not likely to have significant adverse effects on the environment. It is predicted that the Project will have major beneficial local and regional economic effects, including major increases in the local and regional employment numbers.

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ACCDC	Atlantic Canada Conservation Data Centre
AFRP	Archaeological Field Research Permit
AIA	Archaeological Impact Assessment
AMEC	AMEC Environment & Infrastructure, a division of AMEC Americas
APC	Atlantic Potash Corporation
AQO	Air Quality Objective
ARD	acid rock drainage
ARM	Air Resources Manager
ASNB	Archaeological Services New Brunswick
CAC	Criteria Air Contaminants
CBC	Canadian Broadcasting Corporation
CCME	Canadian Council of Ministers of the Environment
CEAA	*Canadian Environmental Assessment Act*
CEPA	*Canadian Environmental Protection Act*
CH_4	Methane
CNR	Canadian National Railway
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	CO_2-equivalents
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
DCS	Distributed Control System
DFO	Fisheries and Oceans Canada
DUC	Ducks Unlimited Canada
EC	Environment Canada
ECC	Environmental Components of Concern
ECM	Environmental Compliance Monitoring
EEM	Environmental Effects Monitoring
EHJVs	Eastern Habitat Joint Venture Areas
EIA	Environmental Impact Assessment
EMP	Emergency Management Plan
EPA	Elevated Potential Areas
EPP	Environmental Protection Plan
ESA	Environmentally Significant Area
ESD	Electrostatic Discharge
EWWTF	East Waste Water Treatment Facility
FUNA	forest unit name
GHG	Greenhouse Gas
GIS	Geographic Information System
GLC	ground level concentration
GWP	global warming potential
H_2SO_4	Sulphuric Acid
HASP	Health and Safety Plan
HATGU	Hydrogenation Amine Tail Gas Unit

HazMat	Hazardous Material
HCl	Hydrochloric Acid
HDD	Horizontal Directional Drill
HRIA	Heritage Resource Impact Assessment
HSE	Health, Safety and Environment
HVAC	Heating, Ventilation, & Air Conditioning
ICT	Information and Communications Technology
K_2SO_4	Potassium sulfate
KCl	Potassium chloride, or Potash
KNO_3	Potassium Nitrate
LNG	Liquefied Natural Gas
MAC	Maximum Acceptable Concentration
MBBA	Maritime Breeding Birds Atlas
MBCA	*Migratory Birds Convention Act*
MPN	Most Probable Number
MSDS	Material Safety Data Sheets
N_2O	Nitrous Oxide
NAAQO	National Ambient Air Quality Objective
NaCl	Sodium Chloride
NB	New Brunswick
NBAQO	New Brunswick Air Quality Objective
NBCC	New Brunswick Community College
NBDELG	New Brunswick Department of Environment and Local Government
NBDENV	New Brunswick Department of Environment
NBDNR	New Brunswick Department of Natural Resources
NBDTI	New Brunswick Department of Transportation and Infrastructure
NBDWCS	New Brunswick Department of Wellness, Culture and Sport
NBOHSA	*New Brunswick Occupational Health and Safety Act*
NBSRA	*New Brunswick Species at Risk Act*
NGOs	non-Government organizations
NH_3	Ammonia
NH_4Cl	Ammonium Chloride
NH_4NO_3	Ammonium Nitrate
NO	Nitrogen Oxide
NO_2	Nitrogen Dioxide
NO_x	Nitric Oxides
NPRI	National Pollutant Release Inventory
NRCan	Natural Resources Canada
NTNB	Nature Trust of New Brunswick Inc.
OFC	Old Forest Communities
OFH	Old Forest Habitat
OHWH	Old Hardwood
OMWH	Old Mixedwood
OPIH	Old Pine

OSFH	Old Spruce-fir
OTHH	Old Tolerant Hardwood
OWL	Online Well Log
PDA	Project Development Area
PID	Property Identification Number
PM	particulate matter
POL	petroleum, oils, lubricants
PPE	Personal Protective Equipment
Pre-FEED	Pre-Front End Engineering Design
SARA	*Species at Risk Act*
SARPR	Species at Risk Public Registry
SJIP	Saint John Industrial Parks
SJPA	Saint John Port Authority
SO_2	Sulphur Dioxide
SO_x	Sulphur Oxides
SQM	Sociedad Química y Minera de Chile
StatsCan	Statistics Canada
STP	Strategic Test-Pit
the Agency	Canadian Environmental Assessment Agency
TPM	Total Particulate Matter
TRC	Technical Review Committee
TSP	Total Suspended Particulate
TSS	Total Suspended Solids
UNB	University of New Brunswick
US	United States
USDOT	United States Department of Transportation
VEC	Valued Environmental Component
VOC	Volatile Organic Compound
WAWA	Watercourse and Wetland Alteration
WHMIS	Workplace Hazardous Materials Information System
WHO	World Health Organization
WMO	World Meteorological Organization
YBP	years before present

LIST OF UNITS

℃	degrees Celsius
cm	centimetre
dB	decibels
dB (LAmax)	decibels (maximum sound level)
dB (Leq))	decibels equivalent sound level
dB(A)	decibels A-weighted
DWT	dead weight tonnage
ha	hectares
K_2SO_4	Potassium sulfate
km	kilometre
km/h	kilometres per hour
km^2	square kilometres
kt	kilotonnes
kV	kilovolt
L/s	litres per second
LC	lethal concentrations
Ldn	Day-Night level
LPA	litres per annum
m	metre
m^3/day	cubic metres per day
m^3/s	cubic metres per second
Ma	million years
mg/L	milligrams per litre
MGPD	Million Imperial Gallons per Day
mL	millilitres
mm	millimetres
MMBTU/hr	million British thermal units per hour
MN	Magnitude
Mt	Million metric tonnes; megatonnes
MT	metric tonnes
MTPA	metric tonnes per annum
MW	megawatt
Nm^3/hr	normal cubic meter per hour
PM$_{10}$	Particulate Matter, 10 microns or less
PM$_{2.5}$	Particulate Matter, 2.5 microns or less
ppb	parts per billion
ppm	parts per million
PSI	pounds per square inch
t/h	tonnes per hour
v	volt
μg/m^3	micrograms per cubic metre; ppb
μm	micrometre

1.0 INTRODUCTION

Atlantic Potash Corporation (APC) is proposing to construct and operate a potassium nitrate (KNO_3) fertilizer production facility (Project) in McAllister Industrial Park in Saint John, New Brunswick (NB) (Figure 1.1). Phase I of this Project consists of constructing and operating a 60,000 metric tonnes per annum (MTPA) potassium nitrate fertilizer production facility. Another 60,000 MTPA of potassium nitrate will be added as part of Phase II, with an additional 60,000 MTPA of potassium nitrate capacity introduced in Phase III. In total, the Project will have a capacity of 180,000 MTPA of potassium nitrate per year. Potassium nitrate will be produced at international standards into potash fertilizer and be sold to worldwide markets for agricultural use. The primary customers will be South American countries (such as Brazil), Europe and China (APC, 2011).

Following completion of the phases, the next stage of this Project will be to analyse the feasibility of constructing and operating a urea and/or a potassium sulphate facility. At the completion of the market analysis, customer survey and economic feasibility study, APC will make a decision to move forward or cease work on these two facilities. If a positive decision is taken, APC will submit a separate Environmental Impact Assessment (EIA) for these two facilities. Neither the urea and/or potassium sulphate facility option is included in this EIA submission.

The following EIA document supports the registration of the Project under the EIA process of the *New Brunswick Clean Environment Act*, Regulation 87-83. This document, which includes recommendations for mitigation measures to minimize potential Project related effects, was developed for APC by AMEC Environment & Infrastructure, a division of AMEC Americas Limited (AMEC).

1.1 Name, Address and Identification of the Proponent

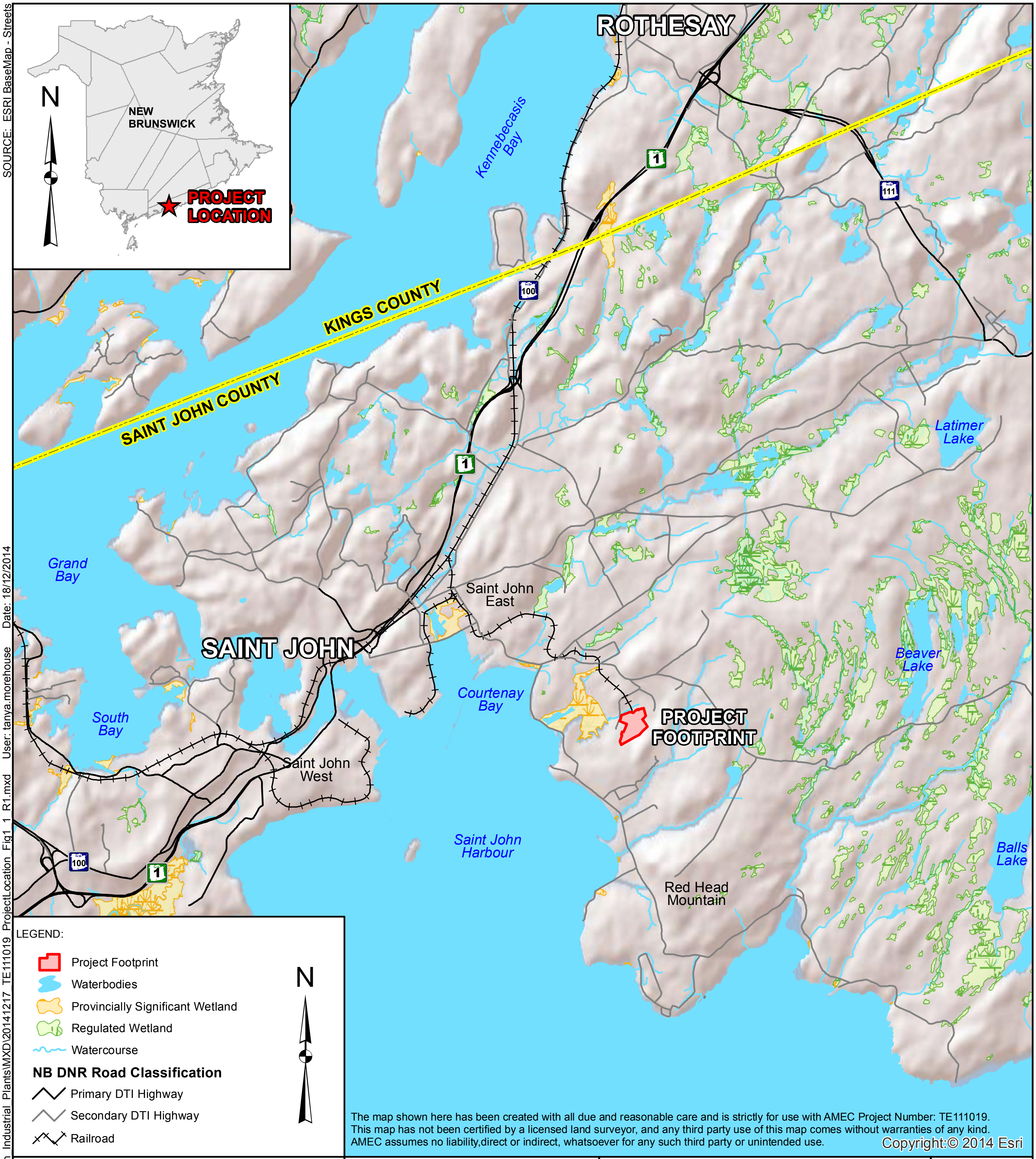
Atlantic Potash Corporation (APC)
Keith Attoe, Director
101-133 Prince William St.Saint John, NB
E2L 2B5

1.2 Corporate Information and Organization

APC is a New Brunswick mineral exploration and development company focused on exploring potash development and production opportunities in southern New Brunswick. The company was incorporated under the *New Brunswick Corporations Act* on 9 December, 2010 and is headquartered in Saint John, NB.

SOURCE: ESRI BaseMap - Streets

Path: G:\GIS\PROJECTS\TE111019 Potash Industrial Plants\MXD\20141217 TE111019 ProjectLocation Fig1 1 R1.mxd User: tanya.morehouse Date: 18/12/2014



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CLIENT:

ATLANTIC POTASH CORPORATION

SCALE:

0 1,000 2,000 4,000 6,000

Metres

1:150,000

PROJECT:

APC McALLISTER INDUSTRIAL PARK FERTILIZER PRODUCTION FACILITY

DWN BY: TM

CHK'D BY: CL/JB

DATE: Dec 17, 2014

REV. NO: 1

FIGURE NO: 1.1

AMEC Environment & Infrastructure,
a Division of AMEC Americas Limited.

Suite 1 - 495 Prospect Street
Fredericton, NB E3B 9M4
Tel. 506-458-1000 Fax 506-450-0829
www.amec.com

DATUM: NAD 83 CSRS

PROJECTION: New Brunswick Stereographic

PROJECT NO: TE111019

TITLE:

PROJECT LOCATION

The design team in China has built and currently operates state of the art potassium nitrate and potassium sulphate facilities; which include the latest technology for safety and protection of the environment. These facilities have been developed both independently and as joint ventures with Sociedad Química y Minera de Chile (SQM), a globally recognized Chilean potash mine operator and fertilizer producer. APC's mission is to become a leading supplier of specialty potash fertilizers for global markets such as China – the world's largest consumer at 25% of the global demand (APC, 2011).

Global potash capacity is forecasted to increase from 41.6 million metric tonnes (Mt) in 2009 to 54.7 Mt in 2014. This represents an additional 13 Mt of capacity, mostly in Canada and Russia. New tonnage will also emerge in Argentina, Chile, China, the Republic of Congo, Israel, Jordan and Laos. Most industry analysts agree that fertilizer demand will outstrip supply capacity for the next twenty years (Food and Agriculture Organization of the United Nations, 2010).

New Brunswick is currently the only Canadian province besides Saskatchewan known to contain mineable potash and these two provinces combined currently provide 50% of the world's product. APC also holds key mineral rights for approximately 103 square kilometres (km^2) of New Brunswick property known as the Millstream Potash Deposit, located 10 kilometres (km) northwest of Sussex.

APC's Project team is led by:

- Guocai Liu, Chairman; and
- Keith Attoe, C.A., C.Dir., Director.

2.0 PROJECT PLANNING AND MANAGEMENT

2.1 Purpose of the Undertaking

To construct and operate a potassium nitrate fertilizer production facility.

2.2 Location of the Undertaking

McAllister Industrial Park in Saint John, NB (Figure 1.1).

2.3 Purpose of the EIA Report

The purpose of this EIA report is to fulfill the requirements under the EIA process of the *New Brunswick Clean Environment Act*, Regulation 87-83. In addition, the EIA report provides valuable information to the public about this endeavour and serves as a resource for the proponent regarding recommendations of mitigation measures to minimize potential Project related effects.

2.4 Report Organization

The Project Description consists of the following sections and associated Appendices:

Sections:

- Section 1.0 – Introduction;
- Section 2.0 – Project Planning and Management;
- Section 3.0 – Project Description;
- Section 4.0 – Regulatory Framework, Scoping and Stakeholder Input;
- Section 5.0 – Existing Environment;
- Section 6.0 – Valued Environmental and Socio-Economic Components (VECs);
- Section 7.0 – Environmental and Socio-Economic Impact Effects Assessment;
- Section 8.0 – Conclusions; and
- Section 9.0 – References;

Appendices:

- Appendix A Geotechnical Survey Report;
- Appendix B Potential Safety Hazards and Control Measures;
- Appendix C Emergency Response Plan Outline;
- Appendix D Watercourse Photo Log/ Habitat Characterization/ Electrofishing Data Sheet;
- Appendix E Legislated Species at Risk List; and
- Appendix F Air Quality Dispersion Modelling Report.

3.0 PROJECT DESCRIPTION

3.1 Project Components, Structures and Site Layout

3.1.1 Fertilizer Production Facility

3.1.1.1 Introduction

APC is proposing to construct and develop a fertilizer production facility in McAllister Industrial Park, Saint John, NB (Figure 1.1). APC facilities will be designed to refine and produce potassium nitrate fertilizer (Figure 3.1).

Supplementary products as a result of the aforementioned processes will include ammonium chloride (NH4Cl) derived from the potassium nitrate process.

The phases of the potassium nitrate fertilizer plant being considered are:

- Phase I – 60,000 MTPA ;
- Phase II – 60,000 MTPA ; and
- Phase III – 60,000 MTPA

For a total of 180,000 MTPA of potassium nitrate. In addition, by-products include 60,000 MTPA of ammonium chloride for each Phase for a total of 180,000 MTPA.

3.1.1.2 Materials Supply and Storage

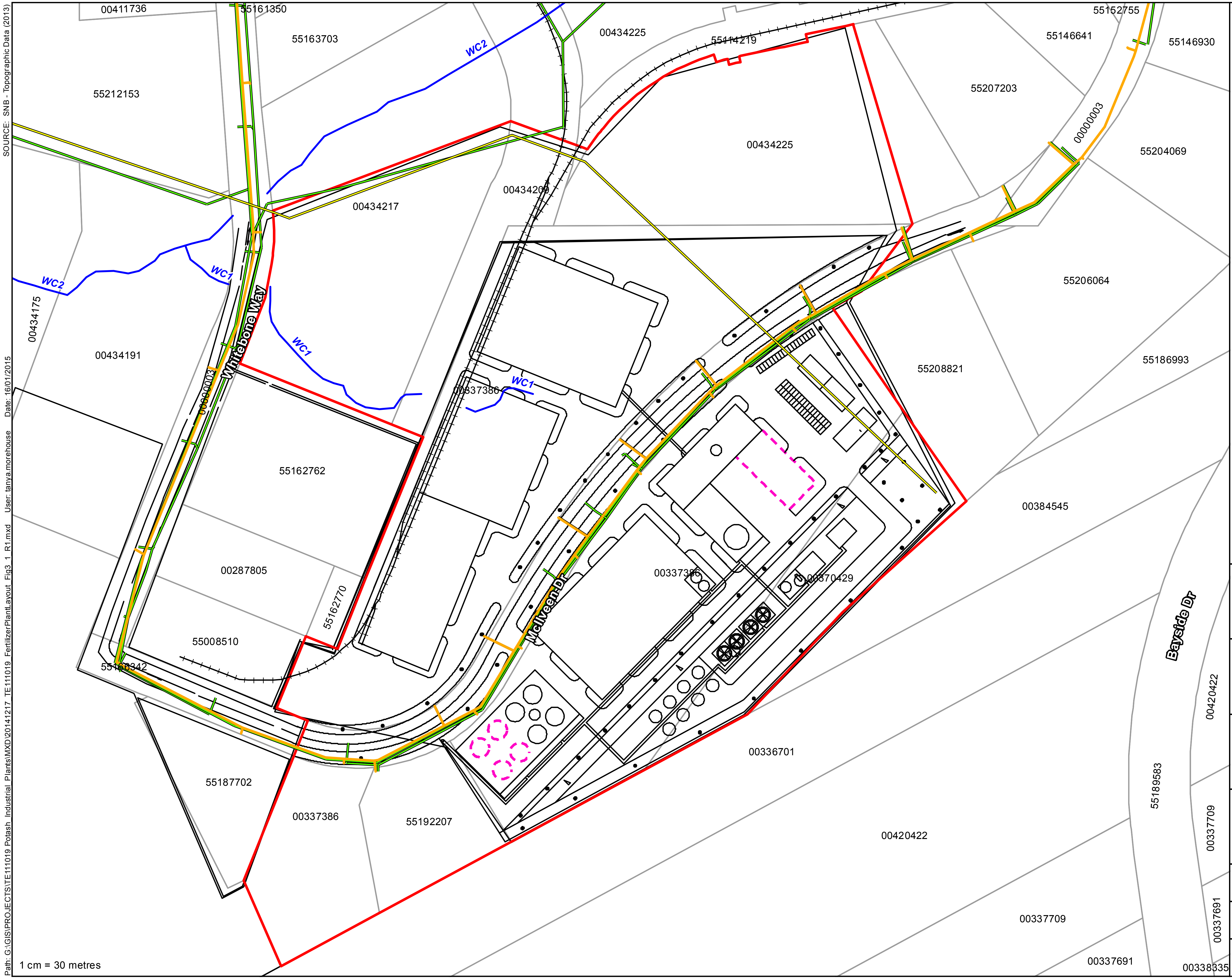
Raw Materials:

- Ammonium nitrate in liquid form (90% strength) is delivered to site by road and stored in heated tanks to maintain suitable temperatures. The ammonium nitrate is stored in a tank farm with a containment berm to ensure safe storage and containment of any leaks. It is pumped as required to the processing area.
- Potassium chloride (KCl) is delivered to site by road and stored in a warehouse in dry granular solid form. It is conveyed to the processing area by belt conveyor.

Products:

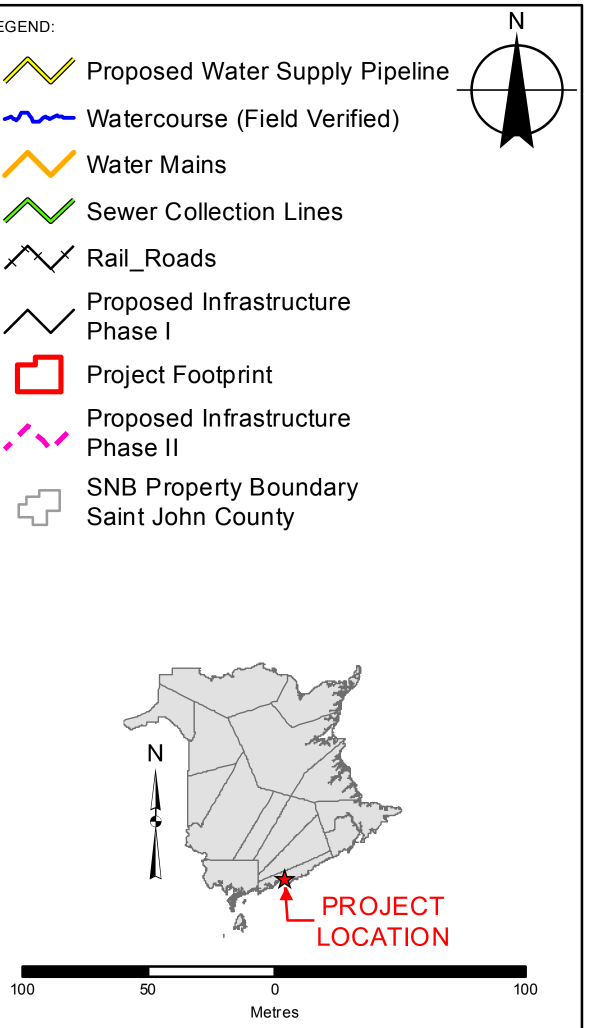
- Potassium nitrate is packaged into bags and stored in a single story warehouse. Anti-caking agent is applied to prevent the granules from solidifying.
- Ammonium chloride is similarly packaged and stored in a separate warehouse. Anti-caking agent is applied to prevent the 3% moisture granules from solidifying.

Path: G:\GIS\PROJECTS\TE111019 Potash Industrial Plants\MXD\20141217 TE111019 FertilizerPlantLayout Fig3 1 R1.mxd User: tanya.morehouse Date: 16/01/2015 SOURCE: SNB - Topographic Data (2013)



LEGEND:

- Proposed Water Supply Pipeline
- Watercourse (Field Verified)
- Water Mains
- Sewer Collection Lines
- Rail_Roads
- Proposed Infrastructure Phase I
- Project Footprint
- Proposed Infrastructure Phase II
- SNB Property Boundary Saint John County



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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:

APC McALLISTER INDUSTRIAL PARK
FERTILIZER PRODUCTION FACILITY

TITLE:

FERTILIZER PRODUCTION PLANT LAYOUT

DATUM: NAD 83 CSRS	DWN BY: TM	DATE: Dec 17, 2014
PROJECTION: New Brunswick Stereographic	CHK'D BY: CL/JB	SCALE: 1:3,000
PROJECT NO: TE111019	REV NO: 1	FIGURE NO: 3.1

3.1.1.3 Ancillary Equipment and Buildings

In addition to the buildings required specifically to house the above process equipment, the plant site will consist of ancillary units to provide the requisite utilities, e.g. process water, potable water, electricity, natural gas, steam, etc. There will be a requirement for cooling towers for cooling process water and a boiler plant to provide steam for heating to the evaporators, crystallizers and plant heating. Dust control equipment consisting of bag-houses and scrubbers will be incorporated in the process design to control dust and vapours within acceptable limits, with suitable exhaust stacks venting cleaned air and water vapour to atmosphere. Administration offices, changing facilities and vehicle parking for up to 150 personnel will be included, with maintenance facilities, including a suitably equipped workshop and vehicles as required.

3.1.1.4 Principal Building Dimensions

The following table (Table 3.1) describes the building dimensions of the main components associated with the potassium nitrate facility.

Table 3.1 Principal Building Dimensions

Building	Dimensions: Length x Width x Height (metres (m))
KCl Warehouse	130 x 90 x 8
NH_4NO_3 Tank Farm	100 x 50 – with 2 m berm
Process Building #1 (Phase I: 60,000 MTPA)	60 x 30 x 20
Process Building #2 (Phase II: 60,000 MTPA)	60 x 30 x 20
Process Building #3 (Phase III: 60,000 MTPA)	60 x 30 x 20
KNO_3 Drying	90 x 30 x 8
Boiler House	20 x 14 x 8
Cooling Towers	28 x 14 x 8
KNO_3 Packaging	60 x 45 x 10
KNO_3 Warehouse	100 x 100 x 8
NH_4Cl Warehouse (1)	100 x 80 x 8
NH_4Cl Warehouse (2)	130 x 60 x 8
Administrative Offices & Laboratory	30 x 15 x 4 (x2)
Maintenance Workshops	35 x 20 x 5
Electrical Load Centre	50 x 40 x 5

3.1.2 Water Supply

Phase I of the Project will require approximately 1635 cubic metres per day (m^3/day) (19 litres per second (L/s)) of process water. This water will be supplied via a 450 millimetres (mm) diameter pipeline from the Saint John “East Waste Water Treatment Facility” (EWWTF), and will be approximately 3 km in length (Figure 3.2). The pipeline is sized to accommodate potential future requirements which could bring the total process water requirement up to a maximum of 13,000 m^3/day (150 L/s). The water for this pipeline will be pumped from an APC owned pump-house directly adjacent to and supplied by the EWWTF. The water will be pumped to a holding tank on the plant site to provide adequate quantities of process water to the operations. Approximate dimensions for this tank would be 5.0 m in diameter and 7.0 m high.

Potable water for personnel use would be supplied by the McAllister Industrial Park water supply, essentially as supplied by Saint John Water Authority.

Fire protection water would be provided by the McAllister Park Fire Protection firewater loop, to which a connection would be made. This could also be backed up by the process water supply tank and system.

3.1.3 Electrical Supply

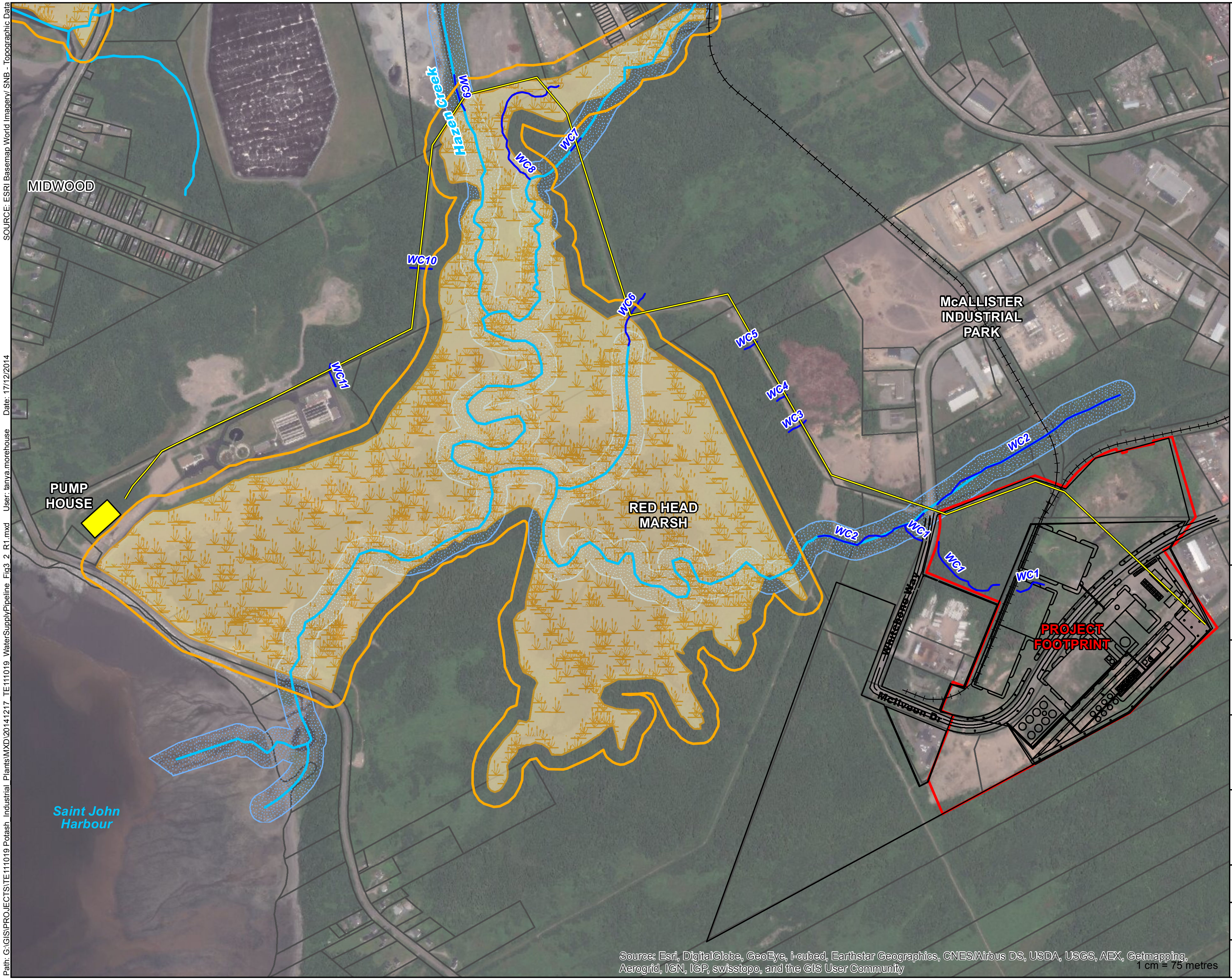
Approximately 5.0 megawatts (MW) of electricity will be required for Phase I and Phase II of the potassium nitrate facility. This would be supplied by NB Power. There is a current electrical supply to the industrial park by NB Power at the 12.47 kilovolt (kV) level. It is most likely therefore that a connection to this supply would be made.

A step down transformer would be located within the plant site to distribute at 5 kV within the plant area to the respective switch gear rooms for each unit, where the supply would be further stepped down to 600, 240 and 120 volts (V) as required.

If future plants are envisaged, the power requirement could reach as high as 20 MW. In this case it may be necessary to connect directly to the NB Power line which runs across the south west corner of the property. This line is a main transmission line at 138 kV. A main sub-station, transformers and switch-yard would therefore be required to be built to step down the voltage to the required levels for the respective plants. This scope of work is not included in this EIA.

3.1.4 Natural Gas Supply

Approximately 1.25 Billion cubic feet (Bcf) of natural gas will be required to run all three Phases of the Project. Natural gas would be supplied from the Brunswick Pipe owned line located to the north of the site, currently supplying gas to the Emera power plant at Bayside in Saint John. A lateral connection to this line would be made with a suitable valve station at the connection point and a metering station set at the entrance to the APC facility. This scope of work is not included in this EIA as Emera intends to design, construct and operate this pipeline.



Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

1 cm = 75 metres

Path: G:\GIS\PROJECTS\TE111019 Potash Industrial Plants\MXD\20141217_TE111019_WaterSupplyPipeline_Fig3_2_R1.mxd User: tanya.morehouse Date: 17/12/2014 SOURCE: ESRI Basemap World Imagery/ SNB - Topographic Data

LEGEND:

- Proposed Water Supply Pipeline
- Provincially Significant Wetland (30 metre Buffer)
- Watercourse (Field Verified)
- NBDNR Watercourse
- Proposed Infrastructure
- Provincially Significant Wetland
- NBDNR Watercourse (30 metre Buffer)
- 🟥 Project Footprint
- ☐ SNB Property Boundary Saint John County

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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:

APC McALLISTER INDUSTRIAL PARK FERTILIZER PRODUCTION FACILITY

TITLE:

WATER SUPPLY PIPELINE FOOTPRINT

DATUM: NAD 83 CSRS	DWN BY: TM	DATE: Dec 17, 2014
PROJECTION: New Brunswick Stereographic	CHK'D BY: CL/JB	SCALE: 1:7,500
PROJECT NO: TE111019	REV NO: 1	FIGURE NO: 3.2

3.2 Alternative Means of Carrying out the Project

3.2.1 Alternative Locations for processing Plant

A location in the province of Quebec was also considered for the placement of the proposed fertilizer processing plant. The City of Saint John was selected due to the Industrial Park's proximity to the port, availability of services and suitable land parcels. The port in the City of Saint John can accommodate the export of the fertilizer and has access to markets in the US, Europe, and South America.

3.2.2 Alternative Energy Sources

Electricity, oil and natural gas are energy sources considered for the proposed fertilizer processing plant. Based on the amount required, economics and environmental considerations, a combination of electricity and natural gas will be used as energy sources for the Project. Electricity will be used to run the facility and natural gas will be used for the actual processing of the fertilizer.

3.2.3 Alternative Water Sources

There are two main sources of water available for the Project:

- City of Saint John municipal water; and
- EWWTF water.

Due to the quantity of water required and cost, the EWWTF water was deemed to be the most economical solution.

3.3 Description of Project Phases and Activities

3.3.1 Construction Phase Activities

A large portion of the site has been cleared and leveled as part of the McAllister Industrial Park development. In addition, the route for the water supply pipeline follow existing roads and easements. Consequently, there will be limited new clearing of trees and brush required. Any clearing will be undertaken during winter months, while the grubbing and grading will be staged during construction phases.

There will be a requirement for leveling the ground to meet the layout requirements of the plant site. The foundations will consist of piles and reinforced concrete, the requirement for which will be determined by the design and weights of the process buildings and equipment and by seismic requirements, consistent with the current Building Code regulations. A preliminary geotechnical survey (Appendix A) was conducted in the fall and winter of 2013/2014 by Brunswick Engineering & Consulting Inc. and provides the initial recommendations for the construction of the plant.

3.3.2 Construction Phase Scheduling

A preliminary construction schedule will incorporate the following activities:

- site clearing and leveling as required;
- upgrading of access roadways as required;
- installation of temporary power systems;
- pile placement - quantities and types dependent on geotechnical investigation;
- construction of foundations for all buildings, including pile-cap placements for Phases II and III;
- construction of main process buildings structures;
- construction of ancillary buildings structures;
- delivery and rough-set installation of process and ancillary equipment in conjunction with building construction;
- cladding of buildings;
- installation of power and water supplies;
- natural gas installations within the process plants and ancillary buildings;
- final setting and installation of process and ancillary equipment;
- final installations of process and potable water, natural gas, electrical supplies and HVAC (Heating, Ventilation, & Air Conditioning) systems to process, ancillary and administration buildings;
- electrical power and control wiring installations to process equipment; and
- control systems installations - including Distributed Control System (DCS) and computer installations and programming.

For the purpose of this EIA the Project construction was divided into eight stages over a period of 5 years governing the construction of the three potassium nitrate plants:

- mobilization/design (2016) / 3-18 months;
- clearing/grubbing/grading (2016) / 1 month;
- construct water supply pipeline from EWWTF (2016 - 2017) / 6-12 months;
- construction Phase I (2016 - 2017) / 18 months;
- operation of Phase I (2017);
- construction of Phase II (2017 - 2018) / 8-12 months;
- operation of Phase II (2018); and
- construction / Operation of Phase III (2020).

3.3.3 Operation Phase Activities

Potassium nitrate is produced by combining potassium chloride and ammonium nitrate.

Potassium chloride is supplied in “Standard Grade” solid form, averaging 0.65 mm particle size. It is brought to site either by rail or road transport and off-loaded and stored on site in a warehouse, from where it is transported by conveyor as required by the process.

Ammonium nitrate is supplied in liquid form at a solution strength of 80–90 % at 65 to 100°C. The actual source of ammonium nitrate can be derived in several ways:

- Direct supply as liquid via rail or road transport to a suitable on-site storage facility.
- Manufactured on-site by combination of oxygen (from air) and ammonia in a proprietary ammonium nitrate production process.

For the purposes of this report, the supply of ammonium nitrate is assumed to be in liquid form via rail or road transport.

The process of producing potassium nitrate is considered to be a "double decomposition" process whereby two new compounds are produced, namely, potassium nitrate and ammonium chloride, from the combination of the two feed compounds. Thus, the plant is in fact a potassium nitrate and ammonium chloride production plant.

With reference to the Process Flow Diagram (Figure 3.3), the process involves the following:

1. Potassium chloride (KCl) particles are conveyed from storage to a dissolving tank where they are mixed with hot water to form a solution of approximately 28% w/w strength.
2. The solution is stored in a heated tank from which the desired quantity is pumped to a mixing reactor where the KCl solution is mixed and reacts with recycled solution from the ammonium chloride (NH_4Cl) circuit, described below, containing approximately: 23% potassium nitrate (KNO_3), 20% ammonium nitrate (NH_4NO_3), 10% NH_4Cl and 6% sodium chloride (NaCl).
3. The resulting solution from the reactor thus consists of: 28% KNO_3, 3% NH_4NO_3, 13% NH_4Cl, and 4% NaCl.
4. This solution is fed to a bank of crystallizers where KNO_3 alone is crystallized from the solution to form a slurry of 29% KNO_3, 4% NH_4NO_3, 14% NH_4Cl, and 4% NaCl. All constituents other than KNO_3 being dissolved in the solution.
5. This slurry is pumped to a thickener where the KNO_3 solids are settled to form a concentrated slurry which is then fed to a centrifuge.
6. The centrifuge de-waters the slurry to produce a cake, at approximately 3% moisture content, consisting of 94% KNO_3, 2% NH_4NO_3, and 1% NH_4Cl.
7. This cake is conveyed to a fluid bed dryer where it is dried to approximately 0.4% moisture and then conveyed to the shipping area, where it is mixed with anti-caking agent for packaging and storage prior to shipping.
8. The centrate (solution) from the centrifuge contains 4% NH_4NO_3, 19% KNO_3, 16% NH_4Cl and 5% NaCl. This is transferred via an agitated tank, to keep the particles in solution and a shell and tube heat exchanger to increase temperature, to a mixing tank where it is mixed with the incoming NH_4NO_3. This is essentially the starting point for the NH_4Cl production process.
9. NH_4NO_3 is delivered to site and stored in heated tanks to maintain suitable temperatures, in a tank farm with a containment berm to ensure safe storage and

containment of any leaks. From the storage tanks it is pumped to a heated solution buffer tank within the production facility to supply the requisite amount for the process.

10. From the buffer tank it is pumped to the mixing tank where it is mixed with the heated solution from the KNO_3 centrifuge centrate stream as described in “8” above.
11. The solution from the mixing tank consists of: 14% NH_4NO_3, 16% KNO_3, 14% NH_4Cl and 4% NaCl. This is fed to a string of evaporators wherein the solution is concentrated by boiling off water, to bring the solution to a concentration of: 17% NH_4NO_3, 19% KNO_3, 16% NH_4Cl with 5% NaCl.
12. This solution is then fed to crystallizers which precipitate the NH_4Cl out of solution leaving a slurry containing 18% NH_4Cl as solids with 18% NH_4NO_3, 21% KNO_3 and 5% NaCl in solution.
13. The slurry is fed to a thickener where it is partially de-watered, with the thickener underflow being fed to a centrifuge which separates the solids of NH_4Cl from the solution, producing a cake comprising of 90% NH_4Cl, 6% KNO_3, 1% NaCl with 3% moisture. The cake is conveyed to the NH_4Cl packaging area where it is mixed with anti-caking agent and bagged for shipment.
14. The centrate from NH_4Cl centrifuge is the feed stream to the KNO_3 circuit which is pumped to the KNO_3 mixing reactor as described in “2” above.

3.3.4 Decommissioning and Abandonment Phase Activities

Decommissioning and abandonment plans will be developed in accordance with regulatory requirements of that time after consulting with New Brunswick Department of Environment and Local Government (NBDELG) and other regulatory authorities. Environmental issues associated with decommissioning and abandonment activities will be similar those during construction.

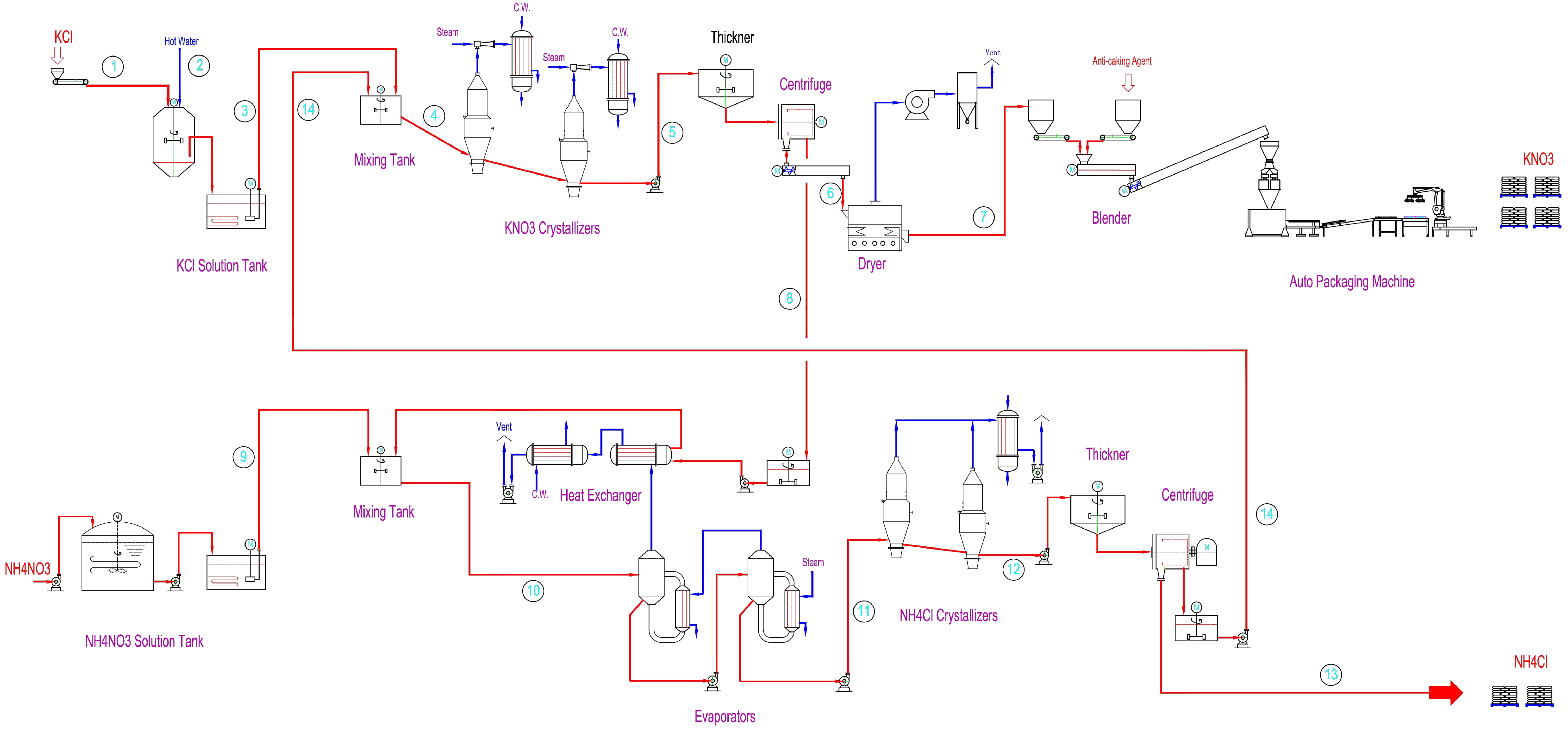
3.3.5 Waste Management, Emissions

The Project will produce the following general types of emissions, discharges, and waste:

- solid waste (construction & domestic);
- wastewater (construction, process, and domestic);
- air emissions, including volatile organic compounds (VOCs), sulphur oxides (SO_x), Nitric oxides (NO_x), particulate matter (PM), and greenhouse gases (GHGs); and
- noise.

3.3.5.1 Solid and Liquid Waste

Solid waste generated during construction, operations, maintenance and domestic activities may include wood debris, temporary fencing, signs, metal containers and canisters, waste metal and spent welding rods. These wastes will be collected and disposed of in a manner consistent with the applicable local and provincial regulations. Materials that can be reused or recycled will be taken to the appropriate facilities.



SOURCE: SICHUAN MIGAO FERTILIZER CO.,LTD, 2014.

CLIENT:

ATLANTIC POTASH CORPORATION

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

SCALE: NOT TO SCALE

DATUM & PROJECTION:
-

PROJECT NO:
TE1111019

FILE NO:
APC-PFD-KNO3-R0

PROJECT:
MCALLISTER INDUSTRIAL PARK
FERTILIZER PRODUCTION FACILITY

TITLE:
PROCESS FLOW DIAGRAM OF
POTASSIUM NITRATE PROCESS

DWN BY:
D.M.

CHK'D BY:
J.B.

DATE:
2014/11/14

REV. NO:
0

FIGURE NO:
3.3

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Liquid wastes generated during construction of the proposed Project are expected to include various products from the operation of construction equipment and maintenance vehicles (petroleum, oil, lubricants (POL)), paints and organic solvents as well as wastewater generated from hydrotesting of the pipelines. These wastes are considered hazardous and will be collected and disposed of in accordance with applicable local and provincial requirements. Liquid waste from construction personnel, including sewage and grey water, will be collected and disposed in a manner consistent with applicable local and provincial standards.

During operation liquid wastes generated from personnel will be disposed of using the existing City of Saint John sewer system. Liquid wastes generated during operational activities will be recycled where possible or disposed of using the existing City of Saint John sewer system. All liquid wastes generated at the facility will conform to the wastewater standards set by the City of Saint John prior to disposal.

3.3.5.2 Air and Noise Emissions

During construction, air emissions will generally include carbon monoxide (CO) and CO_2 emissions from construction equipment exhaust (e.g. heavy equipment, trucks, etc.) and fugitive dust from construction areas.

During operation of the fertilizer facility air emissions arise from venting of equipment, the combustion process of the gas boiler and dust generated from the drying system and conveyers. The main air emission sources will be generated from:

- enclosed vessels with a breathe pipe;
- open vessels;
- exhaust pipes of vacuum pumps, scrubber and deaerator;
- evaporating steam from cooling tower;
- exhaust gas from boiler; and
- drying system exhaust and conveyors.

Noise will be generated through a variety of sources. Construction equipment includes a large number of types of machines and devices, varying widely in physical size, horsepower rating and principle of operation. Noise levels will vary with the equipment used. Potential sources of noise during operation are predominantly associated with equipment operation and steam vent at the fertilizer plant. Typical noise levels are anticipated to be between 55 to 60 decibels (A-weighted) (dB(A)) during the day and 50 to 55 dB(A) during the evening hours.

More information related to air emissions and noise levels is included in Section 7.2.2 with a discussion of proposed mitigation measures.

3.3.6 Malfunctions and Accidents

The Project components will be designed, constructed and operated in accordance with codes and standards for industrial plants. Nonetheless, accidental events are always a possibility.

Accidental events may include but are not limited to: industrial accidents, traffic accidents, fires, and GHG emissions. By nature, accidents are difficult events to foresee. Prevention and preparedness is the key to prevent accidents from arising.

During operation there are four main types of hazardous materials that will be located at the fertilizer plant:

- ammonium nitrate;
- agricultural potassium nitrate;
- ammonium chloride; and
- natural gas.

Table 3.2 lists the potential risks or hazards that may potentially occur during operation at the fertilizer plant.

Table 3.2 Identification of Risks or Hazard

Risk or Hazard	Possible Location or Process
Explosion of container	Boiler room, air compression station, evaporator of agricultural potassium, steam pipeline and other pressure vessel or equipment.
Fire explosion	Production process of agricultural raw potassium and agricultural potassium product, transportation and storage process of NH_4NO_3, boiler room, and maintenance process.
Electric shock	Production process of agricultural raw potassium and agricultural potassium product, packing process of agricultural potassium product, switch room, water circulation process and maintenance process.
Scald	Production process of agricultural raw potassium and agricultural potassium product, and boiler room.
Suffocation or poisoning	Packing process of agricultural potassium product, maintenance process and boiler room.
Fall or object blow	Production process of agricultural raw potassium and agricultural potassium product, storage and transportation process, and maintenance process.
Mechanical injury	Production process of agricultural raw potassium and agricultural potassium product, water circulation process, air compression station and maintenance process.
Vehicle injury	Travelling, storage and transportation process, packing process of agricultural potassium product and production process of agricultural raw potassium.
Dust hazard	Production process of agricultural potassium product.
Noise hazard	Production process of agricultural potassium product, air compression station, boiler room and water circulation process.
Hoisting hazard	Maintenance process.
Other hazard	Production process of agricultural raw potassium, storage and transportation process.

Refer to Appendix B for a list of several control measures can be applied to the potential safety hazards identified in Table 3.2.

In addition, to address, manage and respond to these events, Environmental Management Plans (EMPs) with detailed emergency response plans will be developed for the Project and specific components and activities (Section 3.3.7). Further, as part of the Project development, potential for malfunctions and accidents are being addressed throughout the planning and design process.

3.3.7 Health, Safety and Environmental Management

Good Health, Safety and Environment (HSE) performance is critical to the Project. Safety is APC's greatest responsibility and they believe that prevention is the greatest factor in maintaining a healthy, safe, productive workplace.

Everyone at APC, including partners working with them, are expected to adhere to the highest standards for the safe operation of equipment and facilities, and the protection of the environment, employees, customers and the people of the communities in which they do business with.

P – Properly maintained equipment, machinery, facilities

R – Required use of Personal Protective Equipment (PPE) and Safety Devices

E – Encourage employees to report and resolve safety hazards and recommend improvements

V – Verify proper storage and labelling of substances with Material Safety Data Sheets (MSDS)

E – Establish a Safety First culture with Zero Tolerance for incidents

N – Notify the proper authorities and departments if an accident or incident occurs

T – Training employees and partners and participation in monthly safety workshops

I – Inspect work stations, equipment, operating procedures, facilities regularly

O – Online monitoring alert system with automatic shutdown

N – New standards and certifications are to be met and exceeded where possible

To establish specific HSE objectives and ensure their implementation, the Project will include a comprehensive Health and Safety Plan (HASP) and an EMP. The latter will also entail contingency and emergency response plans. Emergency Solutions International will be assisting with the emergency response planning. Draft contents of the Health, Safety, Environment, Emergency Management and Security Planning Document Framework for the Project can be found in Appendix C.

A detailed emergency response plan for the Project will be developed and implemented as part of a regionally coordinated approach to emergency preparedness and response. Consultations will be conducted with the local fire department as well as other local and provincial authorities prior to the finalization of the emergency response plan and start up of the facilities. This plan will be developed in accordance with all relevant provincial requirements for emergency response plans.

Further, inherent to the Project design will be numerous environmental management features. They are the result of a design philosophy with full integration of HSE considerations into all aspects of the design, including materials, process and equipment selection, as well as site and layout choices.

3.3.7.1 Public and Worker Health and Safety Plan (HASP)

A HASP will be developed for the site that will cover all phases and elements of the Project. The HASP will be developed by a health and safety professional to ensure adequate precautions are taken for the protection of workers and the general public. The HASP will be modified over the life of the Project as new information becomes available for improved worker protection. The objectives of the plan will be to:

- Define activities which are likely to represent risks to worker safety and health, requiring planning, design, inspection or supervision by an engineer, competent person (as defined by regulations) or other professional.
- Identify worker and public protection measures.
- Establish supervisor and employee training requirements according to the Project plan including recognition, reporting and avoidance of hazards, and knowledge of applicable Standards and the Project-specific HASP.
- Provide general guidelines for controlling the most commonly identified hazardous operations, such as: cranes, scaffolding, trenches, etc.
- Identify hazards and preventive measures that are implemented in a timely manner;
- Provide a process for reporting near-misses and accidents.
- Implementation of Workplace Hazardous Materials Information Systems (WHMIS) procedures and training.
- Establish Project-specific emergency response plans.
- Define the requirement for a designated competent person responsible for and capable of implementing the program/plan.
- Establish a communications plan to provide preventative and emergency information to the general public.

Each contractor, sub-contractor and consultant retained for the Project will be required to submit for review, a Project-specific HASP for its workforce, and will be responsible for its implementation. Audits will be completed to ensure compliance with the Project-specific HASP.

3.3.7.2 Environmental Management Plan (EMP)

To make sure that the protection of the environment is managed effectively, a comprehensive EMP will be developed to communicate to all Project participants and stakeholders the commitment and efforts to be undertaken to prevent, manage and minimize any potential environmental impacts related to the Project.

The EMP will be developed for the construction, operation and decommissioning phases, and will be the principal component to safeguard that mitigation is implemented as directed by all applicable regulatory requirements with a particular purpose to:

- support the Project's commitments to minimize environmental effects;
- document environmental concerns and appropriate protection measures; and
- provide instructions to relevant Project personnel regarding procedures for protecting the environment and minimizing environmental effects.

The Project will involve a wide range of activities necessitating the implementation of mitigation measures that will be developed as the Project proceeds. All mitigation recommended in the EIA, as well as any regulatory requirements, or conditions of permits/approvals, will be implemented via the mechanisms outlined in the EMP. The EMP will also provide implementation guidelines to help ensure compliance with the monitoring and follow-up commitments and requirements identified through the environmental assessment process.

The EMP represents Project-inherent features and procedures and, together with the Environmental Management Features (Section 3.3.7.3) and Project Description (Section 3.0), serves as the basis for the effects assessment. Where required and applicable, the effects assessment supplements the EMP with more detailed or new mitigation and environmental management measures. Key components and minimum content and subjects of the EMP are summarized in Table 3.3. APC is committed to elaborate on and detail the EMP prior to commencement of the construction phase based on the outcome of the regulatory review and approval process and the final Project design.

It is of note that the EMP is considered a dynamic "living" document that will continuously require revision due to site activities, adjustments to the approach, changes in legislation, monitoring results, etc. It will be incumbent on the Proponent to make sure that routine reviews of the document are completed and that the contents remain current over the entire length of the Project.

Table 3.3 Environmental Management Plan (EMP)

EMP Components	Key Content and Subjects (Minimum)
Definition of roles and responsibilities	• Overall Project management structure. • Safety Health and Environmental Coordinator. • Contractors. • Other staff.
General and site-specific EMP components	General EMP: • WHMIS implementation. • Hazardous material management (transportation, handling, storage; incl. designated storage areas). • Equipment maintenance and fuelling. • Material storage (incl. designated storage areas and handling. • Work yard development.

EMP Components	Key Content and Subjects (Minimum)
	EMPs for specific site locations / facility components: • Watercourses (pipeline crossings). • Wetlands (pipeline crossing).
General and site-specific Environmental Protection Plan (EPP) components	• Clearing and grubbing. • Stormwater management. • Wastewater management. • Erosion and sediment control plan. • Work in/near watercourses. • Work in/near wetlands. • Dust control. • Noise control.
Environmental Effects Monitoring (EEM)	• Air quality. • Archaeological construction monitoring and contingency plan.
Environmental Compliance Monitoring (ECM) / Inspections	• Effluent quality and quantity. • Wastewater discharge quality.

Contingency and Emergency Response Planning (Operational Emergencies and Natural Events)	• Emergency Response Plan.
	• Hazard analysis and risk determination.
	• Project-specific policies and procedures for events such as:
	  • fires;
	  • explosions;
	  • spills;
	  • transport accidents;
	  • equipment malfunctions; and
	  • severe weather.
	• Minimum plan requirements (prevention, preparedness, equipment, response, recovery/clean up).

Training and Education	• Inspection staff training. • Health and safety training (see HASP). • Emergency response training (re.: fire, spills, explosions etc) • WHMIS training. • Handling and storage of hazardous materials. • Environmental management / awareness training.
Communications and reporting	• Document control (distribution and updating of EMP). • Public information and communication. • Reporting (environmental report with summary of monitoring results).

3.3.7.3 Environmental Management Features

The Project design includes a series of design features and implementation protocols to avoid, minimize, and remediate adverse effects and minimize risks. These environmental management features are planned, pre-emptive measures developed from experience and based on good design practice and in anticipation of likely site conditions and effects. Together, with the EMP and the Project Description (components, construction phase, operation phase and decommissioning phase), this information serves as the basis for the effects assessment. Where required and applicable, the effects assessment supplements the environmental management features with more detailed or additional mitigation and management measures. These additional measures are identified in the context of the effects assessment for individual VECs (Section 7.0). An overview of mitigation and environmental management measures is presented in each effects assessment in Section 7.0.

Key environmental management features that have been included in the conceptual Project design (Pre-Front End Engineering Design (Pre-FEED design) are presented in Table 3.4.

Table 3.4 Key Environmental Management Features

Environmental Management Feature	Description	Objective
Erosion control features (construction, operation, decommissioning phases).	Erosion and sediment control plans to prescribed soil stabilization requirements, silt fences, sediment traps etc.	Avoid soil erosion and increased sedimentation loadings in freshwater environments.
Hazardous waste management system (construction, operation, decommissioning phases).	Designated storage location(s) for hazardous materials.	Compliance with national policy Control of hazardous materials used in the operation of the fertilizer plant.
On-site emergency response unit and systems.	• On-site emergency response unit equipped and trained to address fires, explosions, spills, and hazardous material management. • Process control and Electrostatic Discharge (ESD) protocols. • General alarm equipment. • Emergency escape lighting. • Regular drills to practice emergency team response time.	• Immediate response in case of emergencies. • Provide multiple systems for emergency management. • Prevent potential loss of life and impacts to the environment. • Proactive management of emergency response teams.
Spill prevention and response system.	Spill contingency plan. Secondary containment for all on-site liquids (e.g. NH_4NO_3).	Prevent exposure for workers, public and the receiving environment.
Uninterrupted power supply.	Emergency power system. Automatic power transfer of essential services.	• Help protect against extreme weather events where loss of power could have created an incident. • Prevent an automatic shut down of the fertilizer plant.
Air quality/emission controls.	Air emission contingency plan.	• To minimize air emissions. • To prevent worker, public and environmental exposure to air emissions. • To provide compliance reporting on emissions to regulators. • To provide chemical characterization of the emissions from the fertilizer plant. • To provide chemical emission rates for the fertilizer plant.
Noise abatement.	• Mufflers at high noise machinery. • Housing of equipment in enclosures with insulation (combined with winterisation).	• Limit the occupational exposure for workers to noise in the fertilizer plant. • Limit exposure to off-site receptors. • Limit the exposure of wildlife to noise from the fertilizer facility.

3.3.8 Workforce and Capital Expenditure

3.3.8.1 Workforce

The construction of the Project is expected to be carried out by workforce crews totaling up to 1200 personnel at the height of construction. A range of skills will be required for the construction crews. Some of the workforce will require previous experience in order to perform specialized duties but most will require only previous construction experience. Positions that require prior experience include but are not limited to: steelworkers and iron workers, pipefitters, millwrights, electricians, heavy equipment operators.

In addition to the construction crew, employees will also be required for warehousing, transportation, and equipment maintenance duties.

It is expected that a good portion of the construction crews will come from the local and surrounding areas. Subcontractor crews would be largely local hires. The construction jobs are primarily temporary and will only exist for the duration of the construction phase.

During operation, it is anticipated that Phase I would require approximately 120 to 150 individuals. With the addition of Phase II, a total of approximately 220 to 260 individuals would be required. An additional 100 individuals would be required once Phase III becomes operational.

Available employment would include:

- operators;
- maintenance workers (mechanical, instruments, and electrical workers);
- quality controller;
- logistics;
- engineers;
- sales and purchase;
- administration;
- managers; as well as
- labourers.

3.3.8.2 Capital Expenditure

During the 18-month construction period for Phase I it is anticipated there will be a $75-80 million dollars capital investment directly related to the fertilizer production facility. Subsequent phases are anticipated to cost approximately $35 million dollars per phase. During operation, annual operating and maintenance costs are anticipated to be approximately $34 million dollars. These operation and maintenance costs do not include the cost of raw materials such as natural gas and potash.

3.4 Future Development

As discussed previously, should the market analysis, customer survey and economic feasibility study, determine that a urea and/or a potassium sulphate facility option is viable APC will make a decision to move forward or cease work on these two facilities.

3.4.1 Potassium Sulphate Facility

Potassium sulphate is produced by the combining of potassium chloride and sulphuric acid (H_2SO_4) in a specialized oven at temperatures of approximately 1000^{o}C. A by-product of this process is hydrochloric acid (HCl). The potassium sulphate is produced in granular form and is slightly acidic; it is therefore mixed with calcium carbonate to neutralize it, prior to conveying to the packaging and storage warehouse.

Potassium chloride is supplied in “Standard Grade” solid form e.g. size SGN 70, averaging 0.65 mm particle size. It is brought to site either by rail or road transport and off-loaded and stored on site in a warehouse, from where it is transported by conveyor as required by the process. Sulphuric acid is delivered to site in liquid form at a solution strength of 98.5 % by rail or road tanker and stored on site in suitable bulk storage tanks, from where it is pumped to the process as required.

The process for producing potassium sulphate is as follows:

1. Potassium chloride particles are conveyed from storage via drag conveyors and bucket elevators to the feed hopper of the proprietary reaction oven. The potassium chloride is fed into the oven by a metering screw feeder.
2. Sulphuric acid is pumped from the bulk storage tanks to a metering system which meters the H_2SO_4 at a ratio of approximately 2/3 weight for weight to potassium chloride into the oven.
3. The oven is a patented (Mannheim Oven) brick furnace design with a vertical internal mixer incorporated, driven by an external pinion and wheel drive mechanism, to continually mix the two feed stocks. Heat is derived from either fuel oil or natural gas burners.
4. Potassium sulphate product is discharged from the oven into a drag conveyor which in turn feeds to a bucket elevator which elevates the product up to the screening floor. The product is then discharged into a cage mill which in turn discharges to a drag conveyor which feeds sizing screens. Oversize product is returned by gravity to the bucket elevator inlet for recycle through the cage mill. Acceptable size product is discharged to a storage bin below the screens.
5. From the storage bin, product is fed to a mixing screw conveyor, which mixes the product with calcium carbonate, fed from a second storage bin, to neutralise any entrained HCl in the product.
6. The mixing screw discharges to a drag conveyor which conveys the neutralised product to the packaging area, from where the finished, packaged product is conveyed to the storage warehouse.

7. Hydrochloric acid is produced in the reaction furnace from the combination of H_2SO_4 and potassium chloride to form potassium sulphate (K_2SO_4) and HCl. At the temperatures present in the furnace, the HCl is in gaseous form.
8. The HCl gas is bled from the furnace into a carbon heat exchanger through which water is pumped to both cool and liquefy the HCl.
9. The dilute HCl, which also contains small amounts of H_2SO_4, is piped to a series of washing and absorption towers, whereby it is first stripped of the residual H_2SO_4 and progressively concentrated to a strength of approximately 30-33% HCl. It is then stored in suitable tanks for shipment.
10. The cooling water required for the carbon heat exchanger is recirculated through cooling towers to reduce water consumption. However since some of this water is also used to liquefy the HCl gas, a relatively small amount of make-up water is required.

4.0 REGULATORY FRAMEWORK, SCOPING AND STAKEHOLDER INPUT

4.1 Regulatory Framework

This Project involves processing of a mineral as defined in the *Mining Act*; which is an activity described in Schedule A of the New Brunswick *EIA Regulation* that requires provincial approval. The NBDELG, Sustainable Development, Planning and Impact Evaluation Branch, is responsible for coordinating the review by provincial and federal regulatory agencies.

Based on a review of the Regulations Designating Physical Activities SOR/2012-47, it is not anticipated that a federal environmental assessment, under the *Canadian Environmental Assessment Act* (CEAA), will be required. However, it is likely that several federal departments will identify themselves as having jurisdiction in some component of the Project and will be part of the Technical Review Committee (TRC).

Several other provincial and federal approvals will be required prior to construction; which are identified in Table 4.1.

4.2 Scope of Assessment

The proposed Project is considered an “Undertaking” under Schedule A of Regulation 87-83 of the *Clean Environment Act*, and therefore subject to the provincial EIA process. The EIA process for this Project will follow the outline provided by the 2012 publication of the NBDELG, “*A Guide to Environmental Impact Assessment in New Brunswick*” (NBDELG, 2012a). The purpose of the EIA will be to proactively gather additional information about the Project and assess potential interactions between the environment and Project development activities.

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.

Generally, the literature presents 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
- developing monitoring and follow-up programs.

Table 4.1 Environmental Legislation and Guidelines which may be Applicable to the Project

I. Acts or Regulations	**Section**	**Requirement**	**Department or Agency**
A. PLANNING/PRE-CONSTRUCTION PHASE			
1. Provincial – Approvals			
(i) *Historic Sites Protection Act*	S.2(1) S.3	Authority to declare any site, parcel of land, building, or structure a Protected Site. License required to conduct archaeological field research in the province.	New Brunswick Department of Wellness, Culture and Sport (NBDWCS).
B. DETAILED DESIGN /CONSTRUCTION PHASE			
1. Provincial – Approvals			
(i) *Clean Air Act* and Regulation 97-133 under the *Clean Air Act* – Air Quality Regulation	S.6(2) S.3(1)	Permission or authority required for the release of contaminant into the air.	NBDELG
(ii) *Clean Environment Act*	S.5.3(1)	Authority or permission required under Act or Legislation to release waste or contaminant.	NBDELG enforces – due diligence required to avoid releases.
(iii) Regulation 82-126 under the *Clean Environment Act* – Water Quality Regulation	S.3(1)	Approval required to release contaminant that may cause water pollution.	NBDELG
(iv) Regulation 87-97 under the *Clean Environment Act* – Petroleum Product Storage and Handling Regulation	S.6(1)	Permit required for the storage of two thousand litres or more of petroleum products onsite.	NBDELG
(v) Regulation 87-83 under the *Clean Environment Act* – Environmental Impact Assessment Regulation	S.4	Authority or permission required prior to carrying out an undertaking (as defined in Schedule A of the Regulation).	NBDELG
(vi) *Clean Water Act*	S.12(1)	Authority or permission under Act or Legislation required for release of contaminant in watercourse.	NBDELG enforces – due diligence required to avoid releases.
(vii) Regulation 90-80 under the *Clean Water Act* – Watercourse and Wetland Alteration (WAWA) Regulation – and – *Clean Water Act*	S.3(1) And 15(1) (b)	Permit required for any project or structure involving alteration of designated watercourse or wetland.	NBDELG
(ix) *Species at Risk Act*	S.28	Compliance with established prohibitions on persons in terms of impacts on specific endangered species of flora and fauna and their habitat.	New Brunswick Department of Natural Resources (NBDNR).
(x) Regulation 2013-39 under the *Species at Risk Act* (NBSRA) – Prohibitions	S.2	Compliance with established prohibitions on persons in terms of impacts on specific endangered species of flora and fauna and their habitat listed in Schedule A.	NBDNR
	S.2	Designates species of flora and fauna that are subject to prohibitions within the NBSRA.	NBDNR

I. Acts or Regulations	Section	Requirement	Department or Agency
(xi) Fish and Wildlife Act	S.37(2) S.90(1)	• Do not disturb, injure, gather or take the nest or egg of any bird. • Permission or authority required for the capture of fish and wildlife for scientific research.	NBDNR
(xii) *Pipeline Act*, 2005	S.29.1- S.29.6	Ground disturbance over or near pipeline.	New Brunswick Department of Energy and Mines
2. Provincial – Other Statutes & Regulations			
(ii) Highway Act	S.45 S.46	Authority to order removal of works (subject to franchise) and right to maintain signs, etc., during work (Highway Usage Permit).	New Brunswick Department of Transportation and Infrastructure (NBDTI).
(iii) Regulation 89-108 under the *Municipality Act* – Blasting Code Approval Regulation		Authority or permission under Act or Legislation required for blasting operations.	NBDELG
(iv) Regulation 95-66 under *Topsoil Preservation Act (R.S.N.B. 2011, c.230)* – General	S.3 (1) (Reg)	Permit required for removal of topsoil from a site.	NBDELG
(v) Transportation of Dangerous Goods Act	S.4(1)	Permit required for the transportation of dangerous goods.	New Brunswick Department of Public Safety.
(vi) T-11.02-*Transportation of Primary Forest Products Act*	S(2)	Compliance with specified documentation requirements for the transportation of primary forest products within New Brunswick.	NBDNR
3. Federal Approvals			
(i) *Canadian Environmental Assessment Act* 2012 (CEAA 2012)	S.5	Minister will determine whether to designate a project for federal assessment based on potential for environmental effects in areas of federal jurisdiction such as fish habitat, migratory birds or effects which cross provincial or international boundaries.	Canadian Environmental Assessment Agency (the Agency).
(ii) Federal Wetlands Policy		No net loss of wetland function.	Environment Canada (EC)
(iii) *Fisheries Act*	S.35	Prohibition on harming of fish that are part of a commercial, recreational or Aboriginal fishery, or to fish that support such a fishery except as authorized.	Fisheries and Oceans Canada (DFO).
	S.36	Prohibition on deposition of deleterious substances in water frequented by fish unless authorized.	DFO
	S.37(1)	Requires submission of Plans to Fisheries and Oceans Canada (DFO).	DFO
(iv) 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.	EC
	S 5.1	Prohibition of deposit of a deleterious substance into migratory bird habitat.	EC
(v) 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).	EC

I. Acts or Regulations	**Section**	**Requirement**	**Department or Agency**
4. Municipal Approvals & Regulations			
Noise By-law (2006)	S.3(3f) S.3(3i)	• Prohibition of operating any construction equipment at any time without an effective muffling device in good working order and in constant operation. • Prohibition of operating any construction equipment between the hours of 9:00 pm to 7:00 am the next morning.	City of Saint John
Litter By-law	S.3 S.7	• No littering. • Trucks are to be constructed and loaded as to prevent any load contents from being blown or deposited on any street.	City of Saint John
C. GUIDELINES AND STANDARDS			
1. Provincial			
(i) A Guide to Environmental Impact Assessment in New Brunswick (2012a)		Guidelines summarize the main components of the provincial assessment process as stipulated by Regulation 87-83.	NBDELG
(ii) WAWA Technical Guidelines		• These guidelines were prepared to complement the WAWA *Regulation 90-80.* • Discusses potential impacts of watercourse and/or wetland alteration. • Outlines those activities which require a permit and those which do not. • Documents required when submitting WAWA Applications. • Details specific guidelines and construction techniques for WAWA.	NBDELG
(iii) New Brunswick Wetlands Conservation Policy		No net loss of wetland function.	NBDELG NBDNR

The impact assessment focused on the evaluation of potential interactions between Project components and activities, and Valued Environmental Components (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.

For the purposes of impact assessment, the interactions (effects) between Project outputs, or activities, and VECs are described as either positive or negative. The significance of potential interactions and the likelihood of the interactions are also considered.

This approach is presented in Figure 4.1 and includes the following steps:

- **Step 1 - Assembling Project Baseline Information**

A Project Description is developed; including construction and operations activities, and a description of existing environmental conditions is prepared to allow assessment of the potential effects of the various Project activities on the environment and the potential effects of the environment on the Project.

- **Step 2 - Issue Scoping**

Issues are identified during development of the EIA Document as well as comments received from regulatory bodies and members of the public. The concerns of the public potentially affected by the Project are identified. These include concerns expressed by the public at large, community groups and stakeholders, the scientific community, and governments during public consultation. As a result of this "social scoping" effort (Beanlands and Duinker, 1983), environmental issues or Environmental Components of Concern (ECC) that may be affected by the Project are identified by professionals in the field and by the public. Pathways between the ECCs and Project activities are then identified. Where pathways cannot be identified, the ECC or issue is deemed not to be affected by the Project and is therefore no longer part of the analysis. Appendix C of the *New Brunswick Guide to EIA Assessment* describes the minimum stakeholder standards for registered projects (NBDELG, 2012a). There has been ongoing consultation with key stakeholders and groups as well as the local elected officials. Formal Public Consultation has not yet been undertaken for this Project; however, APC plans to initiate the first of two rounds of public consultation early 2015.

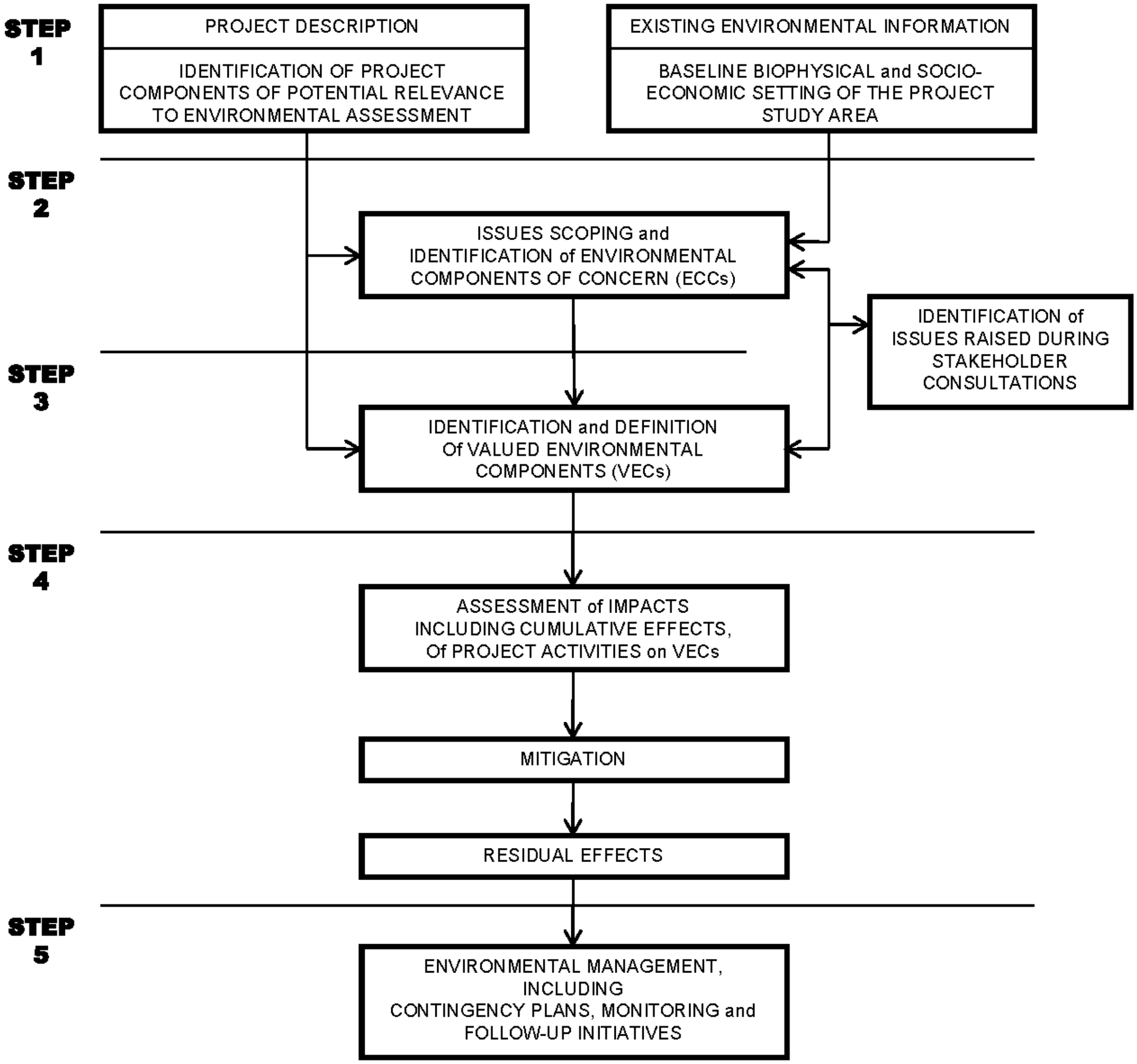


Figure 4.1 Approach to Assessment

- **Step 3 - Identification of VECs**

The result of Step 2 of the assessment is a list of VECs on which the impact assessment focuses. Elements of the environment that could be affected by the Project and are protected by legislation or regulation are included as VECs. A definition of each VEC is developed, including its spatial and temporal boundaries, as well as a description of potential linkages (or pathways) of effect with the Project and with other components of the environment.

- **Step 4 - Assessment of Impacts**

The potential impacts of the relevant Project phases (construction, operation, and decommissioning/abandonment) and activities are assessed for each VEC. Environmental effects, including cumulative effects, are categorized in terms of whether they are adverse (negative) or positive, their significance, and their likelihood. These effects are assessed using defined rating criteria. Residual impacts are those that remain after all mitigation measures have been considered and cumulative effects are assessed.

- **Step 5 - Conclusion**

A brief conclusion of the environmental and socio-economic impacts is addressed.

4.3 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 in the following sections.

The initial range of potential VECs was established based on consultation with stakeholders, and regulatory agencies. No additional potential VECs were identified.

Consideration was given to the possibility of Project activities to interact with each VEC. Only those potential VECs that could be subjected to significant effects from Project activities were discussed in the report. 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. 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. The VECs were also chosen to reflect the scientific concerns of the professional community.

Scoping is a process used to focus the EIA on the most directly relevant issues and concerns. Scoping can reduce potential delays and lead to a more comprehensive EIA by:

- starting the communication process early during Project planning;
- involving directly and indirectly affected parties;
- identifying the key issues and concerns requiring assessment; and
- eliminating issues of little or no consequence of interaction between the Project and the environment.

Several aspects of scoping have been employed for the proposed Project. To date, these have included:

- Identification and review of issues of concern based on previous EIA experience, including projects with similar components conducted in the vicinity of the Project site and elsewhere in the Maritimes.
- Discussions with various regulatory and resource management agency personnel with expertise in areas relevant to the Project or Project Study Area.

4.3.1 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 in which VECs may be affected by Project activities.

Temporal bounds for a Project such as this are typically categorized into three phases:

- construction;
- operation, and
- decommissioning and abandonment.

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

4.3.2 Approach to Determination of Significance

The assessment, or determination of the significance of potential effects, is normally based on the framework/criteria provided by the Agency, with consideration of other relevant provincial and federal requirements, as well as the process and guidelines presented by the New Brunswick "*Guide to Environmental Impact Assessment in New Brunswick*" (NBDELG, 2012a).

The Reference Guide entitled "*Determining Whether A Project Is Likely To Cause Significant Adverse Environmental Effects*" included within the Responsible Authority's Guide (the Agency,

1994) is 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.

Although the terms "adverse," "significant" and "likely" are not directly defined, the Agency (1994) provides criteria to facilitate interpretation (Table 4.2). The following interpretations are drawn from the same document. The significance of adverse effects will be directly related to regulatory guidelines and statute requirements where applicable. The determination as to whether the residual environmental effects of the Project are significant or non-significant after application of mitigative measures is made during the EIA.

Table 4.2 Criteria to be Considered in the Assessment of Potential Environmental Effects

Key Terms	Criteria
Adverse	• Loss of species of special status (i.e. species at risk). • Reductions in species diversity. • Loss of critical/productive habitat. • Transformation of natural landscapes. • Toxic effects on human health. • Reductions in the capacity of renewable resources to meet the needs of present and future Generations. • Loss of current use of lands and resources for traditional purposes by Aboriginal persons. • Foreclosure of future resource use or production.
Significant	• Magnitude. • Geographic extent. • Duration and frequency. • Reversibility. • Ecological context.
Likely	• Probability of occurrence. • Scientific uncertainty.

Source: The Responsible Authority's Guide (The Agency, 1994).

For the purposes of the EIA, an “effect” is defined as the change effected on a VEC 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 as discussed above. The Assessment will focus on those interactions between the VECs and Project activities which are likely.

4.3.3 Approach to Cumulative Effects Assessment

The effect of a project on the environment may not be fully reflected by the individual interactions of project components or activities with VECs. In many cases, individual projects and/or project components produce environmental effects that are not significant. However, when cumulatively combined with the effects of other project components or other projects and activities, these small effects may become important. The basis for considering which of the cumulative environmental effects should be addressed, are provided in the Responsible Authority's Guide (The Agency, 1994), and supplemented by the Cumulative Effects Practitioners Guide (Hegmann et al., 1999).

The assessment will consider any potential cumulative effects that may result from Project construction or operation or in concert with any other projects known for the reasonably foreseeable future (typically five years). The assessment of cumulative effects is done between both the Project and other projects, and between Project components.

4.4 Stakeholder, Public and First Nations Engagement

Stakeholder, public and First Nations engagement and input are integral components in the EIA process. Engagement activities have been undertaken through personal communication with major landowners, provincial and local government representatives, several non-Government organizations (NGOs), meetings with key stakeholders, meetings with several First Nations representatives as well as utilities and transportation systems operating in the area. APC did a market awareness study polling 250 adults in the greater Saint John area aged 18 years or older which has shown that there is 81% support for the project and 8% opposed to the proposed development. A sample of this size provides an overall margin of error of +/- 6.2% with a 95% accuracy.

APC plans to conduct an Open House in the Saint John area in the spring of 2015 to introduce the proposed Project and receive feedback from the local population. Details of the proposed Open House will be finalised in the near future.

5.0 EXISTING ENVIRONMENT

This section provides a description of the environmental and the socio-economic setting for the region, and includes those components of the environment potentially affected by the proposed Project or which may influence or place constraints on the execution of Project-related activities. The Project Footprint which includes related infrastructure, utilities, natural gas pipeline, water pipeline and access roads as well as the surrounding biophysical environment is depicted in Figure 5.1.

The following sections 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, fish habitat and fish resources; designated areas and other critical habitat features; and heritage resources.

5.1 Study Area Definition

The development of the Study Area was based on:

- size and location of the Project Footprint;
- related infrastructure including utilities;
- water pipeline and associated components;
- access roads; and
- biophysical setting.

The Study Area reflects the vicinity of the proposed Footprint area (fertilizer production facilities site) (Figure 5.1) and takes into consideration the 1 km^2 area centered over the proposed Footprint. Downstream areas of the airshed and watershed are also included, with increasing priority placed on those areas in close proximity to the proposed Project Footprint.

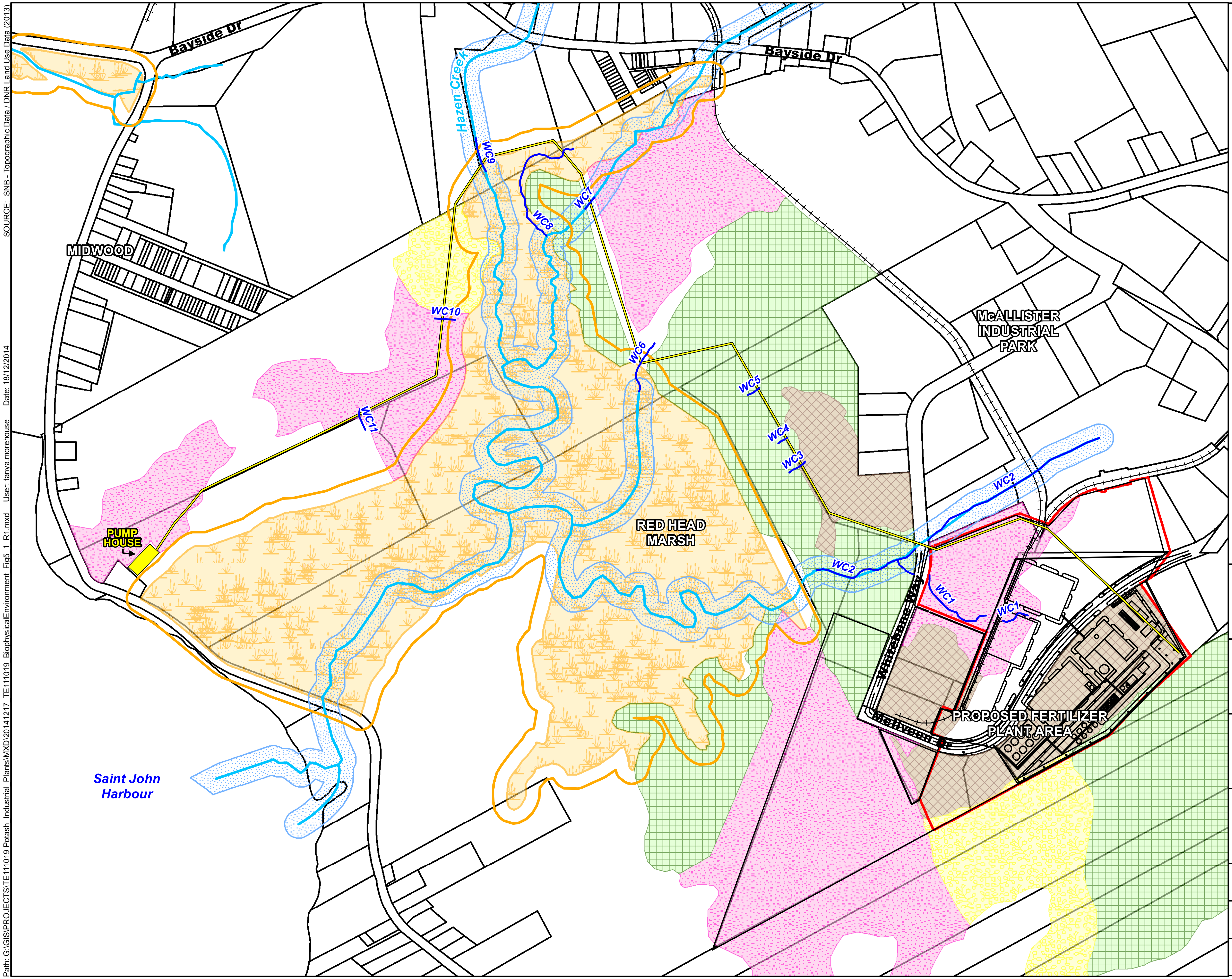
5.2 Atmospheric Environment

The atmospheric environment is considered to be the layer of air immediately surrounding the Earth’s crust, i.e. the troposphere. This layer can vary from 7 km near the Polar Regions to 20 km in the Tropics in depth. For the purposes of this EIA a depth of 10 km will be assumed. Components of the atmospheric environment, including the climate and ambient air quality climatology of the region are described below.

5.2.1 Climate

The climate of New Brunswick is typically continental due to the westerly air flows dominant in the region, having passed over the interior of the continent - not over a temperature-moderating ocean. The coastal areas of New Brunswick 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 (EC, 1990; Hinds, 2000).

Path: G:\GIS\PROJECTS\TE111019 Potash Industrial Plants\MXD\20141217 TE111019 BiophysicalEnvironment Fig5 1 R1.mxd User: tanya.morehouse Date: 18/12/2014 SOURCE: SNB - Topographic Data / DNR Land Use Data (2013)



LEGEND:

The map shown here has been created with all due and reasonable care and is strictly for use with AMEC Project Number: TE111019. 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.

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ATLANTIC POTASH CORPORATION

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:

APC McALLISTER INDUSTRIAL PARK
FERTILIZER PRODUCTION FACILITY

TITLE:

BIOPHYSICAL ENVIRONMENT

DATUM: NAD 83 CSRS	DWN BY: TM	DATE: Dec 17, 2014
PROJECTION: New Brunswick Stereographic	CHK'D BY: CL/JB	SCALE: 1:8,000
PROJECT NO: TE111019	REV NO: 1	FIGURE NO: 5.1

5.2.1.1 Climate Normals for the Region

The climate of the Project area is best characterized by long-term meteorological data collected by EC. There are forty-seven (47) stations that record data for climate normal calculations in New Brunswick. The station closest to the Project is EC's Saint John Area (A) Canadian Climate Station, which meets the United Nations' World Meteorological Organization (WMO) Standards. The Normals available from that station (Table 5.1) are based on data collected between 1981 and 2010 (EC, 2014a). Saint John (A) is at an elevation of 108.8 m with a latitude of 45°19'N and longitude 65°53'W.

5.2.1.2 Temperatures

The range of temperatures in Saint John is rather large (33 degrees Celsius (ºC)) from winter to summer with January being the coldest month and July the warmest (EC, 1990). The mean annual temperature is 5.0ºC with extremes ranging from -36.7 in the winter to 34.4ºC in the summer. Saint John is considered to have a modified marine climate which is a result of the continental influence from the westerly air flows and the moderating effect of the sea breeze of the Bay of Fundy (EC, 1990). Summers are relatively cool, with the warmest average daily maximum temperature recorded of 22.6 from July to August in Saint John (EC, 2014a). Winters are milder with an average daily minimum temperature in January of -13.3ºC (EC, 2014a) but are subject to highly fluctuating temperatures from day to day. This is due to the fast-moving and highly contrasting weather systems that travel across the province every two to three days (EC, 1990).

5.2.1.3 Precipitation

In general, New Brunswick receives between 1000 to 1200 mm of precipitation per year with the greatest amounts occurring in the interior highlands and along the coast. Of all the Atlantic Provinces, New Brunswick is considered to be the snowiest with snow accounting for approximately 30% of the precipitation. However, Saint John receives less than 20% of its annual total precipitation in snow with the ground often snow-free even during the winter months (EC, 1990). Measurable precipitation per year is approximately 1295.5 with extreme daily precipitation of 154.4 mm rain and 58.2 centimetres (cm) snow (EC, 2014a).

Typically the highest amount of precipitation in New Brunswick occurs during the summer months. However, along the southern shoreline, such as in Saint John, maximum precipitation is more likely to occur in fall and early winter (EC, 1990). Total monthly precipitation ranges from approximately 80 mm (August) to 135 mm (November) (EC, 2014a).

5.2.1.4 Fog and Sunshine

In general, autumn is the foggiest season in New Brunswick with occurrences on four or five days of each month. However, in Saint John, due to the influence of the Bay of Fundy, summers are typically the foggiest days. This results when moist air from the interior of the Province meets the cold waters of the bay. Fog can occur on more than 185 days of the year with most of the fog occurring in July. Sea fog most commonly occurs at night and the early morning with it burning off by the afternoon (EC, 1990; EC, 2014a).

Table 5.1 Saint John (A) Climate Normals (1981-2010) and Extremes

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature												
Daily Average (°C)	-7.9	-7.1	-2.5	3.7	9.5	14	17.1	16.8	13	7.6	2.3	-4.4
Daily Maximum (°C)	-2.5	-1.5	2.4	8.5	15	19.6	22.6	22.4	18.2	12.3	6.4	0.5
Daily Minimum (°C)	-13.3	-12.6	-7.4	-1.2	3.9	8.4	11.6	11.2	7.7	2.8	-1.9	-9.3
Extreme Maximum (°C)	14.5	13.3	17.5	22.8	33	32	32.8	34.4	31	25.6	21.7	16.1
Date (yyyy/dd)	2006/14	1994/21	1999/28	1976/20	1992/22	1983/22	1963/26	1976/22	1999/03	1947/18	1956/01	1973/17
Extreme Minimum (°C)	-31.7	-36.7	-30	-16.7	-7.8	-2.2	1.1	-0.6	-6.7	-10.6	-16.9	-34.4
Date (yyyy/dd)	1971/18	1948/11	1948/14	1969/04	1947/15	1949/01	1948/08	1947/28	1947/29	1974/22	1996/30	1989/30
Precipitation												
Rainfall (mm)	66.1	49	66.6	85.7	108.5	101	88.4	81.7	105.6	115.8	123.7	84
Snowfall (cm)	64.3	48.4	44.4	20	1.2	0	0	0	0	0.5	10.8	49.9
Precipitation (mm)	123.5	91	108.2	105.3	109.8	101	88.4	81.7	105.6	116.4	134.1	130.4
Extreme Daily Rainfall (mm)	83	82.3	74	125.5	66.5	108.2	79.4	125.2	83.2	85.3	154.4	92.4
Date (yyyy/dd)	1978/26	1947/05	1980/18	1962/01	1973/21	1985/01	1990/25	1970/02	1999/22	1963/29	1975/13	1981/02
Extreme Daily Snowfall (cm)	42.4	34.8	40.1	26.2	10.2	0	0	0	0	19.8	28.4	58.2
Date (yyyy/dd)	1975/07	1978/07	1963/06	1958/02	1967/08	1947/01	1947/01	1947/01	1947/01	1974/20	1989/21	1960/12
Days With												
Maximum Temperature >0°C	12.2	11.7	22.3	29.4	31	30	31	31	30	31	27.3	
Measurable Rainfall	6.7	5.3	7.6	11	13.6	12.9	11.5	10.5	10.5	11.7	12.5	
Measurable Snowfall	12.9	10.2	9.4	5.1	0.5	0	0	0	0	0.5	3.9	
Measurable Precipitation	16.2	12.8	14	13.9	13.7	12.9	11.5	10.5	10.5	11.9	14.4	
Wind Speed												
Speed (km/h)	16.9	17.1	17.5	17.2	15.4	13.4	12.0	11.3	13.0	15.1	16.4	17.1
Most Frequent Direction	NW	NW	N	N	S	S	S	S	SW	SW	NW	NW
Maximum Hourly Speed	111	100	80	85	64	61	76	68	97	89	89	83
Date (yyyy/dd)	1978/09	1976/02	1964/05	1963/05	1961/26	1958/08	1958/31	1971/16	1960/13	1963/29	1963/30	2000/18

Source: EC, 2014a

Notes: km/h = kilometres per hour
NW = northwest
N = north
S = south
SW = southwest

New Brunswick averages between 140 and 160 sunny days and approximately 75 sunless days (EC, 1990). The presence of the fog reduces the number of available sunshine hours. Saint John can expect approximately 1950 hours of total sunshine per year (EC, 2014a).

5.2.1.5 Winds

The wind at any given location is often quite different from the wind conditions which prevail even a short distance away. Wind direction and speed varies as a result of natural and manmade obstructions, topography, and surface cover. Along the coast, an onshore sea breeze circulation often sets up, particularly during a warm, sunny afternoon in the spring or early summer.

Winds at the Saint John A station are fairly light with the highest speeds occurring in the winter and early spring months (December to April) with an average of 17.2 km/h for those months. A peak gust of 148 km/h was recorded in December of 2002. The lightest winds occur in summer with a monthly average wind speed of 11.3 km/h in August. The mean wind speed for the year is 15.2 km/h. The prevailing wind direction at the Saint John A station is from the south or southwest from May through October and from the northwest or north from November through April.

5.2.1.6 Severe Weather

Stormy weather is commonplace in New Brunswick throughout the year with thunderstorms occurring on average between 10 to 20 days. Generally New Brunswick's storms are more severe and frequent during the winter months, packing strong winds with rain, freezing rain, and snow mixes. Freezing rain can be expected to occur approximately 12 days a year (EC, 1990).

During the summer and fall months, the storms bring rain, wind, lightening and at times hail but are generally short-lived. At least once a year in the southern portion of the province, severe storms such as weakened tropical storms and hurricanes can be expected to occur (EC, 1990).

Tornadoes do occur in New Brunswick, but are rare and more often seen in the northwest portion of the province (EC, 1990). The most recent confirmed tornado is an EF1 which touched down in Grand Lake, New Brunswick. Winds hit 175 km/h with numerous trees uprooted as well as several structures destroyed (Canadian Broadcasting Corporation (CBC) News, 2013).

5.2.1.7 Thermal Inversions

Under certain conditions, an atmospheric thermal inversion layer occurs. Thermal inversions result when a layer of cooler air is trapped near ground level by a layer of warmer air above. Under these conditions, the vertical motion of air flow is strongly suppressed. If the base of the inversion lies above the level of the plume, then the volume of air available for dilution is limited. The elevated inversion acts as a lid, restricting vertical mixing, reducing dilution and increasing ground-level concentrations in areas with high emissions.

Temperature Inversions are expected to be experienced for short durations in the assessment area due to the influence of the sea-land interface. The temperature inversions are particularly important due to the ability to hinder dispersion or to promote a phenomenon known as fumigation (trapping of stack emissions near the ground).

5.2.1.8 Climate Update and Predicted Future Trends

Several studies have been conducted in the last decade to better understand climate change in New Brunswick. Based on those reports it has been determined that the average annual temperatures in New Brunswick have already increased by 1.5 ºC this century, the bulk of which (1.1ºC) has occurred in the last 30 years. It is predicted that a further 3 to 3.5 ºC increase in New Brunswick's average temperature will occur causing longer and warmer summer as well as a shorter winter. In addition, New Brunswick has been experiencing more extreme storm and rainfall events. Future trends predict total precipitation increasing and mostly in the form of rain. All this combined will have for effect more frequent flooding of low-lying areas, increased soil erosion and water contamination, increased risks of forest fire, as well as increased risk for new pests and invasive species to become established (NBDELG, 2014).

5.2.2 Air Quality

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. Air contaminants eventually settle or are washed out of the atmosphere by rain and are deposited back to the earth. In some cases, contaminants may be redistributed into the atmosphere by wind.

New Brunswick has a *Clean Air Act*, which includes the Air Quality Regulation. The Air Quality Regulation contains maximum permissible ground level concentrations for air quality in New Brunswick. The Air Quality Regulation states that a stationary "source" that releases air contaminants to the environment must obtain approvals to release those air contaminants.

Air quality in New Brunswick is routinely monitored by the provincial and federal governments at various stations, usually located in or near population centres. The following Table (Table 5.2) lists the air quality standards under Schedule B of the New Brunswick *Clean Air Act* in addition to the New Brunswick Air Quality Objectives (NBAQO) established by the Province under the same Act.

Table 5.2 Air Quality Guidelines in New Brunswick

Pollutant (μg/m^3)	**Averaging Period**							
	1-hour		**8-hour**		**24-hour**		**1 year**	
	Clean Air Act	**NBAQO**	***Clean Air Act***	**NBAQO**	***Clean Air Act***	**NBAQO**	***Clean Air Act***	**NBAQO**
CO	35,000	30,000	15,000	13,000				
Hydrogen sulphide (H_2S)	15	11			5	3.5		
Nitrogen dioxide (NO_2)	400	210			200	105	100	52
Sulphur dioxide (SO_2)	900	339			300	113	60	23*
Total Suspended Particulate (TSP)					120	120	70	70

Note: μg/m^3 = micrograms per cubic metre
* The standards for SO_2 are 50% lower in Saint John, Charlotte, and Kings counties.

The Canadian Council of Ministers of the Environment (CCME) (2000) have developed a Canada-Wide Standard for fine particulate matter ($PM_{2.5}$) of 30 µg/m^3, based on a 24-hour average over three consecutive years.

It should be noted that in October 2012 jurisdictions, with the exception of Quebec, agreed to begin implementing a new air quality management system. The Air Quality Management System is a comprehensive approach for improving air quality in Canada and is the product of collaboration by the federal, provincial and territorial governments and stakeholders. It includes:

- New Canadian Ambient Air Quality Standards to set the bar for outdoor air quality management across the country.
- Industrial emissions requirements that set a base of performance for major industries in Canada.
- A framework for air zone air management within the provinces and territories that enables action tailored to specific sources of air emissions in a given area.
- Regional airsheds that facilitate coordinated action where air pollution crosses a border.
- Improved intergovernmental collaboration to reduce emissions from the transportation sector.

The Canadian Ambient Air Quality Standards will be established as objectives under the *Canadian Environmental Protection Act* (CEPA), and will replace the existing Canada-Wide Standards under CCME (2000). Standards for fine PM and ground-level ozone have been developed and work has begun on standards for NO_2 and SO_2. Table 5.3 provides a list of the Canadian Ambient Air Quality Standards for $PM_{2.5}$ and ozone.

Table 5.3 Canadian Ambient Air Quality Standards for Fine Particulate Matter ($PM_{2.5}$) and Ozone

Pollutant	Averaging Time	Standards (numerical values)		Metric
		2015	2020	
$PM_{2.5}$	24-hour (calendar day)	28 µg/m^3	27 µg/m^3	The 3-year average of the annual 98th percentile of the daily 24 hour average concentrations.
$PM_{2.5}$	Annual (calendar year)	10 µg/m^3	8.8 µg/m^3	The 3-year average of the annual average concentrations.
Ozone	8-hour	63 parts per billion (ppb)	62 ppb	The 3-year of the annual 4th highest daily maximum 8 hour average concentrations.

Source: CCME, 2000

The new Air Quality Management System is designed to address the challenges of air quality management, including cross-jurisdictional issues, and deliver a Canada-wide approach that provides flexibility to deal with regional differences in air quality issues while, at the same time, ensuring a level of consistency so that Canadians can be assured of good air quality outcomes.

For industry, the Air Quality Management System proposes establishing base-level industrial emissions requirements in major industrial sectors, initially for SO_2, NOx, VOCs and Total Particulate Matter (TPM). Eventually other pollutants may be addressed. The Base-level Industrial Emissions Requirement is intended to ensure that all significant industrial sources in Canada, regardless of where facilities are located, meet an acceptable benchmark of environmental performance. Wherever possible, the Base-level Industrial Emissions Requirement would build on existing pollution controls, agreements and protocols that assure the appropriate standard of emissions performance.

The Base-level Industrial Emissions Requirement would be set under a federally lead, time-limited federal/provincial/territorial consensus process, with stakeholder involvement, and will be reviewed regularly to ensure they reflect technological improvements.

5.2.3 Regional Air Quality Baseline

The information in this section is based on the most up-to-date results available from monitoring stations in Saint John, New Brunswick, operated by the Air Quality Branch of the NBDELG. In 2009, the NBDELG 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 the latest readings. This system's frequency of data capture and archiving capability allows the Province to issue a regional Air Quality Health Index to the public and identify abatement initiative requirements (NBDELG, 2011a).

Air quality monitoring began in the Saint John region in 1961 before any other region in New Brunswick, and has been monitored at thirty (30) different sites in the Saint John area since that time. The most recent report is the 2011 Annual Report (NBDELG, 2013). During 2011, there were a total of sixteen (16) monitoring stations owned by NBDELG, as well as many others operated by industry, collecting data in the Province. Monitoring stations located nearest the Project include the Champlain Heights location, which is owned by NBDELG, as well as seven (7) industrial sites: Irving Forest Products, Irving Paper, Irving Refinery and Irving Silver Falls; Grandview West; Midwood Avenue and Courtney Bay (NBDELG, 2013). The parameters discussed in the reports are CO, NO_x, SO_2, particulate matter (PM), ground level ozone, VOCs and CO_2. NBDELG concluded in their 2013 report that air quality trends in sites with long records, such as Saint John, have shown improvements in all parameters.

There were however, ten (10) events of exceeding the 1 hour objective for H_2S recorded near the Irving Oil Refinery and Irving Pulp and Paper in Saint John during 2011 (NBDELG, 2013). In addition, the 1 hour SO_2 Air Quality Objective of 170 ppb was exceeded during three (3) separate air quality events at Grandview West, which is relatively close to the Project (NBDELG, 2013). Overall, SO_2 levels detected at Grandview West have been reported as greatly improved since commissioning of the new Hydrogenation Amine Tail Gas Unit (HATGU) at the Irving Refinery in 2008 (NBDELG, 2012b). An episode control program is currently in place in Saint

John, which includes control actions for mandatory implementation under Approvals to Operate for major industries in the City.

5.2.4 Criteria Air Contaminants (CAC) and Greenhouse Gases (GHG)

It is useful to examine the existing releases of air contaminants from local sources in the assessment area. This serves as a benchmark for comparing the emissions related to the proposed Project and to assist in the assessment of cumulative environmental effects. These existing releases of air contaminants are generally classified into two categories: CACs, which include particulate matters, sulphur dioxide, nitrogen oxides, carbon monoxide and GHGs.

5.2.4.1 Criteria Air Contaminant (CAC) Emissions

This section provides a summary of CAC emissions for all sources in New Brunswick (Table 5.4) and for major regulatory permitted industrial sources (Table 5.5) in the area that submit emissions information to the National Pollutant Release Inventory (NPRI). The NPRI is a legislated, nation-wide, publicly accessible inventory of pollutants released, disposed of, and recycled by facilities in Canada. Facilities which meet reporting requirements are required to report to the NPRI under the CEPA.

Table 5.4 NPRI 2012 CAC Emissions of New Brunswick (tonnes/year)

Category	TPM	PM_{10}	$PM_{2.5}$	SO_x	NO_x	VOC	CO	NH_3
Industrial Sources	13,560	4,381	2,474	15,678	7,982	4,784	18,500	272
Non Industrial Fuel Combustion	6,076	5,516	5,277	13,765	8,303	7,816	33,424	104
Total Mobile Sources	1,312	1,298	1,120	2,541	20,806	15,141	160,260	610
Incineration	-	-	-	3	3	4	11	-
Open Sources	461,874	120,668	22,623	2,304	310	2,010	597	2,770
Miscellaneous	222	222	220	-	-	9,525	195	39
Total Natural Sources	-	-	-	-	793	235,422	-	-
Total	**483,044**	**132,085**	**31,714**	**34,291**	**38,198**	**274,702**	**212,969**	**3,796**

Notes: PM_{10} = Particulate Matter, 10 microns or less.
NH_3 = Ammonia.
Source: EC, 2014b

A review of Table 5.4 indicates that the majority of particulate matter and NH_3 emissions in the province originate from open sources. Open sources include agriculture, construction activities, paved and unpaved roads, forest fires, landfill sites, mine tailings, and prescribed burning. Industrial fuel combustion sources generated the most SO_2. The total mobile source category accounted for the most NO_X, VOC and CO emissions. Mobile sources include air and marine transportation, diesel and gas vehicles and rail transportation.

Table 5.5 provides a summary of CAC emissions from regulatory permitted point sources in the area.

Table 5.5 Emissions from Permitted Point Sources in the Assessment Area - 2012

Source	Criteria Air Contaminant Emissions (tonnes/year)						
	CO	NO_X	SO_2	VOCs	TSP	PM_{10}	$PM_{2.5}$
Bayside Power – Bayside Power L.P. (5084)	431	154	2.4	11	49	--	--
Canaport liquefied Natural Gas (LNG) Limited Partnership Terminal and Multi-purpose Pier – Canaport LNG Limited Partnership (8125)	--	26	--	--	--	--	--
Coleson Cove Generating Station – NB Power Corporation (1696)	53	323	309	0.211	3	3	2.9
Irving Paper – Irving Paper Limited (3394)	63	102	--	36	19	12	8.4
Irving Pulp & Paper – Pulp & Paper Ltd. (2604)	2,085	935	409	241	56	40	27
Refinery – Irving Oil Refining G.P.	1,692	2,859	1,330	401	353	283	214

Source: EC, 2014b

A review of Table 5.5 indicates that there are five NPRI permitted point sources in the assessment area in 2012.

5.2.4.2 Greenhouse Gas (GHG) Emissions

GHGs including CO_2, methane (CH_4), and nitrous oxide (N_2O) can be emitted from a number of natural and anthropogenic sources. Emissions from biogenic or other sources generally exhibit little variation from one year to the next, and are considered to be nominal when compared to those resulting from the combustion of fossil fuels.

Total GHG emissions are normally reported as CO_2-equivalents (CO_2e). This is accomplished by multiplying the emission rate of each compound by the global warming potential (GWP) relative to CO_2. CO_2e considers the global warming potential of the three main GHGs: CO_2, CH_4 and N_2O. The global warming potential of these gases are as follows: CO_2 = 1.0, CH_4 = 21 and N_2O = 310. Therefore, the CO_2 equivalency factor (CO_2e) is equal to ((CO_2 mass x 1.0) + (CH_4 mass x 21) + (N_2O mass x 310)).

The Canada total GHG emissions for the years 1990 and 2010 are presented in Table 5.6 (EC, 2014c).

Table 5.6 GHG Emissions: Canada

Application	1990 Emissions (Mt CO_2e)	2010 Emissions (Mt CO_2e)
Energy	467	562
Industrial Processes	56	51.8
Solvent and Other Product Use	0.18	0.24
Agriculture	47	56
Land Use, Land-Use Change and Forestry	-67	72
Waste	19	22
Total	**589**	**692**

Source: EC, 2014c

In 2010, energy use for stationary combustion sources accounted for almost 81% of the CO_2e emitted in Canada. There is an increasing trend in GHG emissions. Between 1990 and 2010, Canada saw GHG emissions rise by 103 megatonnes (kt) CO_2e (approximately 17%).

The New Brunswick total GHG emissions for the years 2005 and 2010 are presented in Table 5.7.

Table 5.7 GHG Emissions: New Brunswick and Canada

Totals	2005 Emissions (kilotonnes (kt) CO_2e)	2010 Emissions (kt CO_2e)
New Brunswick Provincial Total	23,000	19,000
Canadian Total	740,000	692,000

Source: EC 2014c

Between 2005 and 2010, New Brunswick saw GHG emissions decrease by 4000 kilotonnes (kt) CO_2e (approximately 17%).

The total GHG emissions for the NPRI sources located in the Saint John region for the Year 2012 are presented in Table 5.8.

Table 5.8 GHG Emissions from Permitted Point Sources in the Immediate Assessment Area – 2012

Point Sources	CO_2	CH_4	N_2O	Total
Bayside Power – Bayside Power L.P. (5084)	627	252	11,346	12,225
Canaport LNG Limited Partnership Terminal and Multi-purpose Pier – Canaport LNG Limited Partnership (8125)	54,607		527	55,134
Coleson Cove Generating Station – NB Power Corporation (1696)	330, 616			330, 616
Irving Paper – Irving Paper Limited (3394)	92,407	40	529	92,975
Irving Pulp & Paper – Pulp & Paper Ltd. (2604)	69,639	825	9,043	79,506
Refinery – Irving Oil Refining G.P.	2,843,439	1,284		2,844,722
Sum (tonnes CO_2e)	3,391,335	2,400	21,444	3,415,179

Source: Extracted from NPRI 2012 (EC, 2014b).

The 2012 total GHG emissions for NPRI emission sources in the Saint John region expressed as CO_2e was 3,415 kt (EC, 2014b).

5.2.5 Acoustic Environment (Noise)

In New Brunswick, there are no specific guidelines for environmental noise. However the Project area is governed by the City of Saint John. The City's Noise By-Law provides sections that refer to the governance of noise during the operation of construction equipment. The following provides pertinent excerpts from the By-Law:

- No person shall operate any item of construction equipment without an effective muffling device in good working order and in constant operation, at any time.

- No person shall operate construction equipment between the hours of 9:00 o'clock in the evening and 7:00 o'clock of the following morning.

The World Health Organization (WHO) and Health Canada provide noise guidelines on noise assessment. The WHO (1999) suggests, a night-time guideline for noise of 45 decibels equivalent sound level (dB (Leq)) and 60 decibels (maximum sound level) (dB (LAmax)), which is acceptable level at the outside facades of living spaces. Health Canada (2010a and b) assesses the environmental impact of noise on sensitive receptors such as residences, based on the calculated Day-Night level (Ldn). The Ldn is determined by imposing a 10 dB penalty to the night-time noise levels and calculating the subsequent 24 hour cumulative sound level. Night-time period is taken from 22:00-07:00 and daytime as 07:00-22:00. For quiet areas that are expected to continue to be quiet, Health Canada applies an Ldn of 45 dB(A).

The context for noise assessment may be assisted by an understanding of typical noise levels for a variety of scenarios/activities. These are described in Table 5.9.

Table 5.9 Typical Noise Values[1]

Sound Level (dB(A))	Descriptor
0-25	Threshold for Normal Hearing
10	Normal Breathing
40 (generally lower limit of ambient sound)	Quiet Office, Quiet Residential Street
50	Rainfall
60	Normal Conversation
80	Average City Noise
80-120	Typical Construction Equipment
130	Jet Takeoff

Note 1: Adapted from Table E-1: Comparison of Common Sound Levels (US Department of Interior, 2008)

5.2.6 Ambient Lighting

Existing ambient light levels were not monitored in the Project area; however, they would be typical of a semi-rural environment with low levels of ambient luminance.

5.3 Physiography and Geology

The Project Footprint lies within the Caledonian Highlands – Mispec Plateau physiographic division (Rampton *et al*., 1984). The following sections describe the geology, the potential to encounter seismic activity, areas with acid generating bedrock, areas of subsidence and soils.

5.3.1 Bedrock Geology

The bedrock in the underlying region is composed of Quaco Formation of the Fundy Group from the Late Triassic period (200-250 million years (Ma)) (NBDNR, 2007). It is described as "Buff and reddish-brown sandstone, and maroon and green siltstone and mudstone: buff, polymictic conglomerate". A preliminary geotechnical investigation was conducted in the fall and winter of 2013/2014 by Brunswick Engineering & Consulting Inc. (2014). The bedrock at the Project site was confirmed to be conglomerate bedrock. Refer to geotechnical investigation report located in Appendix A for more details.

5.3.2 Seismicity

New Brunswick is positioned within the continental section of the North American plate. There are no areas of tectonic subduction, convergence, or divergence associated with earthquake activity in the Province. New Brunswick 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. In summary, the potential for seismic activity in the region is low.

Saint John lies within the Northern Appalachians seismic zone, which includes most of the Province. Several earthquakes have been recorded in this zone to reach magnitudes (MN) of 5 to 6. Epicentres are clustered in the Moncton and Passamoquody Bay regions, where the most recently “felt” earthquake occurred in March 2012, registering at 3.4 MN in the Central Highlands. New Brunswick has also felt the effects from more distant earthquakes centered in Quebec and the Grand Banks. Seismic activity in New Brunswick is believed to be related to the regional stress fields, with the earthquakes concentrated in regions of crustal weakness (Natural Resources Canada (NRCan), 2011).

5.3.3 Potential for Acid Generating Bedrock and Subsidence

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.

Sinkholes are unique geologic structures that result from surface water infiltration into, or groundwater flow through soluble geological formations, leading to the creation of cavities (sinkholes) that may or may not be filled with water. These structures may also be simulated by underground mining activity.

The bedrock was confirmed to be a conglomerate bedrock (Brunswick Engineering & Consulting Inc., 2014) and is therefore considered to have a low potential for acid generating rocks and subsidence (Susan Johnson, pers. comm., 2014).

5.3.4 Surficial Geology

Surficial geology in this area is described as Pre-Quaternary Rock. This has various lithologies and ages and can be described as weathered and partially disintegrated (Rampton et al., 1984). Brunswick Engineering & Consulting Inc. (2014) observed weathered bedrock and bedrock outcrops at the Project site. Above various layers and thicknesses of silty sand, grey/brown clay silt, ablation till and red clay silt was observed. Deposits were observed to be “close to horizontal in the southwest to northeast direction (parallel to the bedrock outcrop and having a steeper bedding east to west.” Refer to geotechnical investigation report located in Appendix A for more details.

5.3.5 Soils

In New Brunswick, soil parent material distribution closely correlates with bedrock lithology due to limited distances of glacial transport and shallow overburden, typically under 2 m in depth. Mapping criteria are based on soil lithology, depth, texture and moisture. Agriculture and forest production is affected by soil texture, available rooting depth, slope, stoniness and soil drainage. Though agriculture can be supplemented by application of fertilizers and minerals, forest productivity depends on weathering of soil parent material and nutrients deposited by atmospheric and environmental deposition. Soils in New Brunswick are classified under 50 different “forest soil units” which are based on regional regolith (parent soil type) and topographic morphology that naturally affect inherent soil fertility (Colpitts *et al*, 1995).

Most sedimentary rocks are cemented aggregates of silicate material clasts and are thereby classified by relative proportions of quartz (quartzose), feldspar (feldspathic) and rock (lithic) fragments. Conglomerates are composed of more than 15% clasts that are greater than 2.0 mm in diameter. Polymictic conglomerates contain clasts of more than one lithologic type. Chemical sedimentary rocks are cemented by carbonate materials produced from precipitation. When the cementing material is composed of calcite, the rocks are identified as being “calcareous”. Calcareous rocks are well buffered, meaning they resist acidification (Colpitts *et al*, 1995).

The Project Footprint lies within the Kennebecasis forest soil unit (identified on mapping as “KN”) whose matrix is slightly calcareous red polymictic conglomerates of feldspathic to lithic sandstones and/or mudstones. The deposition is considered glacialfluvial, being deposited by glacial streams and rivers. The typical depth to the contrasting layer, where bedrock or compact subsoil is reached, is approximately 4 m. The texture of both the solum (top 30 cm) and regolith (30 cm and below) are medium to coarse, denoting a mix of loam to sand. The coarse fragment content, which is the average percentage of soil particulate larger than 2 mm, is considered to be medium to high (ranging from 21 – 100%) in this forest soil unit. The calcite and feldspars of this region create inherent fertility and increased potential for plant nutrition (Colpitts *et al*, 1995).

At the Project site, Brunswick Engineering & Consulting Inc. (2014) observed fairly irregular soil conditions typical of the site having been used in the past as an aggregate source as well as fill site. The top layer was generally classified as organic and fill soils which were highly variable and had a high fines content. Refer to geotechnical investigation report located in Appendix A for more details.

5.3.6 Topography and Drainage

The drainage in this area is classified as “3”, which is dominantly (60-100% of area) moderately well drained with significant (0-40% area) well or imperfectly drained (Colpitts *et al*, 1995). Brunswick Engineering & Consulting Inc. (2014) describes the east side of the property to have a 4% slope from the northwest at McIlveen Road up towards the southeast for approximately 100 m before it increases from a 10 to 33% slope near the eastern property line. Natural drainage channels are observed which direct surface runoff from the east to the west into deep ditches that run along McIlveen Road. Within the west side of the property the area is relatively flat. Refer to geotechnical investigation report located in Appendix A for more details.

5.4 Hydrology and Hydrogeology

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

5.4.1 Surface Water

McAllister Park falls within the hydrometric subdivision 1AP as defined by EC (EC, 1985). The site is located within the relatively small watershed of Hazen Creek, which drains through Red Head Marsh into Saint John Harbour on the Bay of Fundy. There are no protected watersheds located within 5 km of the Project (NBDELG, 2013b). There is significant sloping in McAllister Park, where the Project Footprint is located, which drains surface water to an unnamed tributary of Hazen Creek located in the center of the Park, which drains to the Marsh.

5.4.1.1 Surface Water Quantity

McAllister Park is typical of expanding industrial environments; moderately forested with many roads and cleared areas. Surface runoff generated from such areas is collected more slowly than in heavily urbanized areas. Runoff is collected in ditches and small watercourses which drain into the larger watercourses. In contrast to urban areas, where runoff collects very quickly into storm sewers, developing industrial areas are characterized by more moderate peaks and longer duration. There is a storm drain system along the roads in the industrial park and overland runoff intercepted by the road largely drains into the sewer system.

The region’s average annual precipitation (as measured at Saint John) is 1390.3 mm, including approximately 256.9 cm of snowfall (EC, 2013). 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.

The Project Footprint lies within the Fundy Coastal region in the lower portion of the Saint John Watershed. The Saint John River drains an area of approximately 55,500 km^2. In 2009, the Saint John River level at Saint John averaged 1.77 m, with peak height reaching 4.05 m in April and a low of 0.87 in September. The mean annual discharge for the Saint John River is approximately 1100 cubic metres per second (m^3/s) (Canadian Rivers Institute, 2011).

Additional information related to the hydrology of the area is discussed in the context of fish habitat and fishery resources in Section 5.8.

The City relies on five main surface water sources to meet its municipal and industrial water demands. These water sources include Loch Lomond Lake, Carpenters Pond, Little River, Spruce Lake, and East and West Musquash River. All the water supply sources are located outside the Study Area. McAllister Industrial Park is currently being serviced by the Loch Lomond Watershed. The area of the watershed is 104 km^2. Water is treated with chlorine and fluoride at the Latimer Lake Drinking Water Treatment Facility (Saint John Water, 2011) prior to being distributed. Two gravity mains (0.3 m and 0.4 m in diameter) serve as the water transmission system for the McAllister Industrial Park (Saint John Industrial Parks (SJIP), 2014). Average daily demand on Loch Lomond is 30 to 35 Million Imperial Gallons per day (MGPD), which is 50 -60% of the source's safe yield.

5.4.1.2 Surface Water Quality

Regional surface water quality is dependent primarily on geology, watershed size, topography, and vegetation.

Drinking water quality in the Saint John River is generally classified as "fair" which is defined by the CCME as "usually protected but occasionally threatened or impaired; conditions sometimes depart from natural or desirable levels" (Canadian Rivers Institute, 2011). Water quality in the lower reaches of the River is best as there is less industry and agriculture, no dams and more water from tributaries flowing in (such as the Kennebecasis River) to dilute chemical and bacterial levels.

For surface water bacteria levels, the CCME stipulates a maximum acceptable concentration (MAC) of 200 most probable number (MPN) per 100 millilitres (mL) for water intended for recreational use. Since the year 2000, 60% of the samples analysed from the lowest region of the River had bacterial counts below 10 MPN/100 mL. Recent data for metals such as iron, copper, nickel, arsenic and lead were typically below the CCME Guidelines for the Protection of Aquatic Life (Canadian Rivers Institute, 2011).

Water service for the proposed fertilizer production plants will be provided by the municipal service Saint John Water, sourced from the Loch Lomond Watershed and treated with chlorine and fluoride by the Latimer Lake Drinking Water Treatment Facility (SJIP, 2014). This facility analyses the water to confirm compliance with the New Brunswick Drinking Water Guidelines on a regular basis. There is continuous automatic monitoring of chlorine and fluoride levels, while bacterial levels are tested weekly, organic compounds quarterly, metals biannually and a full scan of 200 parameters once per year (Saint John Water, 2011).

5.4.2 Groundwater

Groundwater resources are often developed for municipal water supply purposes, for which a large volume of groundwater may typically be extracted from a group of production wells and distributed to areas of a municipality. For such uses, the groundwater pumping rate is high and influences a relatively large area referred to as a "capture zone". Groundwater protection areas are delineated to conserve water quality and quantity. Developments within a groundwater protection area require approval from NBDELG and affected municipalities (New Brunswick Department of Environment (NBDENV), 2005).

The nearest designated wellfield protected area, The City of Saint John, is located approximately 1 km south of the McAllister Industrial Park (NBDELG, 2013b). At this time no development is anticipated in this area as tests did not support an adequate supply (Saint John Water, 2014).

5.4.2.1 Groundwater Quantity

On site, a monitoring well was installed in one of the boreholes surveyed by Brunswick Engineering & Consulting Inc. (2014) to determine seasonal water levels. After 48 hours from the time of drilling, groundwater could be observed 4.25 m below surface in the well. Due to the highly disturbed nature of the site, groundwater can be expected within the fill soils at any depth or in the silty sand and gravel layers. The west side of the property was determined to have the highest level of disturbance.

According to the most recent provincial annual summary (2011), groundwater levels across the Province were above normal most of the year and no water availability issues were observed within New Brunswick (NBDELG, undated).

5.4.2.2 Groundwater Quality

Mandatory testing for water quality of all newly drilled or redrilled domestic water wells in New Brunswick 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 used 10,500 samples analysed between 1994 and 2007 to produce the New Brunswick Groundwater Chemistry Atlas (NBDENV, 2008). The database can also be searched for these results, and more current results, by region in New Brunswick 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 a property identification (PID) number central to the Footprint (55162762) a search of the database displayed records for 83 wells drilled within 5 km of the Project between 1994 and 2010, though only 40 of these display sample analysis results (NBDENV, 2011b). There were no newly drilled wells recorded since 1994 within 500 m of this PID.

The New Brunswick Department of Health has adopted the Guidelines for Canadian Drinking Water Quality established by Health Canada (Health Canada, 2012) to assess groundwater quality (New Brunswick Department of Health, 2012). Groundwater quality in New Brunswick 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 New Brunswick as well as the 5 km surrounding area is presented in Table 5.10.

Comparison of regional results against those for the Province as a whole show similar trends. Iron and manganese tend to be higher than MAC values. Hardness and pH values for the area appear to be worse than the Provincial value, but fluoride levels are better. Drill reports for the 83 records show an average well depth of 67.4 m. Average bedrock level is 4.2 m and bore records list shale, conglomerate, granite, clay, soapstone, limestone, rock, till, sandstone and boulders as being encountered in the surrounding 5 km (NBDENV, 2008; NBDENV, 2011b).

Table 5.10 Summary of Selected Groundwater Quality Parameters

Parameter	Percentage of Samples in Compliance in New Brunswick	Percentage of Samples in Compliance Within 5 km of Project
Antimony	99.4	97.6
Arsenic	94.1	95.1
Barium	98.6	97.6
Boron	100	100
Cadmium	99.9	100
Chromium	99.8	100
Fluoride	95	100
Lead	97.3	95.1
Nitrate	99.4	100
Selenium	98.9	97.4
Uranium	97.9	96.3
Chloride	96.7	100
Copper	99.9	100
Hardness	89.2	78.6
Iron	71.2	63.4
Manganese	60.2	58.5
pH	86.3	78.0
Sodium	96.6	97.6
Sulphate	99.4	100
Zinc	99.9	100

Source: NBDENV, 2008; NBDENV, 2011b

5.5 Biological Environment (Flora and Fauna)

5.5.1 Terrestrial Habitat and Vegetation

The Study Area is located within the Fundy Coast Ecodistrict (NBDNR, 2007), where vegetation communities are strongly influenced by the unique coastal climate. Milder temperatures both in Summer and Winter, and frequent fog and overcast conditions bring about a reduced growing season, soil temperature, and fire frequency, while promoting vegetation communities that are more boreal in nature.

The proposed potassium nitrate fertilizer plant area is located mainly on sparsely vegetated land that show signs of previous disturbances. There is an area in the northeastern portion of the property that is composed of young forest. The proposed water supply pipeline follows to the extent possible an existing access road easement. This access road traverses a variety of habitat including cleared land, young forest, mature coniferous forest, mature deciduous forest as well as wetland (Figure 5.1). In general the area is highly disturbed.

Biodiversity in New Brunswick is supported through integrated planning, which requires provincial government departments to forecast and cooperate for sustainable resources which depend on one another. In 2009, NBDNR released both the Biodiversity Strategy (NBDNR, 2009a) and the Balanced Management Approach for New Brunswick's Crown Forest (NBDNR, 2009b). These strategies work together in order to maintain and encourage growth of various forest communities which in turn support biodiversity in other flora and fauna on Crown land. In order to support biodiversity, the province plans to increase protected areas and use harvest treatments that encourage the development of old Acadian forests known as Old Forest Communities (OFC).

There are eighteen (18) OFC types in seven (7) ecoregions across New Brunswick. OFCs are categorized by composition (prevalent tree species) and structure (tree size) as well as by “tolerance” to low light conditions (NBDNR, 2013a). The Province protects these stands through harvest permits, permanent sample plots and EIAs. The nearest old softwood plot is approximately 2.5 km from the Project (NBDNR, 2011). The closest OFC is almost 5 km from the Project.

There are no forest sample plots located within 5 km of the Project (NBDNR, 2011). Forest sample plots have high educational and research value and contribute to enhancement of forest management practices in the Province, and have been avoided.

5.5.2 Wetland Habitat

Wetlands are defined by Chapter C-6.1 of the *Clean Water Act* as "Land that either periodically or permanently, has the water table at, near, or above the land’s surface, or which is saturated with water, and sustains aquatic processes as indicated by the presence of hydric soils, hydrophytic vegetation and biological activities adapted to wet conditions.”

Both collectively and as individual units, wetland resources serve a variety of important ecological and socio-economic functions. Wetlands function in the maintenance of surface and groundwater resources and quality, as well as providing fish and wildlife habitat. The value of wetlands to society and their ecological value are derived from their biological productivity and biodiversity. Ecological wetland values may include sustenance for waterfowl, sources of fish production, storage, and slow release of water, erosion protection, and areas of aesthetic or recreational enjoyment.

Wetlands are generally characterized by hydrophytic vegetation, and can vary from a closed peat bog to an open lake dominated by submergent vegetation. By providing natural flood control, points of recharge and discharge of groundwater, acting as filters, and by trapping silt, wetlands play an important role in the hydrological cycle and generally enhance the water regime. As they provide habitat for a wide variety of plants and animals, they may be highly productive and often exceed adjacent uplands in their standing crops, productivity, and biodiversity. With increasing competition for land, particularly in urban areas, wetlands have continued to be impacted through dyking, filling, drainage, flooding, and other forms of conversion. Such use has caused the number and extent of wetlands to decrease substantially (Bond *et al.*, 1992). The Federal government has established a “no net loss of wetland function” policy in co-operation with the Provinces (EC, 1991). In addition to the provincial WAWA Regulation, the Province has also created a Wetland Conservation Policy with commitments to the “no net loss of wetland function” objective and to identify specific wetlands and wetland types as Provincially Significant. Activities proposed within Provincially Significant Wetlands are usually subject to severe restrictions.

Currently, wetland habitat in New Brunswick represents only 4% of land base (New Brunswick Department of Natural Resources and Energy, 2002). Bogs and shrub swamps are considered to be the most and second most numerous type of wetland in New Brunswick, respectively (Hanson and Calkins, 1996). Wetlands in New Brunswick have been given specific protection under the *Clean Environment Act* and the *Clean Water Act*. The New Brunswick EIA Regulation requires registration of "all enterprises, activities, projects, structures, works, or programs affecting two hectares (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.

5.5.2.1 Wetland Identification

There is one large wetland, Redhead Marsh, identified within the Study Area. The wetland is approximately 71.7 ha in size. It is an open water freshwater marsh with tidal flats and considered significant due to its uniqueness and habitat for a variety of bird species. Please refer to Section 5.10.3. The proposed water pipeline will traverse a portion of this wetland within an existing easement area at its northern tip where Hazen Creek enters. At this location the wetland is riparian shrub wetland.

5.6 Wildlife

There are 57 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) known to inhabit New Brunswick. Vegetative communities are the main determinant of habitat for most area wildlife species.

As described in the *Old Forest Community and Old-Forest Wildlife Habitat Definitions for New Brunswick 2012* (NBDNR, 2013a), NBDNR maintains six old-forest habitat types on Crown Lands: Old Tolerant Hardwood (OTHH), Old Hardwood (OHWH), Old Spruce-fir (OSFH), Old Pine (OPIH), Old Mixedwood (OMWH) and Old Forest Habitat (OFH). These forest types are critical to certain vertebrate species in New Brunswick.

OTHH stands are typically composed of at least 50% hardwood and of at least 35% tolerant hardwood. This habitat provides for 28 faunal species of which 5 are dependent. The criteria set for OTHH is based on the habitat requirements of the barred owl and white-breasted nuthatch. The barred owl needs an OTHH area of greater than 20 ha whereas the white-breast nuthatch requires an OTHH area of greater than 100 ha (NBDNR, 2013a). OHWH encompass stands that are OTHH as well as stands composed of at least 50% hardwood, less than 20% tolerant hardwood and less than 35% tolerant hardwood and red maple combined. OHWH are known to provide habitat for 23 vertebrate species of which 12 are dependent. The criteria set for OHWH is based on the habitat requirements of the hairy woodpecker and pileated woodpecker. The hairy woodpecker requires an OHWH of greater than 30 ha whereas the pileated woodpecker only requires an OHWH area of greater than 20 ha.

OPIH stands are usually composed of at least 50% softwood and of at least 35% red and/or white pine. This habitat provides for up to 12 species however only the pine warbler is dependent. The criteria set for the pine warbler requires an OPIH area of greater than 15 ha. OSFH stands are principally composed of at least 50% softwood and of at least 35% balsam fir, red spruce, white spruce, black spruce and eastern cedar combined. OSFH areas provide habitat for up to 24 species of which 13 are dependent. The criteria set for OSFH is based on the habitat requirements of the black-backed woodpecker which requires an OSFH area of greater than 375 ha (NBDNR, 2013a).

OMWH stands are generally composed of between 25% and 75% hardwood and always meet the definition of at least one other habitat type (OTHH, OHWH OPIH, and OSFH). OMWH habitat provides habitat for a variety of species of which five are dependent. The criteria set are based on the fisher and northern flying squirrel. The fisher requires an area greater than 20 ha whereas the northern flying squirrel requires at least 50 ha. OFH consists of all old-forest species that are not associated with one of the previously-identified habitat types. Depending on the ecodistrict the criteria set is based on the American marten or brown creeper. The American marten requires an OFH area greater than 375 ha in the ecodistrict where they occur and the brown creeper requires at least 30 ha elsewhere (NBDNR, 2013a).

Based on the forestry inventory mapping there are no forest areas that fulfill the criteria of old-forest habitat in the Study Area. While there are smaller stands that contain habitat consistent with other old forest types, these are far too small to support significant populations of the key indicator species.

The location of the Project Footprint is highly disturbed and does not provide quality habitat for wildlife species.

5.7 Migratory Birds

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 New Brunswick to the date of publication; data are updated and presented online as the Maritime Breeding Bird Atlas (MBBA). According to the most recent atlas (2006 - 2010), a total of 84 species of birds have been reported to potentially use breeding habitat within and adjacent to the Project (square summaries 19GL31 and 20KR61 in Region 12 of Saint John East (MBBA, 2011).

Migratory birds are protected under the federal MBCA. Under this Act, no person shall deposit or permit to be deposited oil, oil wastes or any other substance harmful to migratory birds in any waters or any area frequented by migratory birds, and no person shall possess, buy, sell, exchange or give a migratory bird or nest or make it the subject of a commercial transaction, without lawful excuse, and no person shall disturb, destroy or take a nest, egg, nest shelter, eider duck shelter, or duck box of a migratory bird without a permit. In New Brunswick, migratory birds typically nest during the "sensitive nesting window" of 1st May to 31st August, 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:

- MBBA (2nd Atlas, 2011); and
- Atlantic Canada Conservation Data Centre (ACCDC).

Once the above sources were consulted, all of the bird species that could potentially occur in the surrounding area were compiled into a species list. Within the MBBA 2nd Atlas (MBBA, 2011), which was compiled over the period of 2006 – 2010, the Project is located within Region #12, Saint John, and more specifically in Squares 20KR61 and 19GL31, located in Saint John East. There were 184 bird species identified in the Saint John area. Within the two squares covering the Project, 84 species were identified as possible, probable or confirmed breeders at least once since 1986. Most of these species nest within the sensitive nesting window.

Sixteen (16) of these species have been known to breed outside the sensitive breeding window and are protected under the MBCA, as listed in Table 5.11.

Table 5.11 Migratory Bird Species Potentially Breeding in the Region Outside the Sensitive Nesting Window

Species	*Habitat	[1]Breeding Dates
Wood duck	Wooded wetlands, nests high in tree holes.	Late April – 31 August
Gadwall	Nests in thick vegetation upland of wetlands.	Late July – 15 September
American black duck	Nests on ground, favouring wooded wetlands.	1 April – 31 August
Ring-necked duck	Nests on ground, favouring wooded wetlands.	15 May – Early September
Common merganser	Forested regions near lakes and rivers.	Early April – 31 August
Common loon	Nests on ground edging clear ponds and lakes.	Early May – 30 September
Great blue heron	Nests high in trees edging shallow waters for foraging.	15 April – 31 July
Killdeer	Open fields and pastures; nests on the ground.	15 April – early August
American woodcock	Edge and young forest; nests in young deciduous trees.	Early April – 31 July
Mourning dove	Open woodland and forest edge; nests on ground or low branches.	15 May – 30 September
Red-eyed vireo	Hardwood groves; nests on deciduous trees.	Early June – 15 September
Barn swallow	Nests inside barns or beneath overhanging structures.	15 May – Early September
American robin	Varied interior habitat; nests in tree forks, branches or building ledges.	1 May – Late September
Cedar waxwing	Open woodland and forest edge; nests in shrubs or trees.	Early June – 15 September

Species	*Habitat	[1]Breeding Dates
Dark-eyed junco	Open woodland and forest edge; concealed nest on ground.	1 May – Early September
Northern cardinal	Open woodland and forest edge; nests in shrubs or trees.	Late April – 15 June

Source: *Natureserve, 2012
[1] MBBA, 2011

Two of these migratory birds that nest outside the sensitive breeding period were listed by the ACCDC as species of conservation concern that have been observed in the area: the Barn swallow and Killdeer. Both are ranked by the ACCDC as S3B, indicating that they are uncommon or found in a restricted range nesting in New Brunswick. In addition the Barn swallow is listed under the New Brunswick *Species at Risk Act* as Threatened.

The Killdeer is a shorebird which was commonly hunted in Atlantic Canada in the early 1900s. Its tendency for nesting on the ground near disturbed areas makes nests prone to destruction by other animals found in developed areas, such as cats, dogs and raccoons. The Killdeer population is considered secure, however, and has no status under Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (NatureServe, 2012).

Comparing its first and second Atlas editions, the MBBA has reported notable changes in some migratory bird populations of the species noted in Table 5.11. The range of the Northern cardinal appears to be shifting northwards in response to climate change. In turn, new breeding species are appearing in the Maritimes from the south, such as the Chuck-wills-widow, Red-bellied woodpecker, Carolina wren and Yellow-throated vireo (MBBA, 2011).

Based on a review of MBBA 2011 habitat criteria and the habitat preference as detailed on the SARPR website, habitat requirements for bird species consist of forested areas, forest edge, fields, wetlands and waterbodies.

Geographic Information System (GIS) digital datasets were supplied by NBDNR to derive potential habitat types in the Study Area. Forest habitat types were defined using NBDNR Forest Unit Name (FUNA) types, development stages of the forest, the primary species in each forest stand (Sp1), and the NBDNR age classes from the forest GIS database. The criterion for “old” was determined by the age of the species. In the case of species other than balsam fir, the “old” criterion was set at greater than 90 years. For balsam fir, the “old” criterion was set at greater than 60 years. These age designations follow the age designations for “old” recognized by NBDNR.

Forest edge habitat was defined as forested area found within the first 100 m into the forest from any disturbance (i.e., roads, suburban or urban development, industry, etc.). Disturbance areas were defined as Occupied Land using NBDNR Primary Land Use DND, IND, INF, REC, and SET classes.

Field was defined using NBDNR Land Cover NV and VG classes as well as Primary Land Use AGR and WIL classes from the forest GIS database.

From available mapping, in addition to occupied land, ten (10) broad habitat types were identified as occurring within 5 km of the Project (Figure 5.2):

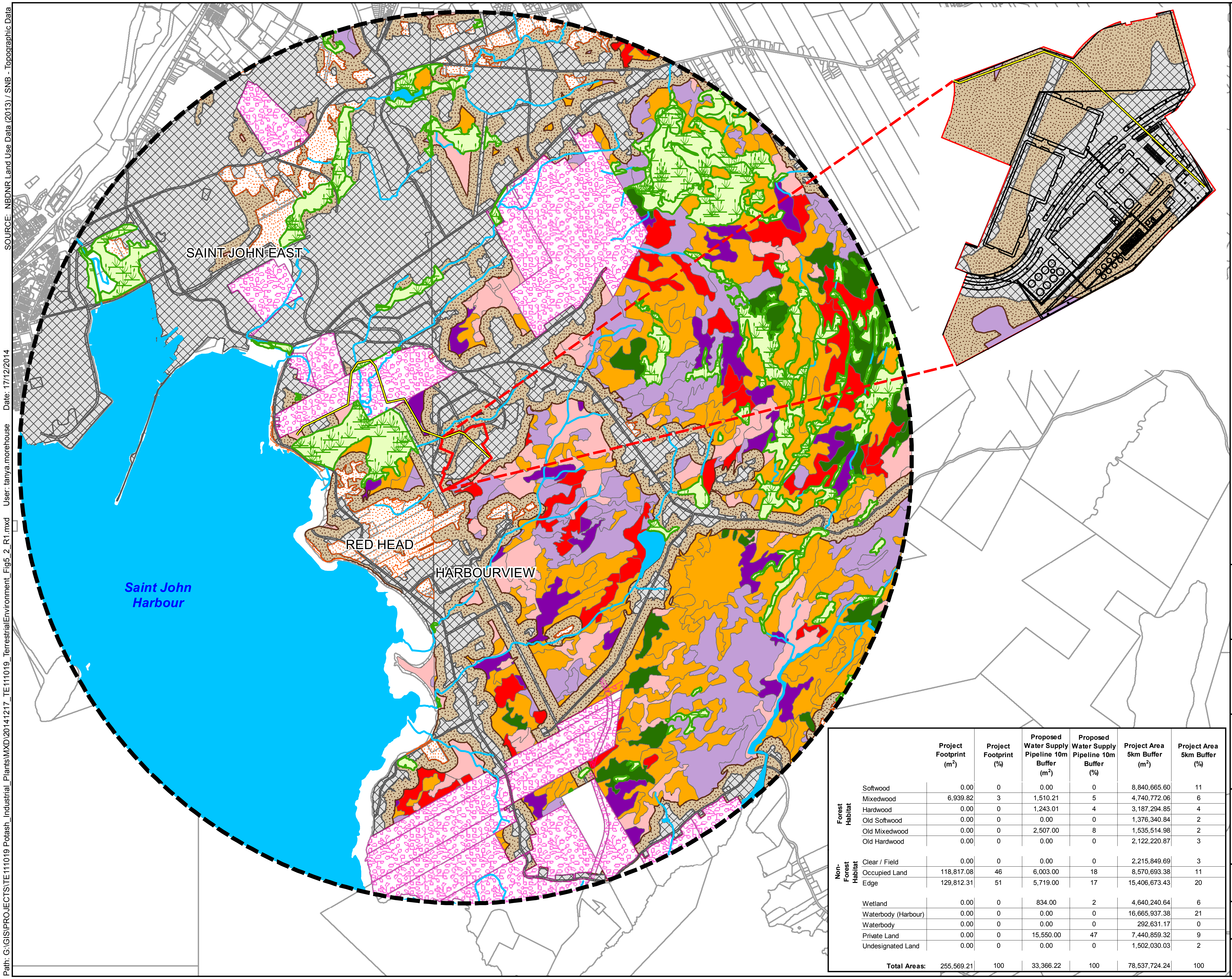
- softwood;
- hardwood;
- mixedwood;
- old softwood;
- old hardwood;
- old mixedwood;
- edge;
- clear / field;
- waterbodies; and
- wetland

In order to determine the amount of habitat affected by the Project, the total area in hectare was calculated for each habitat type. The same procedure was carried out to determine the total area of each habitat type within 5 km. The fertilizer plant Footprint, the proposed water supply pipeline 10 m right-of-way and surrounding 5 km (Study Area) within the NBDNR datasets consisted of approximately 25.6 ha, 3.3 ha and 7854 ha of area, respectively. Within the Study Area, the Saint John harbour consisted of approximately 1667 ha (21%). The following table (Table 5.12) provides the area for each habitat type excluding the Saint John harbour for the fertilizer plant Footprint, water supply footprint, and Study Area.

Table 5.12 Migratory Bird Habitat Present in the Study Area

Habitat Type	Fertilizer Plant Footprint (ha)	Water Supply Pipeline Footprint (ha)	Study Area (ha)
Occupied Land / Private Land	11.88 (46%)	2.16 (64%)	1601.16 (26%)
Softwood	---	---	884.07 (15%)
Mixedwood	0.69 (3%)	0.15 (5%)	474.08 (8%)
Hardwood	---	0.12 (4%)	318.73 (5%)
Old Softwood	---	---	137.63 (2%)
Old Mixedwood	---	0.25 (8%)	153.55 (2%)
Old Hardwood	---	---	212.22 (4%)
Clear/Field	---	---	221.58 (4%)
Edge	12.98 (51%)	0.57 (17%)	1540.67 (25%)
Waterbody (excluding Harbour)	---	---	29.26 (1%)
Wetland	---	0.08 (2%)	464.02 (8%)
Total	**25.55**	**3.33**	**6036.97**

Path: G:\GIS\PROJECTS\TE111019 Potash_Industrial_Plants\MXD\20141217_TE111019_TerrestrialEnvironment_Fig5_2_R1.mxd User: tanya.morehouse Date: 17/12/2014 SOURCE: NBDNR Land Use Data (2013) / SNB - Topographic Data



LEGEND:

- Undesignated Land
- Private Land

Non-Forest Habitat

- Cleared/Field
- Occupied Land
- Edge

Forest Habitat

- Softwood
- Mixedwood
- Hardwood

Old Forest Habitat

- Old Softwood
- Old Mixedwood
- Old Hardwood
- Wetland
- Watercourse
- Waterbody
- Proposed Water Supply Pipeline
- Project Footprint
- 5km Project Study Area
- SNB Property Boundary Saint John County

		Project Footprint (m^2)	Project Footprint (%)	Proposed Water Supply Pipeline 10m Buffer (m^2)	Proposed Water Supply Pipeline 10m Buffer (%)	Project Area 5km Buffer (m^2)	Project Area 5km Buffer (%)
Forest Habitat	Softwood	0.00	0	0.00	0	8,840,665.60	11
	Mixedwood	6,939.82	3	1,510.21	5	4,740,772.06	6
	Hardwood	0.00	0	1,243.01	4	3,187,294.85	4
	Old Softwood	0.00	0	0.00	0	1,376,340.84	2
	Old Mixedwood	0.00	0	2,507.00	8	1,535,514.98	2
	Old Hardwood	0.00	0	0.00	0	2,122,220.87	3
Non-Forest Habitat	Clear / Field	0.00	0	0.00	0	2,215,849.69	3
	Occupied Land	118,817.08	46	6,003.00	18	8,570,693.38	11
	Edge	129,812.31	51	5,719.00	17	15,406,673.43	20
	Wetland	0.00	0	834.00	2	4,640,240.64	6
	Waterbody (Harbour)	0.00	0	0.00	0	16,665,937.38	21
	Waterbody	0.00	0	0.00	0	292,631.17	0
	Private Land	0.00	0	15,550.00	47	7,440,859.32	9
	Undesignated Land	0.00	0	0.00	0	1,502,030.03	2
	Total Areas:	255,569.21	100	33,366.22	100	78,537,724.24	100

The map shown here has been created with all due and reasonable care and is strictly for use with AMEC Project Number: TE111019 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:

ATLANTIC POTASH CORPORATION

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:

APC McALLISTER INDUSTRIAL PARK
FERTILIZER PRODUCTION FACILITY

TITLE:

TERRESTRIAL HABITAT

DATUM:	DWN BY:	DATE:
NAD 83 CSRS	TM	Dec 17, 2014
PROJECTION:	CHK'D BY:	SCALE:
New Brunswick Stereographic	CL/JB	1:42,000
PROJECT NO:	REV NO:	FIGURE NO:
TE111019	1	5.2

From Table 5.12 it is apparent that the dominant habitat within all the areas surveyed is Occupied Land and Edge. This is certainly the case within the proposed fertilizer plant footprint. Although along the proposed water supply pipeline footprint, it shows areas of hardwood, mixedwood and old mixedwood will be crossed, many of these areas have already been cleared for an existing access road. Therefore the land to be used for the pipeline right-of-way will be mainly cleared or edge habitat.

The species listed in Table 5.11 nest in forest clearings, edge habitat, manmade structures and wetlands; therefore, there is some potential for migratory birds to be present within the Project Footprint, especially during the “sensitive nesting window”. Many of these birds would be found in the neighbouring Red Head Marsh area.

5.8 Fish, Fish Habitat, and Fisheries

Existing fish habitat and fishery resource information was collected in order to characterize aquatic habitat and fish populations that are potentially affected by the Project. The study focused on fish species of economic/human importance potentially impacted by the Project and important habitat areas (spawning, nursery, feeding and overwintering). There is one watercourse located within the Project Footprint of the fertilizer plant and ten watercourses along the water supply pipeline route (Figure 5.1).

5.8.1 Fish and Fish Habitat

The freshwater environment in the area around the Project Footprint is in the midst of a high degree of industrial development. The potential exists for several fish species, such as the Atlantic salmon or sea-run brook trout, to be present within the assessed area. AMEC conducted habitat characterization and index electrofishing on the watercourse (WC1) present within the proposed fertilizer plant Footprint. A photo log, habitat characterization sheet and electrofishing data sheet are provided in Appendix D. It is unknown the degree to which downstream reaches have been compromised by development or natural degradation. There is no obvious source of upstream water feeding the watercourses within the fertilizer plant Footprint.

An additional ten watercourses were observed along the proposed water supply pipeline route. No characterization or index electrofishing were conducted on these watercourses. A photo log is attached in Appendix D.

5.8.1.1 Watercourses Within Fertilizer Plant Footprint

WC1

WC1 is an unmapped watercourse with an unknown origin, draining into a tributary of Hazen Creek. Upstream fish passage through the watercourse has been compromised due to the presence of two perched culverts.

From the confluence of WC1 with the Hazen Creek tributary, the watercourse has a slight gradient upstream to a culvert under Whitebone Way. This culvert was perched approximately

40 cm and had a slight uphill orientation that would preclude many fish species from getting further upstream.

The habitat characterization began on the upstream side of Whitebone Way. The first 100 m upstream of Whitebone Way is comprised of a riffle-cascade habitat type. The mean wet width was approximately 1.75 m and bank channel width averaged 3.5 m. The substrate was predominantly coarse material ranging from boulder to gravel. There was little undercut bank and minimal overhanging vegetation. Riparian vegetation was predominantly grass with lesser amounts of bare substrate and trees as well as minimal coverage from shrubs.

The gradient flattens over the next 75 m and the substrate has a corresponding increase in sand and fines. Undercut banks were still absent, but overhanging vegetation became more prevalent. Vegetation was still dominated by grasses, including moss, but there was a higher percentage of shrubs throughout this reach. The upstream terminus of the reach ended at another perched culvert that ran beneath a decommissioned rail road track. The culvert was perched approximately 40 cm. The downstream side of the culvert was partially submerged and largely blocked by debris.

The next 60 m of upstream watercourse was comprised of a run with wet width of 2 m and bank channel width of 4.5 m. The substrate was predominantly rubble and gravel with lesser amounts of boulder, rock, sand, and fines. Undercut bank was absent from the reach and overhanging vegetation was minimal. Riparian vegetation was an even distribution of grass, trees, and shrubs with minimal instances of bare substrate.

The last 20 m of the watercourse was comprised of a steep grade to a culvert. The surrounding area was entirely armourstone that presumably was placed during construction of McIlveen Drive. The grade and water depth preclude any fish from moving any further upstream. The terminus of the culvert was not found can be presumed to cross beneath McIlveen Drive.

The watercourse in its entirety has moderate to high degrees of shade and stable banks. Depth was low throughout, ranging between 10 and 22 cm. Large woody debris within the water was common.

A total of 685 seconds of index electrofishing was completed in WC1. A lone brook trout was collected, measuring 151 mm in length and weighing 39 g. This brook trout was found in a small pool at the base of the culvert passing beneath Whitebone Way.

5.8.1.2 Watercourses Along Water Supply Pipeline

WC2

WC2 is a provincially-mapped watercourse that runs in an east-west orientation north of the APC Project Footprint. WC2 is the most substantial watercourse in the area, with a wet width between 1.5 and 4 m and a bank full channel width between 3 and 7 m. The habitat is primarily riffle so the depths are rarely greater than 30 cm. There are pools on the downstream side of culverts that are as deep as 1 m.

The substrate was dominated by cobble and rocks with lesser amounts of gravel and sand. Riparian vegetation was an even distribution of grass, shrubs, and trees which provided excellent shade but offered little in terms of overhanging vegetation.

The watercourse has seen some rehabilitation recently. A preliminary survey in 2012 showed perched culverts in multiple areas along the watercourse. These culverts were fixed in 2013, either by complete reconstruction or habitat alterations. Small bridges over the watercourse were present in both 2012 and 2013.

WC3, WC4, and WC5

WC3, WC4 and WC5 are not provincially-mapped watercourses. They appear to have developed as drainage with a flow from east to west. The watercourses are all under 1 m in width with a mostly sandy-silt to gravel/rubble bottom. Each watercourse has a culvert that allows it to flow under the existing access road. To the east of the access road the watercourses flow through lands that have been recently cleared. To the west, the watercourses flow through a mature coniferous forest to Redhead Marsh.

WC6

WC6 is a larger watercourse (1-2 m wide) and not provincially-mapped. It also appears to have developed as drainage with a flow from the northeast to southwest. The watercourse appears to have a mostly sandy bottom. The watercourse has a large concrete culvert that allows it to flow under the existing access road. To the east of the access road the watercourses flow through lands that have been recently cleared. To the west, the watercourses flows directly into Redhead Marsh.

WC7

WC7 is a provincially-mapped watercourse that runs from the northeast to southwest. The watercourse is small (<1 m) and appears to have a sandy to rubble bottom. There is a small culvert that allows the watercourse to flow under the existing road. On either side of the road easement the watercourse flows through coniferous forest. Within the easement the watercourse flows through a very shrubby environment with several species of narrow-leaved herbaceous vegetation.

WC8

WC8 is not a provincially-mapped watercourse but is located within Redhead marsh. It is a shallow watercourse measuring approximately 1-2 m in width and 30 cm in depth with a bottom of predominately sand and rock. Riparian vegetation is composed mainly of grasses and sedges with some alders.

WC9

WC9 is a provincially-mapped watercourse that runs from the north to south into Redhead Marsh. The watercourse appears to be approximately 1-2 m wide and 30 cm in depth with a sandy to rubble bottom. There is a culvert that allows the watercourse to flow under the existing road. On the north side of the existing road the watercourse flows through a disturbed area. To the south the watercourse flows into a large pond in Redhead Marsh.

WC10 and WC11

WC10 and WC11 are not provincially-mapped watercourses. They appear to have developed as drainage with a flow mainly from northwest to southeast. The watercourses are all under 1 m in width with a mostly sandy-silt to gravel/rubble bottom. Each watercourse has a culvert that allows it to flow under the existing access road. The entire area surveyed shows signs of previous disturbance. WC11 flows adjacent an industrial facility.

5.8.2 Fisheries

Fishery resources, including fish species targeted, and recreational, commercial, and Aboriginal/First Nations fisheries, are described below.

5.8.2.1 Fish Species Targeted

Recreational fisheries in the lower Saint John River system (all lakes, main stem and tributary rivers and streams of the Saint John River drainage area and tributaries from the covered bridge at Hartland to the Saint John Harbour Bridge) include landlocked salmon (*Salmo salar*), brook trout (*Salvelinus fontinalis*), lake trout (*Salvelinus namaycush*), brown trout (*Salmo trutta*), rainbow trout (*Salmo gairdneri*), arctic charr (*Salvelinus alpinus*), smallmouth bass (*Micropterus dolomieu*), striped bass (*Morone saxatalis*), rainbow smelt (*Osmerus mordax*), yellow perch (*Perca flavescens*), white perch (*Morone Americana*), pickerel (*Esox niger*), muskellunge (*Esox masquinongy*), burbot (*Lota lota*) and shortnose sturgeon (*Acipenser brevirostrum*) (Canadian Rivers Institute, 2011).

5.8.2.2 Recreational Fisheries

The possibility of recreational fishing within the Project Footprint exists but is highly unlikely. The watercourses are mainly diminished and within an industrial area. The nearby Loch Lomond lakes and Mispec River offer better sites for recreational fishing.

5.8.2.3 Commercial Fisheries

There are no commercial fisheries located in the vicinity of the Project.

5.8.2.4 Aboriginal/First Nations Fisheries

There are no Aboriginal fisheries being conducted within the Project area.

5.9 Species at Risk

The following section focuses on Species at Risk (i.e. endangered, threatened, of special concern, and rare species), which could potentially be disturbed as a result of Project development. Available information on the known occurrence of floral and faunal Species at

Risk within 5 km of the Project was compiled and reviewed to determine their presence relative to the proposed infrastructure. Sources included published and unpublished listings of occurrences of such species as described below.

The federal SARA came into force in June 2003 as part of a three-part national strategy for the protection of wildlife species at risk, which also includes commitments under the Accord for the Protection of Species at Risk and activities under the Habitat Stewardship Program for Species at Risk. The listing process begins with a species assessment that is conducted by the COSEWIC. Based on a status report, species specialist subcommittees assess and assign the status of a wildlife species believed to be at some degree of risk. 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. An ongoing process of monitoring, assessment, response, recovery, and evaluation will be undertaken to improve the species status and ecosystem. The prohibitions and offences portions of the Act came into effect in June 2004. The status of species protected under SARA can be found at the SARPR online at http://www.registrelep-sararegistry.gc.ca. Refer to Appendix E for a list of SARA and COSEWIC listed species.

New Brunswick 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. Refer to Appendix E for a list of NBSRA listed species.

The ACCDC is part of the NatureServe network, a non-government agency which maintains conservation data for the Atlantic Provinces. Information from the ACCDC for a list of occurrences of rare and endangered flora and fauna within and near the proposed Project was received 21 November, 2014. The paragraphs below detail species of conservation concern that could potentially occur in the vicinity of the proposed Project. S1, S2, and S3 ranked species are considered to be extremely rare to uncommon within its range in the Province and are discussed in the following sections. S4 and S5 ranked species are not discussed, as these species are widespread and their occurrences are fairly common to abundant.

5.9.1 Plant Species at Risk

The ACCDC identifies the following plant species as occurring within a 5 km radius of the Project Footprint (Table 5.13).

Table 5.13 Plant Species of Conservation Concern Occurring within a 5 km Radius of the APC Fertilizer Production Facilities Project Area

Common Name	Scientific Name	*ACCDC Rank	**Habitat
Strawberry-blite	*Chenopodium capitatum*	S1	Edge, clearings and burned areas.
Sago pondweed	*Stuckenia pectinata*	S2	Brackish still water.
Pennsylvania blackberry	*Rubus pensilvanicus*	S2?	Edge, clearings and roadsides.
Purple-veined willowherb	*Epilobium coloratum*	S2?	Open, seepy areas.
Seabeach dock	*Rumex pallidus*	S2S3	Coastal shores and sandy roadsides.
Herb Robert	*Geranium robertianum*	S2S3	Rocky woods and wet ledges.
Horned pondweed	*Zannichellia palustris*	S3	Brackish pools.
Loesel's twayblade	*Liparis loeselii*	S3	Damp alder thickets, meadows, roadsides and cleared areas.
Siberian water milfoil	*Myriophyllum sibiricum*	S3	Alkaline waters.
Whorled water milfoil	*Myriophyllum verticillatum*	S3	Still waters.
Farwells's water milfoil	*Myriophyllum farwellii*	S3	Acidic still waters.
Weigand's sedge	*Carex wiegandii*	S3	Shapgnum bogs, boggy thickets and along shores.
Spotted coralroot	*Corallorhiza maculate*	S3S4	Old mixed forests.
Brook lobelia	*Lobelia kalmia*	S3S4	Calcareous shores and wet ledges.
Blue-stemmed goldenrod	*Solidago caesia*	SX	Rich woods and clearings.

Source: *ACCDC, 2014
**Hinds, 2000

It is unlikely to find any of the plant species listed under SARA Schedule 1 and NBSRA as the proposed Project Footprint is highly disturbed. Habitat potential is more likely to be found in adjacent areas such as the nearby Red Head Marsh and coastal shore. With respect to the species identified by the ACCDC, those species found in drier, edge areas and roadsides, such as the strawberry-blite, Pennsylvania blackberry and seabeach dock could potentially inhabit the proposed Project Footprint. The blue-stemmed goldenrod is believed to be extirpated. No rare plant species or plant species at risk were identified in the area by AMEC Biologists during field investigations conducted in 2013.

5.9.2 Terrestrial Mammal Species at Risk

The ACCDC lists one observation of the gray wolf (*Canis lupus*) within 5 km of the Project (ACCDC, 2014). The gray wolf, though common throughout areas of Canada, is considered extirpated in New Brunswick. It is the largest of the wild dog species and travels within home ranges of 100 to 1000 km in packs of typically 2 to 8 members. Habitat preferences are broad, but require large expanses of land with few roads. Populations are more dependent on availability of prey, which is primarily ungulate (moose and deer) (NatureServe, 2012). Young are born in dens during the spring.

5.9.3 Bird Species at Risk

Table 5.14 lists the ACCDC bird species of conservation concern identified as occurring within a radius of 5 km of the Project Footprint.

Table 5.14 Potential Bird Species of Conservation Concern Occurring within a 5 km Radius of the APC Fertilizer Production Facilities Project Area

Common Name	Scientific Name	ACCDC Rank*	SARA Rank	NBSRA Rank	Habitat
Wilson's phalarope	*Phalaropus tricolor*	S1B	----	----	Nests on ground in variety of marsh or open water areas.
Least bittern	*Lxobrychus exilis*	S1S2B	Threatened	Threatened	Oligotrophic (nutrient-poor), spring-fed lakes.
Willow Flycatcher	*Empidonax traillii*	S1S2B	----	----	Shrubby areas with low growth on abandoned farmlands and in riparian corridors.
Common moorhen	*Gallinula chloropus*	S1S2B	----	----	Freshwater marshes, nesting on plants in water.
Black-crowned Night-heron	*Nycticorax nycticorax*	S1S2B	----	----	Wooded areas edging coasts and marshes.
Green heron	*Butorides virescens*	S1S2B	----	----	Freshwater or brackish marshes, nesting on plants in water.
Piping plover	*Charadrius melodus melodus*	S2B	Endangered	Endangered	Atlantic coastline beaches.
Whip-poor-will	*Caprimulgus vociferous*	S2B	Threatened	Threatened	Patchy and disturbed forests with pine and oak.
Marsh wren	*Cistothorus palustris*	S2B	----	----	Freshwater or brackish marshes, nesting on plants in water.
Northern shoveler	*Anas clypeata*	S2B	----	----	Freshwater areas, ground nesting near water edge.
Gadwall	*Anas strepera*	S2B	----	----	Open lakes and marshes.
Solitary sandpiper	*Tringa solitaria*	S2B, S5M	----	----	Swampy margins of brackish pools, freshwater ponds and woodland streams.
Barn swallow	*Hirundo rustica*	S3B	----	Threatened	Nests inside barns or beneath overhanging structures.
Common nighthawk	*Chordeiles minor*	S3B	Threatened	Threatened	Open fields and woods, as well as disturbed areas. Nests on ground in open.
Brown-headed cow bird	*Molothrus ater*	S3B	----	----	Edge forest (primarily deciduous) and disturbed areas.
Northern mockingbird	*Mimus polyglottos*	S3B	----	----	Various forest edge habitats, nesting in trees.
Bank swallow	*Riparia riparia*	S3B	----	----	Embankments, usually near flowing water.
Great crested flycatcher	*Myiarchus crinitus*	S3B			Nests in tree cavities in edge woodlands.

Common Name	Scientific Name	ACCDC Rank*	SARA Rank	NBSRA Rank	Habitat
Killdeer	*Charadrius vociferous*	S3B	----	----	Open fields and pastures; nests on the ground.
Virginia rail	*Rallus limicola*	S3B	----	----	Freshwater or brackish marshes, nesting on plants in or near water.
American wigeon	*Anas americana*	S3B	----	----	Wooded areas near freshwater with exposed shorelines for foraging.
Bald eagle	*Haliaeetus leucocephalus*	S3B	----	Endangered	Nests in variety of forest types or cliffs near open water.
Common tern	*Sterna hirundo*	S3B	----	----	Nests on ground in variety of marsh or open water areas.
Bobolink	*Dolichonyx oryzivorous*	S3S4B	----	Threatened	Nests on ground in grasslands and wet meadows.
Canada warbler	*Wilsonia Canadensis*	S3S4B	Threatened	Threatened	Variety of forest types with wet, dense ground cover.
Cliff swallow	*Petrochelidon pyrrhonata*	S3S4B	----	----	Nest in coastal cliffs in colonies.
Red-breasted merganser	*Mergus serrator*	S3B, S4S5 (non-breeding)	----	----	Freshwater and sometimes marine areas, ground nesting near water edge.
Red knot rufa ssp	*Calidris canutus rufa*	S3 (migratory)	----	Endangered	Uses coastal land for staging areas in large flocks.
American golden-plover	*Pluvialis dominica*	S3 (migratory)	----	----	Uses coastal or short-grassed land for staging areas in large flocks.
Evening grosbeak	*Coccothraustes vespertinus*	S3S4B, S4S5 (nonbreeding)	----	----	Mixed woods.

Notes: ACCDC (2014) Rank Definitions:
S1 – extremely rare throughout its range in the Province.
S2 – rare throughout its range in the Province; Breeding refers to the breeding population only.
S3 – uncommon throughout its range in the Province, or found in a restricted range.
S4 – fairly common throughout its range in the Province, and apparently secure with many occurrences, but the Element is of long-term concern.
B – Breeding.

The ACCDC 5 km buffer encompasses the Project Footprint as well as the surrounding wood areas, the Red Head Marsh Environmentally Significant Area (ESA) and much of the Saint John Harbour – representing a broad range of habitat types to support bird species.

Five of the bird species of concern listed in Table 5.14 are SARA Schedule 1 and NBSRA listed species with an additional four species also protected by NBSRA.

The Least bittern and Canada warbler are both Threatened species under SARA who prefer dense marshes around freshwater lakes and rivers. In southern New Brunswick, the Least bittern has been reported in the areas of Red Head Marsh, Musquash, and Piries Lake (Erskine,

1992) but listed as S1S2 under the ACCDC, indicating that its presence is extremely rare throughout its range in the Province.

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, 2011). The Common nighthawk, which is listed as Threatened under SARA, is commonly found throughout the Maritimes and nests in a wide range of open, vegetation-free habitats, including dunes, beaches, recently harvested forests, burnt-over areas, logged areas, rocky outcrops, rocky barrens, grasslands, pastures, peat bogs, marshes, lakeshores, and river banks. This species also inhabits mixed and coniferous forests (COSEWIC, 2012) and is known to feed on insects attracted by artificial light during the evening. The Whip-poor-will, listed as Threatened under SARA, prefers to breed in forests that are neither too dense nor too open and are thereby typically found in forest patches and disturbed areas (SARPR, 2011).

The Piping plover and Bald eagle are both listed as Endangered under the NBSRA. Both nest near open areas of water, such as the Atlantic coast. The Bald eagle is currently listed as Not at Risk by COSEWIC and does not appear on any SARA Schedule. The Bald eagle prefers to nest near open water where an abundant source of food is available and is frequently found in the southwest part of the Province (NBDNR, 2012a).

In addition to its provincial protection, the Piping plover is also listed as Endangered federally under SARA. It is a small, thrush-sized shorebird that breeds along the Atlantic coast from Newfoundland to South Carolina. Piping plovers nest above the normal high-water mark on exposed sandy or gravelly beaches. On the Atlantic coast, they often nest in association with small cobble and other small beach debris on ocean beaches, sand spits, or barrier beaches, where they also forage for food (SARPR, 2011).

Both the Barn swallow and Bobolink are listed as Threatened under NBSRA. The MBBA has records of Barn swallow presence in the region in both the first and second editions of the Atlas (MBBA, 2011). This bird’s population in the Maritimes is actually larger than it was during European settlement, as man-made habitat is preferred, but the bird’s presence has been in steady decline since the mid-1980s. Nests of 4-5 eggs are typically found in barns, beneath roof eaves, and under bridges on vertical surfaces close to the ceiling (Tufts, 1986). Nesting occurs between mid-May and early September (MBBA, 2011). They often re-use old nests in successive years, which can allow for earlier nesting periods. Barn swallows mainly feed on flying insects.

The Bobolink is a ground nester whose habitat is grasslands. Recent population declines have been attributed to increased hay cropping in the Maritime breeding area, as well as agricultural practices in its South American wintering area (NatureServe, 2011).

The Red knot is a migratory bird species normally seen in Atlantic Canada during migration. They can be observed in vast coastal zone stopover areas that are swept by tides twice per day, usually sandflats, but sometimes mudflats. This species feed on mollusks, crustaceans, and other invertebrates (SARPR, 2011).

Though the 5 km ACCDC observation list encompasses habitat-rich lands such as the Red Head Marsh ESA and the Atlantic coast, the Footprint of the proposed Project lies within an existing industrial park and is not expected to disturb critical habitat for any of the bird species discussed.

5.9.4 Freshwater Herpetile Species at Risk

There are approximately 25 species of amphibians and reptiles that inhabit New Brunswick, including various species of salamanders, frogs, turtles, and snakes (Gorham, 1970). It is possible that some of these species inhabit the watercourses or marsh near the Project.

There is only one terrestrial herpetile species, wood turtle (*Glyptemys insculpta*), listed under both SARA Schedule 1 and the NBSRA and one species, snapping turtle (*Chelydra serpentine*), listed as Species of Special Concern under the NBSRA. The ACCDC report for the 5 km surrounding area identified wood turtle observations.

The wood turtle is a medium-sized aquatic turtle found throughout the Maritimes and considered to be “location sensitive”. They are common in areas where habitat is intact and human disturbance is minimal, within 150 to 300 m of water in deciduous forests, woodland bogs and marshy fields. 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. In New Brunswick, copulation occurs in the spring and eggs are buried from mid-May to early July, with hatchling emergence in September or October. In the fall, both adults and hatchlings retreat to freshwater and bury themselves for winter hibernation. Populations are currently declining as a result of over-collection for the pet-trade as well as increased egg-predation by skunks and raccoons, which accompany human settlement.

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 surrounding 5 km did not contain any observations of the snapping turtle, nor was its presence indicated in the range maps.

5.9.4.1 Wood Turtle Survey

Wood turtles are most easily detected during early spring during mating season, found sun-basking and foraging along freshwater shorelines. The six watercourses within the property Footprint and one watercourse just outside the property were surveyed on 29 May, 2013 by AMEC biologists. The watercourses were well shaded and offered little area for basking. The banks of half of the watercourses were very steep and rocky. There was very little sandy substrate along the banks of any of the watercourses no evidence of wood turtle presence was found.

5.9.5 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. Several butterfly species as well as one ladybird beetle (*Coccinella transversoguttata richardsoni* (S1S2)) and one dragonfly (*Aeshna clypsydra* (S2)) were listed by the ACCDC as being observed within 5 km of the Project Footprint. Only the Monarch (*Danaus plexippus*) is known to breed in the region or is considered a Species at Risk. The Monarch is designated as Special Concern in both SARA Schedule 1 and NBSRA. In New Brunswick, Monarch butterflies utilize habitats such as meadows, wild fields, and watercourses where milkweed is present during their breeding season. The major threat to the Monarch butterfly is not breeding habitat, but where it overwinters in coastal Monterey pine, Monterey cypress, eucalyptus groves in California and in fir forests in the Mexican mountains, which are threatened by developments. Mexican and international efforts are now in place to protect the Monarch butterflies in Mexico.

No milkweed was identified during field surveys.

5.9.6 Freshwater Fish Species at Risk

The ACCDC identifies the following freshwater fish species as occurring within a 5 km radius of the Project Footprint (Table 5.15).

Table 5.15 Freshwater Fish Species of Conservation Concern Occurring within a 5 km Radius of the APC Fertilizer Production Facilities Project Area

Common Name	Scientific Name	ACCDC Rank	SARA Rank	NBSRA Rank	*Habitat
Atlantic salmon (Inner Bay of Fundy pop.)	*Salmo salar*	S2	Schedule 1 Endangered	Endangered	• Marine habitat: near shore, pelagic. • Estuarine habitat: bay, river mouth. • Riverine habitat: rocky runs and pools of small to large rivers. • Lacustrine Habitat: deep water.
Atlantic salmon (Outer Bay of Fundy pop.)	*Salmo salar*	S2		Endangered	• Marine habitat: near shore, pelagic. • Estuarine habitat: bay, river mouth. • Riverine habitat: rocky runs and pools of small to large rivers. • Lacustrine Habitat: deep water.
Redbreast sunfish	*Lepomis auritus*	S3?	Schedule 3 Special Concern	----	Sandy pools and margins of creeks and small to medium rivers, including tidal freshwater areas; also rocky and vegetated lake margins.

Common Name	Scientific Name	ACCDC Rank	SARA Rank	NBSRA Rank	*Habitat
Shortnose sturgeon	*Acipenser brevirostrum*	S2	Schedule 1 Special Concern	Special Concern	Rivers, estuaries, and the sea. Usually they are most abundant in estuaries, generally within a few miles of land when at sea.
Striped bass	*Morone saxitilis*	S2	----	Endangered	• Marine habitat: near shore. • Estuarine habitat: bay, river mouth. • Riverine habitat: large to medium size rivers. • Lacustrine Habitat: deep water.

Source: ACCDC, 2014

All four of the species identified by ACCDC are anadromous fish with potential for presence within the watercourses in the Study Area, being in close proximity to the ocean. None of these four species were detected, however, during electrofishing surveys of the watercourses in McAllister Park during the summer of 2013.

5.10 Designated Areas and Other Critical Habitat Features

Available information on designated areas and other habitat features identified as sensitive or critical was compiled and reviewed to determine their location in the surrounding area (Clayden *et al.*, 1984; Nature Trust of New Brunswick Inc. (NTNB), 2011; NBDNR, 2012b).

A number of natural areas within the Province of New Brunswick have been either formally protected or inventoried as sites of potential significance, and are recommended for protection as Conservation Areas, Significant Natural Areas or Protected Natural Areas.

In March 2012, New Brunswick committed to doubling the amount of Protected Natural Areas on forested Crown land in the Province. Currently 3% of the Province is protected by the provincial or federal government as Protected Natural Areas (158,000 ha), provincial parks, federal parks, national wildlife areas and migratory bird sanctuaries. NBDNR plans to designate an additional 122,000 ha as Protected Natural Areas in an effort to conserve natural habitats to support regional floral and faunal species (NBDNR, 2012b).

Conservation Areas are federally or provincially managed areas which may include:

- protected natural areas;
- wildlife management/protection areas;
- national wildlife areas/migratory bird sanctuaries; and
- designated wetlands/Eastern Habitat Joint Venture (EHJVs) areas.

Categories under the heading Significant Natural Areas include:

- 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. A description of the above-noted areas is provided in the following sections.

5.10.1 Conservation Areas

There are two managed areas located within 5 km of the Project. The first is Redhead Marsh which is managed by Ducks Unlimited and is also designated as an ESA. Redhead Marsh is a significant saltwater marsh for bird habitat. The proposed water supply pipeline crosses the northern tip of the marsh along an existing road easement.

The second managed area is Carleton Martello Tower National Historic Site. This area is located approximately 4 km west of the Project and is managed by Parks Canada. This historic site dates from the War of 1812 and features a restored powder magazine and barracks room in the tower (Parks Canada, 2013). No portion of the Project will impact this site.

5.10.2 National Wildlife Areas/Migratory Bird Sanctuaries

These areas are reserved federally for the protection of wildlife and enhancement of habitat (*Canada Wildlife Act* and MBCA, respectively), and have legal restrictions on some activities.

There are no National Wildlife Areas or Migratory Bird Sanctuaries located within 5 km of the Project.

5.10.3 Environmentally Significant Areas (ESAs)

ESAs in New Brunswick 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 three ESAs located within 5 km of the Project. Just west of the McAllister Industrial Park is the Red Head Marsh and Hazen Creek Flats ESA and Ducks Unlimited Canada (DUC) saltmarsh. Red Head Marsh ESA is a 70 ha wetland that is currently restoring itself to brackish conditions since DUC removed a dam it had installed more than 20 years previously to control freshwater levels. It was removed in 2005 in order to restore the tidal flow and allow fish passage. The restoration of the saltwater tidal infusion has resulted in the return of both fish and bird diversity (DUC, 2006).

The wetland is considered to be highly productive and very important for a variety of the breeding birds. Shorebirds often use the tidal flats from mid-July to October. Species of concern in this area include the Least Bittern, Marsh Wren, Virginia Rail and the Black-Crowned Night-Heron. Current impacts to the wetland arise from industrial runoff, the outlet of the Hazen Creek Sewage Lagoon and residential growth. An independent reassessment of the ESA was conducted in November 2013 by local naturalist and ornithologist Jim Wilson reaffirming the importance of this wetland for birds and as being a unique feature. Ongoing industrial pollution is considered to have caused moderate deterioration in a relatively short period of time for a small portion of the wetland (Roy-MacDougall, V. pers. comm., 2014).

During that survey, bald eagles were observed as being active on site.

Courtney Bay ESA is located approximately 4.5 km northwest of the Project location. Courtney Bay is a tidal bay and sewage mud flat known for fall concentrations of shorebirds, especially Semi-palmated Plover. It is also used as a winter feeding area by various species of gulls and ducks (ACCDC, 2014). The Saint John Cambrian-Precambrian Border ESA is located approximately 4.5 km west of the Project location. This ESA includes the Carleton Martello Tower National Historic Site. This location is considered to be of geological importance as it is one of the few places in the world to observe the boundary between Precambrian and Cambrian rocks (ACCDC, 2014).

5.10.4 National and Provincial Parks

National and Provincial parks are designated and managed by Parks Canada and NBDNR, respectively. There are no such parks within 5 km of the Project Footprint.

5.11 Socio-economic Setting

The following sections describe the regional socio-economic setting in the City of Saint John. Developed in 1785, Saint John is considered to be Canada’s oldest incorporated city. It is situated at the mouth of the St. John River and the Saint John Harbour, centrally on the southern New Brunswick Coast on the Bay of Fundy. The City is known as the Atlantic Gateway, being a natural point of entry between the Maritime region and the northeastern United States. Saint John is recognized for both its historical value as well as its modern innovation. In 2010, the City was designated as a “Cultural Capital of Canada” by the Department of Canadian Heritage (Department of Canadian Heritage, 2010). In 2012 Saint John was named one of the world’s Top 7 Intelligent Communities by the Intelligent Community Forum, an international think-tank dedicated to examining global information and communications technology (ICT) (Enterprise Saint John, 2012). The following information regarding population and employment is based on that most recently reported by Statistics

Canada (StatsCan) from the 2011 Census (StatsCan, 2012) and 2006 Community Profiles (StatsCan, 2007).

5.11.1 Population and Labour Force

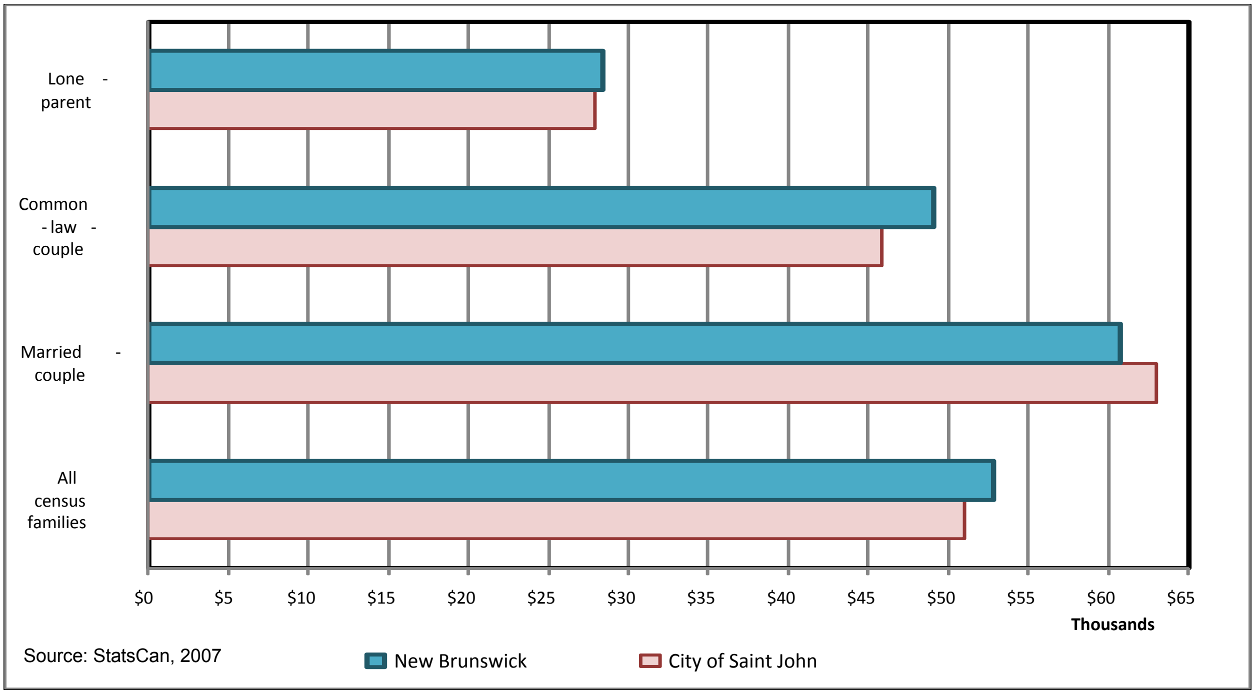
The City of Saint John is the largest city in New Brunswick, having a population of 70,063 in 2011 (StatsCan, 2012). The population of the City increased 3% from 2006 to 2011. With a total land area of 315.8 km^2, the population density of the City of Saint John was 221.8 people per km^2 in 2011, whereas the population density of New Brunswick was 10.5 people per km^2 (StatsCan, 2012).

In 2011, there were approximately 33,530 private dwellings in the City, slightly less than half of the total population. The number of private dwellings occupied by usual residents (i.e. permanent residents) in the City was 30,757 (91.7%), comparable to New Brunswick as a whole where approximately 90.1% of private dwellings were occupied by usual residents (StatsCan, 2012). Only 13% of Saint John's census respondents were bilingual, as compared to 33% in the Province.

According to the 2006 StatsCan Community Profiles, the aboriginal population in the City of Saint John represented approximately 1.3% of the total population, which is almost half the representation recorded in New Brunswick as a whole at 2.4%. Visible minorities in the City of Saint John represented 4.6% of the total population in 2006 and included 31.4% Black population and 28.6% Chinese population. In New Brunswick, approximately 1.9% of the population was comprised of visible minorities, of which 33.4% was Black population and 18.4% was Chinese population (StatsCan, 2007).

In 2006, approximately 74.4% of the population of the City aged 15 years and older had certificates, diplomas or degrees, compared to 70.6% for New Brunswick. In Saint John, 24.9% of male and 26.3% of female aged 15 years and older had no kind of certificate, diploma or degree, which is lower than the 30.8% and 28.1%, respectively observed in the Province as a whole.

The median 2005 incomes of various family types in the City and Province are illustrated in Figure 5.3. In 2005, the median family incomes were approximately $51,000 in the City, compared to a slightly higher $53,000 in the Province.



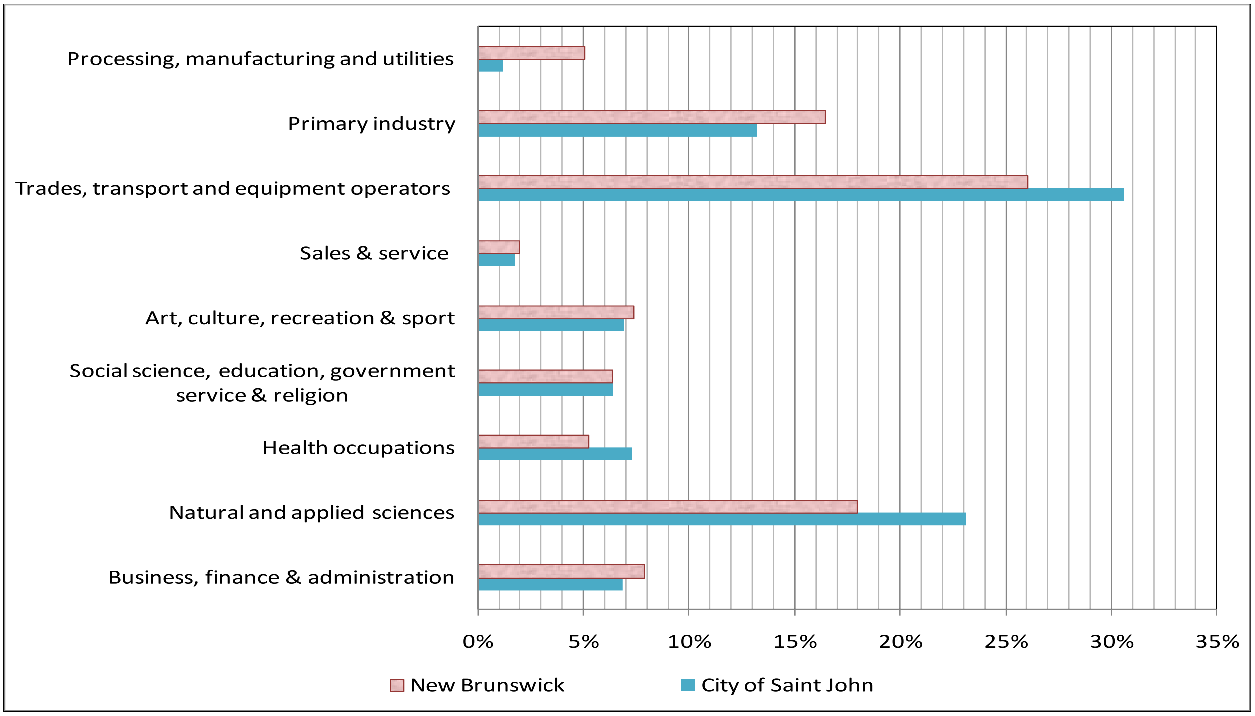
Source: StatsCan, 2007

Figure 5.3 Median Family Incomes in 2005 in the City of Saint John and New Brunswick

The median incomes of married-couple families were highest in both regions, Saint John and New Brunswick. Married-couple families in the City had the higher median income at $63,053, compared to a lower $60,726 in New Brunswick. Common-law-couple families earned incomes lower than married-couple families. The median family income of lone-parent families in the City in 2005 was approximately $27,944 which was just slightly lower than that of $28,416 in New Brunswick (StatsCan, 2007).

5.11.2 Local Economy

In 2006, the highest percentage of people in the City of Saint John and New Brunswick were employed in trades, transport and equipment operations (i.e. 31% and 26%, respectively). In the City of Saint John, the second and third highest proportions of population had occupations related to natural and applied sciences (23%) and primary industry (13%). Similarly, New Brunswick had a high proportion of people employed in natural and applied sciences (18%) and primary industry (16%). It is noticed in Figure 5.4 that Saint John had very small proportion of population (1%) working in occupations related to processing, manufacturing and utilities while it was 5% for New Brunswick (StatsCan, 2007).



Source: StatsCan, 2007

Figure 5.4 Labour Force Distributions by Occupation in the City of Saint John and New Brunswick

Labour associated with Saint John Port activities also provides a significant contribution to the local economy. From 2005 to 2010, an annual average of 294,000 man-hours was documented at the Port with total earnings averaging $9.9 million per year (Saint John Port Authority (SJPA), 2014).

5.11.3 Existing Land Use

5.11.3.1 Industrial

The Port of Saint John is the principal cargo port in New Brunswick. Total cargo tonnage through the Port of Saint John varies between approximately 27 to 30 Mt per year with the majority of this cargo made up of liquid bulk products. Dry bulk, such as potash, represents only approximately 3 to 5% of the Port's traffic in the last five years. Cargo vessels contribute $46 million in direct spending in the community. On average, each cargo vessel contributes an estimated $115,000 in spending within the local community (SJPA, 2014).

The fertilizer facilities will be initially exporting approximately 60,000 MTPA of potassium nitrate, through the Port. The Port will be capable of receiving Panamax-sized ships, which will have a working capacity of around 50,000 DWT (dead weight tonnage) (John McCann, pers. comm., 2013). This will provide a minor increase the dry bulk exports from the Port.

The majority of waterfront industry is located on the west side of the City. This includes the JD Irving, Limited Paper Mill, Moosehead Brewery, and Ocean Steel metal fabrication plant. The Irving Oil Limited bulk petroleum storage facilities and PotashCorp potash terminal are located in Courtenay Bay, west of the Project area. Other major industry in the Saint John area includes the Irving Oil Limited Refinery and the New Brunswick Power Courtenay Bay Generating Station.

Enterprise Saint John has recorded growth in many sectors, notably ICT; Energy and Advanced Manufacturing; Health Sciences and Tourism. Over $3 billion in Energy projects are underway and over $100 million in waterfront development initiatives. Major employers include Air Canada, Bell Aliant, Canada Revenue Agency, Horizon Health Network, Irving Oil Ltd, Moosehead Breweries, Saputo, Sitel and UNB (Enterprise Saint John, 2012).

The proposed Project Footprint is located within the McAllister Industrial Park, which was classified as one of Atlantic Canada's fastest growing manufacturing and commercial parks. In fact, in 2013 all available land in the Park sold out (SJIP, 2014). Currently the Park is broken down into the following land uses: Occupied (23%), Serviced Private (6%), Service SJIP (36%) and Green Space/Roads and Rail (35%).

5.11.3.2 Commercial

McAllister Industrial Park has been developed to accommodate a broad mix of industrial operations ranging from light to heavy. Current commercial tenants include Canada Bread Atlantic, Coca Cola, Humpty Dumpty and Praxair (SJIP, 2014).

The Port of Saint John is currently the second busiest cruise port in Atlantic Canada, hosting 166,616 passengers in 2013. The industry has grown from 1 ship call in 1989 to an estimated 64 calls in 2013. Previous years have seen as many as 76 calls. An economic analysis published in 2008 estimated that cruise ship passengers each spent an average of $56.75 while in Saint John (Business Research & Economic Advisors, 2008). With these figures, expected revenue generated equates to almost $9.5 million spent in 2013 by cruise passenger traffic.

5.11.3.3 Residential

The City of Saint John has a population density of 221.8 people per km^2. The Project is located within an existing industrial park and is not zoned for residences.

5.11.3.4 Cultural/Institutional

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

There are no places of worship in the area, but there are approximately 140 within the City of Saint John (Saint John Multicultural and Newcomers Resource Center, 2013).

There are no schools within the area. Children commute by bus to the regional schools under New Brunswick Anglophone South School District.

Saint John has a variety of post secondary schools which include the Saint John campuses of the University of New Brunswick (UNB) and the New Brunswick Community College (NBCC) as well as the Saint John College, Eastern Trades College and the Atlantica Centre for the Arts.

5.11.3.5 Recreational

The region is predominantly urban, and as such, there is an ample population base to support recreational facilities.

The Canada Games Aquatic Center is the largest aquatic facility in New Brunswick. This area of Saint John is also host to a sports arena/concert venue (Harbour Station), several municipal parks, and a newly constructed skateboard park.

The Red Head ESA located directly west has recently incorporated walking trails and is a favorite for bird watching. Other nature parks in and near the City include the Irving Nature Park, Rockwood Park and Fundy National Park (Saint John Multicultural and Newcomers Resource Centre, 2013).

5.11.3.6 Forestry

Most of the developed portion of McAllister Industrial Park has already been cleared, with predominantly spruce and other softwoods comprising the undeveloped areas (SJIP, 2014). Most of the Project Footprint is located in a developed section of the Park. The water pipeline will follow as much as possible existing roads.

5.11.4 Transportation and Transportation Infrastructure

The following transportation corridors are located within or near the Project:

5.11.4.1 Highway

Highway 1 is located approximately 4 km from McAllister Industrial Park. There is an interchange with the highway allowing for easy access on and off the highway (SJIP, 2014).

5.11.4.2 Rail

Canadian National Railways (CNR) currently operates a mainline through the McAllister Industrial Park. However there is no rail station in the Park (SJIP, 2014). A decommissioned rail line is located adjacent the proposed fertilizer facility.

5.11.4.3 Air

The nearest airport serving domestic and international commercial passenger and cargo flights is the Saint John Airport, located near Loch Lomond, which is approximately 17 km from the proposed Project.

5.11.4.4 Seaport

The proposed Project is within 10 km of the Port of Saint John, which is the largest seaport in the Province. The Port handles an average of 30 Mt of cargo annually using advanced terminal facilities (SJPA, 2014). Product from the proposed Project will be exported via the existing Forestry Terminal.

5.11.5 Utility Corridors

5.11.5.1 Electricity

There are no electrical generating facilities near the Project. Saint John Energy supplies the McAllister Industrial Park with single phase, standard three phase and combination phase power. An NB Power transmission corridor runs southeast adjacent to the Project Footprint (Figure 3.1).

5.11.5.2 Water/Sewer

Water and sewerage services are provided to the McAllister Industrial Park by the City of Saint John. Water is sourced from Loch Lomond Watershed and treated at the Latimer Lake Drinking Water Treatment Facility. Water is metered for consumption, and currently operating at approximately 50% capacity. Sewage is handled at the Lancaster Waste Water Treatment Plant, which is capable of removing 60-70% biochemical oxygen demand (SJIP, 2014).

5.11.5.3 Communications

Bell Aliant has fibre optic lines located within the region. Other communications companies, such as Rogers, also have lines and communication towers.

5.11.5.4 Natural Gas

Enbridge Gas New Brunswick supplies natural gas to the McAllister Industrial Park. The supply is sufficient for large consumers at 1440 pounds per square inch (PSI) (SJIP, 2014). Emera operates the Brunswick pipeline which flows from the coast in a northwest direction. The Brunswick pipeline is located approximately 1 km east of the Project Footprint.

5.11.5.5 Oil

An Irving Oil pipeline easement runs southeast near the Project Footprint (Figure 3.1 and Figure 3.2). Two pipelines, 16” and 20”, transport crude oil at a rate of approximately 300,000 barrels daily to the Irving Oil Refinery, located 5 km south of the Project (S. Arsenault, pers. comm.). The pipelines are located 5 m below ground. The design of the Project has taken the easement under consideration and will not disturb access or operation.

5.11.6 Emergency Services

The following sections provide descriptions of community/emergency services, including medical, fire protection, and police protection services.

5.11.6.1 Medical Services

The Atlantic Health Sciences Corporation administers the overall health services for Region 2 of the New Brunswick Department of Health where the Project is located. The Saint John Regional Hospital is a 524-bed facility providing emergency care in addition to 23 areas of specialty medicine and surgery 24 hrs/day. There are four other community-based hospitals in the Saint John region, as well as a veterans unit, managed by the Horizon Health Network (Horizon Health Network, 2013).

5.11.6.2 Fire Protection Services

Emergency services for the region are provided through the 911 Public Safety Communication Service. The City of Saint John provides fire protection and Hazardous Materials (HazMat) response for the region (Enterprise Saint John, 2012).

5.11.6.3 Police Protection Services

Police Protection is provided by the Saint John Police Force, which is the largest municipal force in New Brunswick. Emergency services are 911 activated (Enterprise Saint John, 2012).

5.12 Heritage and Archaeological Resources

A Heritage Resource Impact Assessment (HRIA) was conducted in anticipation of an EIA submission. In 2012 the provincial regulator, Archaeological Services New Brunswick (ASNB) changed the name of this type of investigation from HRIA to Archaeological Impact Assessment (AIA). However, as these investigations were initiated in 2011, the use of “HRIA” is appropriate for this report.

An HRIA is conducted to define the existing heritage and archaeological resources within the area. The objectives of an HRIA are to identify, inventory, and evaluate all sites of archaeological, historical, and architectural significance within the surrounding area and to assess the potential effect of the Project on these heritage resources. The objectives of an HRIA are accomplished via a four-phase process:

- Phase 1: Background desktop review (documentary research, regulator consultation);
- Phase 2: Field examination (visual surface survey, informational interviews);
- Phase 3: Field evaluation testing (archaeological survey); and
- Phase 4: Significance determination, impact assessment, mitigation, and contingency plan.

In 2011, AMEC procured an Archaeological Field Research Permit (AFRP) from ASNB to conduct the preliminary heritage resources investigations for this proposed development (AFRP 2011NB97). The investigations included a background desktop review and a surficial visual survey of the proposed development area.

The preliminary archaeological investigations for the Project, Phases 1 and 2, were conducted in the fall of 2011 under AFRP 2011NB97 (AMEC 2012). Geological research, in combination with the results of the visual survey, indicates that there is potential for late Palaeoindian and/or early Maritime Archaic archaeological resources in this area (10,000 to 7,500 years before present (YBP)). Therefore, additional field investigations, in the form of subsurface testing in elevated potential areas (EPAs), were conducted for this Project to minimize the potential of uncovering subsurface archaeological resources during the construction of the Project. This field evaluation phase of the archaeological investigations was conducted in May of 2013 under AFRP 2013NB4.

In addition to the subsurface field evaluation activities, in the fall of 2013 a proposed water supply pipeline from the EWWTF was added to the Project Description. Therefore, preliminary archaeological and heritage investigations were conducted for the proposed pipeline route and pump station location as well under AFRP 2013NB4.

5.12.1 Phase 1: Background Desktop Review

An initial pre-fieldwork review of topographic mapping, aerial photographs, and the ASNB GIS mapping of the Project Study Area indicated that there are locations within the area that may have elevated potential for both Native and Historic heritage resources. The specific areas with the highest potential are in the vicinity Hazen Creek, the potentially historic trails and railway line, the southwest side of the EWWTF, and any relatively elevated ridges that could hold potential for a Palaeo-shoreline. Much of the 2011 desktop research conducted for the general Project Study Area was determined to be applicable to the water supply pipeline impact area as well.

5.12.1.1 Potential for Palaeoindian Native Resources

A review of the Quaternary Period geology for the Project Study Area was conducted to assess the potential for Native, in particular Palaeoindian (9,000 to 11,000 YBP), activities and/or settlement in the area. Using a stratographic framework for the Wisconsinan glaciation in New Brunswick (Seaman et al. 2011), the Study Area was likely free from glacial ice during the Shullie Lake Phase of the Older Dryas Stadial (13,800 YBP). Approximately 1,000 years later, while the major part of the Wisconsinan ice cap had melted away, a climatic cold interval occurred which reactivated remnant glaciers during what has been called the Collins Pond Phase (Younger Dryas) around 12,900 YBP (Ibid.). The melting of the ice both prior to and after the Younger Dryas would have caused a change in water levels and created water pathways on the land. The Hazen Creek area may represent one of these water pathways, where the melting of the ice cap created a southwestern flow of water towards the Hazen Delta from Loch Lomond during the Younger Dryas (Seaman, pers. comm., 2011). Prehistoric water levels have not yet been well defined for the Fundy Bay area, particularly for the periods during and immediately following the Younger Dryas. Marine and fluvial waters levels are not known for that time; therefore, potential cultural occupation locations are difficult to identify. A terrace next to a depression or ravine (a possible post-glacial waterway) may have been at one time a location that would have attracted past populations to occupy.

New Brunswick’s first reported *in situ* Palaeoindian archaeological site (BgDq-38) was recently identified by the province’s southern shoreline in Pennfield (AMEC, 2011; Stantec, 2011; Dignam and Blair, 2011; and Dignam et al., 2012). The identification of this *in situ* site, in conjunction with two other Palaeoindian artifact spot finds (without provenience) along the New Brunswick southern shoreline (Quaco Head and New Horton Creek) begin to indicate a Palaeoindian presence in this part of the province. Since the Project area shares a number of geological and geographical attributes with the Pennfield site (BgDq-38), there is potential for Palaeoindian archaeological resources in this area. Sub-surface field evaluation testing could identify cultural materials associated with these geological features.

5.12.1.2 Potential for Post-Palaeoindian Native Resources

The Project Study Area is located by Saint John Harbour, by the mouth of the Saint John River. The largest watershed that flows into the Atlantic Ocean between the St. Lawrence and the Susquehanna, the Saint John River was utilized extensively as an avenue of travel and a source of subsistence in prehistoric times (Blair, 2004). The river, its tributaries, and the adjacent lands were the traditional territory of the Wolastoqiyik (Maliseet) people (Ibid). The Project Development Area (PDA) is situated at an ecological “crossroads” between the rich waters of the Bay of Fundy and Saint John River.

To-date, no prehistoric archaeological sites have been identified in the PDA. A review of the registered archaeological sites for the vicinity of the PDA revealed that within a radius of approximately five km there are only two registered sites with Native cultural components (BhDm-9 and BhDm-7). Both of these reported sites are located at the mouth of the Saint John River. The Native components of site BhDm-7 have been interpreted to include a small Maritime Archaic cemetery (ca. 9,000 – 4,000 YBP), subsequent Transitional Archaic (ca. 4,000 – 3,000 YBP) and Maritime Woodland activity (ca. 3,000 – 500 YBP), and a post-contact Native cemetery (Jeandron et al. 2000, Harper 1956). This indicates a long-term presence of Native peoples in the vicinity of present-day Saint John. Site BhDm-7 also includes Historical components, which included a 17th century French fort (Fort La Tour), and an 18th century American trading post (Ibid.).

5.12.1.3 Potential for Historic Heritage Resources

In 1631 Charles de Saint-Étienne, Sieur de la Tour, built a fortification atop Portland Point (Site BhDm-7). In 1635 the French Crown granted the mouth of the Saint John, including the Project area, as a Seigniory to la Tour (Ganong, 1899). After the expulsion of the Acadians in 1755, William Hazen, James White, and James Simonds relocated from the Boston-Newburyport area and established a trading post on the east side of the Saint John (Fort La Tour Development Authority et al., 1992). Two foundation features from the trading post were uncovered during archaeological investigations in the 1950s along with historic ceramic, metal, and lithic artifacts (Harper, 1956). In the 1760s, permanent English settlement began in the area with an influx of settlers from New England. After the end of the American Revolutionary War, thousands of United Empire Loyalists (Loyalists) flooded into New Brunswick (New Brunswick Historical Society, 1984), establishing themselves on the east side of the harbour (Parr Town) and on the west side (Carleton) (Hamilton 1996). In 1785 this city was renamed Saint John.

In addition to the French and English historic components associated with Site BhDm-7 (Fort La Tour), there are eight other historic sites registered within a five km radius of the Project area (BhDm-8, 13, 14, 21, 27, 28, 29 and BhDl-1). None of these sites are located within the PDA. An extensive review of historic mapping (Champlain, 1612; LaLanne, 1684; Anonymous, 1686; “Anonyme”, 1702; McCarthy, 1751; Holland, 1758; Anonymous, 1791; Sproule, 1813; and Roe and Colby, 1875) and historic aerial photographs (1945, 1953, 1962, and 1984) for the Saint John area did not indicate visual evidence of historic habitation in the immediate vicinity of the PDA.

A review of selected historical aerial photographs of the proposed pipeline route (1940s-1980s) indicates that the existing sewer line, which the pipeline will follow, was constructed in the 1960s-1970s. This line connects McAllister Industrial Park with the present-day EWWTF[1] and its construction is associated with the construction of the industrial park which opened in 1974 (Saint John Industrial Parks, 2013).

The proposed location for the pump house is within the property boundaries for the EWWTF (PID 00337956). The ASNB GIS mapping for this location does not indicate any elevated potential for archaeological resources in this area. Presently, the only structures located on this property are associated within the recently constructed EWWTF compound (City of Saint John, 2011). While this area (Midwood area by McNamara Point) was granted in the late 1700s, it was part of a large 2000 acre tract of land. The area in the vicinity of the EWWTF does not appear to have been settled until much later. A review of historic mapping and aerial photographs indicate that this specific property was used in the historic past for farming. This is evident in the 1945 and 1953 aerial photographs (#8369-74 and #3028-009 respectively), by the presence of cleared fields and building structures. As indicated in Figure 5.5, the locations of the buildings evident in the 1945 aerial photograph are within the Footprint of the already constructed EWWTF. These structures are interpreted as a residential structure (house) and a barn/outbuilding. The Footprint for the proposed pump house is west of where these structures were located in 1945 (approximately 50 m from the barn/outbuilding and 120 m from the house). However, the proposed routing for the water supply pipeline runs between the mapped locations of these two historic structures. These structures were demolished in the 1960s-70s, prior to the construction of the Hazen Creek Wastewater Treatment facility in 1979 (Leonard, 2005).

An HRIA was not carried out prior to the construction of Hazen Creek Wastewater Treatment facility in 1979 (Ibid.). However, in 2005 archaeological investigations were conducted for the expansion of the facility Footprint (the construction of the EWWTF) because the area was identified “as having high potential for pre-European aboriginal archaeological deposits” (Leonard, 2005). The 2005 field survey program included a sweep of the testing areas with a metal detector, which produced negative results (Leonard, 2005). These field investigations also included subsurface field evaluation testing, for the proposed facility Footprint expansion, at the southwest and northeast ends of the then existing Hazen Creek Wastewater Treatment facility Footprint. As a result of the 2005 testing program, only one historic artifact was collected from a test-pit in the southwest testing area; a clay tobacco pipe stem fragment. This artifact, interpreted as likely 19th century (Ibid.), was recovered from the area where the 1945 aerial photograph indicates the presence of a residential building. No further artifacts or features were identified during these investigations (Ibid.). The 2005 HRIA for the expansion of the facility Footprint concluded that the “absence of significant finds in the test pits suggests that no unique archaeological resources will be jeopardized by the proposed Hazen Creek Waste Water Treatment Plant expansion” (Leonard, 2005).

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[1] Between 2009 and 2011 the EWWTF was constructed on the site of the previously operating Hazen Creek Wastewater Treatment Plant, which was demolished and removed (City of Saint John, 2011).

Path: G:\GIS\PROJECTS\TE111019 Potash Industrial Plants\MXD\20141217_TE111019_WaterSupplyRouteSurvey_Fig5_5_R1.mxd User: tanya.morehouse Date: 18/12/2014 SOURCE: ESRI Basemap - Aerial Imagery/ SNB - Topographic Data

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

LEGEND:

- ● Watercourse Crossing
- Proposed Water Supply Pipeline
- Watercourse (Field Verified)
- Provincially Significant Wetland (30 metre Buffer)
- NBDNR Watercourse
- Refined Test Areas
- 🟩 Approximate Locations of 1945 Identified Structures
- 🟥 Project Footprint
- Provincially Significant Wetland
- NBDNR Watercourse (30 metre Buffer)
- ☐ SNB Property Boundary Saint John County

N

100 50 0 100 200 300

Meters

The map shown here has been created with all due and reasonable care and is strictly for use with AMEC Project Number: TE111019 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:

ATLANTIC POTASH CORPORATION

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:

APC McALLISTER INDUSTRIAL PARK FERTILIZER PRODUCTION FACILITY

TITLE:

HRIA REFINED TESTING AREAS AND WATER SUPPLY PIPELINE SURVEY ROUTE

DATUM: NAD 83 CSRS	DWN BY: TM	DATE: Dec 17, 2014
PROJECTION: New Brunswick Stereographic	CHK'D BY: CL/JB	SCALE: 1:8,000
PROJECT NO: TE111019	REV NO: 1	FIGURE NO: 5.5

5.12.2 Phase 2: Field Examination

5.12.2.1 Informational Interviews

Consultations were conducted with representatives of the provincial government specializing in archaeology and heritage resources. In addition, limited contacts were made with representatives of organizations who may have historical or archaeological information to contribute to the Project investigations. A representative of the Oromocto First Nation, Chief Roger Atwin, was also contacted concerning the Project (R. Atwin, pers. comm.). The information gleaned from the informational interviews indicated that there appears to be potential within the PDA for a Palaeo-shoreline geological feature, which in turn may have potential for Late Palaeoindian or Early Maritime Archaic archaeological resources (10,000 to 7,500 YBP).

5.12.2.2 Visual Survey

Due to the results of the background research for the Project area, the items of particular interest for the surficial visual survey were geological features (potential for Palaeo-shorelines), watercourses (mapped and unmapped), and cultural features (potential heritage resources). The thorough surficial visual survey of the area provided additional geological and geographical data to inform next steps and determine the requirement of a Phase 3 Field Evaluation Testing program. The geological information supported the thesis that there is potential for early Native land use in this area. In addition, mapped and unmapped watercourses were field-identified for possible Phase 3 investigations. While 14 cultural features were observed during the visual survey, all of them have been assessed as late 20th century features and as such have not been classified as heritage or archaeological resources.

As indicated in Figure 5.5, several areas in close proximity to Hazen Creek were assessed as having elevated potential for Late Palaeoindian or Early Maritime Archaic archaeological resources and were designated “Recommended Testing Areas”. In addition, a section along the west edge of the Study Area was also recommended for subsurface testing. The rationale for these recommendations was due to the field assessed physical attributes of these locations, in combination with the review of the geological record for this area. Also, while considered to have relatively low potential for heritage resources, limited subsurface testing was recommended for a portion of a minor watercourse at the southern extreme of the Study Area (Area 4 on Figure 5.5). While this is a small watercourse, it is felt that this area could potentially represent a portion of an historic or prehistoric travel route. Therefore, as a result of the preliminary studies conducted in 2011, Phase 3 Field Evaluation Testing investigations were recommended for the Project.

The visual survey of the pipeline linear corridor confirmed that the proposed routing between the EWWTF and the industrial park is alongside an existing sewer line within a road/trail constructed from imported fill materials. It is presently proposed that the water supply line will be constructed within the same impacted right-of-way that the sewer line is in. As illustrated in Figure 5.5, in addition to crossing WC2 this alignment crosses an additional three mapped and six unmapped minor watercourses. However, these crossings are not considered to negatively impact potential archaeological resources since the proposed water supply line between the industrial park and the EWTF will be constructed completely within fill materials and areas previously impacted by the construction of the sewer line/road. Therefore, no areas of elevated potential for archaeological resources were identified within the proposed impact right-of-way for the water supply pipeline between the EWTF and McAllister Industrial Park.

The proposed placement for the pump house (Figure 5.5) is located west of the Footprints of the historical structures, within an area that appears to have been mechanically leveled possibly for the construction of the access road. While this area is located outside any ASNB GIS mapped EPAs and appears to have been negatively impacted by previous construction activities, there remains a limited potential for undiscovered subsurface prehistoric and historic archaeological resources.

5.12.3 Phase 3: Field Evaluation Testing

As a result of the preliminary Phase 1 and 2 investigations conducted in 2011 for the Project, Phase 3 Field Evaluation Testing was recommended in order to protect potential subsurface archaeological resources within the Project area and to comply with regulatory requirements. The specific Phase 3 recommendations made following the 2011 field season (AMEC 2012) were approved by ASNB. These recommendations thereby became the methodology for the Phase 3 investigations conducted in 2013 under AFRP 2013NB4.

Systematic subsurface testing was conducted at the areas assessed to have elevated potential for Palaeoindian-Archaic archaeological resources (ridges and terraces) (Figure 5.5). These areas were tested using standard New Brunswick shovel testing techniques (50 x 50 cm test-pits) placed at 10 m intervals. In addition, a number of strategic test-pits (STPs) were also excavated for locations within the testing areas that lay outside of the testing grid, but were assessed to have potential for archaeological resources. Strategic subsurface testing was also conducted in the vicinity of field identified minor watercourse, at the south end of the Study Area. This area was tested using standard shovel testing techniques (50 x 50 cm test-pits) at strategic locations

Four general testing areas were identified during the Phase 2 visual survey of the Study Area and were refined in the field during the flagging for specific test-pit locations:

- Area 1: east side of the elevated railway line bed, 26 test-pits;
- Area 2: west of the railway line and east of Whitebone Way, 100 test-pits;
- Area 3: west of Whitebone Way and east of Hazen Flats trail, 75 test-pits; and
- Area 4: minor watercourse; 4 STPs.

As indicated in Figure 5.5, Area 1 was divided into “East” and “West” sections, Area 2 into “North” and “South” sections, and Area 3 into sections 3.1, 3.2, 3.3, 3.4, 3.5, and 3.6. The reasoning behind subdividing these areas was due to topographical features (watercourses, sloped ridges, and elevation changes) that provided natural divisions.

A total of 205 test-pits were excavated among the four areas. No test-pits contained any prehistoric or Native artifacts or archaeological features. In fact, there was only one test-pit that contained any artifacts (Test-pit A-5 in Area 2D), which were 20th century refuse (artifacts) identified within construction fill materials. These artifacts are relatively recent (20th century) and are of no archaeological significance. While numerous test-pits contained flecks of charcoal (indicators of possible cultural activity), no artifacts or soil features were associated with them. Therefore, these charcoal flecks were not considered to be of any archaeological significance. Thus, as a result of both the 2011 and 2013 HRIA investigations for the Project, no heritage or archaeological resources were identified within the area.

6.0 VALUED ENVIRONMENTAL AND SOCIO-ECONOMIC COMPONENTS (VECS)

Accepted practice for the EIA process in Canada recommends that an EIA be focused on directly relevant issues and concerns of potentially affected parties (the Agency, 1994). This section describes the process used to identify VECs, which are components of the environment valued by society and upon which an assessment is focused. The selection of VECs for this EIA will involve issues scoping and pathway analysis.

6.1 Issues Scoping

The first step in the selection of VECs involves issues scoping to identify ECCs, and is based on:

- concerns expressed by various stakeholders, including the public, scientific community, and government departments and agencies;
- review of applicable statutes and regulations;
- consideration of available literature and reference materials; and
- previous assessment experience, including proposed developments near the Project.

ECCs identified during the preliminary scoping exercise for the Project Description has been summarized in an issues analysis list (Table 6.1).

6.2 Pathway Analysis

The second step in the selection of VECs involves examination of the issues and concerns identified through issues scoping to assess the pathways (or linkages) by which Project activities may affect each ECC. For this EIA, pathways were considered for facility construction, operation, decommissioning/abandonment activities, and third party damages and accidents. The possible pathways that provide linkages between the proposed Project and the environment (both biophysical and socio-economic) are summarized in Table 6.1.

There was no pathway of concern identified for a number of the ECCs, such as Climatology; Physiography and Geology or Mineral, Oil or Gas Resources. Therefore, these ECCs have not been considered further in the preliminary assessment (refer to Section 7.0). This process will focus the preliminary assessment on those VECs where significant adverse or beneficial effects may potentially arise as a result of the Project.

Table 6.1 summarizes the rationale for exclusion/inclusion of ECCs as VECs. Where a clear linkage or pathway between ECCs and Project activities can be identified, and potential effects may be a concern, these components become the VECs on which the assessment focuses.

Table 6.1 Issues Scoping/Pathway Analysis Summary Matrix - Valued Environmental Components (VECs): Proposed Construction and Operation of APC Facilities

	Environmental Components of Concern (Biophysical and Socio-Economic)	***Pathway of Concern***		***Possible Pathway***	***VEC***		***Project Phase***			***Rationale for Inclusion/Exclusion as Valued Environmental Component (VEC)***
		Yes	***No***		***Yes***	***No***	***Construction***	***Operation***	***Decommissioning***	
Environmental Resources	Air Quality and Climate Change	X		• Overburden disturbance. • Equipment operation. • Accidental release of hazardous materials. • Operation emissions.	X		X	X	X	Included as a VEC – Potential effect on air quality. Protected by statute/regulation.
	Acoustic Environment	X		• Equipment operation.	X		X		X	Included as a VEC – Protected by statute/regulation.
Terrestrial Environment	Physiography and Geology		X	• No possible pathway identified.		X				Excluded as a VEC – No pathway of concern identified.
	Hydrology and Hydrogeology	X		• Excavation near existing watercourse. • Site run-off. • Accidental release of hazardous materials.	X		X	X	X	Included as a VEC – Potential effect on water quality.
	Wetland Resources	X		• Excavation near existing wetland resources. • Accidental release of hazardous materials.	X		X	X	X	Included as a VEC – Potential alteration and displacement of habitat, soil erosion, effects on water quality, physical disturbance of wildlife, and introduction of invasive species.
	Mineral, Energy and Aggregate Resources		X	• Avoided during site selection.		X				Excluded as a VEC – No pathway of concern identified.
Biological Environment	Wildlife	X		• Clearing, grubbing, and excavation activities. • Accidental release of hazardous materials.	X		X	X	X	Included as a VEC – Protected by statute/regulation.
	Migratory Birds	X		• Clearing, grubbing, and excavation activities. • Accidental release of hazardous materials.	X		X	X	X	Included as a VEC – Protected by statute/regulation.
	Fish, Fish Habitat, and Fishery Resources	X		• Construction activities in or adjacent to watercourses. • Accidental release of hazardous materials/contaminant migration.	X		X	X	X	Included as a VEC – Protected by statute/regulation.
	Species at Risk	X		• Clearing, grubbing, and excavation activities. • Accidental release of hazardous materials.	X		X	X	X	Included as a VEC – Protected by statute/regulation.
	Designated Areas and Other Critical Habitat Features	X		• Construction activities. • Accidental release of hazardous materials.		X				Excluded as a VEC – No pathway of concern identified.
Socio-Economic Setting	Local Economy	X		• Expenditures and Employment.	X		X	X	X	Included as a VEC – Potential benefits to local economy.
	Existing Land Use:									
	• Industrial		X	• No interaction.		X		X		Excluded as a VEC – No pathway of concern identified.
	• Commercial		X	• No interaction.		X				
	• Residential		X	• No interaction.		X				
	• Cultural/Institutional		X	• No interaction.		X				
	• Recreational		X	• No interaction.		X				
	• Forestry		X	• No interaction.		X				
	• Road Transportation		X	• Project area is zoned as an industrial park		X				
	• Utility Corridors	X		• Excavation activities adjacent to natural gas pipeline and construction near overhead NB Power Transmission Corridor.	X		X		X	Included as a VEC – Potential to damage pipeline or power corridor.
	Community and Emergency Services	X		• Construction/ decommissioning activities. • Accidental event during operation.	X		X	X	X	Included as a VEC – Potential impact to emergency services.
	Heritage and Archaeological Resources	X		• Excavation activities.	X		X			Included as a VEC – Potential impact to heritage and archaeological resources.

6.3 Determination of Significance

The VECs are identified by issues scoping and pathway analysis for which potential effects may be a concern and are identified in Table 6.1. Those identified require further assessment to determine the significance of potential effects. The following sections provide a definition of a significant adverse effect for each of the VECs listed in Table 6.1. Each definition was established in the context of a "bounded area" (e.g. spatial boundaries) within which Project activities could potentially interact with each VEC. Therefore, a description of the spatial boundaries as well as the temporal boundaries for each VEC is also provided.

The definitions of "significant" have been based on scientific determinations, social values, public concerns, and economic judgments. In assessing the significance of potential effects resulting from a proposed Project, the Canadian Environmental Assessment Agency (the Agency, 1994) recommends consideration of the following criteria:

- magnitude;
- geographic extent;
- duration and frequency;
- reversibility; and
- ecological (and/or socio-economic) context.

These criteria were used to establish a definition of a significant adverse effect for each VEC.

6.4 Boundary Definitions

6.4.1 Temporal Boundaries

Temporal boundaries define the duration over which Project activities and phases interface with each VEC. The Project is broken down into three phases, and it is anticipated that Phase III will become operational in 2020. Consequently the Project construction timeline is expected to be approximately 5 years. The nominal design life for similar projects is approximately 25 years. For the purposes of this EIA, we have assumed an operating life of 25 years. Closure, decommissioning, and post-decommissioning would follow the operating phase. The timing of this Project phase is uncertain. APC will undertake decommissioning and reclamation for the Project as per the legislation and guidelines of the time. Table 6.2 illustrates the temporal boundaries applicable to each of the identified VECs.

6.4.2 Spatial Boundaries

The general Study bounds of the EIA have been defined as comprising:

- the Project Footprint (Figure 3.1) situated in McAllister Industrial Park in Saint John, New Brunswick;
- the lands adjacent to the Project Footprint; the extent of these lands is VEC-specific and dependent on functional ecological considerations as well the predicted Zone of Influence of the Project; adjacent lands therefore can be defined by such areas as a watershed, and the predicted geographic extent of air and noise emissions;

- City of Saint John;
- the Region encompassing the counties of Saint John and Kings; and
- the Province of New Brunswick.

Spatial boundaries establish the limits within which the Project interacts with the surrounding environment. The Zone of Influence reflects an area beyond the Project Footprint and incorporates aspects such as airborne plumes which can act to expand the physical area over which Project features interact with the receiving environment. The spatial boundaries can also vary in accordance with each VEC. Table 6.2 shows the spatial boundaries principally applied in the effects assessment for each of the VECs.

Table 6.2 Temporal and Spatial Boundaries Applied by VECs

Environmental Category	VEC	Temporal Boundary			Spatial Boundary					Comment
		Construction	Operation	Decommissioning	Project Footprint	Adjacent lands	City of Saint John	Region	New Brunswick	
Biophysical Environment	Air Quality and Climate Change	✓	✓	✓	✓	✓	✓	✓	✓	A significant adverse effect is defined as an exceedance of regulatory guidelines for greater than one week. With respect to the spatial boundary for the Province, a significant adverse effect is only addressed in context of Project contributions to GHG emissions.
	Acoustic Environment	✓	✓	✓	✓	✓	✓			A significant adverse effect is defined as non-compliance with City of Saint John noise bylaw for a period of greater than 12 hours.
	Surface Water	✓	✓	✓	✓	✓				A significant adverse effect is defined as an effect resulting in a reduction in the water quality relative to regulatory guidelines for aquatic life.
	Groundwater	✓	✓	✓	✓	✓				A significant adverse effect is defined as an effect resulting in a non-compliance of groundwater quality with regulatory guidelines for current use.
	Wetland	✓	✓	✓	✓	✓				A significant adverse effect is defined as any effect resulting in a net loss of wetland function.
	Wildlife	✓	✓	✓	✓	✓				A significant adverse effect is defined as any effect resulting in a net loss of wildlife habitat function.
	Migratory Birds	✓	✓	✓	✓	✓				A significant adverse effect is defined as any effect resulting in a net loss of migratory bird habitat function.
	Fish, Fish Habitat and Fishery Resources	✓	✓	✓	✓	✓				A significant adverse effect is defined as any effect resulting in a net loss of fish habitat function and/or any effect resulting in a sustained suppression of fitness to maintain the population, or a decrease in density of the population below naturally occurring levels.
	Species at Risk	✓	✓	✓	✓	✓				A significant adverse effect is defined as any effect resulting in a sustained suppression of fitness to maintain the population, or a decrease in density of the population below naturally occurring levels. For species designated as Endangered (or considered significant for other reasons), the loss of these species at an individual level may be considered a significant adverse effect.

Environmental Category	VEC	Temporal Boundary			Spatial Boundary					Comment
		Construction	Operation	Decommissioning	Project Footprint	Adjacent lands	City of Saint John	Region	New Brunswick	
	Designated Areas	✓	✓	✓	✓	✓				The Designated Area identified is the Redhead Marsh ESA. This ESA is a wetland; therefore, a significant adverse effect is defined as any effect resulting in a net loss of wetland function.
Socio-Economic and Cultural	Local Economy	✓	✓	✓	✓	✓	✓	✓		A significant effect of the facility construction and operation expenditures and employment is defined as an effect resulting in an increase in economic benefits.
	Utility Corridors	✓	✓	✓	✓	✓				A significant adverse effect on underground infrastructure is defined as an effect resulting in any sustained reduction in underground infrastructure function, or resulting in increased difficulty in accessing/repairing underground infrastructure.
	Community and Emergency Services	✓	✓	✓	✓	✓	✓			A significant adverse effect is defined as any demand increase greater than 10% over existing volumes for emergency services due to construction accidents or third-party damages.
	Heritage and Archaeological Resources	✓			✓					A significant adverse effect is defined as any disturbance of a heritage resource that compromises the integrity of that resource. Adverse impacts occur under conditions that include: • destruction or alteration of all or part of a heritage resource; • isolation of a site from its natural setting; or • introduction of physical, chemical, visual, audible, or atmospheric elements that are out-of-character with the heritage resource and its setting (ASNB, 2012).

7.0 ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACT EFFECTS ASSESSMENT

This section consists of an assessment of potential environmental effects (including cumulative effects) resulting from the Project, identification of mitigation measures intended to reduce potential effects, and provides a discussion of potential residual effects resulting from the proposed Project.

7.1 Approach

During the scoping phase of the Study, a preliminary issues list containing ECCs was developed, from which VECs were selected. The approach to assessment of potential effects involved an initial evaluation to determine the likelihood of an interaction between ECCs and Project activities. Where linkages between ECCs and Project activities existed, and potential effects were of concern, these components were selected as the VECs (Table 7.1), on which the EIA focuses. Where a linkage between proposed Project activities and VECs was absent or was deemed unlikely to result in an effect, no further analysis was required.

Table 7.1 Valued Environmental and Socio-Economic Components (VECs) List – Proposed Project

Valued Environmental Components
• Air Quality and Climate Change
• Acoustic Environment
• Surface Water
• Groundwater Resources
• Wetland Resources
• Wildlife
• Migratory Birds
• Fish, Fish Habitat, and Fishery Resources
• Species at Risk
• Designated Areas
Valued Socio-Economic Components
• Local Economy
• Utility Corridors
• Community and Emergency Services
• Heritage and Archaeological Resources

The EIA has considered potential effects at the population level. For example, potential effects on wildlife resulting from the proposed Project were assessed in the context of potential effects on the entire population, rather than on individual animals. For endangered species, where potential effects on individuals could result in population level consequences, potential effects on individuals are classified as a concern.

7.2 Environmental Effects Assessment

7.2.1 Air Quality and Climate Change (GHG)

Air quality and climate change was identified as a VEC based on the effects construction, operation and decommissioning may have on the surrounding environment and population. Potential effects include:

- reduction in localized air quality to below regulated thresholds; and
- release of additional GHG into the environment exacerbating existing local levels.

7.2.1.1 Effects of Construction

The use of equipment to construct the site will result in temporary, short-term emissions of air pollutants that will be restricted to the construction period for the Project, and will terminate once construction has been completed.

Construction activities can generally be categorized into site preparation, fertilizer plant construction, and water supply pipeline construction. During construction, activities associated with the fertilizer plant will include the use of internal combustion engines in various cranes, backhoes, dozers, loaders, pavers, trucks, welders, generators, air compressors, pumps, pile drivers, miscellaneous heavy construction equipment, and worker commuting vehicles will result in air emissions of NO_X, SO_2, CO, PM_{10}, $PM_{2.5}$, and VOCs.

The primary air quality concern during construction is the effect of PM, mainly fugitive dust on the surrounding environment. Dust generated from these open sources is termed as “fugitive” because it is not discharged to the atmosphere in a confined flow stream. Particulate emissions during construction are associated with grubbing, excavation, backfilling, and material transport activities. It is estimated that 14% of PM emissions in Canada result from construction activity (EC, 2009).

The potential effect of particulates is influenced by site and weather conditions (rain and wind direction) and by preventative measures implemented during Project activities to minimize emissions. Emissions of particulates that exceed air quality guidelines may result in problems on the construction site and under special circumstances (such as strong winds), off-site. The level of particulates at construction sites depends on the silt content of the soils being disturbed, the proportion of dry days, operator habits, construction vehicle type and speeds, vehicle weights, and the number of vehicles.

Fugitive dust contains both large and fine particulate matter. Generally, large particles settle out near the source, while the fine particles are dispersed over much greater distances from the source. Particles larger than 100 micro metres (μm) are likely to settle out within 6 to 10 m from the edge of the road or other point emission. PM_{10} and $PM_{2.5}$, however, have much slower gravitational settling velocities and are likely to have their settling rate retarded by atmospheric turbulence and travel further (EC, 2009).

APC will use mitigation measures to minimize the fugitive dust emissions associated with construction of the Project. These measures may include the application of water or dust suppressants, covering of haul trucks, use of paved roads to the extent possible, limiting vehicle speed, and stabilizing disturbed areas.

It is expected that construction activities may last as long as 5 years to complete construction of all three phases of the Project.

As the site is fairly isolated from residents and schools of the area, the impact to the public are expected to be insignificant, approaching background concentrations at off-site locations. Air emissions will likely not result in significant adverse impacts to the air quality within the vicinity of the Project site and adjacent lands.

7.2.1.2 Effects of Operation

In general, emissions from the operation of the potassium nitrate and ammonium chloride plant will be conducted in a manner to meet ambient air quality objectives that fall under the New Brunswick's Air Quality Regulation 97-133.

The Project will consist of the construction and operation of a 60,000 MTPA potassium nitrate and ammonium chloride plant. Raw materials used at the site include 46,000 MTPA potassium chloride and 7.75 metric tonnes per hour (t/h) ammonium nitrate solution. The conceptual plan for the Project consists of the following major elements:

- Natural gas boiler that will use 1610 normal cubic meter per hour (Nm^3/hr) of natural gas (54 million British thermal units per hour (MMBTU/hr)).
- 60,000 MTPA processing facility that will include storage warehouses, storage tanks, mixing tanks used to produce potassium nitrate by combining potassium chloride and ammonium nitrate.
- Potassium nitrate drying activities. Part of the process will include the drying of potassium nitrate. Emission from this activity will be controlled by use of a scrubber and/or baghouse.
- Potassium chloride transportation by tandem truck to the Plant: Every year approximately 46,000 MTPA of potassium chloride with be transported to the facility by an estimated 1533 tandem trucks potentially from Penobsquis, New Brunswick.
- ammonium nitrate solution transported by ship to Saint John Port and trucks from the port to facility: ammonium nitrate solution will be stored in a 3000 cubic metre tank that will have a 15 day capacity.
- Hoteling of ships used to supply raw materials and receive final product.

The assessment of air emissions from the operation of the potassium nitrate and ammonium chloride plant included the following:

- An inventory of all combustion emissions and GHGs was developed and compared to the emissions inventory for the Province of New Brunswick; and
- An air dispersion modeling study was performed to predict the impacts on air quality in the airshed surrounding potassium nitrate and ammonium chloride plant property.

The following sections provide an inventory of emissions estimated to be generated from these activities.

Inventory of Project Emissions

Table 7.2 provides a summary of the annual air emissions estimated to be produced by the operation at full production of the proposed potassium nitrate and ammonium chloride plant.

Table 7.2 Estimated Annual Emissions – Proposed Potassium Nitrate and Ammonium Chloride Plant (Tonnes/Year)

Activity	CO	NO_X	PM	SO_2	NH_3
Buffer Tank Vent V104	-	-	-	-	2.6
KNO_3 Dryer Scrubber Vent S402	-	-	3.5	-	
Natural Gas Boiler Exhaust Vent B601	18.1	10.7	1.6	0.1	-
Truck Emissions	1.5	1	0.12	0.03	-
Ship Hoteling(1)	15.2	160	9.8	59.1	-
Total	**34.8**	**171.7**	**15.0**	**59.2**	**2.6**

Note: (1) Estimate based on ships hoteling at the Saint John Port for 24 hours per day, 4 months of the year.
Odour threshold ammonia = 5 parts per million (ppm)

It is estimated that the operation, including transportation of raw materials, of the proposed potassium nitrate and ammonium chloride plant will produce 34.8 tonnes of CO, 171.7 tonnes for NO_x, 15 tonnes of TPM, 59.2 tonnes of SO_2, and 2.6 tonnes of NH_3 emissions.

Emissions for trucking assumed 46,000 MTPA of potassium chloride will be transported to the site by tandem truck from Penobsquis and 60,000 MTPA of ammonium nitrate will be transported by heated tanker truck from the Port of Saint John. The round trip distance per truck is 154 km for the transport of potassium chloride and 6 km for the transport of ammonium nitrate.

Emissions from shipping will result from the use of diesel engines during the hoteling of ships at the Saint John Port.

GHG Emissions

Table 7.3 provides a summary of GHG emissions for the proposed potassium nitrate and ammonium chloride plant.

In 2010 the estimated GHG emissions generated in New Brunswick was 19,000 kt CO_2e and 692,000 kt CO_2e for all of Canada. In 2012, the estimated GHG emissions for NPRI permitted sources in Saint John was 3,415 kt CO_2e. The Project is expected to generate an estimated 34 kt of CO_2, which would result in an increase in CO_2 emissions of approximately 1 % to the NPRI totals for the Saint John Region, 0.18 % to the Provincial levels and 0.005% to the Canadian levels.

Table 7.3 Estimated Annual GHG Emission – Proposed Potassium Nitrate and Ammonium Chloride Plant (Tonnes/Year)

Activity	Methane as CO_2e	CO_2
Buffer Tank Vent V102	-	-
KNO_3 Dryer Scrubber Vent S402	-	-
Natural Gas Boiler Exhaust Vent B601	12	25,765
Truck Exhaust	-	222
Ships Hoteling$^{(1)}$	-	8,354
Subtotal	**12**	**34,341**
Total CO_2e		**34,353**

Note (1) Estimate based on ships hoteling at the Saint John Port for 24 hours per day, 4 months of the year.

With reference to climate change, one of the main contributors to GHG for the Project will be the 54 MMBTU/hr natural gas boiler, which accounts for approximately 75 % of the Projects CO_2 emissions.

Comparison of Project Inventory with Provincial Inventory

This section provides a summary of CAC emissions for all sources in New Brunswick compared to the total estimated CAC emissions for the proposed potassium nitrate and ammonium chloride plant (Table 7.4).

Table 7.4 Comparison of Annual Project Emissions with Provincial Totals (Tonnes/Year)

Category	TPM	SO_2	NOx	CO	NH_3
Total Project Emissions for APC	15	59.2	171.7	34.8	2.6
New Brunswick Total CAC Emissions (2012)[1]	483,044	34,291	38,198	212,969	3,796

Note (1) Source: EC, 2014b

A comparison of total CAC emissions in the Province with estimated emissions from the potassium nitrate and ammonium chloride plant determined that the operation of the facility will increase provincial emissions of particulate matter by 0.003%, SO_2 by 0.17%, NO_x by 0.45%, NH_3 by 0.07% and CO by 0.016%.

Please refer to Appendix F for the complete air dispersion modeling report.

7.2.1.3 Effects of Decommissioning

Air impacts during decommissioning are expected to be comparable to construction related air impacts.

7.2.1.4 Mitigation

Mitigation for air emissions will be required for a number of the potential effects described above, including:

- fugitive dust emissions from activities such as site preparation, grading and vehicle traffic during construction periods and the decommissioning phase, which will also include demolition activities;
- dust hoods with bag filters will be installed within the dryer exhaust system and at points along the conveyers;
- impacts to the air shed from exhaust emissions from the gas boiler and drying system during operation of the fertilizer plant; and
- contribution of GHG to the atmosphere.

Mitigation during Construction

In conducting site construction operations, APC will:

- conduct periodic inspections of all work areas particularly during dry and windy conditions;
- require all construction equipment to be properly maintained to ensure exhaust emissions are typical for each piece of equipment;
- apply water to disturbed areas, as necessary, to reduce vehicle traffic dust;
- cover open hauling trucks with tarps, as necessary;
- use paved roads for construction vehicle traffic, wherever practical;
- use best practices to limit and remediate track out onto paved sections;
- limit vehicle speeds as required to reduce dust generation;
- set limits on equipment and vehicle idling;
- respond promptly to any significant particulate emission concerns that occur during construction by evaluating the source of emissions and ensuring all practicable mitigation measures are being implemented; and
- upon completion of construction activity, stabilize disturbed areas.

Mitigation during Operation

During operation of the facility, APC will implement the following measures to minimize effects to air quality:

- All equipment used on-site is to be properly maintained to ensure exhaust emissions are typical for each piece of equipment.
- Conform to current and proposed regulated emissions standards for state of the art natural gas combustion boilers.
- As part of the facility design, use particulate emission controls such as scrubbers or a baghouse for the potassium nitrate drying facility.

Mitigation during Decommissioning

Air emissions during decommissioning are expected to be comparable to construction related air emissions. Mitigation measures proposed for the construction phase therefore generally also apply to the decommissioning phase.

7.2.1.5 Summary and Residual Effects

Residual effects on air quality during the Project's construction and operation phase are not expected to be significant. It is noted that over the last 20 years regulations on internal combustion engines have become increasingly strict, resulting in a significant lowering of priority pollutants in engine exhaust. This trend is expected to continue. The Project will use state of the art equipment that will conform to industry emissions standards, as these standards are developed in the future with the intention to further reduce emissions as new emissions reducing technologies become available. Overall, no significant adverse residual effects are likely, with proper implementation of the identified mitigation measures.

7.2.2 Acoustic Environment

The acoustic environment was identified as a VEC based on the effects construction, operation and decommissioning may have on the surrounding environment and population. Potential effects include:

- noise contravening City of Saint John bylaw guidelines; and
- noise disturbing local wildlife.

7.2.2.1 Effects of Construction

The use of equipment to construct the site will result in temporary, short-term elevated noise levels that will be restricted to the construction period for the Project, and will terminate once construction has been completed.

Construction equipment includes a large number of types of machines and devices, varying widely in physical size, horsepower rating and principle of operation. Despite the variety in type and size of construction equipment, the similarities in dominant noise source and in patterns of operation are sufficient to define three categories:

- equipment powered by internal combustion engines;
- impact equipment; and
- other equipment.

Equipment Powered by Internal Combustion Engines

The internal combustion engine is used to provide movement to the wheels or tracks and/or operating power for working mechanisms such as buckets, dozers, etc. Exhaust noise is usually the most important component of engine noise in internal combustion engines; however, noise from the intake, cooling fans and mechanical/hydraulic transmission and control systems also can be significant contributors. The tracks of earthmoving equipment, and the interaction of materials handling equipment and earthmoving equipment with the material on which it acts, often produce significant noise output (Harris, 1979).

Impact Equipment

Impact equipment includes pile drivers, pavement breakers, tampers, rock drills and small handheld pneumatically, hydraulically or electrically powered tools. With the use of pile drivers, the primary noise source is the impact of a hammer striking the pile; engine related sources are secondary. The dominant sources of noise in pneumatic tools are the high-pressure exhaust and the impact of the tool bit against the material on which it acts (Harris, 1979).

Other Equipment

Generally, the above-mentioned categories contain the bulk of equipment used in remedial activities. There are, however, many pieces of equipment that do not fit either of these categories. Examples are the high-pitched whine from a power saw or the noise a concrete vibrator produces when it shakes concrete forms (Harris, 1979).

For comparison, a chainsaw at 1 m is approximately 110 dB, a busy highway at roadside is 80 dB, and conversational speech at 1 m is 60 dB. Noise levels in a library can be expected to be at about 40 dB.

Table 7.5 lists typical noise levels for construction equipment (United States Department of Transportation; US DOT, 2006).

Table 7.5 Project Equipment and Associated Operational Noise Levels

Construction Equipment	Noise Levels (dB(A), slow)[1]
	At 15 m
Backhoe	78
Clam Shovel	87
Ground Compactor	83
Compressor (Air)	78
Concrete Mixer Truck	79
Concrete Pump Truck	81
Crane	81

Construction Equipment	Noise Levels (dB(A), slow)[1]
	At 15 m
Dozer	82
Excavator	81
Flat Bed Truck	74
Front End Loader	79
Impact Pile Driver	101
Paver	77
Pneumatic Tools	85
Welder/Torch	74

Note: [1] Representative of the highest noise level, decibels on A scale of sound level meter.

Health Canada does not have set threshold values for noise, but recommends mitigatory measures be employed if levels of 75 dB are exceeded for more than a year (Health Canada, 2010a). With respect to New Brunswick, there are no specific guidelines for environmental noise. For the purpose of this report, the New Brunswick Regulation 91-191 General Regulation under the provincial *Occupational Health and Safety Act* (NBOHSA) noise exposure guideline values have been adopted, which stipulate that the combined levels of exposure do not exceed 85 dBA per 8 hour period or 82 dBA per 16 hour period.

Also, this report will follow the City of Saint John Noise By-Law (No. M-22), enacted in 2005 and amended in 2006, which states in Sections 3(2) and 3(3) that no person shall make or permit to be made on his property noise resulting from construction equipment that is clearly audible on the street and is likely to cause a public nuisance or otherwise disturb one or more inhabitants of the City if:

- there is absence of an effective muffling device; or
- the operation of construction equipment is being conducted between the hours of 9:00 pm and 7:00 am.

It is expected that construction activities may last as long as 5 years to complete construction of all three phases of the Project.

As the site is fairly isolated from residents and schools of the area, the impact to the public are expected to be insignificant, approaching background concentrations at off-site locations. Noise levels will likely not result in significant adverse impacts to the acoustic environment within the vicinity of the Project site and adjacent areas.

7.2.2.2 Effects of Operation

Potential sources of noise during operation are predominantly associated with equipment operation and steam vent at the fertilizer plant. Typical noise levels are anticipated to be between 55 to 60 dB(A) during the day and 50 to 55 dB(A) during the evening hours. Noise monitoring was conducted in 2014 at the Sichuan Migao fertilizer plant located in China. This plant is similar to the proposed Project and results from that location indicated noise levels varied between 53 to 60 dB(A) during the day and 50 to 55 dB(A) in the evening hours at several points (6) located along the plant boundary (APC, 2014).

7.2.2.3 *Effects of Decommissioning*

Noise impacts during decommissioning are expected to be comparable to construction related noise impacts.

7.2.2.4 *Mitigation*

The following noise mitigation measures will be considered:

- All equipment will be assessed at the source to determine the equipment's feasibility for low noise designs.
- Acoustic mitigation will include the use of enclosures, piping insulation and silencers.
- Due to the climate of New Brunswick, most of the equipment will be enclosed or partially enclosed for winterization purposes.

Mitigation during Construction

In conducting site construction operations, APC will:

- Ensure that all equipment has appropriate noise-muffling equipment installed and in good working order.
- Restrict construction activities to the hours of 7:00 am to 9:00 pm where practical.

Mitigation during Operation

During operation of the facility, APC will implement the following measures to minimize effects of excessive noise levels:

- Appropriate and properly operating noise-mufflers on all noise emitting equipment.
- In addition to the noise generating equipment, other potential noise transmission sources such as piping, fittings, valves and feed systems will undergo frequent examination and maintenance. Operational plans will include adequate inspection procedures and maintenance logs.

Mitigation during Decommissioning

Noise levels during decommissioning are expected to be comparable to construction related noise levels. Mitigation measures proposed for the construction phase therefore generally also apply to the decommissioning phase.

7.2.2.5 *Summary and Residual Effects*

Potential effects due to elevated levels of noise during construction are expected to be localized and of short duration (in the context of the Project life cycle). During operation, overall effects are not expected to be significant as noise levels will be well within industrial standards. No significant adverse residual effects are likely, with proper implementation of the identified mitigation measures.

7.2.3 Surface Water

Surface water was identified as a VEC based on the effects construction, operation and decommissioning may have on surface water bodies, streams, and wetlands located within and adjacent to the Project area. Potential effects include:

- land disturbance during and after construction of Project; and
- stormwater discharges during the construction, operation and decommissioning phases of the Project.

The greatest potential for impact to surface waters is expected to be during construction. The largest discharge component by volume is expected to be stormwater both during and after construction.

7.2.3.1 Effects of Construction

Project construction, access to work areas, and the preparation of sites for the placement of buildings and other facilities will require:

- the clearing of vegetation and earthworks including grubbing and stripping topsoil and overburden; and
- the placement of excess material in temporary stockpiles which may be susceptible to erosion and result in sedimentation of watercourses adjacent to the site.

The main types of water discharge expected during construction are:

- clean and possibly sediment-laden stormwater; and
- construction wastewater (hydrostatic test waters, concrete wash water, and stormwater that has been in contact with uncured concrete).

The possible effects of runoff during construction have the highest potential to impact surface water, as construction will result in exposing soil to potential erosion. If unmanaged, erosion of site soils can lead to sedimentation of watercourses. Erosion control measures will be implemented as work progresses following the EPP and site grading plans.

During construction, Total Suspended Solids (TSS) concentrations in stormwater, residual hydrocarbons, and/or metals in hydrostatic test waters, or the concentration of lime in concrete production wastewaters, could exceed the water quality guidelines for the protection of aquatic life published by the CCME (1999).

7.2.3.2 Effects of Operation

The main types of water discharge expected during operation are:

- clean stormwater; and
- process water and cooling water blow down.

The possible effects of runoff are similar to those listed during construction. With respect to process water and cooling water blow down, there are no watercourses in close proximity to the fertilizer plant. Any spills will managed as per the spill management plan to be developed.

7.2.3.3 Effects of Decommissioning

Impacts to surface water during decommissioning are expected to be comparable to construction related surface water impacts.

7.2.3.4 Mitigation

The main potential effect on surface water during construction, operation and decommissioning is the possibility of silt-laden runoff into various surface waters.

Mitigation during Construction

Mitigation measures during construction will include the use of existing vegetated surfaces, silt fences, granular stabilization materials, ditch checks, etc. for sedimentation and erosion control. A site specific erosion and sedimentation control plan for each watercourse/wetland within the Project Footprint will be developed and watercourse/wetland crossing permits will be obtained by APC and supplied to the contractor.

There are a number of accepted approaches to erosion and sediment control from which to select when developing an erosion and sediment control plan. The most commonly used methods are:

- preserving existing vegetation (following the required riparian buffer limits of the New Brunswick WAWA Guidelines);
- minimizing grading;
- installing silt fences to prevent sediment transport with run-off;
- employing straw bales to filter sediment laden water;
- using sediment traps to settle sediment from flowing water; and
- using temporary diversion berms.

Mitigation measures for erosion and sedimentation during the construction of the APC Fertilizer Production facilities may include the following:

- installing erosion and sediment control structures, as required;
- inspecting and maintaining erosion and sediment control measures;
- regulating drainage from construction areas to prevent erosion and sedimentation;
- ensuring that ditches do not drain directly into a watercourse without proper sediment control devices (traps, straw bales, take-off ditches into vegetation, etc.);
- scheduling grading and construction to minimize the time of soil exposure;
- retaining existing vegetation within riparian buffer zones;
- diverting runoff away from denuded areas;
- vegetating and mulching denuded areas;

- minimizing the length and steepness of slopes;
- preparing drainage channels and outlets to handle concentrated or increased runoff;
- installing temporary berms on approach slopes to the watercourse immediately following clearing and grading;
- installing temporary silt fences (geotextiles or straw bales) near the base of slopes if heavy rains or surface erosion could result in siltation of the watercourse; and
- locating sources of clean gravel, cobble, and riprap, if needed, prior to construction and placing them onsite for stabilization and restoration purposes.

Mitigation during Operation

During operation of the facility, APC will implement the following measures to minimize surface water impacts:

- ensure storm water management system is properly maintained; and
- follow spill response management plan.

Mitigation during Decommissioning

Surface water impacts during decommissioning are expected to be comparable or less than construction related impacts. Mitigation measures proposed for the construction phase therefore generally also apply to the decommissioning phase.

7.2.3.5 Summary and Residual Effects

During construction, operation and decommissioning, impacts on surface water (freshwater) resources on and off-site are expected to be not significant as effective mitigation measures are available to minimize construction impacts that are related to erosion, sediment loading, and contamination resulting from accidental spills, fuel storage and handling.

Operation-related effects will be minimized through maintenance of storm water management system and following the spill response management plan.

7.2.4 Groundwater Resources

Groundwater resources were identified as a VEC based on the effects construction, operation and decommissioning may have on the quality of groundwater located within and adjacent to the Project area.

The nearest designated wellfield protected area, The City of Saint John, is located approximately 1 km south of the McAllister Industrial Park (NBDELG, 2013b). At this time no development is anticipated in this area as tests did not support an adequate supply (Saint John Water, 2014).

It is not feasible to assess the effect on groundwater at the present time because drinking water for the area is provided by a municipal distribution system. However, it is possible to predict the nature, or types of effects that Project activities may have on wells in general and on the aquifer in question.

7.2.4.1 Effects of Construction, Operation and Decommissioning

With respect to groundwater quality, the main concern related to plant site construction is the accidental release of fuel, oil, or lubricants due to equipment failure during site preparation and construction. During operation, the main concern is accidental (acute) and chronic spills and release of chemicals, and possible releases due to fires. The effects of decommissioning are anticipated to be similar to those described during construction.

Hazardous materials used during construction of the Project may include POL, paints, solvents, and other typical construction materials. Loss of POL may occur from parked vehicles, working equipment, and refuelling points. Also, construction in existing contaminated areas can result in mobilization and spread of any hazardous materials present.

The severity of the effect resulting from an accidental release of hazardous material will depend on the quantity released, characteristics of the contaminants, local hydrogeologic characteristics, and groundwater use in the area. In areas containing thick deposits of low permeability soil, the migration of contaminants will be impaired and quick response to the release will result in minimal effects on groundwater quality. In areas of shallow, fractured bedrock and/or high hydraulic conductivity, an accidental release may potentially affect a larger downgradient area.

Accidental releases of hazardous materials may cause the concentrations of some parameters in the affected groundwater to exceed the Guidelines for Canadian Drinking Water Quality (Health Canada, 2012). Although prevention and response procedures will be established for hazardous materials, mitigation measures are nevertheless required to ensure the potential effects of accidental spills are minimized.

7.2.4.2 Mitigation

The principal means for minimizing the potential for effects related to accidental releases of hazardous materials is by ensuring that an adequate level of awareness of the environmental sensitivity of environmental components is maintained by contractors and workers, and through incorporation of appropriate prevention and response measures in construction practices. It is recommended that strict on-site control and inspection programs be conducted to ensure that risks are minimized.

Proper precautions such as secondary containment, leak detection systems, and monitoring alarms will be incorporated into the Project design and processes as appropriate. The potential effects of chronic and accidental spills of deleterious materials on groundwater will be reduced through vigilant monitoring and rapid cleanup response.

7.2.4.3 Summary and Residual Effects

The effects on groundwater quality in the area caused by the construction, operation and decommissioning of the Project are not expected to be significant.

7.2.5 Wetland Resources

Wetland resources was identified as a VEC based on the effects construction, operation and decommissioning may have on wetland function. The main regulatory control for wetland conservation is the WAWA Regulation, supported by the New Brunswick Wetland Conservation Policy; which promotes a “no net loss of wetland function” objective. Wetland functions have been defined as the capability of wetland environments to provide goods and services including basic life-support functions (Bond, et al., 1992). Alteration of a wetland may remove or interrupt the ability of the wetland to continue to support the same level of pre-development functions.

One Provincially Significant wetland, Red Head Marsh, which is also designated as ESA, has been identified within the Project area (see Figure 5.1). Red Head Marsh is located approximately 50 m from the western boundary of the fertilizer plant, where a steep slope and an old gravel access road forms a barrier with the wetland. At its northern tip, the proposed water pipeline crosses the wetland following an existing road easement.

7.2.5.1 Effects of Construction

As a result of construction of the proposed water supply pipeline within the existing road easement, potential effects to the wetland include:

- noise/disturbance to wildlife;
- water quality effects; and
- introduction of invasive species.

Construction activities such as excavating and trucking will produce varying levels of noise. These noise levels will be dependent upon many factors including weather conditions, topography, vegetation, and construction practices. During construction, it can be expected that most wildlife and bird species occupying the immediate vicinity of the construction site will initially be affected. Noise or physical disturbance could encourage adult birds to avoid or be displaced from feeding, breeding, or nesting habitat. Similarly, once eggs have been laid, abandonment of nests could occur if adult birds are displaced from the nest. However, construction activities will be of short duration (in the context of the Project life cycle) and assuming construction time and habitat disruption are minimized, it is not likely that significant effects will occur.

Erosion and sedimentation are known to adversely affect the ecology of most aquatic systems. The severity of problems caused by suspended solids generally decreases with distance from the area of disturbance and with time after construction is completed (Shuldiner *et al.*, 1979). Turbidity is known to have adverse effects on aquatic primary productivity, feeding, and reproductive success of higher organisms. When prolonged turbidity is experienced, significant changes in wetland function and class structure can be expected (Shuldiner *et al.*, 1979).

Degradation of water quality in wetlands may occur through contamination from accidental releases of hazardous materials such as leaks from construction machinery, accidental spills of fuels and lubricants, and leaching from surfacing/construction materials. The severity of the effect of these substances on wetland habitat is variable, and may be affected by water regime, precipitation patterns, topography, and the sensitivity of particular organisms to the chemical concerned (Shuldiner, *et al.*, 1979).

Invasive plants are defined as those species that have moved into a habitat and reproduced so aggressively that some of the original components of the vegetative community are displaced. An alien species is one which did not originally occur in an area where it is now established, but which arrived as a direct or indirect result of human activity (White, *et al.*, 1993). Most invasive alien plant species in Canada first become established in the most disturbed areas (e.g. areas of high population density such as southern Ontario) and then spread to less disturbed habitats. There is potential for the use of equipment or machinery that was previously used in areas known to support invasive alien plant species, which may result in the spread of these species to, and within the area. Those species identified as posing the greatest threat of invasion to wetland habitats include those listed in Table 7.6 (from White, *et al.*, 1993).

Table 7.6 Canadian Invasive Alien Species Most Likely to Pose Threat to Wetland Habitat in New Brunswick

Common Name	Scientific Name	Ecology	Effects of Introduction
Purple Loosestrife	*Lythrum salicaria*	Herbaceous perennial with prolific seed production.	• Development of monocultures. • Loss of native fauna. • Clogging of irrigation systems. • Decreased suitability for human use of wetland.
Eurasian Watermilfoil	*Myriophyllum spicatum*	Submersed aquatic perennial plant.	• Displacement of native plants. • Interference with fish spawning. • Decreased suitability for human use of waters increase in mosquito population.
European Frog-Bit	*Hydrocharis morsus-ranea*	Free-floating aquatic plant.	• Development of monocultures.
Flowering-Rush	*Butomus umbellatus*	Reproduces by seed and rootstock.	• May aggressively displace native flora.
Glossy Buckthorn	*Rhamnus frangula*	Seed producing shrub/small tree.	• Displaces native species as a result of its dense shade.
Reed Canary Grass	*Phalaris arundinacea*	Perennial grass with both native and introduced cultivars.	• Development of dense monocultures.

Source: White, et al., 1993

7.2.5.2 Effects of Operation and Decommissioning

There are no anticipated adverse effects as a result of Project activities during operation since the pipeline will be used to transmit treated water that meets CCME guidelines for aquatic life. In addition, during decommissioning the pipeline will be emptied, filled with inert gas and capped. Consequently no adverse effects are anticipated during decommissioning.

7.2.5.3 Mitigation

The water supply pipeline will be located within 30 m of Red Head Marsh in an existing road easement that crosses the wetland. Prior to construction, APC will obtain regulatory approval under the WAWA regulation (*Clean Water Act*). Standard mitigation for work in wetlands will be described in the WAWA application permit.

Definition of appropriate mitigative measures is largely dependent on habitat-specific construction techniques. However, several generally applicable mitigative measures are recommended for wetlands, including:

- Minimize the construction area, and construction period adjacent to wetland.
- Adherence to conditions of an applicable WAWA permit, specific to construction activity.
- Construction following storm events which have resulted in high water levels should be conducted only as approved by qualified inspectors.
- Travel by construction vehicles will be minimized in temporary construction zones.
- Minimize ground and vegetative disturbance by:
  - locating staging areas outside of the wetland, at least 30 m from the edge of wetland, where possible; and
  - using upland access roads wherever practical.
- Maintain vegetative diversity by:
  - incorporating practices to prevent the spread of non-desirable invasive species throughout the construction area, including cleaning and inspection of construction equipment prior to use in wetland areas.
- During site restoration, mitigate effects on vegetation by:
  - not applying fertilizer, lime or mulch to wetland or 30 m wetland buffer as part of revegetation plan; and
  - restoring original contours and cross drainage patterns.

In general, the best method of preventing erosion of bare soils is to encourage vegetation re-establishment as soon as possible. Measures identified for mitigating potential effects on surface water (Section 7.2.3) resulting from erosion/sedimentation are also relevant to wetland resources.

Section 7.2.4.2 recommends environmental awareness and preventative measures intended to mitigate potential effects of an accidental release of potential hazardous materials, which are also applicable to the protection of wetland resources. Any spills that occur will be remediated to meet or exceed regulatory requirements.

To diminish the risk of transferring invasive plants, or their seeds, rhizomes or vegetative structures, it is recommended that:

- Construction equipment (e.g. tracked vehicles) transported from elsewhere in New Brunswick or Canada be thoroughly cleaned and inspected prior to transport to ensure that no vegetative matter is attached to the machinery. The use of a high pressure water hose to clean vehicles prior to transport may facilitate this process.

- Construction equipment will be inspected and cleaned immediately following construction in wetland areas and in areas found to support purple loosestrife.

7.2.5.4 Summary and Residual Effects

With the application of the proposed mitigation measures, significant adverse residual effects are not anticipated to occur due to Project activities on wetland functions.

7.2.6 Wildlife

Wildlife was identified as a VEC based on the effects construction, operation and decommissioning may have on local wildlife populations. The main regulatory control is the New Brunswick *Fish and Wildlife Act*. Potential effects to wildlife include:

- alteration/displacement of habitat;
- noise/disturbance to wildlife;
- behavioural changes; and
- mortality.

7.2.6.1 Effects of Construction

The Project is located within an operating Industrial Park with most of the infrastructure occurring on already cleared ground or following existing easements. Consequently, additional habitat alteration/displacement is expected to be kept to a minimum. With respect to noise disturbance to wildlife, similar impacts and mitigation measures described in Section 7.2.5 can be expected. Noise or physical disturbance could encourage adult birds to avoid or be displaced from feeding, breeding, or nesting habitat. Similarly, once eggs have been laid, abandonment of nests could occur if adult birds are displaced from the nest. During construction, it can be expected that most wildlife and bird species occupying the immediate vicinity of the construction site will initially be affected. An increase in the mortality rate of wildlife may occur due to increased traffic in the area. However, construction activities will be of short duration (in the context of the Project life cycle) and, therefore, it is not likely that significant effects will occur.

7.2.6.2 Effects of Operation

Potential effects of the operation phase of the Project are anticipated from increased noise and disturbance from traffic and other human activities at the fertilizer plant. Impacts for noise and disturbance are anticipated to be similar to those experienced during construction.

7.2.6.3 Effects of Decommissioning

Impacts to wildlife during decommissioning are expected to be comparable to construction related wildlife impacts.

7.2.6.4 Mitigation

The main potential effect on wildlife during construction, operation and decommissioning is noise and disturbance from traffic and other human activities.

The following mitigation to minimize adverse effects on wildlife is recommended:

- schedule construction to occur during periods of lowest sensitivity to wildlife where practical;
- abide by all relevant timing constraints for wildlife as identified by the regulatory agencies;
- dust-prevention measures and dust abatement measures shall be implemented;
- do not harass wildlife; and
- workers will be instructed to maintain good housekeeping practices and not leave any food items and garbage at the Project site in order to avoid attracting omnivorous predators which may disturb or cause direct mortality or injury to wildlife.

7.2.6.5 Summary and Residual Effects

It is not likely that significant adverse residual effects will result from Project interactions with proper implementation of the identified mitigation measures.

7.2.7 Migratory Birds

Migratory birds were identified as a VEC based on the effects construction, operation and decommissioning may have on local wildlife populations. The main regulatory control is the MBCA and the New Brunswick *Fish and Wildlife Act*. Potential effects are similar to those listed for wildlife and include:

- alteration/displacement of sensitive/critical habitat;
- noise/disturbance to wildlife;
- behavioural changes; and
- mortality.

7.2.7.1 Effects of Construction

Habitat fragmentation resulting from increasing intensity of land use in the landscape (Burgess and Sharpe, 1981) has been perceived as a major threat to biological diversity (Wilcove *et al.*, 1986; Noss, 1991; Saunders *et al.*, 1991). The effects of habitat fragmentation on species can be mainly assigned to three processes; reduction of total habitat area within a region, loss of area within each single habitat, and increase in isolation between habitats (Andrén, 1994). Loss of species may lead to changes in the processes of decomposition, pollination, parasitism, and predation (Kareiva, 1987). Another concern is vegetation clearing and grubbing activities may cause destruction of nests and nestlings or eggs if conducted during the breeding season (1st May to 31st August).

The fertilizer plant Footprint and water supply pipeline footprint consist of approximately 13.7 ha and 1.2 ha, respectively, of potential migratory bird habitat (Table 5.12). Ten broad habitat types were identified within 5 km of the Project (only two of which exist in the proposed fertilizer plant Footprint and four for the proposed water supply pipeline). For graphical representations of this habitat, please refer to Figure 5.2. While there will be a reduction in habitat in the Project area, the habitat that will be affected by the Project is mainly already cleared or "edge" area within an Industrial Park, which is not considered critical habitat. If any clearing needs to be conducted it will be conducted outside the breeding season.

In addition to habitat loss, construction noise may have deleterious effects on animals in and near the Project area. Flushing of nesting birds may result in decreased productivity due to increased nest predation and stress to adult birds affecting foraging behaviour (Beale, 2007); as well, birds may leave the Project area and be forced to move to less favourable nesting sites (Larkin, 1996). The data regarding effective distance due to noise disturbance are relatively few and conflicting, with various field studies showing effects from edge of area of disturbance to 200 m.

Construction noise can interfere with normal bird behaviour, such as feeding, migrating, and breeding. The distance of effect is of course related to noise volume and quality. Negative effects from noise vary from species to species because of interspecies differences in both hearing abilities and in behavioural and physiological responses to stimuli. In addition to interspecies differences, there is considerable intraspecies variation in vulnerability to effects of noise, for example in different times of year (i.e. different stages of the breeding cycle) and different life stages (Blumstein et al., 2005). The effects of noise on the site due to construction are expected to be temporary and short-term.

7.2.7.2 Effects of Operation

Potential effects of the operation phase of the Project are anticipated from increased noise and disturbance from traffic and other human activities at the fertilizer plant. Impacts for noise and disturbance are anticipated to be similar to those experienced during construction.

7.2.7.3 Effects of Decommissioning

Impacts to migratory birds during decommissioning are expected to be comparable to construction related migratory bird impacts.

7.2.7.4 Mitigation

The main potential effect on migratory birds during construction, operation and decommissioning is noise and disturbance from traffic and other human activities.

The following mitigation to minimize adverse effects on migratory birds is recommended:

- Reduce Project Footprint and temporary work areas to the extent possible.
- Clearing and grubbing should be restricted to areas absolutely necessary to carry out the Project.

- Vegetation clearing should be avoided during the nesting season (1st May to 31st August). Particular care will be taken that trees with a diameter at breast height (DBH) of 15 cm or more are not cut down unnecessarily.
- If a Bald Eagle nest is found within the forested areas to be cleared, even outside of the breeding season, a buffer zone must be placed around the nest and clearing can only occur outside of the buffer zone.
- All construction equipment should have appropriate noise-muffling equipment installed and in good working order in order to minimize noise disturbance. The duration of noise disturbance should be minimized. Lighting should be restricted to areas where it is necessary.
- Dust-prevention measures and dust abatement measures shall be implemented.
- To minimize interference of nesting activities from noise and human presence, workers will be encouraged to refrain from entering surrounding undisturbed habitat areas where no work is done, as those areas likely hold the largest number of birds.
- Workers will be instructed to maintain good housekeeping practices and not leave any food items and garbage at the Project site in order to avoid attracting omnivorous predators which may disturb or cause direct mortality or injury to birds.
- In the event that impacts on migratory birds are detected during construction, further mitigation will be developed in consultation with NBDNR and EC.

Should clearing and construction activities be required during the sensitive nesting season the following measures will be implemented:

- Clearing activities will be scheduled in consideration of critical habitat features (e.g. open water wetland areas) identified during the pre-construction field survey.
- APC will instruct the Environmental Inspector and contractors about the regulations of the MBCA, the importance of habitat, the significance of the nesting period, and measures to be implemented to minimize any disturbance to birds/nests.
- A bird nest survey of the area will be conducted by a professional biologist/ornithologist/ birder prior to clearing activities. The bird species recorded during the survey will be used as an indicator regarding the potential nesting habitat in the area.
- The typical nesting habitat for these species would be investigated for potential nests.
- Nest trees will be felled prior to or after the nesting season.
- The occurrence of all identified nests will be documented.

7.2.7.5 Summary and Residual Effects

A habitat assessment of migratory bird species and habitat has been conducted for the Project. With the implementation of the mitigation measures listed previously, it is unlikely that there will be any significant adverse effects on migratory birds or their habitat.

7.2.8 Fish, Fish Habitat, and Fisheries Resources

Fish, fish habitat and fisheries resources were identified as a VEC based on the effects construction, operation and decommissioning may have on local fish populations. The main regulatory control are the federal *Fisheries Act* and the New Brunswick *Fish and Wildlife Act*. Potential effects are similar to those listed for surface waters as well as wildlife and include:

- alteration/displacement/destruction of aquatic habitat;
- degradation of aquatic habitat;
- erosion/sedimentation;
- watercourse channel structural changes;
- interference with fish passage/migration;
- behavioural changes; and
- mortality.

The federal *Fisheries Act* (Subsection 35(1)) is a prohibition against causing serious harm to fish that are part of a commercial, recreational, or Aboriginal fishery, or to fish that support such a fishery. Authorization is required when projects are likely to result in a localized effect to fish population or fish habitat in the vicinity of the project.

Serious harm to fish is defined as:

- The death of fish.
- A permanent alteration of fish habitat of a spatial scale, duration, and intensity that limits or diminishes the ability of fish to use such habitats as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order carry out one or more of their life processes.
- The destruction of fish habitat of a spatial scale, duration, and intensity that fish can no longer rely upon such habitats for use as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes.

Depending of the final layout of the facility on the Footprint, watercourses may be affected by Project construction. Should this be the case, APC will work with regulatory authorities to come to a mutually acceptable solution.

7.2.8.1 Effects of Construction

Construction Activities in or Adjacent to Watercourses

In-stream and directly adjacent construction can adversely affect aquatic habitat by means of physical habitat changes, such as the loss of riparian vegetation, alteration of the watercourse channel and elimination of undercut banks reducing in-stream cover. Disturbed soils and vegetative die-off can lead to bank erosion and cause increased sedimentation in a watercourse. Excessive sediment will adversely affect aquatic organisms such as benthic invertebrates and fish by clogging feeding structures and burying crucial habitat. The operation of machinery in close proximity to a waterway can cause the potential introduction of chemical contaminants, negatively affecting water quality. All obstructions such as log fords, excavation, or trenching activities in watercourses could potentially impact fish passage, especially during critical spawning windows.

Riparian vegetation stabilizes banks, moderates water temperature by shading, and provides cover for fish. Failure to encourage re-growth of vegetation along watercourse banks following a disturbance may lead to elevated or diminished water temperatures, increased sediment, and loss of refuge for many fish species. The subsequent bank erosion caused by vegetative loss or excavation by heavy machinery can also eliminate undercut banks which in turn will reduce in-stream cover for fish.

Disturbance of Erodible Material in or Adjacent to Watercourses

The erosion of soil from trenches, culvert installation and unstabilized areas can potentially harm fish inhabiting adjacent watercourses. Suspended solids are carried in the water column and can adversely affect fish and benthic invertebrate populations. Potential effects on fish include the elimination of spawning habitat by sediment infilling; clogging of gills; reduction of light and changes in predator-prey interactions by increased turbidity. Benthic invertebrates may become buried under high sediment loads and suffer other ill-effects such as clogged gills, decreased food supply as well as habitat loss. While behavioural effects such as predator-prey interactions are easily reversed (Newcombe, 1994), the physiological damage caused by sediment on aquatic organisms can be fatal.

Sub-lethal effects have been reported for a variety of fish species in waters with suspended sediment concentrations of approximately 650 mg/L or greater, when fish are continually exposed for a period of several days (Appleby and Scarratt, 1989). Physiological effects are related to the concentrations and durations of exposure (Anderson, et al., 1996). Fish mortality can result from exposure to higher concentrations of suspended sediment for a short duration, or a long exposure to suspended solids of lower concentration. There are also differences in sensitivity between species. While levels of 100 milligrams per litre (mg/L) are frequently cited as harmful, lethal concentrations (LC) of suspended sediment (LC10) above 580 mg/L have been reported in static bioassays for a number of fish species (Sherk, et. al., 1974).

Mortality of fish eggs or alevins within the stream substrate may also be caused by the deposition of previously suspended fine material. The size and shape of the suspended particles has a bearing on the suspended sediment concentration that causes fish mortality (Anderson, et. al., 1996).

Effects in Construction Area

Within the construction area, fish, and fish food organisms experience high rates of mortality. This is the case for both wet and dry crossings; however, escape is impossible and mortality is virtually 100% in the case of isolated dry crossings. Fish can move and avoid direct mortality in the case of wet crossings. Removal and release of fish to areas upstream or downstream from the construction area prior to in-stream construction activities will limit this mortality. Once construction is finished and the area is re-stabilized, fish will return to the area provided habitat quality is acceptable (Hynes, 1960).

Fish habitat also includes fish food organisms. Benthic macroinvertebrates make up the majority of fish food organisms in northern temperate streams. These organisms are adversely affected by increased levels of suspended sediment, either through direct mortality, displacement to another area, or loss of habitat. Sedimentation events have been shown to result in decreases in invertebrate density, biomass, and species diversity (Gammon, 1970). Erosion control and sedimentation prevention methods introduced previously will limit the related effects on benthic macroinvertebrate production.

Much of the macroinvertebrate biomass within the construction area will be lost during construction activity. Following construction, given restoration of habitat, macroinvertebrates will rapidly recolonize the area. The mechanism for recolonization is drift (Tebo, 1955; Waters, 1965). Invertebrates emerge from the substrate in the evening, and passively drift with the current to re-establish downstream. The effectiveness of drift in dispersion and recolonization of invertebrate species has been widely demonstrated. Therefore, the effects on resident fish and fish food organisms in the immediate vicinity of the construction area will be short-term.

Effects Downstream of the Construction Area

Direct effects on individual fish from mobilized sediment are theoretically possible, but extremely unlikely in the case of construction. Of potentially greater concern are the effects on aquatic habitat outside the immediate construction zone associated with release of sediments into the watercourses. The severity of effects is related to both the concentration of the sediments and the duration of the release event (Anderson et al., 1996; Newcombe, 1994). The sources of these sediments include in-stream construction activity and activity on the approaches to the watercourse crossing location. There is concern that sediments will be released into the watercourse and move downstream. Depending on the size of the sediment particles and the energy in the watercourse, these sediments will be deposited at some point in downstream areas. Sedimentation may cause mortality of various fish life stages, and habitat degradation and loss. It is not anticipated that activities associated with the proposed Project will significantly increase the sediment load in water crossings.

Interference with Fish Passage

Construction of watercourse crossings can pose barriers to fish movement during routine activities such as predator avoidance, food gathering, and new habitat colonization as well as during timed events such as annual migration and spawning.

Aquatic fauna also undertake seasonal migrations and daily movements, which are directly affected by the immediate hydrologic and water quality characteristics. Physical barriers associated with construction (i.e. dams, flumes, sediment plumes) may make fish passage impossible during construction. Fish passage may also be affected by changes in current patterns or water chemistry.

Loss of Watercourses due to Construction

The development of fertilizer plant infrastructure may result in the loss of a portion of one characterized watercourses within the Project Footprint (WC1). Habitat characterization of the watercourse, as described in Section 5.8 shows this watercourse in general is steep and shallow. Although electrofishing surveys resulted in brook trout being collected from the watercourse it was collected in close proximity to WC2. Perched culverts on WC1 preclude the upstream passage of fish and the lack of true headwaters for any of the watercourses precludes the downstream passage of fish.

Effects on Fisheries

The possibility of recreational fishing within the Project Footprint exists but is highly unlikely. The watercourses are mainly diminished and within an industrial area. The nearby Loch Lomond lakes and Mispec River offer better sites for recreational fishing.

7.2.8.2 Effects of Operation

A Stormwater Management Plan for the Project site will be developed during final design. It is anticipated that much of the site will drain to the new channel and will eventually drain into Redhead Marsh. Discharge of insufficiently treated water and surface runoff could potentially have a deleterious effect on freshwater and aquatic habitat quality in Redhead Marsh. This could include contamination, erosion, increased turbidity, and siltation.

7.2.8.3 Effects of Decommissioning

Effects associated with the decommissioning phase in all Project component Footprints are expected to involve generally similar issues as those identified for the construction phase; however they are predicted to be of lesser magnitude. Demolition or renovation of buildings has the similar potential for contamination of runoff, but in general soil disturbance is expected to be much less than during the construction phase. No stream removal or relocation would be required during the decommissioning phase.

The specific effects on the freshwater aquatic environment will depend on the extent of the decommissioning. Of key importance would be the question of whether or not the Project site would be rehabilitated to pre-development or similar near- natural conditions. It is also likely that the key elements of the infrastructure (roads, water supply, and stormwater management) will remain in place to serve subsequent land uses in the industrial park.

7.2.8.4 Mitigation

Mitigation for potential impacts to the freshwater environment will take a variety of forms.

Mitigation during Construction

The following mitigative measures can be employed to minimize potential adverse effects on aquatic habitat resulting from structural habitat changes:

- limit removal of riparian zone vegetation within the riparian buffer zone;
- promote regrowth of vegetation in areas adjacent to watercourses following disturbance;
- minimize the use of heavy equipment within and adjacent to watercourses;
- keep ground disturbance to a minimum within and adjacent to watercourses; and
- Prior to construction, within 30 m of the watercourse, the proponent will need to obtain regulatory approval under the WAWA regulation (*Clean Water Act*). Prescribed mitigation will be included in the WAWA Permit conditions.

The key elements in a program to minimize adverse effects on aquatic habitat resulting from erosion and sedimentation, and the risk of population level effects on fish populations, include:

- Avoidance of the most sensitive periods for fish populations (preferred construction window is typically between 1st June – 1st October when salmonid eggs and alevins as well as overwintering juvenile salmon, are incubating or sequestered in the substrate).
- Implementation of standard, proven erosion and sediment control measures on approach slopes adjacent to watercourses.
- Minimizing to the extent practical the duration of activity in watercourses and wetlands as well as the duration of sediment releases.
- Minimizing to the extent practical the quantity of sediment released through erosion control measures.
- Restoration of the watercourse substrate, as similar as practical, to the pre-construction condition to ensure habitat availability.
- Designing watercourse crossings in consideration of the WAWA process under the *Clean Water Act*.

It is further recommended that a daily inspection of erosion control devices be conducted to ensure their proper functioning in areas of active construction. Furthermore, detailed inspections of erosion control measures should be conducted on a weekly basis following construction, and after major storm events until vegetation is re-established. Inspectors should keep records of compliance with the environmental conditions of applicable permits.

Once the area has revegetated and stabilized, temporary erosion controls can be removed. Revegetation can be considered successful when the herbaceous and/or woody plants uniformly cover 80% of the total area.

All watercourse crossings will need to obtain regulatory approval under the WAWA regulation. Standard mitigation will be described in the WAWA application permit.

Mitigation in the form of a Section 35 Authorization for ‘serious harm to fish species of commercial, recreational, Aboriginal’ importance may be required for the Project to proceed. An application will be submitted to DFO. An assessor will determine the level of offsets potentially required, if any.

Mitigation during Operation

Mitigation measures during operation for fish and fish habitat are similar to recommendations described in Section 7.2.3.4 relating to Surface Water.

Mitigation during Decommissioning

Fish, fish habitat and fisheries impacts during decommissioning are expected to be comparable or less than construction related impacts. Mitigation measures proposed for the construction phase therefore generally also apply to the decommissioning phase.

7.2.8.5 Summary and Residual Effects

During construction, operation and decommissioning, impacts on the freshwater environment on and off-site are expected to be not significant as effective mitigation measures are available to minimize construction impacts that are related to erosion, sediment loading, and contamination resulting from accidental spills, fuel storage and handling.

Operation-related effects will be minimized through maintenance of storm water management system and following the spill response management plan.

7.2.9 Species at Risk

Species at Risk were identified as a VEC based on the effects construction, operation and decommissioning may have on local populations. The main regulatory control are SARA and NBSRA. Potential effects are similar to those listed for wildlife, migratory birds, and fish (Sections 7.2.6, 7.2.7, and 7.2.8) and include:

- alteration/displacement of habitat;
- loss of sensitive/critical habitat;
- noise/disturbance to wildlife;
- behavioural changes; and
- mortality.

Government agencies tend to manage wildlife populations based on habitat requirements. The Project Team has adopted this habitat management approach to maintain appropriate areas for populations of wildlife species in the area, including those of special status. Maintenance of habitat diversity and specific protection measures for sensitive and/or limiting habitat features will be implemented to ensure protection of those resources potentially affected by Project activities.

- **Plant Species at Risk**

It is unlikely to find any of the plant species listed under SARA Schedule 1 and NBSRA as the proposed Project Footprint is highly disturbed. Habitat potential is more likely to be found in adjacent areas such as the nearby Red Head Marsh and coastal shore. With respect to the species identified by the ACCDC, those species found in drier, edge areas and roadsides, such as the strawberry-blite, Pennsylvania blackberry and seabeach dock could potentially inhabit the proposed Project Footprint. No rare plant species or plant species at risk were identified in the area by AMEC Biologists during field investigations conducted in 2013.

- **Mammal Species at Risk**

No mammal Species at Risk have been identified as occurring within 5 km of the Project by the ACCDC (2014) with the exception of the gray wolf (which is extirpated) and marine mammals which will not be affected by the proposed Project. No mammalian Species At Risk were identified in the field during field surveys in Spring/Summer 2013.

- **Bird Species at Risk**

Several bird Species at Risk species have been identified as potentially occurring within 5 km of the Project Footprint and are known breeders to the region (ACCDC, 2014). However, though the 5 km ACCDC observation list encompasses habitat-rich lands such as the Red Head Marsh ESA and the Atlantic coast, the Footprint of the proposed Project lies within an existing industrial park and is not expected to disturb critical habitat for any of the bird species discussed.

- **Herpetile Species at Risk**

The Wood turtle, a species designated by the ACCDC as uncommon throughout its range in the Province and Threatened by both SARA and NBSRA, is known to inhabit watercourses within 5 km of the Project. Surveys conducted by AMEC Biologists 29 May, 2013 did not detect presence of Wood turtles and the proposed Project lies within an existing industrial park and is not expected to disturb critical habitat.

- **Invertebrate Species at Risk**

Several butterfly species, a ladybird beetle and a dragonfly have been identified by the ACCDC as occurring within 5 km of the Project. The habitat in the Project Footprint is not considered to be critical for these species.

- **Fish Species at Risk**

The Atlantic salmon, Striped bass and Shortnose sturgeon are designated as uncommon throughout their range in the Province by the ACCDC, and none of these species were detected during electrofishing surveys in 2013.

7.2.9.1 Effects of Construction, Operation and Decommissioning

The Project is located within an operating Industrial Park, the proposed Footprint being a primarily cleared or “edge” habitat. The potential effects of the Project on habitat focuses on the presence of Species at Risk as well as the location of designated areas and other critical habitat features. Potential effects on Species at Risk are predicted to be similar to those described for wildlife, migratory birds as well as fish and fish habitat (Sections 7.2.6, 7.2.7, and 7.2.8).

7.2.9.2 Mitigation

Mitigation for potential effects on identified Species at Risk are similar to recommendations for wildlife, migratory birds as well as fish and fish habitat (Sections 7.2.6, 7.2.7, and 7.2.8).

7.2.9.3 Summary and Residual Effects

The Project Footprint is not considered to provide critical habitat for any Species at Risk identified as occurring or potentially occurring in the Study Area. Consequently, it is not likely that any significant adverse residual effects will result from Project interactions, with proper implementation of the mitigative measures identified for wildlife, migratory birds as well as fish and fish habitat listed in Sections 7.2.6, 7.2.7, and 7.2.8, respectively.

7.2.10 Designated Area

The Redhead Marsh ESA, a designated area, was identified as a VEC due construction activities encroaching and crossing a narrow portion of its northern tip. A road easement currently exists where the proposed water supply pipeline will cross Redhead Marsh. Potential effects of construction, operation and decommissioning as well as mitigation measures will be similar to those discussed in Section 7.2.5, wetland resources.

7.2.11 Population and Labour Force

Population and Labour Force was identified as a VEC based on the effects Project-related activities may have on employment and economic activity in the community, region or province.

Potential effects include:

- local purchasing and Provincial fiscal contributions;
- service contracts;
- employment; and
- workforce spending.

As expenditures are made, the economy typically expands to meet these increased demands. The businesses that expand to fulfil increased demands will, in turn, increase their own purchases of goods, services and labour creating additional demand in the economy to be met by further increases in supply.

Economic impacts are dependent on the size and type of expenditures, and on the structure of the economy. The amount of the expenditures is important because the magnitude of the economic impacts is positively related to the amount of expenditure. The type of expenditure and the structure of the economy are important because to the extent that the required goods and services are produced locally, the local impact would be greater than if most of these items need to be imported.

7.2.11.1 Effects of Construction

During the construction of the Project, the purchase of materials and services from local businesses and industries, and the employment of local residents from the surrounding region constitute a pathway of concern. These activities introduce a measurable direct economic impact at the local community and regional level over the construction period. It is estimated that the economic effects resulting from Project construction would be distributed over a period of 5 years (Completion of Phase I, Phase II and Phase III).

Local Purchasing and Provincial Fiscal Contributions

It is estimated that the construction phase of the Project would result in a Gross Domestic Product contribution of $79 million. The tax impacts accruing to New Brunswick would be in the order of $9.3 million. Capital expenditures for the construction are forecasted at $152 million (APC, 2011).

Service Contracts and Employment

The construction of the Project is expected to be carried out by workforce crews totalling up to 1200 personnel over a period of approximately 18 months, totaling in an estimated $45 million in wages and salaries (APC, 2011). A range of skills will be required for the construction crews. Some of the workforce will require previous experience in order to perform specialized duties. Positions that require prior experience include but not limited to: steel and iron workers, electricians, heavy equipment operators, plumbing, etc. Several positions can be filled by those with only previous construction experience.

In addition to the construction crew, employees will also be required for warehousing, transportation, and equipment maintenance duties.

It is expected that a good portion of the construction crews will come from the local and surrounding areas. Subcontractor crews would be largely local hires. The construction jobs are primarily temporary and will only exist for the duration of the construction phase.

Workforce Spending

It is anticipated that a number of the workforce on this Project will not be from the local area and will therefore require temporary lodging and food services. Workers may require either weekly/monthly rental accommodation. Overall, it can be expected that spending by the construction crew will contribute to the local economy through spending for local services.

7.2.11.2 Effects of Operation

During the operational life of the Project, annual expenditures from New Brunswick sources is estimated to be $344 million, generating Provincial tax contributions of $9.5 million each year. The Gross Domestic Product contribution would be $81.4 million per year (APC, 2011).

The assessed value of the two fertilizer plants is anticipated to be approximately $50 million. Based on the Provincial as well as the City of Saint John rates, the property tax contribution would be approximately $2 million each year.

Upon completion of construction, there will be more than 350 new jobs for the operation phase of the facilities. Each year for the duration of the operation of the APC Fertilizer Production Facilities, $16.8 million is projected to be spent on wages and salaries.

7.2.11.3 Effects of Decommissioning

Economic benefits have not been calculated for the decommissioning phase as the after use concept, specific decommissioning activities, and time tables have not been sufficiently defined. Decommissioning costs often approximate construction capital costs and are anticipated to generate significant economic benefits. Decommissioning activities will include works and services related to building and equipment demolition, infrastructure removal, and probably earth works, site contouring and re-vegetation. Decommissioning can be expected to be of rather short duration (many months up to a year) relative to the operation phase.

7.2.11.4 Mitigation

APC is working to inform the local business communities and labour organizations of the opportunities arising from the construction, operation and maintenance of the Project. Information will detail the items that will be purchased, the contracts that will be awarded and the skills required by workers.

7.2.11.5 Summary and Residual Effects

If the recommendations are followed, an increase in the economic impact of the Project will be felt in Saint John and the surrounding region.

7.2.12 Utility Corridors

Utility corridors were identified as a VEC based on the effects Project-related activities may have on disruption of service lines within McAllister Industrial Park. Potential effects include:

- interrupted service to local users;
- hazardous materials spill; and
- health and safety effects.

An oil pipeline belonging to JD Irving is buried 5 m below the Project Footprint, running southerly to the refinery at Canaport (S. Arsenault, pers. comm.). An NB Power transmission line runs through the Footprint of the proposed Project, running southwards. In addition, several service distribution lines currently exist within McAllister Industrial Park, which APC plans to access for support of facility operations such as:

- Emera Natural Gas;
- Saint John Water;
- Saint John Sewer;

- NB Power Electricity; and
- communication lines.

7.2.12.1 Effects of Construction

Service Disruption

Damage to underground pipelines and communication lines, or to above-ground power and communication infrastructure, during construction could result in the disruption of service to other users, including neighbouring facilities within the McAllister Industrial Park. The significance of the disruption will depend on the infrastructure damaged, the number of users affected and the cost and time required for repairs.

Hazardous Materials

Hazardous materials that could potentially be released as a result of service line disruption include oil and natural gas. The severity of the effect resulting from an accidental release of hazardous material will depend on the quantity released, characteristics of the contaminants, and local hydrogeologic characteristics. In areas containing thick deposits of low permeability soil, the migration of contaminants will be impaired and quick response to the release will result in minimal effects on groundwater quality, but more significant effects to wildlife habitat. In areas of shallow, fractured bedrock and/or high hydraulic conductivity, an accidental release may potentially affect a larger downgradient area.

Accidental releases of hazardous materials may cause the concentrations of some parameters in the affected groundwater to exceed the Guidelines for Canadian Drinking Water Quality (Health Canada, 2012). Fish habitat quality (e.g. brook trout spawning, nursery, and/or rearing habitat) may be impaired until the contaminated is completely remediated. There is potential for accidental releases to result in significant effects. Although prevention and response procedures will be established for hazardous materials, mitigation measures are nevertheless required to ensure the potential effects of accidental spills are minimized.

Health and Safety

Health and safety of construction personnel as a result of utility damage could include exposure to hazardous materials or sewage in the event of a spill, or electrocution if the NB Power transmission is contacted accidentally. Health effects of POL may occur through direct skin contact, inhalation or ingestion. Electrocution may be the result of direct contact to an electrical source or conduction through work equipment, water or other people.

7.2.12.2 Effects of Operation

There are no potential effects anticipated during the operational phase of the Project with respect to the utility corridors. All utility owners will be notified should a disruption or emergency occur.

7.2.12.3 Effects of Decommissioning

Impacts to utilities during decommissioning are expected to be comparable but less extensive than during construction. All utility owners will be notified when decommissioning commences and most likely the infrastructure will remain in place for future use.

7.2.12.4 Mitigation

During the design and construction of the Project, a number of buried pipelines and above-ground wiring will need to be located and avoided to prevent negative effects to public health, the environment and services to local users.

The principal means for minimizing the potential for effects related to accidental releases of hazardous materials is to ensure that contractors and workers have an adequate awareness of environmental sensitivity, and that they incorporate appropriate prevention and response measures in their construction practices. In all cases, where there will be a distance of one metre or less between the proposed Project and underground service, a standard “call before you dig” directive should be included in the contractor’s specifications. This will involve locating all service lines prior to commencing construction activities and posting proper signage. A spill response plan will also be communicated. Strict on-site control and inspection programs will be conducted to ensure that mitigative measures and contingency plans are implemented effectively.

Prevention and preparedness is the key to prevent accidents from arising. APC will provide sufficient guidance, safety manuals, and first-aid courses to their employees to maximise the prevention of accidents. Emergency response planning will be based on APC’s EMP manual.

7.2.12.5 Summary and Residual Effects

The design of the Project facilities has taken the utility easement locations under consideration. It is not likely that significant adverse residual effects will result from Project interactions with proper implementation of the identified mitigation measures.

7.2.13 Community and Emergency Services

Community and emergency services was identified as a VEC based on the effects Project-related activities may have on the disruption of emergency services and interference with public safety.

7.2.13.1 Effects of Construction

The emergency services required for various components of the Project are similar to those required for other construction projects which involve heavy machinery. A review of the emergency service capabilities in the Study Area indicate that these communities have adequate services to respond to an emergency. Contractors must also have the capabilities to deal with medical emergencies as required by the *Occupational Health and Safety Act*.

The need for fire suppression services during the Project construction could arise through accidents or third party damages. Contractors are very aware of the costs associated with a fire. Consequently, a considerable effort is made to train employees and to maintain fire suppression equipment along the road allowance to minimize the risk of fire.

There are two issues of public concern associated with the construction phase of the Project. These are noise levels and potential accidents that might occur to non-authorized personnel after hours or to construction workers throughout the duration of the Project. Noise levels are discussed in Section 7.2.2.

With respect to unauthorized personnel, it is possible that a trespasser could fall into an open hole, have pipe roll onto them or hurt themselves on a piece of equipment. This potential is decreased by the installation of a barrier that is erected once construction activities begin. This is to prevent trespassers from exposing themselves to a potentially hazardous situation.

7.2.13.2 Effects of Operation

During operation, fertilizer plants have inherit risks associated with them. There are high risks for fire and explosions that could occur due to accidents and malfunctions. Health, safety and environment are the number one priority for APC and an extensive EMP will be developed to consider various scenarios and how to respond. Refer to Section 3.3.7 for more details.

7.2.13.3 Effects of Decommissioning

Impacts to community and emergency services during decommissioning are expected to be comparable but less extensive than during construction.

7.2.13.4 Mitigation

At all times, especially after hours, it is recommended that the working area be securely barricaded to prevent the general public from entering the site. In addition, signs warning of the dangers in and around the Project area should be clearly visible to all persons entering the site. All employees should also receive relevant safety training prior to their employment on Project related construction activities. This should apply equally to construction and environmental inspectors whether employed by the proponent, its contractors, or a monitoring agency.

During operation, all employees will aware of and employ EMP directives.

7.2.14 Heritage and Archaeological Resources

The results of the HRIA indicate that the area has low potential for heritage or archaeological resources. While numerous test-pits contained flecks of charcoal (indicators of possible cultural activity), no artifacts or soil features were associated with them. Therefore, these charcoal flecks were not considered to be of any archaeological significance. However, archaeological investigations and potential determination are based on modeling. Thus, there remains limited potential throughout any Project area to encounter buried heritage features that do not fit the present model.

7.2.14.1 Mitigation

No further investigations are recommended for this Project. This does not mean, however, that there are no heritage resources within the Project Footprint. Therefore, the following is recommended in order to protect potential heritage resources during the construction of the proposed Project, when impacts to these resources have potential to occur:

- Construction crews should be made aware of the potential for archaeological resources within their construction area.
- Archaeological resources protocols should be in place and adhered to during construction, in the event that possible archaeological resources or human remains are discovered. These protocols will be developed in consultation with the provincial regulator, ASNB. 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 (506) 453-3014. If such a find should occur when a permitted archaeologist is either on-site or on-call, the permitted archaeologist will make the determination and report the find to ASNB.

7.2.14.2 Summary and Residual Effects

With proper implementation of the mitigative measures identified, it is not likely that any significant adverse residual effects will result from the Project.

7.3 Effects of the Environment on the Project

Project infrastructure are subject to the nature of the environment in which they are located. The two main concerns identified for the Project is the potential for land movement (e.g. seismic events) as well as severe weather. A significant effect on the environment on the Project would be one that results in:

- a long term delay in Project schedule during construction;
- a long term interruption in service during operation;
- damage to plant-site infrastructure such that human health and safety is at risk; or
- damage to plant-site infrastructure that would not be technically or economically feasible to repair.

Minor effects of the environment on the Project would be ones that result in a short term delay in construction schedule, frequent short-term disruptions in service, and increased operating or maintenance costs.

7.3.1 Severe Weather

Stormy weather is commonplace in New Brunswick throughout the year with thunderstorms occurring on average between 10 to 20 days. Generally New Brunswick’s storms are more severe and frequent during the winter months, packing strong winds with rain, freezing rain, and snow mixes (EC, 1990). In recent years, New Brunswick has been experiencing more extreme storm and rainfall events. Future trends predict total precipitation increasing and mostly in the form of rain. All this combined will have for effect more frequent flooding of low-lying areas, increased soil erosion and water contamination, increased risks of forest fire, as well as increased risk for new pests and invasive species to become established (NBDELG, 2014).

Heavy rain can result in stoppages of outdoor work, particularly during construction. If unusual wet periods or excessive rain do occur, this can result in Project delays and an associated delay in completion and additional cost. Heavy rainfall events may also cause work-site erosion during the construction phase. A potential exists for failure of erosion and sediment control structures due to such precipitation events. Such a failure could result in the release of a large quantity of sediment-laden runoff to receiving watercourses with potential adverse environmental effects on fish and fish habitat. Local flooding may occur at work sites during extreme precipitation events.

Severe snowfall can affect winter construction or contribute to unusual flooding during snowmelt. It has the potential to increase structural loadings on facility and temporary buildings. Exceptional early snowfall could delay construction and result in additional work for snow clearing and removal. This could increase construction costs. Early snow cover can minimize or prevent ground freezing and this may also affect winter construction intended at improving work progress and accessibility. Freezing rain, hail, ice and snow can interfere with the operation of vehicles on the highway, as it can cause slippery driving conditions and limit visibility.

Dense inland fog is more prevalent in late spring and early summer. Chilled air above southerly-flowing ocean currents mixing with warm, moisture-laden air moving from the Gulf Stream can generate bands of thick, cool fog off the coast. Dense fog originating inland may reduce visibility and can interfere with the operation of vehicles on the highway. With onshore winds, fog banks can move far inland and can interfere with the operation of vehicles near the coast.

7.3.2 Seismic Activity

New Brunswick 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. In summary, the potential for seismic activity in the region is low.

Saint John lies within the Northern Appalachians seismic zone, which includes most of the Province. Several earthquakes have been recorded in this zone to reach magnitudes (MN) of 5 to 6. Epicentres are clustered in the Moncton and Passamoquody Bay regions, where the most recently “felt” earthquake occurred in March 2012, registering at 3.4 MN in the Central Highlands. New Brunswick has also felt the effects from more distant earthquakes centered in Quebec and the Grand Banks. Seismic activity New Brunswick is believed to be related to the regional stress fields, with the earthquakes concentrated in regions of crustal weakness (NRCan, 2011).

All buildings that are constructed as part of the Project will conform to Canadian Building Codes and will consider potential seismic activities.

No potential for interaction of the Project with seismic events is anticipated due to the low frequency and seismic forces anticipated in the area, and thus there will be no adverse effects on the Project.

7.3.3 Mitigation

As part of the ongoing Project pre-design a number of features have been integrated with proposed Project works and activities that have been specifically designed to minimize the potential for adverse effects of environmental conditions on the Project. These measures include:

- Dimensioning the stormwater management system for low frequency storm events (1 in 100 year, 24 hour, rain events; dimensioning will consider most up-to-date Intensity, Duration and Frequency information such as that provided by EC (http://climate.weatheroffice.ec.gc.ca/prods_servs/index_e.html) as well as the latest research on the potential for the increased frequency of such events.
- Implementation of erosion and sedimentation control plans during the construction phase.
- Scheduling of Project works, i.e. ensuring surface water management infrastructure is in place before the start of large excavation and earth works.

7.3.4 Summary and Residual Effects

Taking all mitigation measures into account, no interactions between the environment and the Project during any of the Project phases were identified to affect the Project to such a degree that the residual adverse effects on any of the VECs would be considered significant.

In the detailed Project planning and FEED stage severe weather conditions, will be taken into consideration. No potential for adverse effects from seismic events has been identified due to the infrequent occurrence and limited magnitude of any such events in the region. In addition to Project features inherent to the design, the operation will include routine inspection, monitoring, and maintenance. This will ensure that damage to any of the design features or operational aspects will be identified and corrected.

7.4 Follow-up and Monitoring

The Project will include the implementation of comprehensive monitoring programs (Table 7.7 below). These monitoring programs are the responsibility of APC, and will be integrated into contractual arrangements with contractors and site workers. These programs will be fully documented in the Project EMP.

The objectives of the monitoring programs are to:

- assist in verifying effects predictions of the EIA;
- confirm effectiveness of the mitigation measures proposed in the EIA;
- determine the need for new mitigation strategies as required to address unanticipated;

- adverse effects and/or ineffective mitigation;
- ensure proper implementation of the mitigation measures outlined in the EIA; and
- ensure compliance with regulatory permits, approvals, and requirements.

Environmental management features for the Project include monitoring and maintenance programs such as EEM and ECM. These environmental management features will be refined and expanded on throughout the Project design. The EMP includes EEM for several VECs such as surface water quality, fish and fish habitat, including monitoring of the new surface water course/channel for stability and functioning.

Monitoring programs outlined in Table 7.7 will be designed to verify the effectiveness of the mitigative measures. The details of the monitoring programs (e.g. monitoring frequency/duration, specific locations, parameters, and reporting) will be determined in consultation with regulatory agencies and documented in the EMP.

Prior to the decommissioning and abandoning of the Project facilities, APC will develop a decommissioning plan. The plan will specify decommissioning objectives, approach, activities, schedules, and site rehabilitation and will be developed in consultation with regulatory agencies. The details of the decommissioning monitoring will be determined on the basis of the decommissioning plan and in consultation with regulatory agencies and documented in the Project EMP.

Table 7.7 Monitoring Programs

VEC	Monitoring Area/Locations	Objective	Preconstruction	Construction	Operation	Decommissioning
Air Quality	Construction areas and dirt roads. Fertilizer processing plant.	• Ensure that dust abatement is effective. • Ensure that levels of TSP, NO_2, SO_2 and CO are within Approval to Operate requirements.		✓	✓	
Surface Water Resources	Watercourses impacted by Project activities.	• Ensure that erosion and sediment measures are effective.		✓		
Wetland Resources	Wetland area impacted by Project activities.	• Ensure successful implementation of wetland mitigation measures and detect and remove introduced plant species before they become invasive. • Ensure that erosion and sediment control measures are effective. • Ensure that site hydrology is not impacted by Project site construction. • Identify unintended negative impacts (if any) and develop additional mitigation (if required).		✓		
Fish and Fish Habitat	Watercourses impacted by Project activities.	• Identify unintended negative impacts (if any) and develop additional mitigation (if required).		✓		
Heritage and Archaeological Resources	Construction areas.	• Ensure that archaeological resource protocols are in place and adhered to during construction.		✓		

7.5 Cumulative Effects

The effect of a project on the environment may not be fully reflected by the individual interactions of project components or activities with VECs. In many cases, individual projects and/or project components produce environmental effects that are not significant. However, when cumulatively combined with the effects of other project components or other projects and activities, these small effects may become important.

The basis for considering which of the cumulative environmental effects should be addressed, are provided in the Responsible Authority's Guide (the Agency, 1994), and supplemented by the Cumulative Effects Practitioners Guide (Hegmann et al., 1999). The assessment has considered any potential cumulative effects that may result from the Project construction or operation in concert with any other projects and activities known for the reasonably foreseeable future (five years). The assessment of cumulative effects is done between both the Project and other projects and between Project components.

Information on current and future projects and activities came from several sources including the federal and provincial environmental assessment registries, the Saint John City Hall, the New Brunswick Department of Transportation, and through the stakeholder and public consultation programs.

Air quality is the main VEC considered to result in a potential cumulative effect. An assessment of cumulative impacts on air quality was performed by adding the predicated dispersion modeling results from the location with the highest predicted annual average ground level concentration to the air monitoring data obtained from NBDELG air quality monitoring network 2009 and 2010 results for Saint John for the NO_2, SO_2, and $PM_{2.5}$ parameters, and then comparing the calculated values to the New Brunswick ambient air quality objectives. Refer to Table 7.8 for a summary of estimated cumulative impacts for locations with the highest average annual Ground Level Concentrations (GLCs).

Table 7.8 Assessment of Cumulative Effects

Pollutant	Averaging Time Period	Saint John Monitoring Results (A)	Highest Annual GLCs (B)	Cumulative Impacts (A) + (B)	New Brunswick Annual Objectives
NO_2 (µg/m^3)	Annual	5.1(1)	5.5(1)	10.6	100
SO_2 (µg/m^3)	Annual	3.1(1)	0.00007(1)	3.10007	30
$PM_{2.5}$ (µg/m^3)	Annual	7.2(2)	0.8(2)	8	10
CO (mg/m^3)	1 hour	NA	-	NA	NA

Notes : (1) Annual average for NO_2 and SO_2 are from the Champlain Heights air monitoring location for the Year 2009. The data is calculated based on monthly averages from the 2009 New Brunswick Department of Environment report *Ambient Air Monitoring Results*. http://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/Air-Lair/2009AirQualityReport.pdf

(2) Annual averages for $PM_{2.5}$ is from the Champlain Heights air monitoring location for the Year 2010.

A comparison of the calculated cumulative impact concentrations with New Brunswick annual objectives indicate that all values are lower than the objectives.

8.0 CONCLUSIONS

This EIA has been compiled for the proposed construction and operation of a three-phased potash refinery and fertilizer production facility. This assessment consisted of a description of the proposed Project, documentation of the results of field surveys conducted to date, consideration of potential effects on the environment resulting from the proposed Project (as described in Section 3.0). A description of the existing environment in the region has been presented (see Section 5.0) based on available information and results of field surveys conducted in 2011 to 2013. The VECs identified by issue scoping and pathway analysis (see Section 6.0) for which potential effects may be a concern included:

- air quality and climate change;
- acoustic environment;
- surface water;
- groundwater resources;
- wetland resources;
- wildlife;
- migratory birds;
- fish, fish habitat and fishery resources;
- species at risk;
- designated areas;
- local economy;
- utility corridors;
- community and emergency services; and
- heritage and archaeological resources.

The effects of the Project were assessed for each of the identified VECs. The assessment took into account all Project works and activities associated with the construction, operation and decommissioning phases and included regular activities as well as malfunctions and accidental events. Based on plausible Project-environment interactions, potential adverse effects were identified.

Relevant Project-inherent environmental management measures were reviewed and additional mitigation measures developed. Considering these management and mitigation measures, residual effects were identified and assessed. The significance of the residual effects was determined on a set of prescribed criteria. All residual effects were considered to be non-significant (minimal or minor) during each of the Project phases (construction, operation and decommissioning phases).

It was concluded that the Project is not likely to have significant adverse effects on the environment. It is predicted that the Project will have major beneficial local and regional economic effects, including major increases in the local and regional employment numbers.

The potential for negative environmental effects has been discussed in Section 7.0. No major impacts were identified. Based on the findings of this report, given the proposed mitigation, monitoring and compensation, there will be no significant residual negative effect resulting from the Project.

9.0 REFERENCES

9.1 Literature Cited

AMEC Environment & Infrastructure, a division of AMEC Americas Limited (AMEC). 2011. Preliminary Field Survey Route 1 Gateway (Upgrade) Project St. Stephen to Salisbury, Charlotte, Saint John, and Kings Counties, NB. Submitted to: Archaeological Services Unit, Heritage Branch New Brunswick Department of Wellness, Culture and Sport, Fredericton, New Brunswick. Issued, February 2011.

AMEC Environment & Infrastructure, a division of AMEC Americas Limited (AMEC). 2012. Preliminary Heritage Resource Impact Assessment McAllister Industrial Park Project, Saint John, Saint John County, New Brunswick. Submitted to: Archaeological Services Unit, Heritage Branch New Brunswick Department of Tourism, Heritage and Culture, Fredericton, New Brunswick. Issued, May 2012.

Anderson, P.G., B.R. Taylor, and G.C. Balch. 1996. Quantifying the Effects of Sediment Release on Fish and their Habitats. Canadian Manuscript Report of Fisheries and Aquatic Sciences 2346: 110 p. + 3 Appendices.

Andrén, H. 1994. Effects of Habitat Fragmentation on Birds and Mammals in Landscapes with Different Proportions of Suitable Habitat: A Review. Oikos 71:355-366.

Anonyme. 1702. Untitled Map. Copy on file AMEC office, Fredericton, NB.

Anonymous. 1686. Baye et Entrée de la riviere St. Jean. NB Archives ref. H2/210 – R. St. Jean. ANC.

Anonymous. 1791. Plan of the City and Harbour of St. John in the Province of New Brunswick Bay of Fundy from actual survey. NB Archives reference Dup 1791 Tray5 M243 #217-3.

Appleby, J.P. and D.J. Scarratt. 1989. Physical effects of suspended solids on marine and estuarine fish and shellfish with special reference to ocean dumping: A Literature Review. *Can. Tech. Rep. Fish. Aquat. Sci.* 168:v + 33 p.

Archaeological Services Unit, NB. 2012. Guidelines and Procedures for Conducting Professional Archaeological Assessments in New Brunswick. Archaeological Services Unit, Heritage Branch, Department of Culture, Tourism and Healthy Living, New Brunswick. 31 July, 2012.

Atlantic Canada Conservation Data Centre (ACCDC). 2014. Data report - Response to a data request; Species of Conservation Concern within a 5 km radius.

Atlantic Potash Corporation (APC). 2011. Proposal for the Right to Explore and Develop an Advanced Potash Prospect on the Millstream Potash Deposit, South-Central New Brunswick. 6 June, 2011.

Atlantic Potash Corporation (APC). 2014. Online, Available: www.apcpotash.com.

Beale, C.M. 2007. The behavioural ecology of disturbance responses. International Journal of Comparative Psychology 20:111-120.

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.

Blair, Susan E. 2004. Ancient Wolastoq'kew Landscapes: Settlement and Technology in the Lower Saint John River Valley, Canada. PhD dissertation, University of Toronto.

Blumstein, D.E. Fernandez-Juricic, P. Zollner, and S. Garity. 2005. Inter-specific variation in avian responses to human disturbance. Journal of Applied Ecology 42:943-953.

Bond, W.K., K.W. Cox, T. Heberlein, E.W. Manning, D.R. Witty and D.A. Young. 1992. Wetland Evaluation Guide. Final Report of the Wetlands are Not Wastelands Project. North American Wetlands Conservation Council (Canada). Issues Paper, No. 1992-1, 121 p.

Brunswick Engineering & Consulting Inc. 2014. Geotechnical Investigation Proposed Fertilizer Plant McAllister Industrial Park Saint John, New Brunswick. File 2062.02 – R01 February 2014.

Burgess, R.L. and Sharpe, D.M. (eds.). 1981. Forest Island Dynamics in Man-Dominated Landscapes. Springer, New York.

Business Research & Economic Advisors (BREA). 2008. The Economic Contribution of the International Cruise Industry in Canada 2007. Available: http://nwcruiseship.org/downloads/site4/Canadian%20Economic%20Impact%20Analysis%202007.pdf.

Canadian Broadcasting Corporation (CBC) News. 2013. Tornado winds hit 175 km/h, Environment Canada determines. Posted: 24 July, 2013. Available: http://www.cbc.ca/news/canada/new-brunswick/tornado-winds-hit-175-km-h-environment-canada-determines-1.1324053.

Canadian Council of Ministers of the Environment (CCME). 1999 (updates). Canadian Water Quality Guidelines, 1999 with updates. Available on-line at: http://ceqg-rcqe.ccme.ca/en/index.html#void.

Canadian Council of Ministers of the Environment (CCME). 2000. Canadian Wide Standards for Particulate Matter (PM) and Ozone. June, 2000. Accessible: http://www.ccme.ca/assets/pdf/pmozone_standard_e.pdf.

Canadian Environmental Assessment Agency (the Agency). 1994. Responsible Authority's Guide.

Canadian Rivers Institute. 2011. The Saint John River: A State of the Environment Report. University of New Brunswick.

Champlain, S. de. 1612. Carte Geographic de la Nouvelle France. NB Archives. Accessed March 2012.

City of Saint John. 2011. Saint John Harbour Clean-Up Report to Common Council, M&C 2011 – 256 1st November, 2011.

Clayden, S.R., D.F. McAlpine, and C. Guidry. 1984. Rare and Vulnerable Species in New Brunswick. Publications in Natural Science No. 2. The New Brunswick Museum.

Colpitts, Mark C., Sherif H. Fahmy, John E. MacDougall, Tom T.M. Ng, Bryce G. McInnis, and Vincent F. Zelazny. 1995. Forest Soils of New Brunswick. CLBRR Contribution No. 95-38. NB Department of Natural Resources and Energy, Timber Management Branch.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2012. Available at: www.cosewic.gc.ca/eng/sct5/index_e.cfm.

Department of Canadian Heritage. 2010. Saint John Designated One of the 2010 Cultural Capitals of Canada. Available: http://www.pch.gc.ca/eng/1294862457461/1294862457463.

Dignam, D.J. and Blair, S. 2011. Site BgDq-38: New Brunswick's First Intact Palaeoindian Site. Paper presented at the Canadian Archaeological Association 2011 Annual Meeting. May 2011, Halifax, NS.

Dignam, D.J., Blair, S., and Blair, C. 2012. The Preliminary Assessment of Site BgDq-38, New Brunswick's First Intact Palaeoindian Site. Paper presented at the Society of American Archaeology 2012 Annual Meeting. April 2012:Memphis, TN.

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

Ducks Unlimited Canada (DUC). 2006. Coastal Wetland Restoration Shows to Boost Public's Awareness. Flyway, Vol 27, No. 2.

Enterprise Saint John. 2012. The Greater Saint John Economic Development Agency, Inc. Available: http://www.enterprisesj.com.

Environment Canada (EC). 1985. Atlantic Provinces – Active Hydrometric Stations. Produced by the Water Resources Branch, Inland Waters Directorate, Ottawa, 1986.

Environment Canada (EC). 1990. The Climates of Canada. Government of Canada. 181 pp.

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

Environment Canada (EC). 2009. Background Paper on Reporting of Particulate Matters from Road Dust. Historical NPRI Consultation Documents. Created 2007; last reviewed January 2009. Accessible: www.ec.gc.ca/inrp-npri/default.asp?lang=en&n=94B5F164-1&printerversion=true.

Environment Canada (EC). 2013. Canada's Emission Trends. Available : http://www.ec.gc.ca/ges-ghg/985F05FB-4744-4269-8C1A-D443F8A86814/1001-Canada%27s%20Emissions%20Trends%202013_e.pdf.

Environment Canada (EC). 2014a. Canadian Climate Normals 1981-2010 Station Data. Saint John A* New Brunswick. Date Modified 2014-05-15. Website: http://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?stnID=6250&lang=e&StationName=Saint+John+A&SearchType=Contains&stnNameSubmit=go&dCode=1&dispBack=1.

Environment Canada (EC). 2014b. Facility & Substance Information – 2013 NPRI Data. Last modified: June 5, 2014. Available: http://ec.gc.ca/inrp-npri/donnees-data/index.cfm?do=facility_substance_summary&lang=en&opt_npri_id=0000003394&opt_report_year=2012.

Environment Canada (EC). 2014c. Canada's Emissions Trends 2012. Last modified: October 18, 2013. Available: http://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=022BADB5-1#Toc330988444.

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

Food and Agriculture Organization of the United Nations. 2010. Current World Fertilizer Trends and Outlook to 2014. Available: ftp://ftp.fao.org/ag/agp/docs/cwfto14.pdf.

Fort La Tour Development Authority and Archaeological Services, Municipalities, Culture & Housing. 1992. FORT LA TOUR Crossroads of New Brunswick History: A Proposal for Development. New Brunswick: Archaeological Services, Municipalities, Culture & HousingFranzmann, A.W. 1978. Moose. Big Game of North America, Ecology and Management. P.67-81. Stackpole, Pa.

Gammon, J. R. 1970. The effect of inorganic sediment on stream biota. Environmental Protection Agency, Water Quality Office. Washington, D.C. pp 1-142, Water Pollution Control Research Series.

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.

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.

Hamilton, W. B. 1996. Place Names of Atlantic Canada. Toronto: University of Toronto Press.

Hanson, A.R. and L. Calkins. 1996. Wetlands of the Maritime Provinces: Revised Documentation for the Wetlands Inventory. Technical Report No. 267. Canadian Wildlife Service. Atlantic Region.

Harper, J. Russell. 1956. Portland Point: Crossroads of New Brunswick History – A Preliminary Report of the 1955 Excavation. Historical Studies No. 9, Saint John: Publications of the New Brunswick Museum.

Harris, Cyril. 1979. Handbook of Noise Control. McGraw-Hill Book Company.

Health Canada. 2010a. Information for Environmental Assessments. Cat. H128-1/10-599E. 18pp.

Health Canada. 2010b. Noise from Machinery Intended for the Workplace. Health Canada Consumer and Clinical Radiation Protection Bureau (Acoustics) Notice to Stakeholders. August 2010. Accessible: www.hc-sc.gc.ca/ewh-semt/noise-bruit/machinery-machines-eng.php.

Health Canada. 2012. Guidelines for Canadian Drinking Water Quality. Federal-Provincial-Territorial Committee on Drinking Water of the Federal-Provincial Territorial Committee on Health and the Environment. August 2012. Available: http://www.hc-sc.gc.ca/ewh-semt/alt_formats/pdf/pubs/water-eau/2012-sum_guide-res_recom/2012-sum_guide-res_recom-eng.pdf.

Hegmann, G., C. Cocklin, R. Creasey, S. Dupuis, A. Kennedy, L. Kingsley, W. Ross, H. Spaling and D. Stalker. 1999. Cumulative Effects Assessment Practitioners Guide. Prepared by AXYS Environmental Consulting Ltd. and the CEA Working Group for the Canadian Environmental Assessment Agency, Hull, Quebec.

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

Holland, S. 1758. Untitled map of Saint John Harbour. Source unknown.

Horizon Health Network. 2013. Saint John Regional Hospital. Available: http://www.horizonnb.ca/home/facilities-and-services/facilities/saint-john-regional-hospital.aspx.

Hynes, H.B.N. 1960. The Biology of Polluted Waters. Liverpool University Press, 202pp.

Jeandron, J., Turnbull, C., and Blair, S. 2000. Revisiting Portland Point: Archaic and Maritime Woodland Components from the Mouth of the Saint John River, New Brunswick. Conference paper presented at the Canadian Archaeological Association Annual Meeting, 2000, Ottawa.

Karieva, P. 1987. Habitat-fragmentation and the Stability of Predator-prey Interactions. Nature 326:280-290.

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.

LaLanne. 1684. Coast of Acadia. Reproduced in Acadiensia Nova. Editor Wm. Inglis Mores. 1936. VII Map B.

Larkin, R.P. 1996. Effects of military noise on wildlife: a literature review. US Army Construction Engineering Research Laboratories Technical Report 96/21. January 1996.

Leonard, K. 2005. Archaeological Test Excavations at Hazen Creek Wastewater Treatment Plant Expansion, Saint John, New Brunswick. Submitted to CBCL Ltd. Consulting Engineers. Halifax, N.S. 23 September, 2005.

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/.

McCarthy, C. 1751. Plan-de-la-riviere St. Jean. Reproduced in NB Historical Society undated document, Pg. 36.

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

Natural Resources Canada (NRCan). 2011. Earthquakes Canada: New Brunswick. Available: http://earthquakescanada.nrcan.gc.ca/zones/NASZ/nbrunswick-eng.php.

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

NatureServe. 2012. NatureServe Explorer: An Online Encyclopedia of Life. Available: www.natureserve.org/explorer.

New Brunswick Department of Environment (NBDENV). 2005. Protecting Sources of Municipal Drinking Water: An Overview of New Brunswick's Wellfield Protection Program. March 2005. Available: http://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/Water-Eau/WellfieldProtection.pdf.

New Brunswick Department of Environment (NBDENV). 2008a. New Brunswick Groundwater Chemistry Atlas: 1994-2007. Sciences and Reporting Branch, Sciences and Planning Division, Environmental Reporting Series T2008-01.

New Brunswick Department of Environment (NBDENV). 2011a. New Brunswick Air Quality Monitoring Results, Report for 2009. Environmental Reporting Series. Accessible: http://www2.gnb.ca/content/gnb/en/departments/elg/environment/content/air_quality.html

New Brunswick Department of Environment (NBDENV). 2011b. Online Well Log System (OWL). Accessed 2011: http://app.elg-egl.gnb.ca/0375-0001/.

New Brunswick Department of Environment and Local Government (NBDELG). 2001. An Introduction to Air Quality in New Brunswick. Available: http://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/Air-Lair/IntroductionAirQuality.pdf.

New Brunswick Department of Environment and Local Government (NBDELG). Undated. New Brunswick Water Quantity Information: Annual Water Resources Summary 2011. Accessed 2013: http://www.gnb.ca/redirect/0009/0371/0007/2011/2011-E.asp.

New Brunswick Department of Environment and Local Government (NBDELG). 2012a. A Guide to Environmental Impact Assessment in New Brunswick.

New Brunswick Department of Environment and Local Government (NBDELG). 2012b. New Brunswick Air Quality Monitoring Results 2010. New Brunswick Environmental Reporting Series. Available: http://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/Air-Lair/AirQualityMonitoringResults2010.pdf.

New Brunswick Department of Environment and Local Government (NBDELG). 2013a. New Brunswick Air Quality Monitoring Results 2011. New Brunswick Environmental Reporting Series. Available: http://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/Air-Lair/AirQualityMonitoringResults2011.pdf.

New Brunswick Department of Environment and Local Government (NBDELG). 2013b. Designated Wellfield Protected Areas. Undated. Accessed 2014: http://www2.gnb.ca/content/gnb/en/departments/elg/environment/content/water/content/wellfield_protectionprogram/wellfield_protected_areas.html.

New Brunswick Department of Environment and Local Government (NBDELG). 2014. New Brunswick Climate Change Action Plan 2014-2020.

New Brunswick Department of Health. 2012. Drinking Water Quality Guidelines in New Brunswick. Available:

http://www2.gnb.ca/content/gnb/en/departments/ocmoh/healthy_environments/content/drinking_water_guidelines.html.

New Brunswick Department of Natural Resources (NBDNR). 2007. Topographic Data.

New Brunswick Department of Natural Resources (NBDNR). 2009a. Biodiversity Strategy: Conserving biodiversity and using biological resources in a sustainable manner. June 2009. Available: http://www2.gnb.ca/content/dam/gnb/Departments/nr-rn/pdf/en/ForestsCrownLands/Biodiversity.pdf

New Brunswick Department of Natural Resources (NBDNR). 2009b. Be sustainable in this place: A balanced management approach for New Brunswick's Crown Forest. 2009.01. Available: http://www2.gnb.ca/content/dam/gnb/Departments/nr-rn/pdf/en/ForestsCrownLands/BMAF.pdf.

New Brunswick Department of Natural Resources (NBDNR). 2011. Forest Inventory Data.

New Brunswick Department of Natural Resources (NBDNR). 2012a. Wildlife: Species At Risk. Available: http://www2.gnb.ca/content/gnb/en/departments/natural_resources/wildlife/content/SpeciesAtRisk.html.

New Brunswick Department of Natural Resources (NBDNR). 2012b. Candidate Protected Natural Areas Site Selection. http://www2.gnb.ca/content/gnb/en/corporate/public_consultations/ProtectedNaturalAreas/selection.html.

New Brunswick Department of Natural Resources (NBDNR). 2013a. Old Forest Community and Old-Forest Wildlife Habitat Definitions for New Brunswick.

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 Fossil Database Project. 2007. 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.

New Brunswick Historical Society. 1984. Saint John: Its Beginnings and Glimpses of the Early Days. Collections of the New Brunswick Historical Society No. 22 Saint John: New Brunswick Historical Society.

Newcombe, C.P. 1994. Suspended Sediments in Aquatic Ecosystems: Ill Effects a Function of Concentration and Duration of Exposure. Habitat Protection Branch. British Columbia Ministry of Environment, Lands and Parks. Victoria, British Columbia, Canada 298 pg.

Noss, R.F. 1991. Landscape Connectivity: Different Functions at Different Scales. In: Hudson, W.E. (ed.) Landscape linkages and biodiversity. Island Press, Washington, D.C.

Parks Canada. 2013. Carleton Martello Tower National Historic Site of Canada. Date Modified: 2013-09-26. Date Accessed: 2014-11-21. Accessible: http://www.pc.gc.ca/eng/lhn-nhs/nb/carleton/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.

Roe and Colby. 1875. Atlas of Saint John City and County, New Brunswick. Compiled and drawn from official plans and actual surveys by F.B. Roe and N. Geo. Colby, assisted by J.C. Allison and others. St. John, NB, pp 66.

Saint John Industrial Parks (SJIP). 2014. McAllister Industrial Park. Accessible: http://www.saintjohnindustrial.ca/mcallister-industrial-park.

Saint John Multicultural & Newcomers Resource Centre Inc. 2013. http://www.sjmnrc.ca/sjmnrc/home.jsp.

Saint John Port Authority (SJPA). 2014. Accessible: (www.sjport.com).

Saint John Water. Undated. Accessed 2011: http://www.saint-john-foundation.nb.ca/Water%20Event/Drinking%20Water%20Challenges%20Today%20%26%20Tomorrow%20%5BCompatibility%20Mode%5D.pdf.

Saint John Water. 2014. Safe Clean Drinking Water Project – Project Update: 21 July, 2014. Accessed 2014: http://www.saintjohn.ca/en/home/cityhall/sjwater/drinkingwater/safecleandrinkingwater.aspx.

Saunders, D.A., Hobbs, R.J., and Margules, C.R. 1991. Biological Consequences of Ecosystem Fragmentation. Conservation Biology 5: 18-32.

Seaman, A., Stea, R., and Allard, S. 2011. The Appalchian Glacier Complex in the Canadian Maritime Provinces during the Illinoian and Wisconsinan. Geohydro 2011.ca Conference. 29 August, 2011, Quebec City.

Sherk, J.A., J.M. O'Conner, D.A. Neumann, R.D. Prince and K.V. Wood. 1974. Effects of suspended and deposited sediments on estuarine organisms, Phase II. Univ. Maryland, Nat. Resources Inst., Ref. No. 74-20.

Shuldiner, P.W., D.F. Cope, and R.B. Newton. 1979. Ecological effects of highway fills on wetlands. Research Report. National Cooperative Highway Research Program Report 218.

Species at Risk Public Registry (SARPR). 2011. Available at: http://www.registrelep-sararegistry.gc.ca.

Sproule. 1813. Untitled Map. Copy on file AMEC office, Fredericton, NB.

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

Stantec. 2011. Archaeological Assessment of Route 1 Proposed Upgrades (US Border to Sussex). Submitted to Archaeological Services, New Brunswick Department of Wellness, Culture and Sport.

Statistics Canada (StatsCan). 2007. Saint John, New Brunswick. 2006 Community Profiles. Available: http://www12.statcan.gc.ca/census-recensement/2006/dp-pd/prof/92-591/details/page.cfm?Lang=E&Geo1=CSD&Code1=1301006&Geo2=PR&Code2=13&Data=Count&SearchText=saint john&SearchType=Begins&SearchPR=13&B1=All&Custom=.

Statistics Canada (StatsCan). 2012. Saint John, New Brunswick. 2011 Census Profile. Available: http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/details/page.cfm?Lang=E&Geo1=CSD&Code1=1301006&Geo2=PR&Code2=13&Data=Count&SearchText=Saint%20John&SearchType=Begins&SearchPR=01&B1=All&GeoLevel=PR&GeoCode=1301006.

Tebo, L.B. 1955. The effects of siltation resulting from improper logging on the bottom fauna of a small trout stream in the southern Appalachians. *The Prog Fish Cult*. 55: 4 -64-70.

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.

United States Department of Interior. 2008. Resource Management Plan Navajo Reservoir Area Colorado and New Mexico – Final Environmental Assessment and Finding of No Significant Impact. June 2008. Bureau of Reclamation Upper Colorado Region Western Colorado Area Office Grand Junction – Durango, Colorado

United States Department of Transportation (US DOT). 2006. Construction Noise Handbook. Research and Innovative Technology Administration, Environmental Measurement and Modeling Division, Acoustics Facility. Accessible: www.fhwa.dot.gov/environment/noise/construction_noise/handbook/handbook09.cfm.

Waters, T.F. 1965. Interpretation of invertebrate drift in streams. Ecology 46:327-334.

White, D.J., E. Haber and C. Keddy. 1993. Invasive Plants of Natural Habitats in Canada. Prepared for Environment Canada, in Cooperation with Cdn. Museum of Nature. 121 p.

Wilcove, D.S., McLellan, C.H. and Dobson, A.P. 1986. Fragmentation in the Temperate Zone. In: Soulé, M.E. (ed.) Conservation Biology. The Science of Scarcity and Diversity. Sinauer, Sunderland, pp. 237-256.

World Health Organization (WHO). 1999 ed. Guidelines for Community Noise. Edited by Birgitta Berglund, Thomas Lindvall and Dietrich H Schwela. Available: http://www.who.int/docstore/peh/noise/guidelines2.html.

9.2 Personal Communications

Contact Name	Organization/Agency	Contacted Regarding
Arsenault, Scott	Irving Oil	Pipeline easement
Atwin, Roger	Chief, Maliseet Nation at Oromocto	Heritage Resources/Local History
Bourgeois, Vincent	ASNB	Archaeological Collections
Finley, Scott	New Brunswick Department of Tourism, Heritage and Culture, Heritage Branch	Historic Places and Structures
Fullerton, Jane	New Brunswick Museum	Potential Heritage Resources
Johnson, Susan	New Brunswick Department of Energy and Mines	Potential Acid Generating Rock
McCann, John	SJ Port Authority	Potash Export at SJ Port
Millar, Randall	New Brunswick Museum	Palaeontological Resources
Nicholas, Michael	ASNB	Archaeological Sites
Roy-McDougall, Vanessa	NatureNB	ESA
Seaman, A.	NBDNR	Geology
Suttie, Brent	ASNB	Archaeological Resources

APPENDIX A
GEOTECHNICAL SURVEY REPORT

GEOTECHNICAL INVESTIGATION
PROPOSED FERTILIZER PLANT
MCALLISTER INDUSTRIAL PARK
SAINT JOHN, NEW BRUNSWICK

submitted to

Atlantic Potash Corporation

by

Brunswick Engineering & Consulting Inc.

FILE: 2062.01 – R01
February 2014

BRUNSWICK
Engineering & Consulting Inc.

BRUNSWICK
Engineering & Consulting Inc.

40 Ashburn Lake Road
PO Box 1045, Saint John, NB
E2L 4E3

tel: 506.696.9155
fax: 506.696.9158
reception@brunswickengineering.ca

February 27, 2014

File: 2062.01 - R01

Atlantic Potash Corporation

Attention: Mr Keith Attoe, C.A., C.Dir., Director

RE: GEOTECHNICAL INVESTIGATION, PROPOSED FERTILIZER PLANT, MCALLISTER INDUSTRIAL PARK, SAINT JOHN, NEW BRUNSWICK

Please find attached our geotechnical investigation report which is based on the findings from the field investigations, working knowledge of this area and our understanding of this facility.

AT the time of this report, information on the proposed structures and units for the different plants was not known; therefore this report has been generalized. More detailed geotechnical design can be completed upon receiving more details on the proposed plants and units. Additional geotechnical investigations may be warranted based on the actual location of required infrastructure to service this site.

If any further information or clarification is required, please contact the undersigned

Stephen Perry, P. Eng.

Registered Professional Engineer
Province of New Brunswick
#M6347
Stephen Perry
Signature
Feb 27/14
Date
Province du Nouveau-Brunswick
Ingénieur immatriculé

SRP

Enclosures

GEOTECHNICAL INVESTIGATION
PROPOSED FERTILIZER PLANT
MCALLISTER INDUSTRIAL PARK
SAINT JOHN, NEW BRUNSWICK

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APPENDICES

GEOTECHNICAL INVESTIGATION
PROPOSED FERTILIZER PLANT
MCALLISTER INDUSTRIAL PARK
SAINT JOHN, NEW BRUNSWICK

1.0 INTRODUCTION

Brunswick Engineering & Consulting Inc. (Brunswick Engineering) was retained by Atlantic Potash Corporation to conduct a geotechnical investigation, located in the McAllister Industrial Park at the property identified by PID 00337386 & 00370429. See figure 1 for an overview plan of the site being investigated.

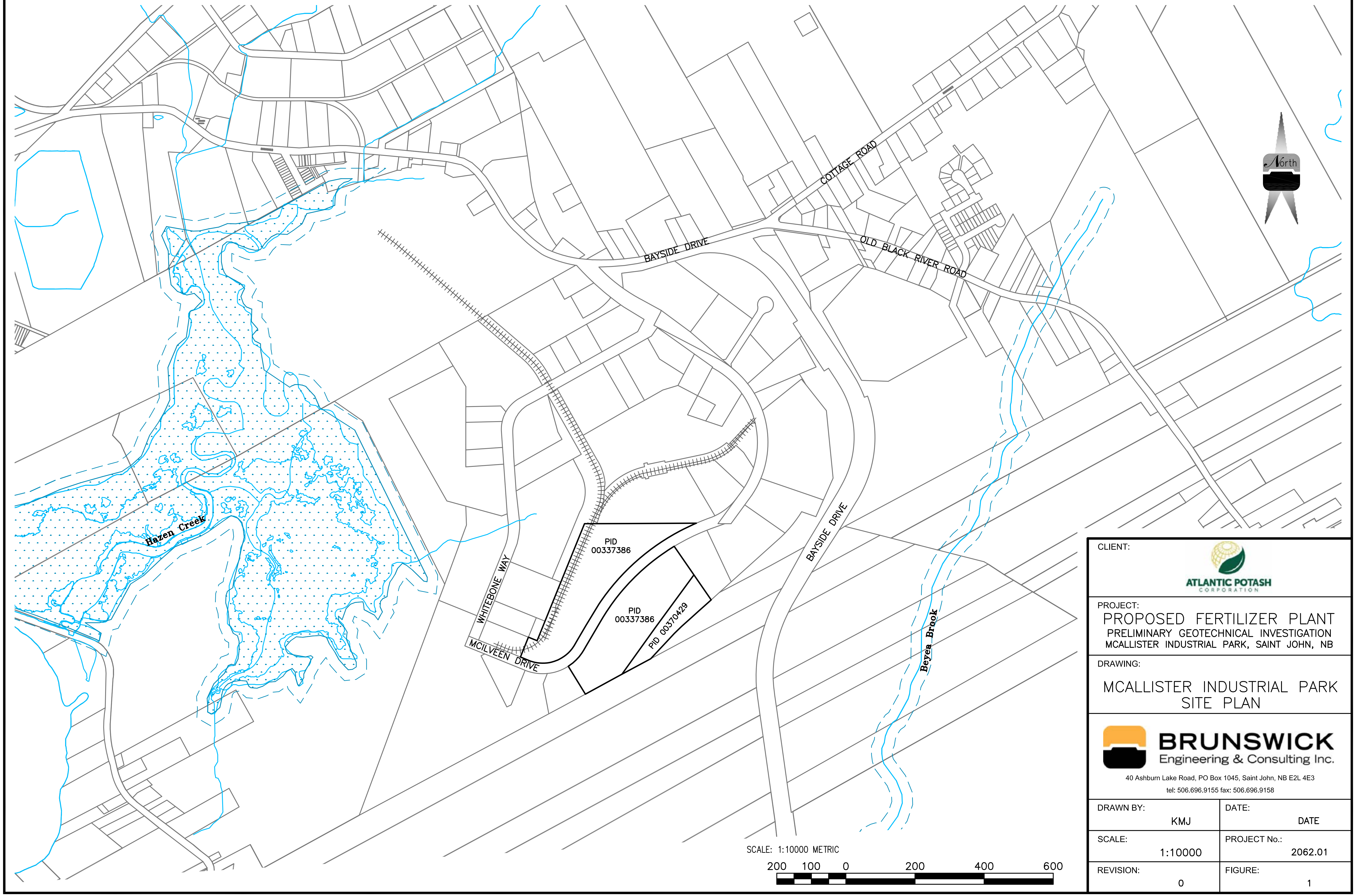
It is our understanding, that Atlantic Potash is proposing to construct a fertilizer plant at this location, taking raw resources such as potash and producing high grade fertilizer to sell on the world market. In order to process potash, there are several steps to refine and process the raw mineral resource and as such large processing units will be required. With the processing units there will be large machine, towers and stacks required to accommodate the different processes.

The purpose of this investigation was to determine the subsurface soil, bedrock and groundwater conditions at the site and provide preliminary geotechnical design and construction considerations. This report contains a general description of the site investigated as well as a summary of the work carried out, the factual findings and inferred assumptions based on the findings.

The investigation consisted of putting down eleven (11) boreholes at random locations across the property. The intent of the investigation was to obtain general soil conditions and to begin to determine the best area to locate the proposed operating units and buildings associated with this facility.

At the time of the investigation the proposed future plans/development for this site were fairly limited with conceptual plans being changed several times and therefore the geotechnical recommendations for this project are generalized and may not cover all aspects required for future design.

It is anticipated that once design is commenced on the fertilizer plant and it's operating units, additional boreholes will be required to obtain more specific geotechnical information to better understand the soil conditions within each unit and area.



CLIENT:

ATLANTIC POTASH CORPORATION

PROJECT:

PROPOSED FERTILIZER PLANT
PRELIMINARY GEOTECHNICAL INVESTIGATION
MCALLISTER INDUSTRIAL PARK, SAINT JOHN, NB

DRAWING:

MCALLISTER INDUSTRIAL PARK
SITE PLAN

BRUNSWICK
Engineering & Consulting Inc.
40 Ashburn Lake Road, PO Box 1045, Saint John, NB E2L 4E3
tel: 506.696.9155 fax: 506.696.9158

DRAWN BY: KMJ	DATE: DATE
SCALE: 1:10000	PROJECT No.: 2062.01
REVISION: 0	FIGURE: 1

2.0 PROPOSED DEVELOPMENT

At the time of this report, the actual site orientation, infrastructure, required foundations, units and plants were not known. It has been assumed that this project will be similar to other processing facilities and consist of a series of processing units, interconnected with pipe racks/ conveyors, serviced by boilers, towers, stacks and pressure units and complimented with a series of pumps, blowers and electric motors.

With a heavy industrial development like this, it is being assumed that the foundations will experience heavy dynamic loadings and the equipment will be sensitive to vibrations, settlement and more importantly differential movements. It is also anticipated that columns and stacks will be an integral part of the facility and as such will have high ground loadings with large overturning pressures. In addition to the operating units of the plant, concrete slabs, tanks, asphalt roadways, buildings, equipment pads will be required and each will have its own design requirements and considerations.

3.0 SITE CONDITIONS

The subject property is located in the McAllister Industrial Park on McIlveen Road in Saint John, New Brunswick. The subject property can be identified as PID 00337386 & 00370429. McIlveen Road runs from the southern edge of the parcel and extends northeast, with the road bisecting the parcel into two halves; one half being located to the east of McIlveen Road and the other being located on the west of McIlveen Road. For the purpose of this report the property will be treated as two parcels, with the two parcels being differentiated by "east side" and "west side". A site location map showing the location of the site is provided as figure 2.

3.1 East Side Site Conditions

The east side of the property is bound to the north by a commercial development which operates as an equipment rental and supply store. To the east are undeveloped vacant properties currently owned by the City of Saint John and the New Brunswick Department of Supply and Service. Beyond the vacant properties to the east is Bayside Drive. Along the southeastern property line, the parcel borders lands owned by a private land owner. Beyond the southwestern boundary are two vacant lots owned by the City of Saint John.

CLIENT:

ATLANTIC POTASH
CORPORATION

PROJECT:

PROPOSED FERTILIZER PLANT

PRELIMINARY GEOTECHNICAL INVESTIGATION
MCALLISTER INDUSTRIAL PARK, SAINT JOHN, NB

DRAWING:

SITE PLAN WITH AERIAL
PID 00337386

BRUNSWICK
Engineering & Consulting Inc.
40 Ashburn Lake Road, PO Box 1045, Saint John, NB E2L 4E3
tel: 506.696.9155 fax: 506.696.9158

DRAWN BY: KMJ	DATE: 29–JAN–14
SCALE: 1:2500	PROJECT No.: 2062.01
REVISION: 0	FIGURE: 2

The east side of the property slopes from the northwest at McIlveen Road up towards the southeast at a 4% grade for approximately 100 metres and increases from 10 to 33% to the eastern property line. Bedrock outcrops are visible at the point where the grade increases from 4% up. Existing contour mapping can be see in figure 3.

The parcel is relatively clear with the exception of some light vegetation throughout. It appears that this site has been used as a gravel source in the past, given the exposed gravel and rock faces to the east, and the relatively flat area near McIlveen Road.

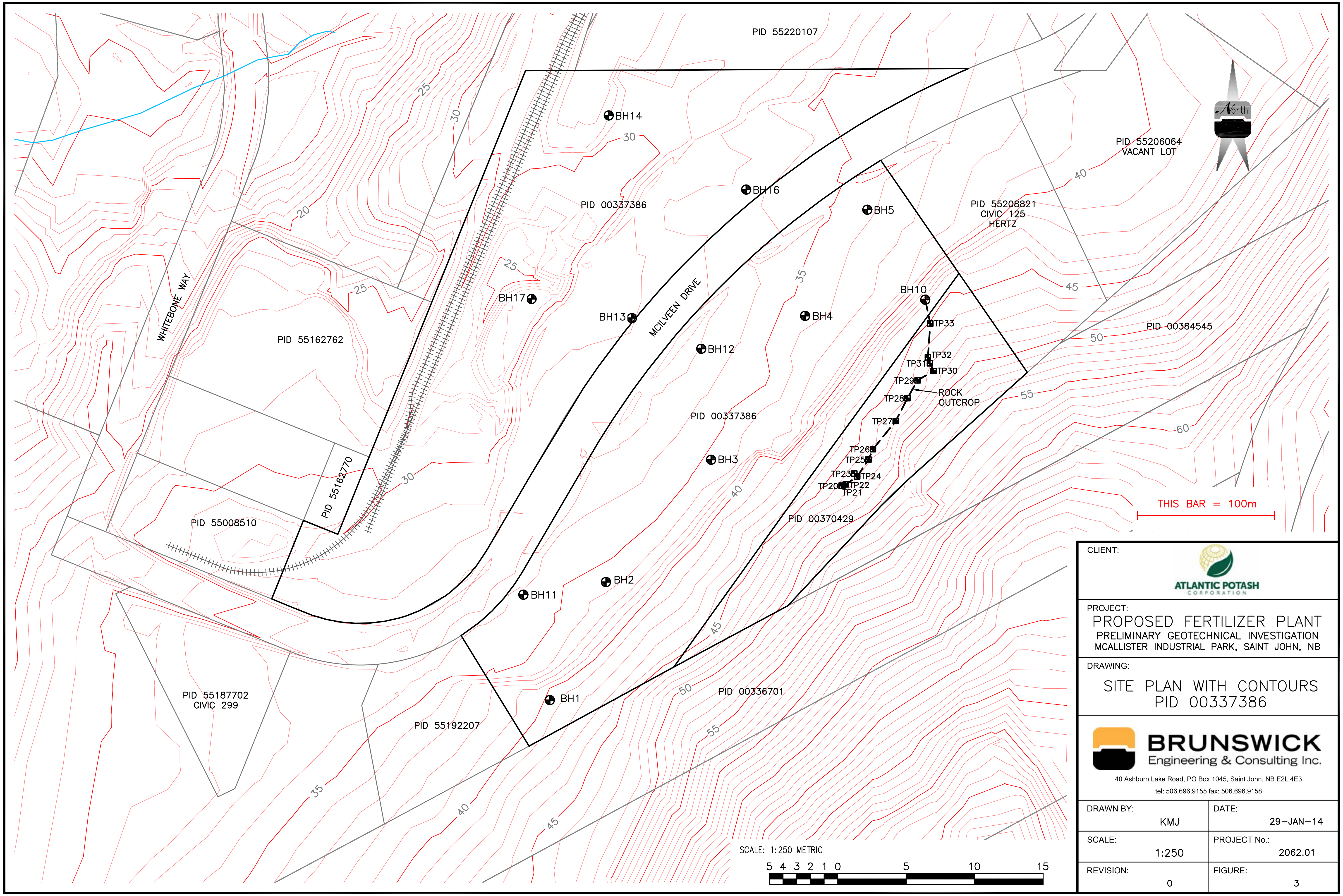
Along the length of the parcel, natural drainage channels can be observed which were created by water draining from the east end and off site sources. These drainage channels direct surface runoff from the east to the west and into deep ditches along McIlveen Road. These ditches eventually cross the road and flow towards an un-named tributary that discharges into the Bay of Fundy.

3.2 __West Side Site Conditions__

The west side of the property is bound to the north by a vacant property and is owned by the City of Saint John. The property to the north has a considerable amount of miscellaneous fill that has been placed over the years. To the west is a heavily wooded area surrounding a natural drainage channel that runs to the north into an unnamed watercourse. The southern end of the western portion of the property is bound by McIlveen Drive as the road swings to the west. The southwestern corner of the property neighbours an existing castings facility complete with a warehouse and storage yard.

The west side of the property is relatively flat and lightly vegetated. The lightly vegetated area corresponds to what appears to have been years of land filling. Ponding water was observed along the northern property line and extends over 100 metres to the southwest. The ponded water is surrounded with vegetation normally associated with wetlands and watercourses (cat tails, alders, etc.).

Along the western property line is a power line and a tree line which appear to mark the limits of the land filling operations. From the tree line the natural grade slopes down to a natural drainage channel which feeds into a watercourse. From aerial photographs and mapping by Service New Brunswick it appears as though a rail line or at least a rail bed is present on this property. A visual observation of the rail line could not be completed due to snow cover.



CLIENT:

ATLANTIC POTASH
CORPORATION

PROJECT:

PROPOSED FERTILIZER PLANT
PRELIMINARY GEOTECHNICAL INVESTIGATION
MCALLISTER INDUSTRIAL PARK, SAINT JOHN, NB

DRAWING:

SITE PLAN WITH CONTOURS
PID 00337386

BRUNSWICK
Engineering & Consulting Inc.

40 Ashburn Lake Road, PO Box 1045, Saint John, NB E2L 4E3
tel: 506.696.9155 fax: 506.696.9158

DRAWN BY: KMJ	DATE: 29–JAN–14
SCALE: 1:250	PROJECT No.: 2062.01
REVISION: 0	FIGURE: 3

4.0 INVESTIGATION METHODS & PROCEDURES

4.1 Field Program

Prior to commencing the field investigation, Brunswick Engineering contacted the appropriate utility companies to determine the presence of public and private buried infrastructure in the vicinity of the site. All buried infrastructure was located in the field by the respective utility companies and an all clear notification was obtained. No site work was completed until each all clear notifications were obtained from each utility company.

The locations of the eleven (11) boreholes advanced for this geotechnical investigation are shown in figure 4 and borehole logs and a geotechnical cross section are appended.

The investigation was completed over three individual mobilizations to the site with the first mobilization occurring on October 30 and 31, 2013, then December 6 and 10, 2013 and finally on January 7, 8 and 9, 2014.

The boreholes were advanced using a track mounted geotechnical drill rig (CME 75) supplied by MEG Drilling, with the worked being completed under the supervision of a geotechnical field technologist from Brunswick Engineering.

Several drilling methods were used for this investigation, as soil conditions and overburden thicknesses made advancing the boreholes slow and difficult. Select boreholes were continuously sampled using standard penetration test (SPT[1]) samplers, where other boreholes were not sampled and were simply used as exploratory probes to confirm the depth of bedrock.

As drilling conditions were difficult, standard flight augers were not used when SPT samples were required, as standard auger holes are prone to the side of the hole caving, thus making the advancement of the borehole difficult and cumbersome. To properly advance the borehole and to obtain SPT samples, hollow stem augers and casing was used. Hollow stem augers were initially used to allow for SPT sampling, however at depth the soil conditions were such that the drill could no longer advance the hollow stem auger due to skin friction on the auger flights and the boreholes were terminate prematurely.

Casing equipped with diamond cutting shoes was used when the borehole was anticipated to be deeper than 20 metres from ground surface. To advance the casing the rotary drill would cut the soil with the diamond shoe, with the centre of the casing being filled with pressurized water and the water would exit the casing via the bottom which would allow the water to return to the surface and in that process transport the soil cutting away form the cutting shoe and allow the casing to advance further. Casing a borehole is the slowest way to advance a borehole, however it does result in the highest quality samples. With casing, it is also possible to core bedrock which was completed in several boreholes.

Following the completion of one of the boreholes, a single 50mm diameter PVC groundwater monitoring standpipe was installed to allow for monitoring and confirmation of the static groundwater elevation. The annulus around the standpipe was backfilled with drill cuttings and silica sand and sealed near the surface with powdered bentonite to minimize surface water infiltration.

Boreholes not receiving standpipes were backfilled with drilling cuttings.

Soil samples recovered from the boreholes were placed in moisture tight containers, appropriately labelled and returned to our laboratory for further review, testing and analysis.

4.2 *Survey*

The borehole locations and bedrock outcrops were surveyed using a high precision GPS and referenced to the New Brunswick High Precision Network (NBHPN). The ground surface elevations referenced in this report are geodetic.

Elevation contours generated for this site were obtained from survey data provided by the City of Saint John. These surveys were validated with the field survey data obtained using the GPS onsite.

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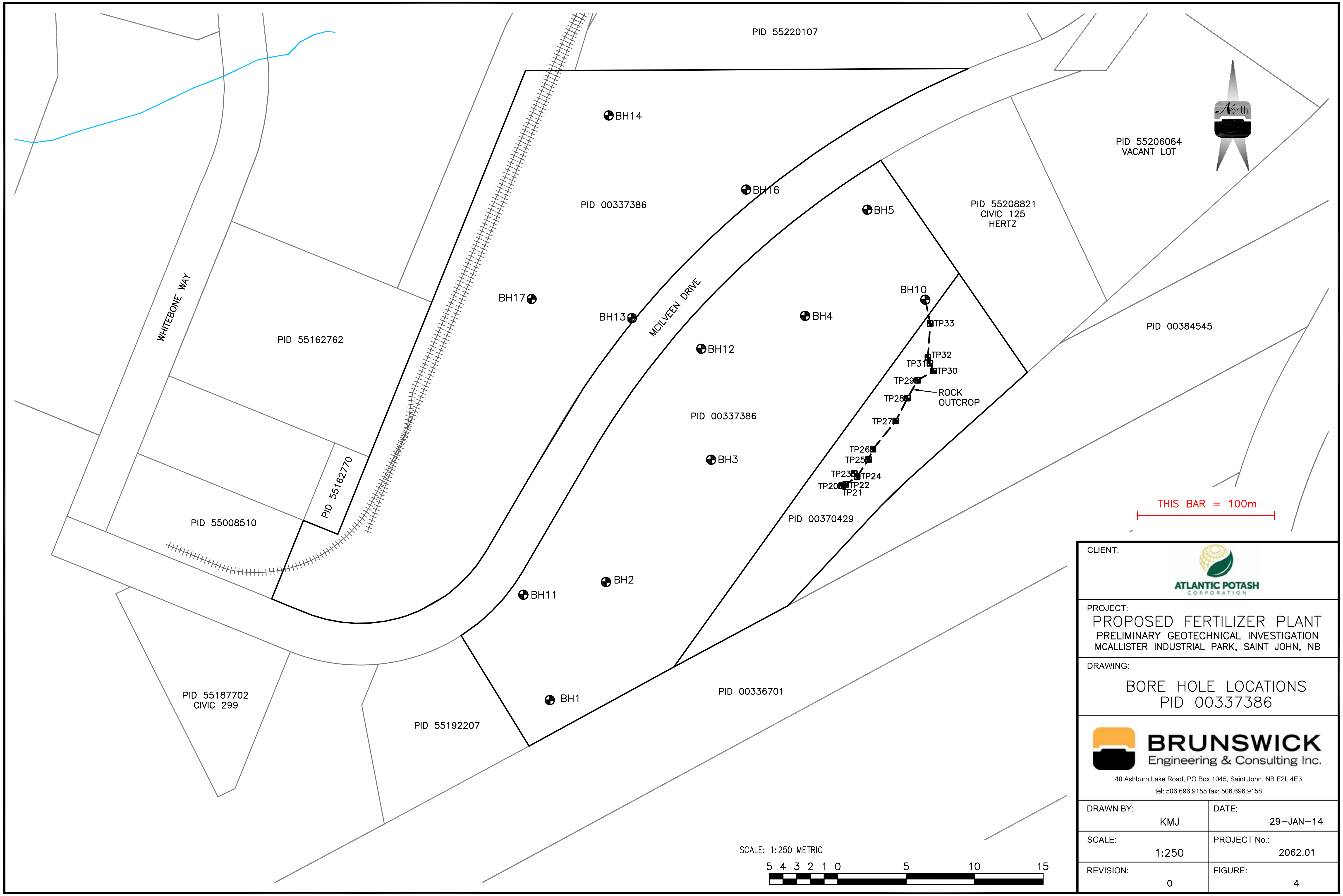
1 The number of blows of a 475 Joule free fall hammer required to advance a 50mm Ø split spoon sampler a distance of 300mm



CLIENT:

ATLANTIC POTASH
CORPORATION

PROJECT:

PROPOSED FERTILIZER PLANT
PRELIMINARY GEOTECHNICAL INVESTIGATION
MCALLISTER INDUSTRIAL PARK, SAINT JOHN, NB

DRAWING:

BORE HOLE LOCATIONS
PID 00337386

BRUNSWICK
Engineering & Consulting Inc.

40 Ashburn Lake Road, PO Box 1045, Saint John, NB E2L 4E3
tel: 506.696.9155 fax: 506.696.9158

DRAWN BY: KMJ	DATE: 29–JAN–14
SCALE: 1:250	PROJECT No.: 2062.01
REVISION: 0	FIGURE: 4

4.3 Laboratory Testing

Soil samples returned to the laboratory were subjected to a visual examination and compared to the field classification, with adjustments being made accordingly.

Six grain size distribution tests (Sieve Analysis) and a series of moisture contents were completed on representative samples of the different soil types encountered during the investigation. On select fine grained samples, the Atterburg (consistency) limits were completed.

An unconfined compression test was completed on several sections of rock core obtained

The results of the laboratory tests are discussed in the next section of this report, with test record reports being appended.

5.0 SUBSURFACE CONDITIONS

Soil conditions at the site are fairly irregular with material layers varying in thickness, composition, moisture content and bedding angle. Some of this is due to the fact the site has been used in the past as an aggregate source and dumping ground for unsuitable construction soils. The local geology and deposit formations are fairly complicated in this area as there have been marine and glacial deposits. As observed in the boreholes, the soils vary considerably across the site, with the deposits being close to horizontal in the southwest to northeast direction (parallel to the bedrock outcrop) and have steeper bedding east to west. Near the location of McIlveen Drive, there appears to be an old channel shaped into the bedrock and has been in filled with material.

For the purpose of this report, the soils observed have been categorized and generalized.

5.1 Soil Conditions

The following table is a summary of the soil conditions encountered and the corresponding depths from existing ground surface they were encountered during the investigation:

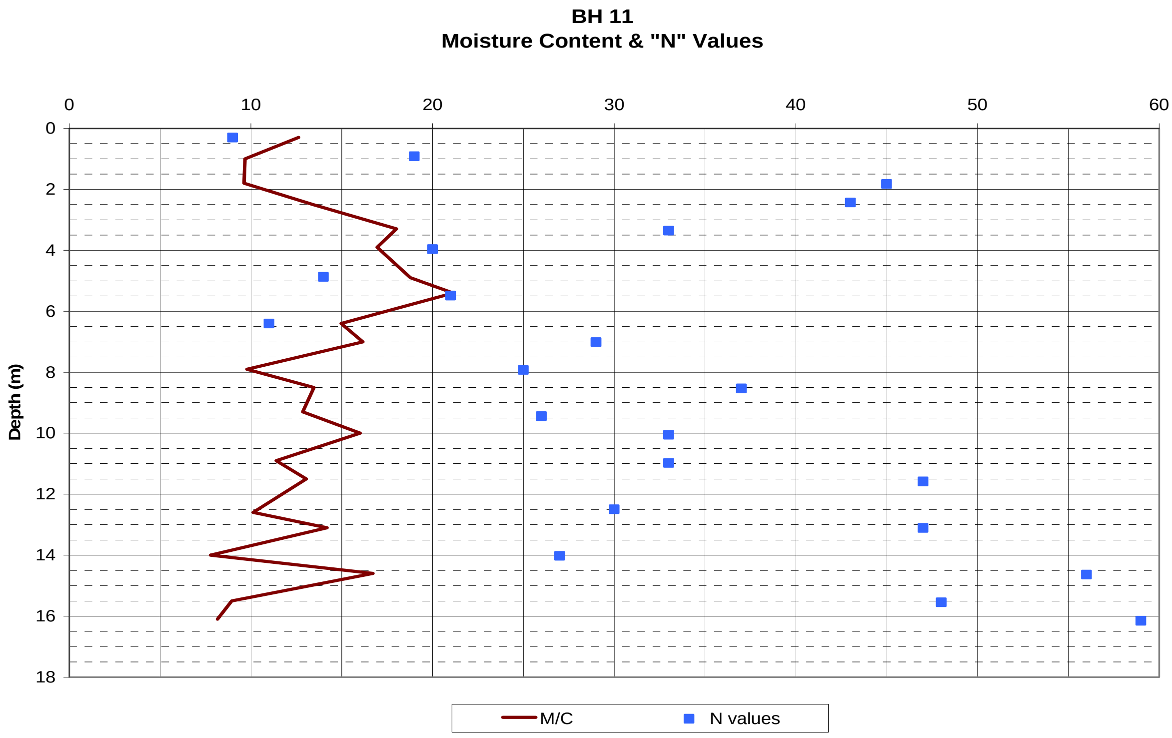
Table 1 - Soil Layers

	Organic & Fill	Silty Sand some Gravel	Grey/Brown Clay Silt some Sand	Ablation Till	Red Clay Silt	Weathered Bedrock	Bedrock
Depth below surface							
BH 2	0- 2.0	2.0- 5.1	5.1- 11.3	11.3- 13.8	13.8- 15.9	-	15.85
BH3	0- 1.0	1.0- 3.0	3.0- 7.4	7.4- 11.4	11.4- 13.4	13.4- 14.3	14.3
BH4	-	0- 4.9	4.9- 11.0	11.0- 16.8	-	16.8- 18.1	18.1
BH5	0- 1.5	1.5- 13.1	13.1- 15.2	-	15.2- 16.2	-	18.6
BH10	-	-	-	0- 1.5	-	1.5- 4.0	4.0
BH11	0- 2.0	2.0- 8.1	-	8.1- 16.5	-	-	-
BH12	0- 2.1	2.1- 15.5	-	15.5- 19.5	-	-	-
BH13							37.8
BH14	0- 7.0	7.0- 12.2				12.2- 12.5	12.5
BH16							36.3
BH17	0- 4.0	4.0- 5.5	11.6- 14.6	14.6- 20.7	5.5- 11.6	-	20.7

Note: All other boreholes listed had bedrock at surface.

In table 2, a vertical profile oh borehole BH11 has been created comparing N values and moisture contents versus depth from existing ground surface. The plot shows the moisture contents are relatively consistent between the different soil types and the increasing depth.

Table 2



5.1.1 ***Organic & Fill Soils***

The organic and fill soils overlay the entire site with the exception of areas where the bedrock outcrops and in previously excavated areas. The organic and fill soils are highly variable, with a high fines content. These material types are considered loose with high moisture contents.

The fill soil is comprised of a mixture of granulars, organics, concrete, asphalt, wood and other miscellaneous materials that would be expected with a construction demolition. Due to the variability it would be reasonable to consider this material loose with a high percentage of voids.

5.1.2 ***Silty Sand & Gravel to Silt & Sand some Gravel***

Silty sand and gravel to silt and sand some gravel was encountered below the organic and fill soils. This material was observed in all boreholes except BH14 and location where bedrock was at surface. The observed thickness of this layer ranged between approximately 1.0 metres at BH17 up to a maximum thickness of 13 metres at BH12.

Split spoon samples were taken in this material with the corresponding uncorrected SPT N values ranged between 2 and 54 and averaged 25. There is no direct correlation between observed N values and depth, however, the higher values measured were due partially to the gravel becoming lodged in the tip of the split spoon sampler. A more reasonable average N value for this material would be in the vicinity of 20. Based on the N values the material is considered loose to compact.

The moisture content on the material was not consistent with depth and ranged from 9 to 22% and averaged 15%. A grain size analysis was completed on this material with the analysis showing the material is comprised of 10% fines, 50% sand and 40% gravel and is reasonably well graded. The sieve analysis completed on this material was taken from BH5 sample 5, with the test result being appended.

5.1.3 ***Red Clay & Silt***

The red clay and silt has trace amounts of sand and organics by the way of shells. The red clay and silt was found below the silty sand and gravel to silt and sand some gravel layer. The clay silt is a marine deposit and appears to have been eroded and replaced by other materials in some locations.

Split spoon samples were taken in this material with the corresponding uncorrected SPT N values ranging between 4 and 22 and averaging 8. With fine grained soils, N values are not reliable in determining the shear strength of the soil. Samples obtained were tested in the field using a hand held shear vane which yielded results between 75 and 100kPa, which corresponds to a consistency of stiff. This is mostly due to the overburden pressures of the silty sand and gravel layers and grey/brown clay silt.

Moisture contents of this material are in the range of 15 to 20%.

A sieve analysis was completed on this material with the results being 4% fine sand and the remainder being clay and silt size material.

Atterburg limits were completed on this material with the liquid limit being 41% and the plastic limit of 18%. Based on these results the clay silt is clay with low plasticity. The low plasticity indicates that silt is the predominate particle size of the material as clay particles give a soil it's plasticity or cohesion.

5.1.4 __Grey/ Brown Clay Silt some Sand__

The grey/brown clay silt some sand was observed in several boreholes below the silty sand and gravel and adjacent to the red clay and silt.

Split spoon samples were taken in this material with the corresponding uncorrected SPT N values ranged between 4 and 30 and averaged 25. Field shear vane tests were completed on samples obtained with indicated the clay silt some sand had a shear strength of 100kPa. Based on the shear vane tests, this material is considered stiff (50-100kPa), however based on N values, there maybe areas where the consistency is firm, which corresponds to an undrained shear strength of 25-50kPa.

Atterburg limits were completed on this material with the liquid limit being 34% and the plastic limit being 20%. Based on these results the clay silt is considered a silt with low plasticity and some clay present in the soil matrix.

5.1.5 __Sand & Silt trace Gravel to Sand, Silt & Gravel (Ablation Till)__

The sand and silt trace gravel to sand and silt some gravel was identified in the field as an ablation till deposit as indicated by the materials shape and composition. Typically ablation tills in New Brunswick have high moisture contents, with particles fractured faces and coarse nature of the material as compared to a marine deposit with smooth rounded edges.

For this material, the till is overlain by at least 15 metres of overburden soils, which have consolidated and settled the material as typical ablation tills in this area have moisture contents in excess of 20%, with this deposit having a high of 14% and a low of 8%.

N values in this material range from a low of 20 and a high of 60 averaging 38, which classifies the material as being dense.

A sieve analysis was completed on this material, with the results showing the composition is made up of 27% gravel, 38% sand and 35% silt. Some samples obtained were identified in the field as having less gravel than that observed in the sieve analysis.

5.1.6 __Weathered Bedrock__

Weathered bedrock was observed in some locations immediately above the bedrock and is thin layer, less than 1.0 metres in thickness. The weathered bedrock was identified as a silty sand and gravel.

This material is considered very dense and is most likely fully saturated as water should be expected in this layer above the bedrock and below the finer grained soils.

5.2 __Bedrock__

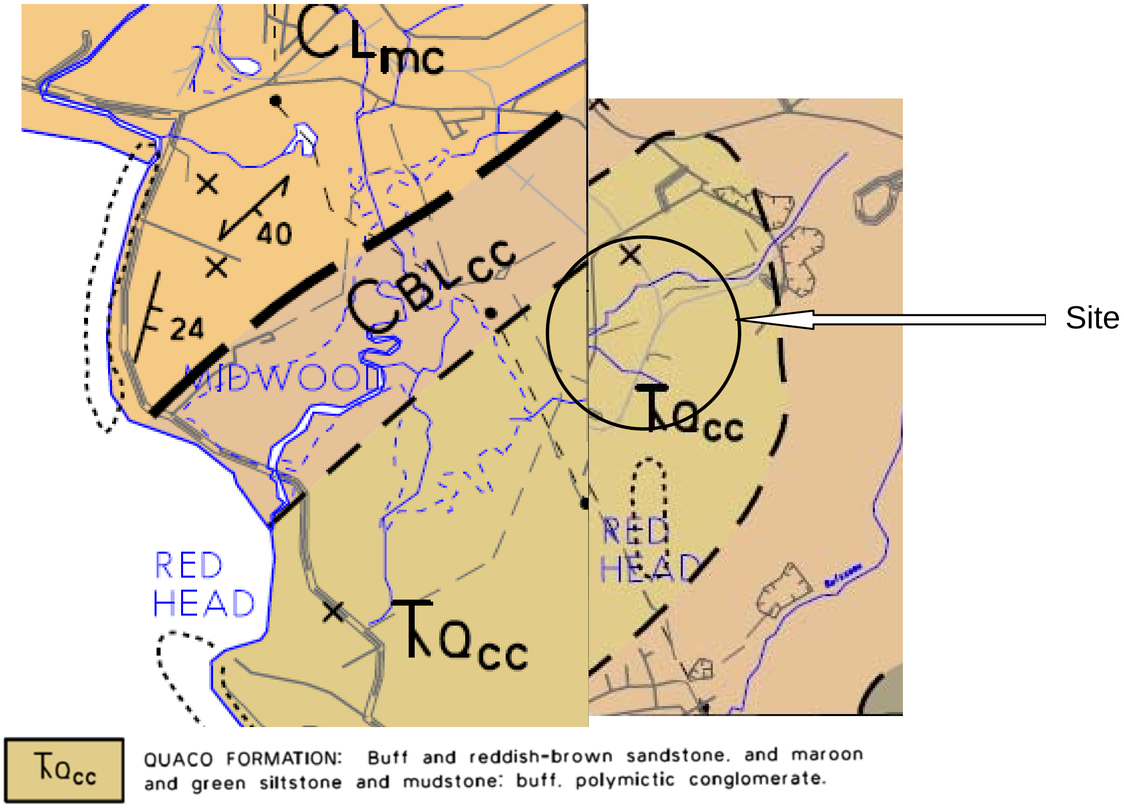
Bedrock was confirmed in several of the boreholes by coring and observed at ground surface on the east side of the property.

The Department of Natural Resources (DNR) Bedrock Geology Plate 2005-41 mapping, shows this area to be Late Triassic and a member of the Fundy Group, further being named as the Quaco Formation which consists of "Buff and reddish-brown sandstone, and maroon and green siltstone and mudstone: buff, polymictic conglomerate". Shown below is a copy of the DNR mapping.

Visual observations of the bedrock cores and rock outcrops would confirm that the bedrock underlying the site is conglomerate bedrock.

Rock coring was completed on BH4, BH13, BH16, BH17 and recovery and RQD were measured in the field. The average % recovery for all the cores was 95% and the average RQD was 50% near surface to

70% 1.0metres into the bedrock. A sample from BH4 was taken and tested for unconfined compressive strength, which gave results of on average 33-35MPa, using a 50mm diameter core.



DNR Mapping Plate 2005-41

Photo 1 Bedrock Conglomerate Core (50mm dia.) – near surface of bedrock

Photo 2 – Conglomerate Bedrock Core (50mm dia) – into bedrock 2 metres

5.3 Groundwater

A monitoring well was installed after the completion of BH5 so that seasonal water levels could be observed. Forty eight hours after drilling, the elevation of the groundwater in the well was +31.62metres (4.25metres below surface).

In general, groundwater could be expected on and in the fill soils at any depth or in the silty sand and gravel layers. As noted earlier, standing water was identified at several locations along the west portion of the property and a natural drainage ditch was following along the western property line.

6.0 ENGINEERING RECOMMENDATIONS

6.1 General

In general, the site is quite variable in regards to soil conditions. This is further complicated by previous excavation and filling activities. In general, the eastern side of McIlveen Road should be considered more desirable from a construction standpoint, given the bedrock outcrops near the eastern property line and the minimal amounts of organic and fill soils, as is the case with the western portion of the site.

The following recommendations are based on the limited information of the proposed facility and therefore these recommendations are preliminary and fairly general.

6.2 Foundations

6.2.1 Earthquake Design

Site classification for seismic site response in accordance with NBC 2005 Table 4.1.8.4.A;
is class E.

NBC 2005 Table 4.1.8.4 B&C:
Use Site Class E to determine values of Fa and Fv for Saint John:
Sa(0.2) = 0.34
Sa(0.5) = 0.18
Sa(1.0) = 0.081
Sa(2.0) = 0.024

$F_a = 1.85$; $F_v = 2.1$

Peak ground acceleration = 0.23

The potential for liquefaction at this site is considered low.

Earthquake induced earth pressures can act in any direction on the footings but only in one direction at a time, i.e. longitudinal or transverse but not both combined. The earthquake induced total active pressure can be calculated from:

$$P_{AE} = ½ K_{AE} \gamma H^2 (1 - K_V)$$

where;
P_{AE} = total active + earthquake induced pressure
$K_{AE} = 0.45$
$\gamma = 20.6$ kN/m^3; and
H equals height of wall or face

The incremental earthquake component acts at 0.6 H from the bottom of the wall or footing. The appropriate design load factor would be applied to each component.

The passive earthquake resistance is equal to:

$$P_{PE} = ½ K_{PE} \gamma H^2 (1 - K_V) \text{ where } K_{PE} = 3.1$$

For ULS resistance a resistance factor of 0.5 is recommended.

Passive pressure will act in addition to base friction.

6.2.2 Frost Design

The frost penetration could reach 1.98metres+/- due to the granular nature of the fill soils. The depth of frost penetration is based on the number of degree-days below freezing and the soil and groundwater conditions. Dense granular soil and bedrock are poor insulators and result in maximum frost penetration whereas frost penetration is less for the same freezing conditions in wet low-density soils such as clays. Normally frost penetrations are based on the coldest year in 10 which gives a freezing index to 915°C days. The published value of Mean Freezing Index for Saint John Airport is 632°C days. Using this value and the CFEM design freezing index equal 100 + 1.29 x Mean Freezing Index = 915°C days.

The City of Saint John requires a depth of bury to the top of their watermains of 1.8 metres or 6 feet. We would recommend using a minimum of 1.5 metres for foundations on non-frost susceptible soils and 2.0 metres for any buried lines where freezing of the product maybe an issue.

6.2.3 <u>Piled Foundations</u>

Given the soil conditions and the dynamic loading of the soils due to heavy machinery and operating units, it is anticipated that some of the operating plant's facilities will be founded on piled foundations.

It is most likely that H piles end bearing on bedrock will be required to support the proposed operating units. The most common pile type installed for facilities such as this would be a 12X89 (310X132). Pile recommendations are as follows:

1. With this pile type an ultimate axial compression per pile would be in the order of 2400kN. These loads are based on a factor of safety of 3.5. These factors of safety can be reduced (i.e. greater allowable capacities for a given pile) given a quality control program which includes sufficient inspection utilizing a Pile Driving Analyzer (PDA). The Canadian Foundation Manual suggests a factor of safety of 2.0 (performance factor of 0.5) on Ultimate Limit States (ULS) loads if Dynamic Testing is utilized (this equates to a factor of safety of around 2.6 for working loads);
2. Corrosion protection for piles are recommended given the soil conditions. Piles should have cathodic protection and/or an allowance of 1.6mm (1/16 inch) for corrosion protection on the complete perimeter of the pile steel in contact with the soil;
3. Driving criteria should be established using Wave Equation Analysis once the hammer and pile types are established;
4. Pile should be driven utilizing a hammer capable of providing120,000 Joules;
5. An appropriate hammer size to develop the required load capacity at a set of 10 – 15 blows/inch will be required to seat the piles on rock;

6. Down drag loads are not anticipated to be significant, but should be reviewed further once pile locations are selected;
7. Piles driven will develop both skin and tip resistance, depending on the pile locations, enough skin resistance may meet the pile capacity requirement;
8. Exterior pile caps and grade beams should be provided with a minimum of 1.5metres of soil cover or an appropriate rigid insulation detail to provide frost protection;
9. With respect to compressive loads on end bearing piles for pile spacing of 4 times the pile diameter, the group capacity can be taken as 90% of the single pile capacity. At spacing of 5D the group factor can be taken as 95% and greater than 6 times the diameter, the group capacity is 100% of a single pile capacity.
10. With respect to uplift, the ULS load resistance for a pile group should be lesser of:

- The individual factored pile design uplift load times the number of piles in the group, using the appropriate group spacing factor
- The ULS resistance equal to the effective weight of the pile group and the soil contained within a block defined by the perimeter of the group and the pile length plus the total shear adhesion and friction on the peripheral of the block. The total shear adhesion can be calculated using the values shown in the table below with the resistance factor being 0.3 applied to both the effective weight and shear.

Design parameters for calculating downdrag and uplift capacities are given below.

Parametres	**Unit**	**Fill**	**Clay Silts**	**Silt & Sand some Gravel**	**Ablation Till**	**Resistance Factors**	
						Compression	**Uplift**
Unit Weight, moist, Y_m	kN/m^3	18.0	18.5	19.5	20.6	-	-
Unit weight, submerged, Y_{sub}	kN/m^3	8.2	8.7	9.7	10.8	-	-
Angle of internal friction, degrees	degree	35	-	30	28	-	-
Undrained Shear Strength, C_u	kPa	-	100	-	-	$\Phi = 0.4$ *	$\Phi = 0.3$
Effective Soil Pile Adhesion, C_a	kPa	-	100	-	-	$\Phi = 0.4$ *	$\Phi = 0.3$

* For static computations, as noted above, 0.5 can be used in combination with PDA testing.

11. For calculating lateral resistances for piles in groups (independent of number of piles in group) in either the weak or strong axis:

Pile Spacing, m	Lateral Load
1.2	0.6
1.5	0.8
1.8	1.0

Note that the bending moment induced stresses will reduce the vertical capacity. Pile soil interaction in the granular fill can be calculated assuming n_h = 16MPa for 6.3mm (0.25") lateral deflections and n_h = 10.9MPa for 12.7mm (0.50") lateral deflections, where n_h is the rate of change in subgrade modulus with depth. The lateral subgrade modulus at any depth is equal to n_h times the depth.

12. We would recommend that the piling contractor submit the installation driving criteria for review by the geotechnical consultant.
13. As a check on pile relaxation retapping of piles is recommended after completion of initial driving for a minimum of 10% of driven piles. If any relaxation is indicated all piles must be retapped;
14. All H piles should have cast steel pile points to prevent damage when penetrating granular layers which could have cobbles and boulders throughout and for seating the pile tip on bedrock, APF HP77600 is recommended.

6.2.4 Rock Anchors

Rock anchors may be required in areas where bedrock is at surface, or foundations will be installed directly on the bedrock. In such a case, grouted anchors can be installed into the bedrock to provide uplift resistance for the foundation. Pull out tests completed to failure on test anchors could prove higher attainable capacities and reduce the resistance factor due to in field testing. The method of installation, bedrock conditions at the location of the anchor, grout strength and workmanship of the installation of rock anchors can affect the capacity.

It is recommended that a single rock anchor be designed using an allowable bond stress of 500kPa between the grout and bedrock or smaller than 1/30 times the compressive strength of the grout or bedrock, with a minimum bond length of 5 metres. Spacing of anchors should be more than 4 times the anchor diameter and should not exceed 1.2 times the embedment depth.

Group effects for rock anchor capacity is related to the spacing and the embedment length of each anchor. To calculate the effect of the group, take the outside perimeter of the group and apply the shear surface (cone) from half of the embedment length of the anchors to the surface of competent bedrock at an angle equal to 10^{O} (shear surface angle) from the vertical. The shear surface angle of 10^{O} is considered conservative and could be increased with the installation and testing of test anchors. The overall capacity of the bedrock is a function of the weight of the rock in the shear surface (cone) and the shear resistance of the bedrock.

6.2.5 Shallow Foundations

Conventional spread footings and/or strip footings with a conventional slab on grade may be appropriate where bedrock is near surface or in facilities which do not have high loads or sensitive equipment. The following are some general recommendations for shallow foundations;

1. Remove all fill soils and organic soils from the footprint of the proposed foundation, to an extent outside the proposed footing line of at least a distance outside the footing line of the fill thickness anticipated;
2. Construction equipment should not be allowed on any exposed subgrade soils within the foundation footprint of the proposed structure;
3. Certain soil types are susceptible to disturbance in the presence of construction equipment and water, therefore once a suitable subgrade soil has been identified and the proper elevations have been achieved, then the subgrade soil should be protected with a layer of suitable structural fill with a thickness of 600mm. Depending on the structural fill used, a geotextile may be required to satisfy filter criteria between the structural fill and subgrade soils. A fill soils should be compacted to 98% of the Standard Proctor density (ASTM D-698).
4. Alternately, a mud slab could be placed in lieu of structural fill. The mud slab can be a lean mix concrete of a strength of 5-10MPa.
5. Prior to placing any structural fill or imported granulars, a proof roll of the subgrade soils should be performed to confirm the absence of soft areas which may need to be undercut and replaced with suitable structural fill. Proof rolls should be completed with a roll placed in static mode and having a minimum drum width of 1.5metres;
6. Any compaction operations within 0.6 metres of the subgrade soils should be completed on static mode. This requirement can be relaxed by a geotechnical engineer at the time of construction should site conditions permit;

7. Keep water from ponding in excavations;
8. For frost protection, exterior footings and footings in unheated buildings should be founded 2.0 metres below finished grade and interior footings on heated buildings should be 1.5 metres below grade. These depths maybe reduced by providing an appropriate rigid insulation detail;
9. Interior slabs on grade should be founded on suitable subgrade soils and have not less than a minimum of 300 mm of 31mm minus crushed rock or crushed gravel, compacted to 98% of the Standard Proctor, overlain by 80mm of compacted sand (which will protect the vapour barrier from becoming punctured);
10. Structural fill material to be used as recommended above should be a well-graded crushed pit run gravel or crushed rock having a maximum particle size of 100mm and a maximum of 6% fines for pit run and 8% fines for crushed rock. Other granular materials may be considered at the discretion of a geotechnical engineer;
11. Shallow foundations could be designed for a net ULS bearing pressure of 150 kPa, based on a footing placed up to 1.5 metres below grade. This ULS bearing pressure includes a resistance factor of 0.5. This would be based on the variable nature of the sand and silt. Net pressure is pressure in excess of the existing overburden pressure;
12. The settlement at SLS (100kPa) due to footing load would be in the order of 25mm of total settlement.

    For ULS loadings K_p can be taken as 3.7 with a resistance factor of 0.5 (factored $K_p = 1.85$) and the coefficient of friction in sliding in the sand and gravel fill = 0.45 with a resistance factor of 0.8 (factored resistance = 0.36).
13. Minimum footing widths of 600 mm and 1000 mm are recommended for strip and square footings respectively;
14. Foundation drains should be installed adjacent to the exterior building footings. The invert elevation of the drain should not exceed the underside of the footing elevation. The drain should consist of a 100 mm diameter perforated pipe bedded upon and backfilled with clear drainage stone. The clear stone must be wrapped with a non-woven filter fabric. Filter fabric joints should be lapped a minimum of 0.60 metres;

6.3 <u>Driveways & Access Roads Recommendations</u>

We anticipate all internal driveways and access roads to be heavy haul roads, with high load vehicles and equipment. We offer the following recommendations for this work:

1. Remove all existing organic and fills soils from the driveway/ road footprint;
2. Provide positive drainage in the subgrade soils so as not to create "bird baths" or areas where water can become trapped thus creating perched water which could weaken the subgrade soils;
3. Construction equipment should not be allowed on any exposed subgrade soils within the foundation footprint of the proposed structure. Except for a roller to perform a static proof roll;
4. The some of the existing soils are highly susceptible to piping so a filter fabric maybe required;
5. Minimum grades of 2% should be maintained in all asphalt areas;
6. As a preliminary design the pavement structure in light duty asphalt areas should be comprised of a minimum of 300mm of granular subbase 75mm minus overlain by 150mm of 31mm minus granular base and capped with 65mm of 19mm Superpave and 40mm of 9.5mm Superpave. For heavy duty asphalt areas we recommend 450mm of subbase, 150mm base and 120mm of 19mm Superpave and sealed with 40mm of 12.5mm Superpave. The design ESALs for the asphalt can be designed once loadings and traffic volumes are better understood. Pavement structures can be modified to suit once development plans have been determined.
7. Alternatively, a roller compacted concrete maybe better suited for this site given the high loads of the mobile equipment and materials being stored. Roller compacted concrete is very well suited for a facility such as this given its resistance to chemical attack and its ability to help contain spills and leaks from the operating plant. Roller compacted concrete would give a rigid pavement structure that would be more durable than asphalt given the anticipated operations at this location.

6.4 General Construction Recommendations

Given the soil conditions on this site, we offer the following recommendations for developing the site;

1. manage off site runoff entering the site by a series of ditches, complete with erosion control measures;
2. provide positive drainage throughout construction, minimizing standing water, as the silty sand and gravel is susceptible to softening in the presence of water;
3. all excavations should have a minimum of a 1H:1V slope when excavating in original ground and 2H:1V when excavating in fill soils, should soils become saturated flatter slopes will be required, consult a geotechnical engineer to determine what safe slope is appropriate;
4. site dewatering maybe required in order to install buried services, as the silty sand and gravel layer does have a higher permeability, and water being near surface at the east end of the site where the bedrock is near surface;

5. fill soils should not be placed on frozen subgrade soils and the fill itself must not have frozen chunks;
6. geotextiles maybe required to meet soil filter conditions;
7. should construction take place on the western side of the site, retaining walls maybe required to properly develop near slope along the property line;
8. field testing of placed soils should be confirmed by Nuclear Density testing and Plate Bearing Testing to accurately determine the reaction of subgrade modulous which can be used to properly design the pavement structure and to calculate settlements in the near surface soils.

7.0 CONCLUSIONS

Based on the findings presented above, this site can be developed provided the site design implements our recommendations and the contractor follows and understands the potential difficulties that could occur with improper construction practises and undue care. We would recommend locating the fertilizer plant on the east side of McIlveen Road, and construct non-essential developments on the west side. Non-essential development could be warehouses, laydown and storage yards and other purposes where some settlement is acceptable and foundations can be on spread footings. It is anticipated that the operating units for this facility will require some piled foundations, with some spread footing for small light load buildings and units located near/ on the bedrock to the east.

Once the site design begins and operating units and anticipated foundation loads are known, we would recommend reviewing the possibility of completing more boreholes to get a better understanding the soils and depth to bedrock.

The test holes put down at this site are scattered and soil conditions may vary from those encountered. A geotechnical engineer should inspect any subgrade soils prior to placing foundations to ensure that the soils revealed are suitable.

Should soil conditions be encountered during construction differ from those reported, we request to be immediately notified so that we may review, reassess and modify our recommendations if and as required.

This report does not address other site considerations related to municipal servicing including stormwater management, which would most likely be handled via a stormwater retention pond, that could require additional geotechnical investigations and design.

APPENDIX A

BOREHOLE LOGS

BRUNSWICK
Engineering & Consulting Inc.

BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01
Project	Preliminary Geotechnical Investigation	Date Drilled	12/9/13
Location	McAllister Industrial Park	BOREHOLE	2
Ground Level, m	35.72	Page	1 of 1
Datum:	Geodetic	Logged By	BB

No	TYPE	N (RQD)	REC (mm)
1	S	9	51
2	S	21	406
3	S	35	457
4	S	37	457
5	S	25	559
6	S	40	559
7	S	22	559
8	S	25	559
9	S	18	508
10	S	26	254
11	S	18	203
12	S	39	254
13	S	30	0
14	S	44	508
15	S	33	533
16	S	46	432
17	S	19	127
18	S	30	356
19	S	14	610
20	S	22	254
21	S	100	152

DESCRIPTION

Silty SAND some Gravel and trace amounts of Ash, miscellaneous FILL

2.00 33.72

SILT & SAND some Gravel

5.10 30.62

brown to red Sandy SILT some Gravel - dry and stiff

9.10 26.62

black SILT & SAND some Gravel - dry and dense

11.30 24.42

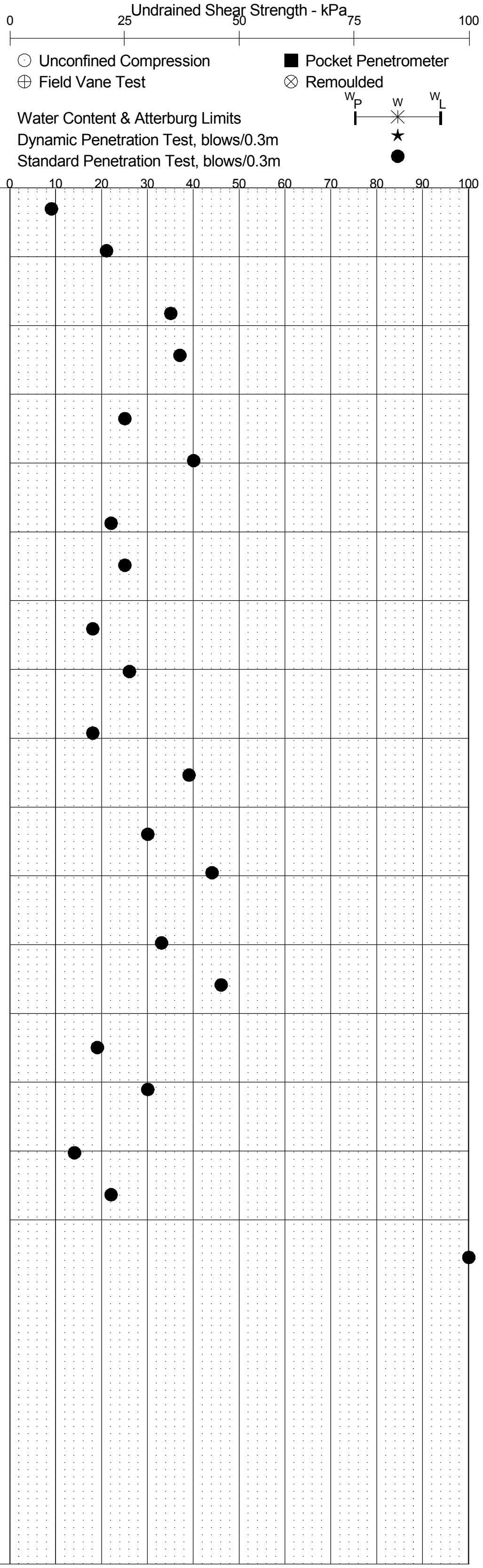
light brown Sandy SILT some Gravel (ablation till)

13.80 21.92

red-brown SILT & CLAY trace Sand trace black Organics(marine sediment)

15.85 19.87

EOH @ 15.85 metres on possible boulder or bedrock, Hollow Stem Auger Refusal



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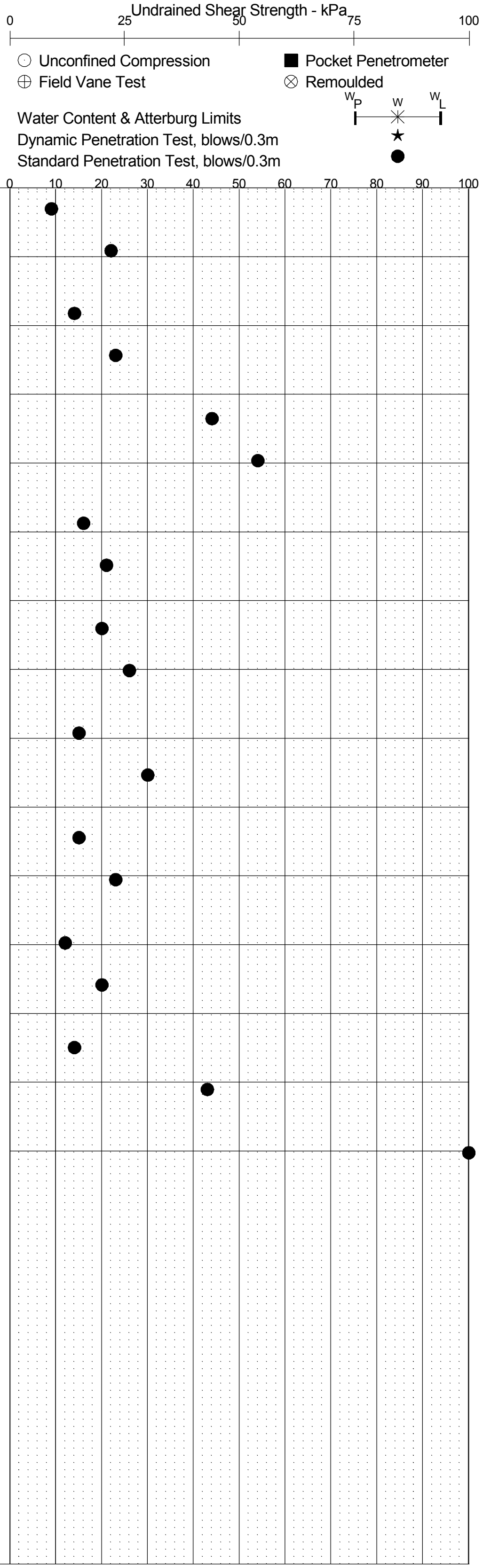
BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01	BOREHOLE 3
Project	Preliminary Geotechnical Investigation	Date Drilled	12/9/13	Page 1 of 1
Location	McAllister Industrial Park			

Ground Level, m 34.97
Datum: Geodetic
Logged By BB

SAMPLE No	TYPE	N (RQD)	REC (mm)
1	S	9	406
2	S	22	203
3	S	14	381
4	S	23	305
5	S	44	406
6	S	54	457
7	S	16	533
8	S	21	305
9	S	20	330
10	S	26	305
11	S	15	75
12	S	30	559
13	S	15	533
14	S	23	610
15	S	12	25
16	S	20	610
17	S	14	610
18	S	43	610
19	S	100	50

DEPTH m	DESCRIPTION	
0	Silty SAND some Orgaincs - FILL	
1.00	red stiff Sandy SILT some Gravel	33.97
3.00	grey stiff Sandy SILT to SILT & SAND some Gravel	31.97
7.40	brown SILT & CLAY some Sand trace Gravel	27.57
11.35	red SILT & CLAY trace Sand trace black Organics (marine sediment)	23.62
14.33	EOH @ 14.33metres on Boulder or possible Bedrock, Hollow Stem Auger Refusal	20.64



BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01	BOREHOLE	4
Project	Preliminary Geotechnical Investigation	Date Drilled	10/31/13	Page	1 of 2
Location	PID 00337386				
Ground Level, m	35.27	Datum:	Geodetic	Logged By	SRP

DEPTH m	No	TYPE	N (RQD)	REC (mm)
0	1	S	9	190
	2	S	50	400
	3	S	34	350
	4	S	18	400
	5	S	32	250
	6	S	27	200
	7	S	22	590
	8	S	13	330
	9	S	28	0
	10	S	28	200
	11	S	61	600
	12	S	18	450
	13	S	21	400
	14	S	13	600
	15	S	15	200
	16	S	14	400
	17	S	21	600
	18	S	26	600
	19	S	52	400
	20	NQ	67	1524
20	21	NQ	60	1524

DESCRIPTION

Silty SAND & GRAVEL with Cobbles and Boulders throughout

4.88 30.39

grey to brown Clayey SILT some Sand with Cobbles throughout

10.97 24.30

red to brown Clayey SILT some fine grained Sand (ablation till)

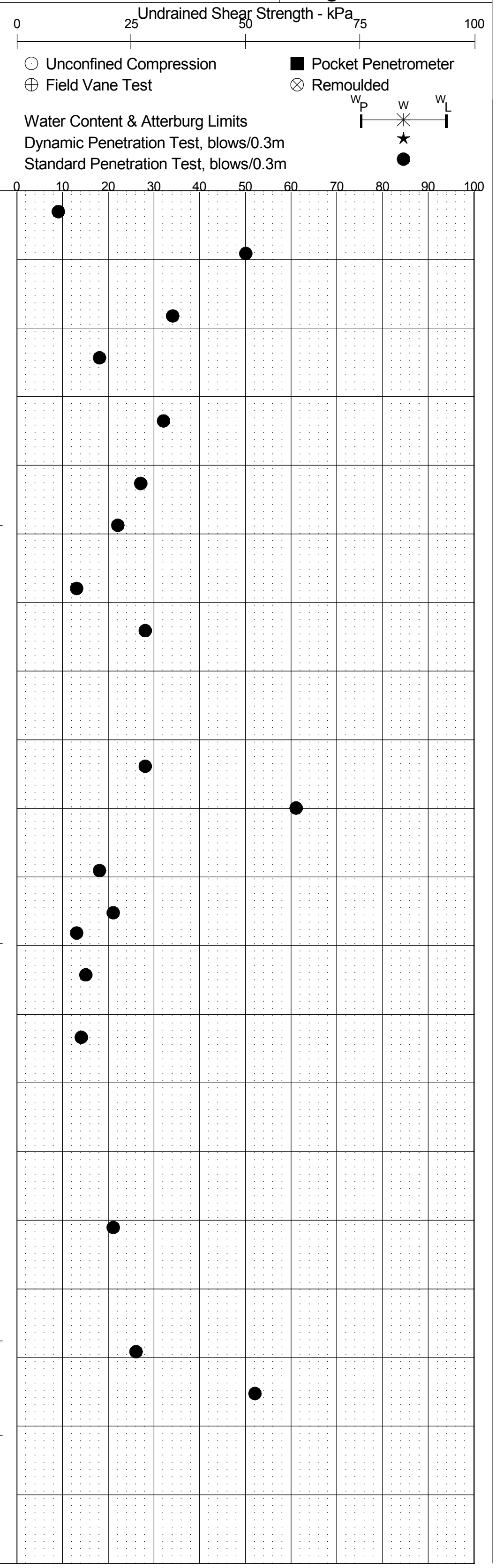
- lost return water

16.76 18.51

Silty SAND & GRAVEL

18.14 17.13

purple to red CONGLOMERATE BEDROCK



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BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01
Project	Preliminary Geotechnical Investigation	Date Drilled	10/31/13
Location	PID 00337386	BOREHOLE	4
		Page	2 of 2

Ground Level, m 35.27	Datum: Geodetic	Logged By SRP

Undrained Shear Strength - kPa: 0, 25, 50, 75, 100

○ Unconfined Compression
⊕ Field Vane Test
■ Pocket Penetrometer
⊗ Remoulded
Water Content & Atterburg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE No	TYPE	N (RQD)	REC (mm)	LOG	DESCRIPTION
20						
21						
	22	NQ	88	1524		
22						
						22.71 12.56
						EOH @ 22.71metres in BEDROCK

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BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01	BOREHOLE	5
Project	Preliminary Geotechnical Investigation	Date Drilled	10/31/13	Page	1 of 1
Location	PID 00337386				

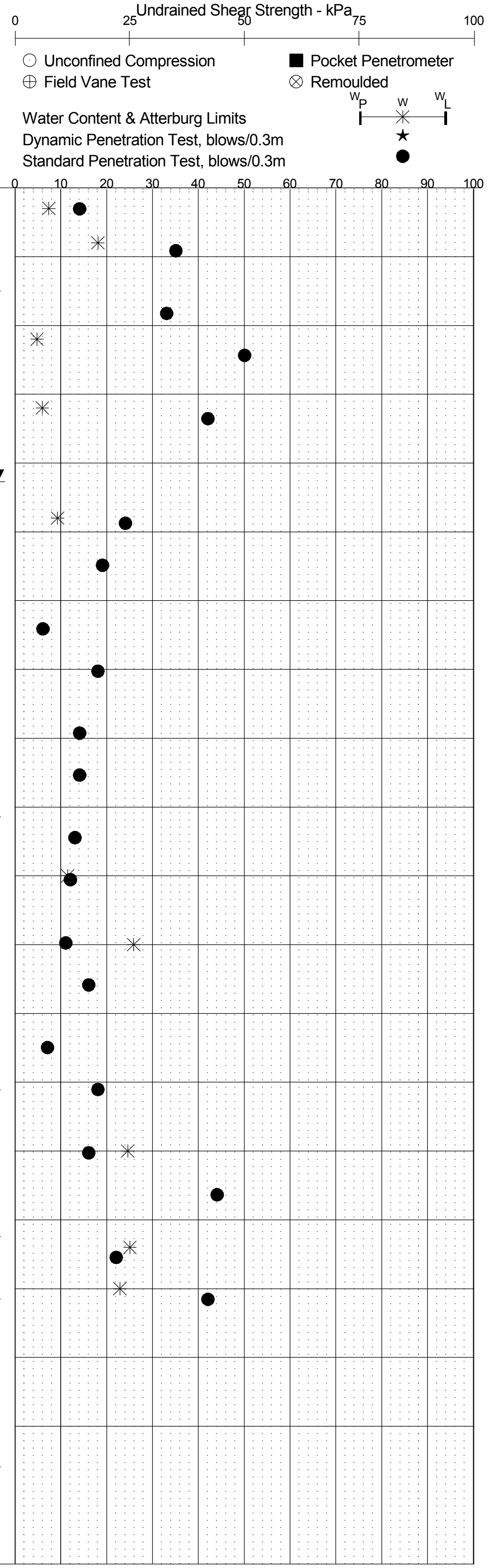
Ground Level, m	Datum:	Logged By
35.89	Geodetic	SRP

SAMPLE

No	TYPE	N (RQD)	REC (mm)
1	S	14	450
2	S	35	420
3	S	33	420
4	S	50	500
5	S	42	450
6	S	24	310
7	S	19	210
8	S	6	100
9	S	18	150
10	S	14	100
11	S	14	100
12	S	13	100
13	S	12	400
14	S	11	100
15	S	16	100
16	S	7	100
17	S	18	0
18	S	16	480
19	S	44	600
20	S	22	600
21	S	42	600
22	Pen Cone	40	
23	Pen Cone	48	
24	Pen Cone	56	
25	Pen Cone	52	
26	Pen Cone	29	
27	Pen Cone	100	
28	Pen Cone	100	

DESCRIPTION

DEPTH m	DESCRIPTION	
0	Miscellaneous Granular Fill	
1.50		34.39
	Silty SAND & GRAVEL trace Cobbles (saturated below water level) Note: Completed hole using hollow stem augers as hole was caving in with standard flight augers	
9.14		26.75
	coarse SAND & GRAVEL trace Silt & Cobbles (saturated)	
13.11		22.78
	grey med stiff SILT some Sand trace Clay (dry)	
15.24		20.65
	red-brown very stiff CLAY & SILT some fine grained Sand	
16.15		19.74
	Pen Cone Penetration Testing - ran out of hollow stem augers	
18.59		17.30
	EOH @ 18.59metres Pen Cone Refusal	



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BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01	BOREHOLE	10
Project	Preliminary Geotechnical Investigation	Date Drilled	12/6/13	Page	1 of 1
Location	McAllister Industrial Park				

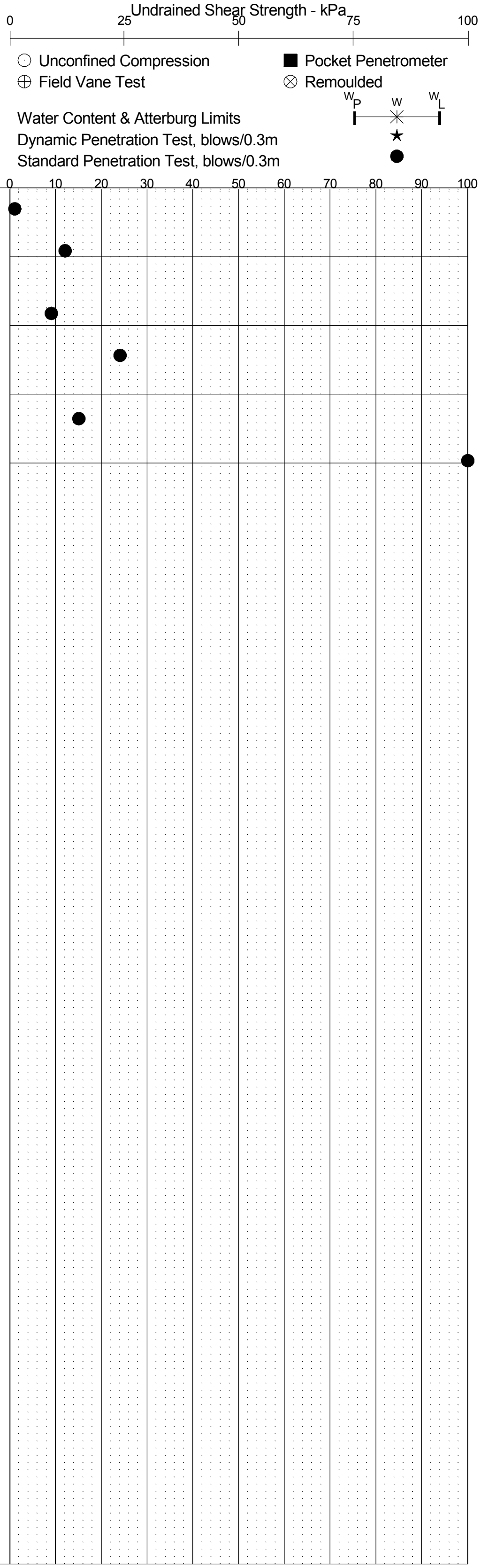
Ground Level, m 38.60	Datum: Geodetic	Logged By BB

DEPTH m	SAMPLE No	SAMPLE TYPE	N (RQD)	REC (mm)	LOG	DESCRIPTION
0	1	S	1	0		SILT & SAND some Gravel (ablation till)
	2	S	12	610		
1						1.50 37.10
	3	S	9	610		Silty SAND & GRAVEL, weather SANDSTONE/ CONGLOMERATE bedrock
2	4	S	24	305		
3	5	S	15	330		
	6	S	100	356		4.00 34.60
4						CONGLOMERATE bedrock 4.57 34.03
						EOH @ 4.57m in BEDROCK, Auger Refusal

Undrained Shear Strength - kPa

○ Unconfined Compression
⊕ Field Vane Test
■ Pocket Penetrometer
⊗ Remoulded

Water Content & Atterburg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●



BOREHOLE LOGS

Client: Atlantic Potash
Project: Preliminary Geotechnical Investigation
Location: McAllister Industrial Park
Proj No.: 2062.01
Date Drilled: 12/10/13
BOREHOLE 11
Page 1 of 1
Ground Level, m: 34.05
Datum: Geodetic
Logged By: BB

DEPTH m	No	TYPE	N (RQD)	REC (mm)
0	1	S	9	360
	2	S	19	279
1				
	3	S	45	508
2	4	S	43	508
3	5	S	33	432
	6	S	20	508
4				
	7	S	14	584
5	8	S	21	610
6	9	S	11	533
	10	S	29	559
7				
	11	S	25	610
8	12	S	37	559
9	13	S	26	330
	14	S	33	584
10				
	15	S	33	406
11	16	S	47	330
12	17	S	30	584
13	18	S	47	356
	19	S	27	432
14	20	S	56	508
15	21	S	48	457
16	22	S	59	457

DESCRIPTION

Silty SAND trace Gravel trace Organics (fill)

2.00 32.05

Silty fine grained SAND & GRAVEL

4.00 30.05

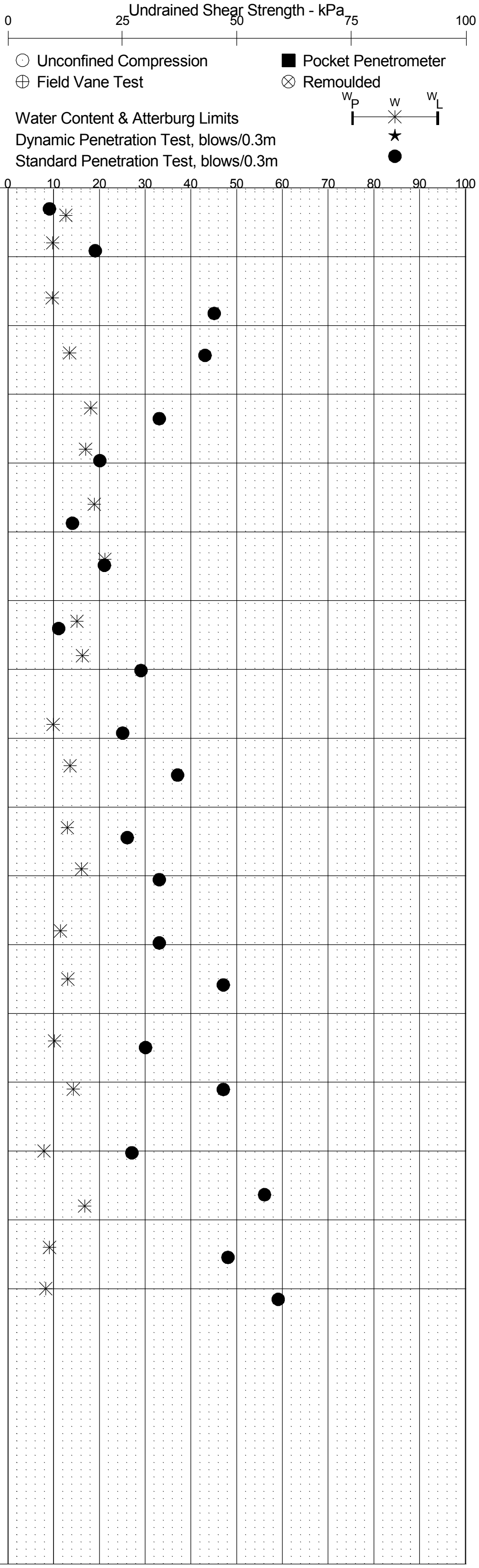
fine grained SAND & SILT

8.10 25.95

SAND & SILT some Gravel (ablation till)

16.46 17.59

EOH @ 16.46metres Hollow Stem Auger refusal



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BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01
Project	Preliminary Geotechnical Investigation	Date Drilled	12/6/13
Location	McAllister Industrial Park		

BOREHOLE 12
Page 1 of 2

Ground Level, m	Datum:	Logged By
33.14	Geodetic	BB

SAMPLE No	TYPE	N (RQD)	REC (mm)
1	S	42	350
2	S	25	300
3	S	24	458
4	S	35	200
5	S	14	432
6	S	19	250
7	S	7	558
8	S	9	610
9	S	2	0
10	S	9	203
11	S	18	610
12	S	10	50
13	S	8	330
14	S	10	254
15	S	16	229
16	S	14	432
17	S	18	381
18	S	8	432
19	S	24	610
20	S	70	508
21	S	20	279
22	S	45	483
23	S	20	355
24	S	32	406
25	S	100	457

DESCRIPTION

Sandy SILT some Gravel trace Orgaincs

2.10 31.04

fine grained SAND & SILT some Gravel to Silty fine grained SAND trace Gravel

11.00 22.14

coarse grained SAND some Silt some Gravel

14.30 18.84

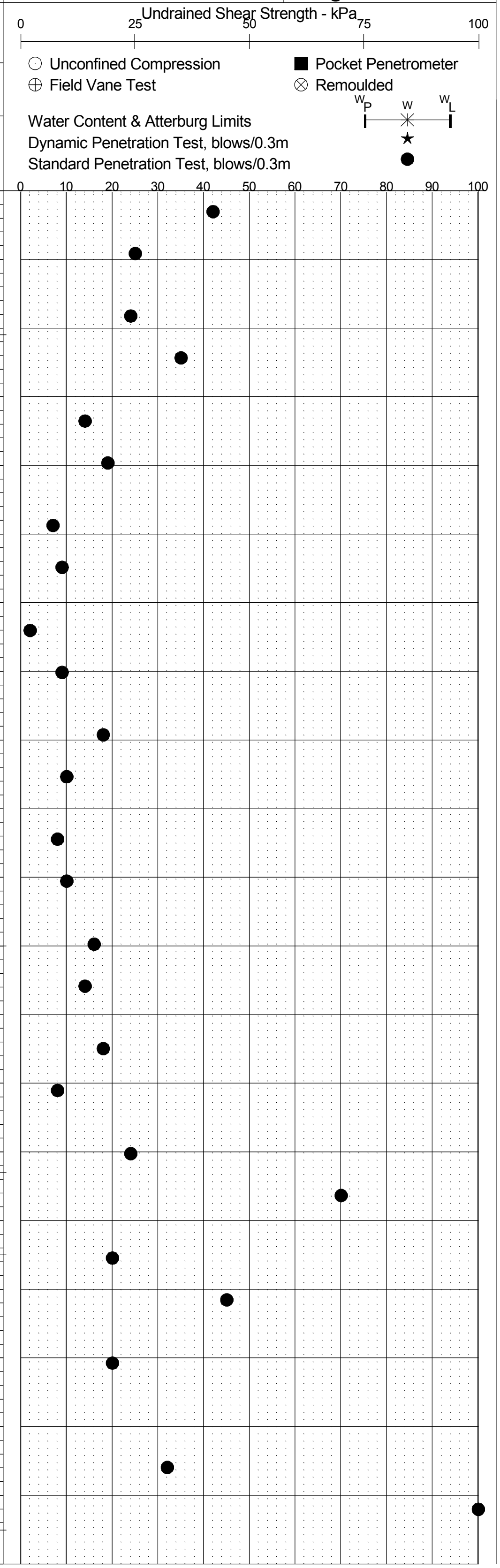
SAND & SILT some Gravel

15.50 17.64

SILT, SAND & GRAVEL (ablation till)

19.51 13.63

EOH @ 19.51metres in Ablation Till - Hollow



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BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01	BOREHOLE 12
Project	Preliminary Geotechnical Investigation	Date Drilled	12/6/13	Page 2 of 2
Location	McAllister Industrial Park			

Ground Level, m 33.14	Datum: Geodetic	Logged By BB

Undrained Shear Strength - kPa: 0 25 50 75 100

○ Unconfined Compression ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded

Water Content & Atterburg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE				LOG	DESCRIPTION
	No	TYPE	N (RQD)	REC (mm)		
						Stem Auger Refusal due to Cohesion

BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01	BOREHOLE 13
Project	Preliminary Geotechnical Investigation	Date Drilled	Dec 10, 2013/ Jan 9, 2014	Page 1 of 2
Location	McAllister Industrial Park			

Ground Level, m 32.16
Datum: Geodetic
Logged By BB

Undrained Shear Strength - kPa: 0 25 50 75 100

○ Unconfined Compression
■ Pocket Penetrometer
⊕ Field Vane Test
⊗ Remoulded

Water Content & Atterburg Limits (w_P w w_L)
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE No	TYPE	N (RQD)	REC (mm)	LOG	DESCRIPTION
0						Advanced borehole with casing and core barrel using water as drilling fluid
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

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BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01	BOREHOLE	13
Project	Preliminary Geotechnical Investigation	Date Drilled	Dec 10, 2013/ Jan 9, 2014	Page 2 of 2	
Location	McAllister Industrial Park				
Ground Level, m 32.16	Datum: Geodetic	Logged By BB			

Undrained Shear Strength - kPa: 0, 25, 50, 75, 100

○ Unconfined Compression
■ Pocket Penetrometer
⊕ Field Vane Test
⊗ Remoulded

Water Content & Atterburg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE No	TYPE	N (RQD)	REC (mm)	LOG	DESCRIPTION
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						37.80 -5.64 EOH @ 37.8m in Conglomerate BEDROCK

n

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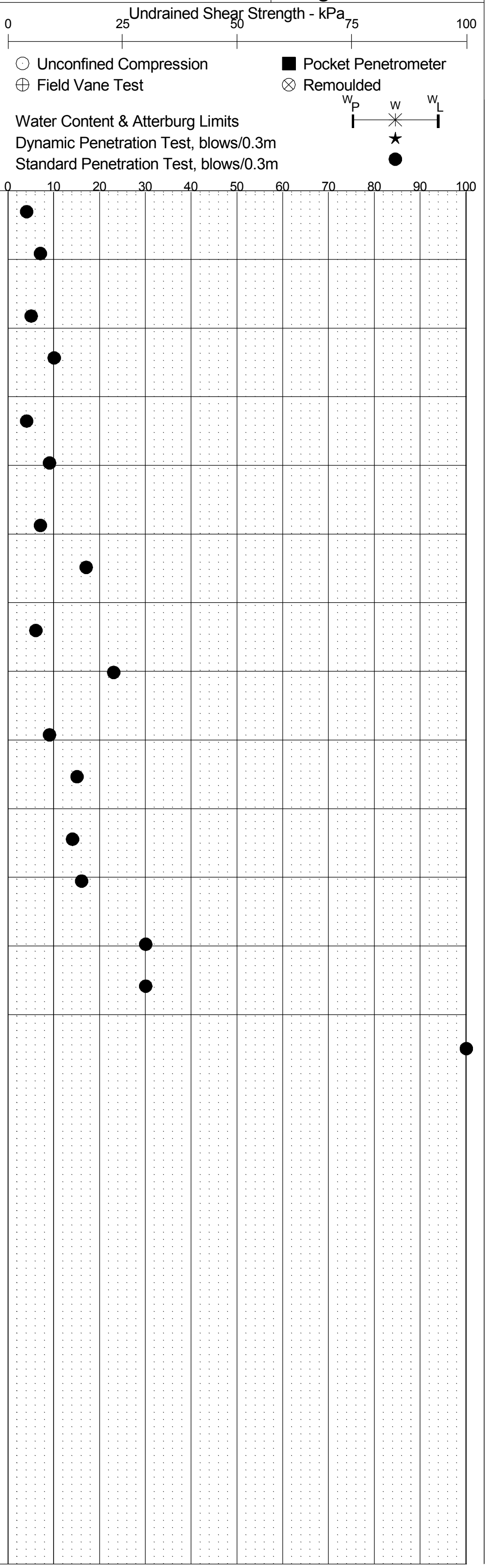
BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01
Project	Preliminary Geotechnical Investigation	Date Drilled	12/10/13
Location	McAllister Industrial Park		

BOREHOLE 14
Page 1 of 1

Ground Level, m	Datum:	Logged By
33.25	Geodetic	BB

DEPTH m	No	TYPE	N (RQD)	REC (mm)	LOG	DESCRIPTION
0	1	S	4	254	F F F	mix of SILT, SAND & GRAVEL with Cobbles (expect Boulders) FILL
	2	S	7	279	F F F	
	3	S	5	483	F F F	
	4	S	10	381	F F F	
	5	S	4	305	F F F	
	6	S	9	508	F F F	
	7	S	7	0	F F F	
	8	S	17	330	F F F	
	9	S	6	432	F F F	
7.00	10	S	23	483		26.25
						Silty fine grained SAND to SILT & fine grained SAND some Gravel
	11	S	9	356		
	12	S	15	610		
	13	S	14	356		
	14	S	16	610		
	15	S	30	330		
	16	S	30	150		
12.19						21.06
12.50	17	S	100	279		weather SANDSTONE/ CONGLOMERATE bedrock 20.75
						EOH @ 12.5metres on BEDROCK - Hollow Stem Auger Refusal



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BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01	BOREHOLE 16
Project	Preliminary Geotechnical Investigation	Date Drilled	1/7/14	Page 1 of 2
Location	McAllister Industrial Park			

Ground Level, m 33.13	Datum: Geodetic	Logged By BB

Undrained Shear Strength - kPa: 0, 25, 50, 75, 100

○ Unconfined Compression
⊕ Field Vane Test
■ Pocket Penetrometer
⊗ Remoulded

Water Content & Atterburg Limits w_P — w — w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

Scale: 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

DEPTH m	SAMPLE				LOG	DESCRIPTION
	No	TYPE	N (RQD)	REC (mm)		
0						Advanced borehole with casing and core barrel using water as drilling fluid
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

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BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01	BOREHOLE 16
Project	Preliminary Geotechnical Investigation	Date Drilled	1/7/14	Page 2 of 2
Location	McAllister Industrial Park			

Ground Level, m 33.13	Datum: Geodetic	Logged By BB

Undrained Shear Strength - kPa: 0, 25, 50, 75, 100

○ Unconfined Compression
■ Pocket Penetrometer
⊕ Field Vane Test
⊗ Remoulded

Water Content & Atterburg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE No	SAMPLE TYPE	SAMPLE N (RQD)	SAMPLE REC (mm)	LOG	DESCRIPTION
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						36.27 -3.15 EOH @ 36.27m in Conglomerate BEDROCK

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BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01	BOREHOLE 17
Project	Preliminary Geotechnical Investigation	Date Drilled	1/9/14	Page 1 of 2
Location	McAllister Industrial Park			

Ground Level, m 28.44
Datum: Geodetic
Logged By BB

Undrained Shear Strength - kPa
0 25 50 75 100

○ Unconfined Compression
⊕ Field Vane Test
■ Pocket Penetrometer
⊗ Remoulded

Water Content & Atterburg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

DEPTH m	No	TYPE	N (RQD)	REC (mm)
0	1	S	3	50
2.45	2	S	7	406
3.96	3	S	6	559
5.49	4	S	7	610
8.53	5	S	5	610
11.58	6	S	4	559
14.63	7	S	29	559
16.15	8	S	60	254
19.20	9	S	31	508

DESCRIPTION

0.40 ORGANIC Soils 28.04

fine grianed SAND trace Silt trace organics

3.96 24.48

Silty fine grained SAND

5.49 22.95

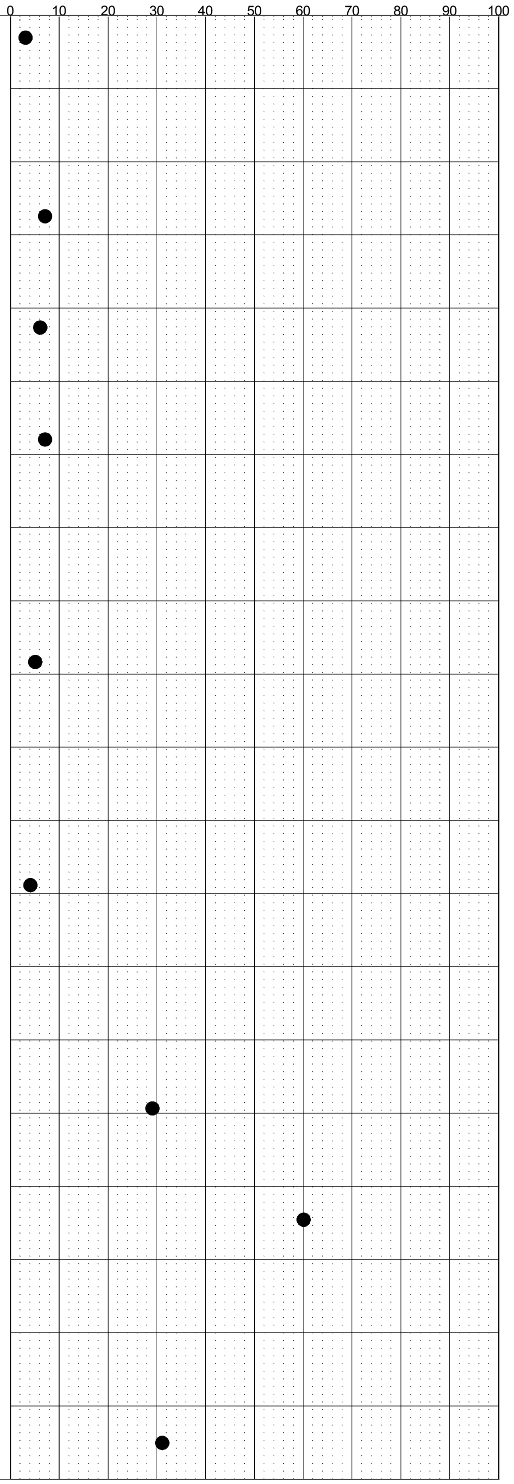
red soft CLAY/SILT with interbedded fine grained Sand seems 50mm thick

11.58 16.86

grey soft SILT some Clay some fine grained Sand

14.63 13.81

Silty SAND some Gravel, ablation till



BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01	BOREHOLE 17
Project	Preliminary Geotechnical Investigation	Date Drilled	1/9/14	Page 2 of 2
Location	McAllister Industrial Park			

Ground Level, m 28.44	Datum: Geodetic	Logged By BB

Undrained Shear Strength - kPa
0 25 50 75 100

○ Unconfined Compression
■ Pocket Penetrometer
⊕ Field Vane Test
⊗ Remoulded
Water Content & Atterburg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE No	TYPE	N (RQD)	REC (mm)	LOG	DESCRIPTION
20						20.73 7.71
21						Conglomerate BEDROCK, weathered near surface and becoming competent with depth
22						22.25 6.19
						EOH @ 22.25m in BEDROCK

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BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01	BOREHOLE 20
Project	Preliminary Geotechnical Investigation	Date Drilled	12/10/13	Page 1 of 1
Location	McAllister Industrial Park			

Ground Level, m 40.18

Datum: Geodetic

Logged By SRP

Undrained Shear Strength - kPa
0 25 50 75 100

○ Unconfined Compression
■ Pocket Penetrometer
⊕ Field Vane Test
⊗ Remoulded

Water Content & Atterburg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE No	SAMPLE TYPE	SAMPLE N (RQD)	SAMPLE REC (mm)	LOG	DESCRIPTION
0						0.10 OUTCROP 40.08

BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01	BOREHOLE 21 Page 1 of 1
Project	Preliminary Geotechnical Investigation	Date Drilled	12/10/13	
Location	McAllister Industrial Park			

Ground Level, m 40.89
Datum: Geodetic
Logged By SRP

Undrained Shear Strength - kPa: 0, 25, 50, 75, 100

○ Unconfined Compression
■ Pocket Penetrometer
⊕ Field Vane Test
⊗ Remoulded

Water Content & Atterburg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE No	SAMPLE TYPE	N (RQD)	REC (mm)	LOG	DESCRIPTION
0						0.10 OUTCROP 40.79

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BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01	BOREHOLE	22
Project	Preliminary Geotechnical Investigation	Date Drilled	12/10/13	Page	1 of 1
Location	McAllister Industrial Park				
Ground Level, m	40.38	Datum:	Geodetic	Logged By	SRP

Undrained Shear Strength - kPa: 0, 25, 50, 75, 100

○ Unconfined Compression
■ Pocket Penetrometer
⊕ Field Vane Test
⊗ Remoulded

Water Content & Atterburg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

DEPTH m	SAMPLE No	SAMPLE TYPE	SAMPLE N (RQD)	SAMPLE REC (mm)	LOG	DESCRIPTION	
0						0.10 OUTCROP	40.28

0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

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BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01	BOREHOLE	23
Project	Preliminary Geotechnical Investigation	Date Drilled	12/10/13	Page 1 of 1	
Location	McAllister Industrial Park				

Ground Level, m 40.53	Datum: Geodetic	Logged By SRP

Undrained Shear Strength - kPa: 0 25 50 75 100

○ Unconfined Compression
■ Pocket Penetrometer
⊕ Field Vane Test
⊗ Remoulded

Water Content & Atterburg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE No	SAMPLE TYPE	SAMPLE N (RQD)	SAMPLE REC (mm)	LOG	DESCRIPTION
0						0.10 OUTCROP 40.43

BRUNSWICK
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BOREHOLE LOGS

Client: Atlantic Potash
Project: Preliminary Geotechnical Investigation
Location: McAllister Industrial Park
Proj No.: 2062.01
Date Drilled: 12/10/13
BOREHOLE 24
Page 1 of 1
Ground Level, m: 41.59
Datum: Geodetic
Logged By: SRP

Undrained Shear Strength - kPa: 0, 25, 50, 75, 100

○ Unconfined Compression
■ Pocket Penetrometer
⊕ Field Vane Test
⊗ Remoulded

Water Content & Atterburg Limits: w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

DEPTH m	SAMPLE No	TYPE	N (RQD)	REC (mm)	LOG	DESCRIPTION	0 10 20 30 40 50 60 70 80 90 100
0						0.10 OUTCROP 41.49	

BRUNSWICK
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BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01	BOREHOLE 25
Project	Preliminary Geotechnical Investigation	Date Drilled	12/10/13	Page 1 of 1
Location	McAllister Industrial Park			

Ground Level, m 40.70	Datum: Geodetic	Logged By SRP

Undrained Shear Strength - kPa: 0, 25, 50, 75, 100

○ Unconfined Compression
■ Pocket Penetrometer
⊕ Field Vane Test
⊗ Remoulded

Water Content & Atterburg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE No	TYPE	N (RQD)	REC (mm)	LOG	DESCRIPTION
0						0.10 OUTCROP 40.60

BOREHOLE LOGS

Client Atlantic Potash
Project Preliminary Geotechnical Investigation
Location McAllister Industrial Park
Proj No. 2062.01
Date Drilled 12/10/13
BOREHOLE 26
Page 1 of 1
Ground Level, m 40.98
Datum: Geodetic
Logged By SRP

Undrained Shear Strength - kPa
0 25 50 75 100

○ Unconfined Compression
⊕ Field Vane Test
■ Pocket Penetrometer
⊗ Remoulded

Water Content & Atterburg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

DEPTH m	SAMPLE No	TYPE	N (RQD)	REC (mm)	LOG	DESCRIPTION
0						0.10 OUTCROP 40.88

0 10 20 30 40 50 60 70 80 90 100

BRUNSWICK
Engineering & Consulting Inc.

BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01	BOREHOLE 27 Page 1 of 1
Project	Preliminary Geotechnical Investigation	Date Drilled	12/10/13	
Location	McAllister Industrial Park			

Ground Level, m 42.65	Datum: Geodetic	Logged By SRP

Undrained Shear Strength - kPa
0 25 50 75 100

○ Unconfined Compression
■ Pocket Penetrometer
⊕ Field Vane Test
⊗ Remoulded

Water Content & Atterburg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE				LOG	DESCRIPTION
	No	TYPE	N (RQD)	REC (mm)		
0						0.10 OUTCROP 42.55

Client	Atlantic Potash	Proj No.	2062.01	BOREHOLE 28 Page 1 of 1
Project	Preliminary Geotechnical Investigation	Date Drilled	12/10/13	
Location	McAllister Industrial Park			

Ground Level, m	Datum:	Logged By
43.62	Geodetic	SRP

Undrained Shear Strength - kPa: 0, 25, 50, 75, 100

○ Unconfined Compression
■ Pocket Penetrometer
⊕ Field Vane Test
⊗ Remoulded

Water Content & Atterburg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE No	TYPE	N (RQD)	REC (mm)	LOG	DESCRIPTION	
0						0.10 OUTCROP	43.52

BRUNSWICK
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BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01	BOREHOLE 29
Project	Preliminary Geotechnical Investigation	Date Drilled	12/10/13	Page 1 of 1
Location	McAllister Industrial Park			

Ground Level, m 43.22	Datum: Geodetic	Logged By SRP

Undrained Shear Strength - kPa: 0, 25, 50, 75, 100

○ Unconfined Compression
■ Pocket Penetrometer
⊕ Field Vane Test
⊗ Remoulded
Water Content & Atterburg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE No	TYPE	N (RQD)	REC (mm)	LOG	DESCRIPTION	
0						0.10 OUTCROP	43.12

BRUNSWICK
Engineering & Consulting Inc.

BOREHOLE LOGS

Client Atlantic Potash
Project Preliminary Geotechnical Investigation
Location McAllister Industrial Park
Proj No. 2062.01
Date Drilled 12/10/13
BOREHOLE 30
Page 1 of 1
Ground Level, m 43.14
Datum: Geodetic
Logged By SRP

Undrained Shear Strength - kPa: 0 25 50 75 100

○ Unconfined Compression
⊕ Field Vane Test
■ Pocket Penetrometer
⊗ Remoulded

Water Content & Atterburg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE No	SAMPLE TYPE	SAMPLE N (RQD)	SAMPLE REC (mm)	LOG	DESCRIPTION
0						0.10 OUTCROP 43.04

BRUNSWICK
Engineering & Consulting Inc.

BOREHOLE LOGS

Client	Atlantic Potash	Proj No.	2062.01
Project	Preliminary Geotechnical Investigation	Date Drilled	12/10/13
Location	McAllister Industrial Park	BOREHOLE	31
		Page	1 of 1

Ground Level, m 41.86
Datum: Geodetic
Logged By SRP

Undrained Shear Strength - kPa: 0, 25, 50, 75, 100

○ Unconfined Compression
■ Pocket Penetrometer
⊕ Field Vane Test
⊗ Remoulded
Water Content & Atterburg Limits (w_P, w, w_L)
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

DEPTH m	SAMPLE No	SAMPLE TYPE	SAMPLE N (RQD)	SAMPLE REC (mm)	LOG	DESCRIPTION
0						0.10 OUTCROP 41.76

0 10 20 30 40 50 60 70 80 90 100

BRUNSWICK
Engineering & Consulting Inc.

BOREHOLE LOGS

Client Atlantic Potash
Project Preliminary Geotechnical Investigation
Location McAllister Industrial Park
Proj No. 2062.01
Date Drilled 12/10/13
BOREHOLE 32
Page 1 of 1
Ground Level, m 40.06
Datum: Geodetic
Logged By SRP

Undrained Shear Strength - kPa
0 25 50 75 100

○ Unconfined Compression
⊕ Field Vane Test
■ Pocket Penetrometer
⊗ Remoulded

Water Content & Atterburg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE				LOG	DESCRIPTION
	No	TYPE	N (RQD)	REC (mm)		
0						0.10 OUTCROP 39.96

BRUNSWICK
Engineering & Consulting Inc.

BOREHOLE LOGS

Client: Atlantic Potash
Proj No.: 2062.01
BOREHOLE 33
Project: Preliminary Geotechnical Investigation
Date Drilled: 12/10/13
Page 1 of 1
Location: McAllister Industrial Park
Ground Level, m: 39.36
Datum: Geodetic
Logged By: SRP

Undrained Shear Strength - kPa: 0 25 50 75 100

○ Unconfined Compression
■ Pocket Penetrometer
⊕ Field Vane Test
⊗ Remoulded

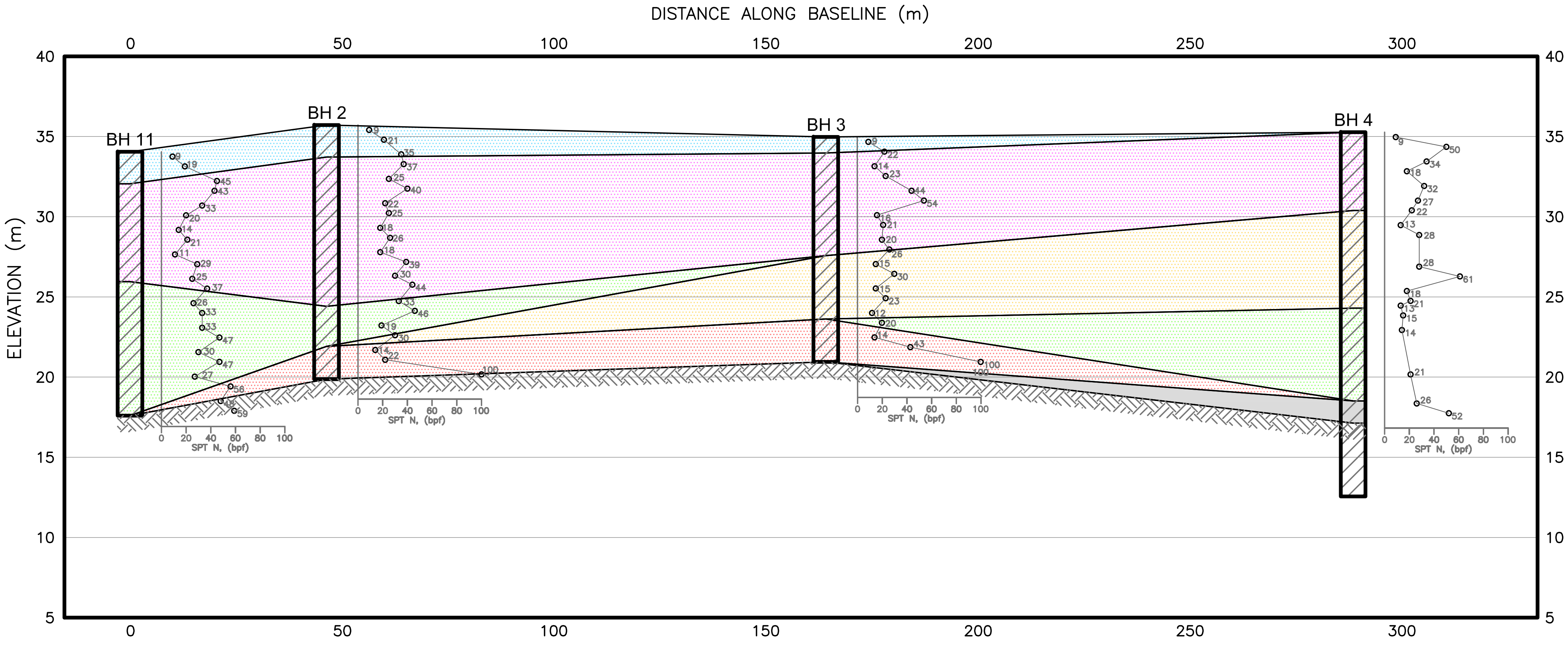
Water Content & Atterburg Limits w_P w w_L
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

0 10 20 30 40 50 60 70 80 90 100

DEPTH m	SAMPLE				LOG	DESCRIPTION
	No	TYPE	N (RQD)	REC (mm)		
0						0.10 OUTCROP 39.26

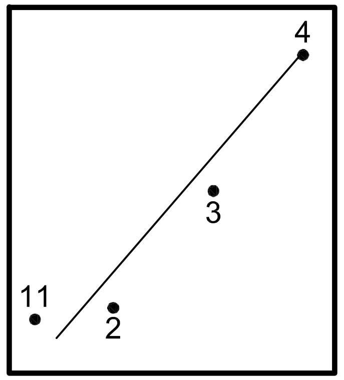
APPENDIX B

GEOTECHNICAL CROSS SECTION



SECTION LOCATION PLAN

NTS



LEGEND

- ▨ ORGANIC AND FILL SOILS
- ▨ SILTY SAND AND GRAVEL TO SILT AND SAND SOME GRAVEL
- ▨ GREY/BROWN CLAY SILT SOME SAND
- ▨ SAND AND SILT TRACE GRAVEL (ABLATION TILL)
- ▨ RED CLAY AND SILT
- ▨ WEATHERED BEDROCK
- ▨ CONGLOMERATE BEDROCK

NOTE:
PROFILES ARE INTENDED AS AN AID IN VISUALIZING THE CONTINUITY OF STRATA.
STRATA BOUNDARIES HAVE BEEN INFERRED FROM BORING DATA AND MAY VARY FROM THAT SHOWN.

CLIENT:
ATLANTIC POTASH CORPORATION

PROJECT:
PROPOSED FERTILIZER PLANT
PRELIMINARY GEOTECHNICAL INVESTIGATION
MCALLISTER INDUSTRIAL PARK, SAINT JOHN, NB

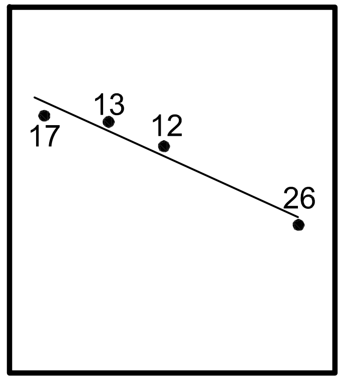
DRAWING:
BORE HOLE SECTION
BORE HOLES:
11, 2, 3 & 4

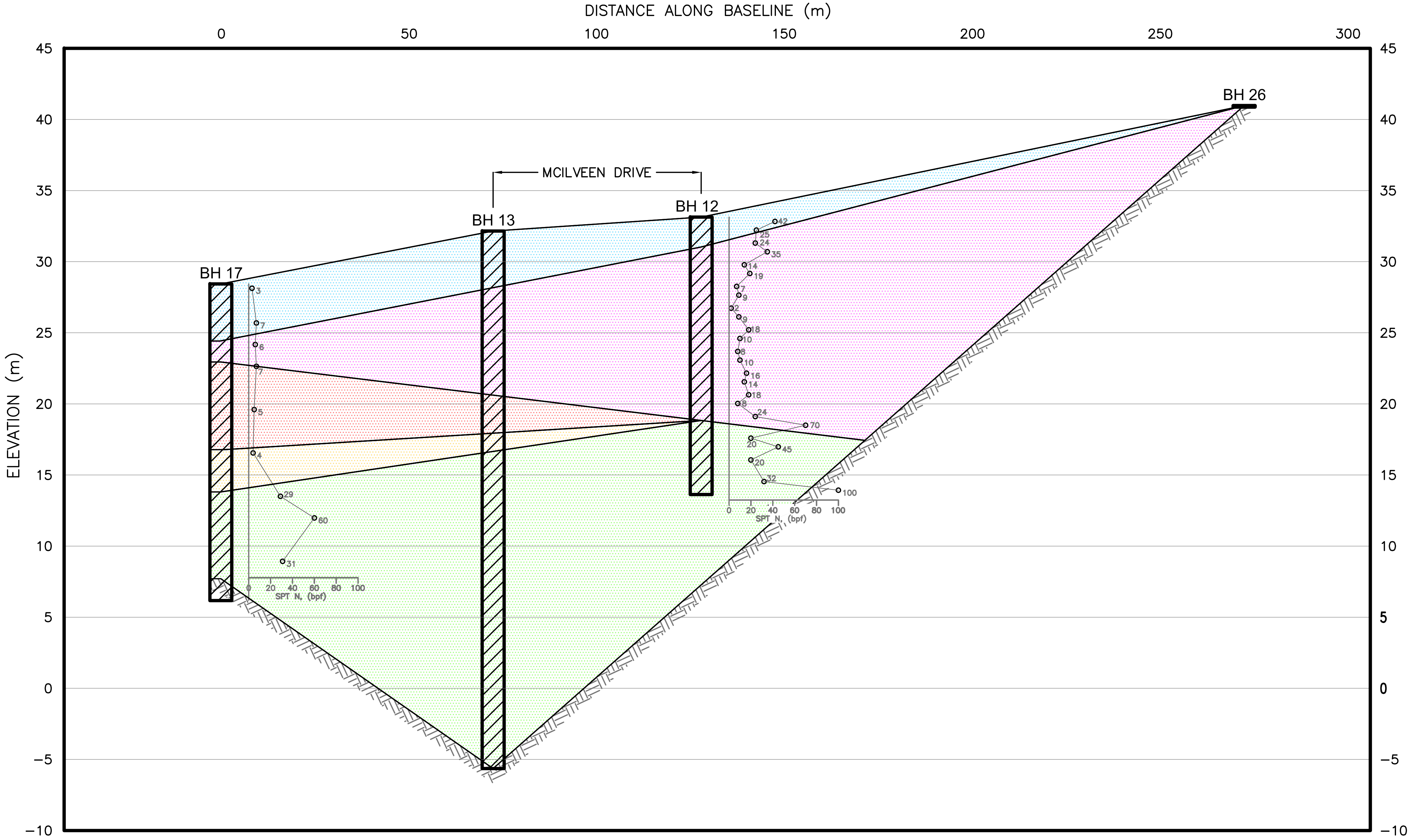
BRUNSWICK
Engineering & Consulting Inc.
40 Ashburn Lake Road, PO Box 1045, Saint John, NB E2L 4E3
tel: 506.696.9155 fax: 506.696.9158

DRAWN BY: KMJ	DATE: 29–JAN–14
SCALE: N/A	PROJECT No.: 2062.01
REVISION: 0	SKETCH: 1

SECTION LOCATION PLAN

NTS





LEGEND

- 🟦 ORGANIC AND FILL SOILS
- 🟪 SILTY SAND AND GRAVEL TO SILT AND SAND SOME GRAVEL
- 🟨 GREY/BROWN CLAY SILT SOME SAND
- 🟩 SAND AND SILT TRACE GRAVEL (ABLATION TILL)
- 🟥 RED CLAY AND SILT
- ⬜ WEATHERED BEDROCK
- ▨ CONGLOMERATE BEDROCK

NOTE:
PROFILES ARE INTENDED AS AN AID IN VISUALIZING THE CONTINUITY OF STRATA.
STRATA BOUNDARIES HAVE BEEN INFERRED FROM BORING DATA AND MAY VARY FROM THAT SHOWN.

CLIENT:
ATLANTIC POTASH
CORPORATION

PROJECT:
PROPOSED FERTILIZER PLANT
PRELIMINARY GEOTECHNICAL INVESTIGATION
MCALLISTER INDUSTRIAL PARK, SAINT JOHN, NB

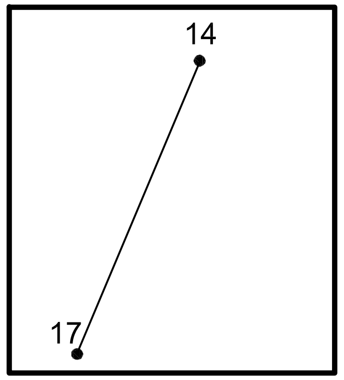
DRAWING:
BORE HOLE SECTION
BORE HOLES:
17, 13, 12 & 26

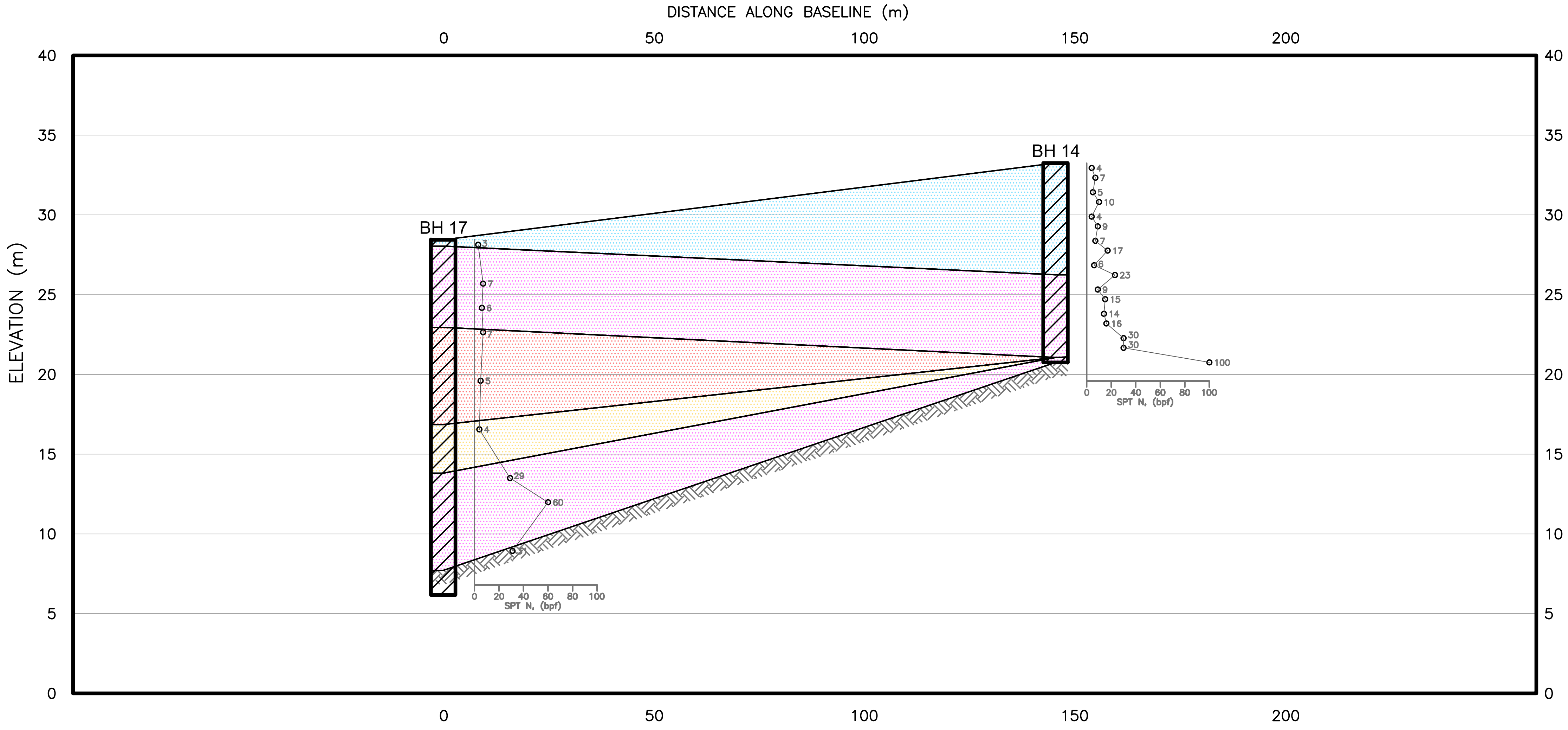
BRUNSWICK
Engineering & Consulting Inc.
40 Ashburn Lake Road, PO Box 1045, Saint John, NB E2L 4E3
tel: 506.696.9155 fax: 506.696.9158

DRAWN BY: KMJ	DATE: 29–JAN–14
SCALE: N/A	PROJECT No.: 2062.01
REVISION: 0	SKETCH: 2

SECTION LOCATION PLAN

NTS





LEGEND

▨	ORGANIC AND FILL SOILS
▨	SILTY SAND AND GRAVEL TO SILT AND SAND SOME GRAVEL
▨	GREY/BROWN CLAY SILT SOME SAND
▨	SAND AND SILT TRACE GRAVEL (ABLATION TILL)
▨	RED CLAY AND SILT
▨	WEATHERED BEDROCK
▨	CONGLOMERATE BEDROCK

NOTE:
PROFILES ARE INTENDED AS AN AID IN VISUALIZING THE CONTINUITY OF STRATA.
STRATA BOUNDARIES HAVE BEEN INFERRED FROM BORING DATA AND MAY VARY FROM THAT SHOWN.

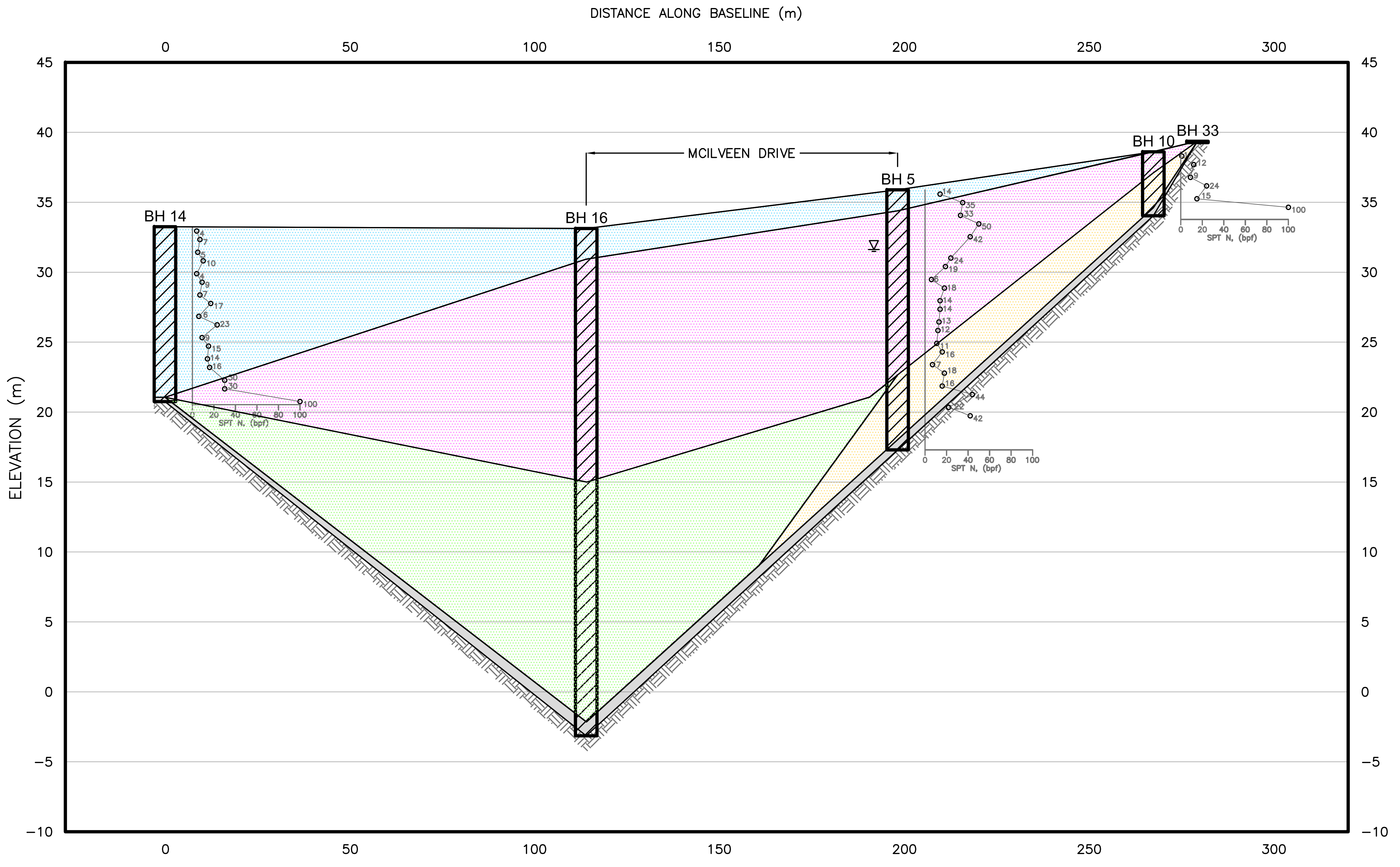
CLIENT:
ATLANTIC POTASH
CORPORATION

PROJECT:
PROPOSED FERTILIZER PLANT
PRELIMINARY GEOTECHNICAL INVESTIGATION
MCALLISTER INDUSTRIAL PARK, SAINT JOHN, NB

DRAWING:
BORE HOLE SECTION
BORE HOLES:
17 & 14

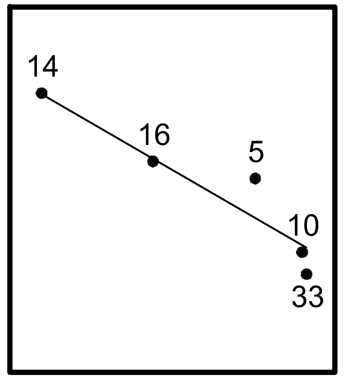
BRUNSWICK
Engineering & Consulting Inc.
40 Ashburn Lake Road, PO Box 1045, Saint John, NB E2L 4E3
tel: 506.696.9155 fax: 506.696.9158

DRAWN BY: KMJ	DATE: 02–DEC–13
SCALE: N/A	PROJECT No.: 2062.01
REVISION: 0	SKETCH: 3



SECTION LOCATION PLAN

NTS



LEGEND

- 🟦 ORGANIC AND FILL SOILS
- 🟪 SILTY SAND AND GRAVEL TO SILT AND SAND SOME GRAVEL
- 🟨 GREY/BROWN CLAY SILT SOME SAND
- 🟩 SAND AND SILT TRACE GRAVEL (ABLATION TILL)
- 🟥 RED CLAY AND SILT
- ⬜ WEATHERED BEDROCK
- ▨ CONGLOMERATE BEDROCK

NOTE:
PROFILES ARE INTENDED AS AN AID IN VISUALIZING THE CONTINUITY OF STRATA.
STRATA BOUNDARIES HAVE BEEN INFERRED FROM BORING DATA AND MAY VARY FROM THAT SHOWN.

CLIENT:
ATLANTIC POTASH CORPORATION

PROJECT:
PROPOSED FERTILIZER PLANT
PRELIMINARY GEOTECHNICAL INVESTIGATION
MCALLISTER INDUSTRIAL PARK, SAINT JOHN, NB

DRAWING:
BORE HOLE SECTION
BORE HOLES:
14, 16, 5, 10 & 33

BRUNSWICK
Engineering & Consulting Inc.
40 Ashburn Lake Road, PO Box 1045, Saint John, NB E2L 4E3
tel: 506.696.9155 fax: 506.696.9158

DRAWN BY: KMJ	DATE: 29–JAN–14
SCALE: N/A	PROJECT No.: 2062.01
REVISION: 0	SKETCH: 4

APPENDIX C

LABORATORY TEST RESULTS

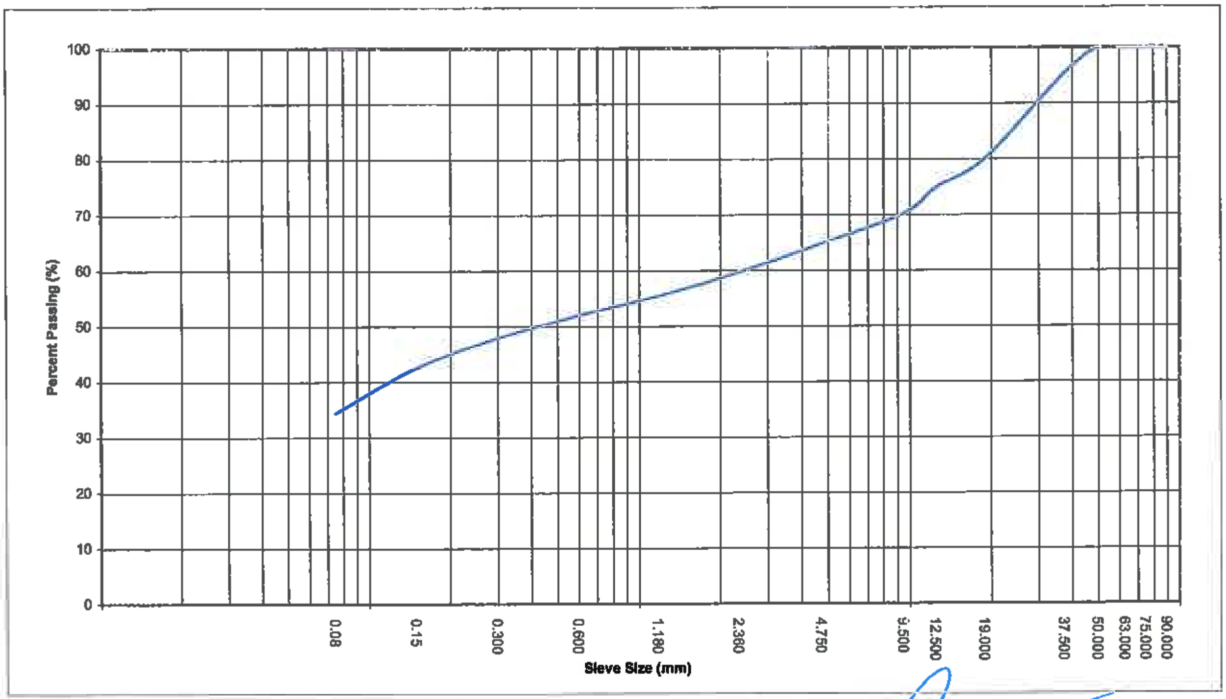
BRUNSWICK
Engineering & Consulting Inc.

Soil Sieve Test Result

Sample # S116

Project #:	2062.01	Material Type:	Insitu Material
Date Sampled:	Dec-13	Material:	Insitu Material
Date Tested:	Dec-13	Quarry/ Pit:	BH11 S16

Sieve Size (mm)	% Pass	% Retained	Limits	
			Max	Min
90.000	100.00	0.00		
75.000	100.00	0.00		
63.000	100.00	0.00		
50.000	100.00	0.00		
37.500	95.43	4.57		
19.000	80.13	19.87		
12.500	74.94	25.06		
9.500	70.25	29.75		
4.750	64.86	35.14		
2.360	59.78	40.22		
1.180	55.54	44.46		
0.600	52.00	48.00		
0.300	47.98	52.02		
0.15	42.63	57.37		
0.08	34.48	65.52		



Reviewed By: Stephen Perry, P.Eng.

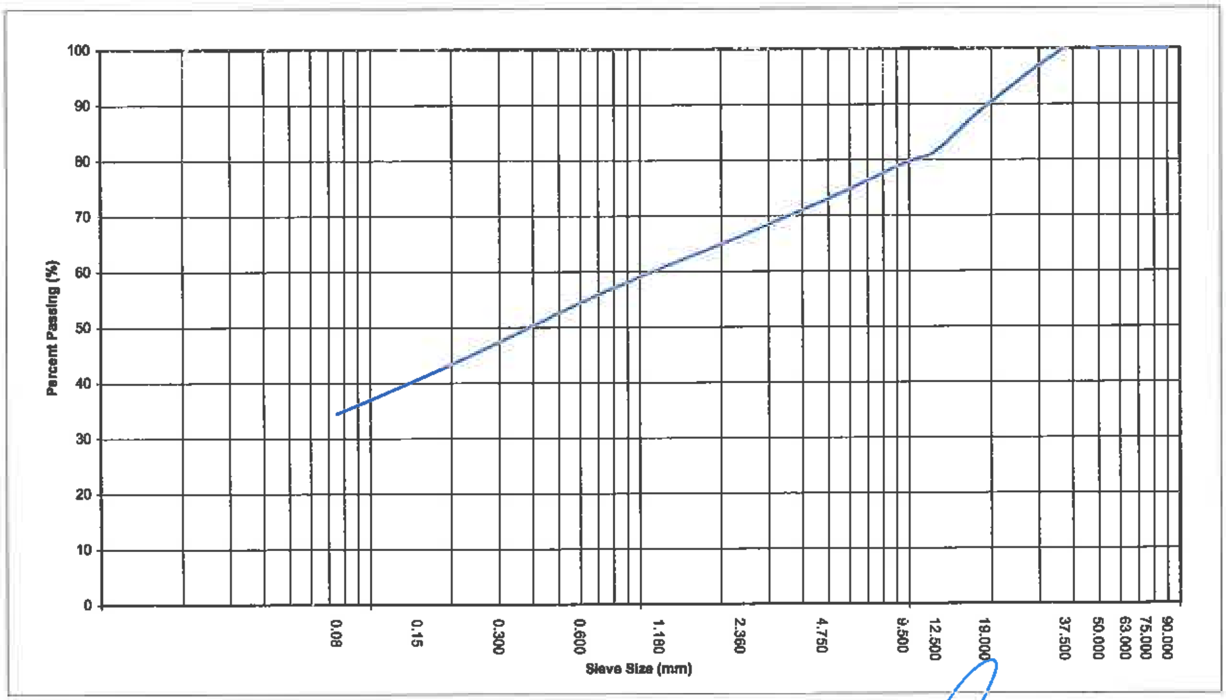
BRUNSWICK
Engineering & Consulting Inc.

Soil Sieve Test Result

Sample # S115

Project #:	2062.01	Material Type:	Insitu Material
Date Sampled:	Dec-13	Material:	Insitu Material
Date Tested:	Dec-13	Quarry/ Pit:	BH11 S20

Sieve Size (mm)	% Pass	% Retained	Limits	
			Max	Min
90.000	100.00	0.00		
75.000	100.00	0.00		
63.000	100.00	0.00		
50.000	100.00	0.00		
37.500	100.00	0.00		
19.000	89.49	10.51		
12.500	81.55	18.45		
9.500	79.32	20.68		
4.750	72.61	27.39		
2.360	66.30	33.70		
1.180	60.49	39.51		
0.600	54.44	45.56		
0.300	47.37	52.63		
0.15	40.63	59.37		
0.08	34.54	65.46		



Reviewed By: Stephen Perry, P.Eng.

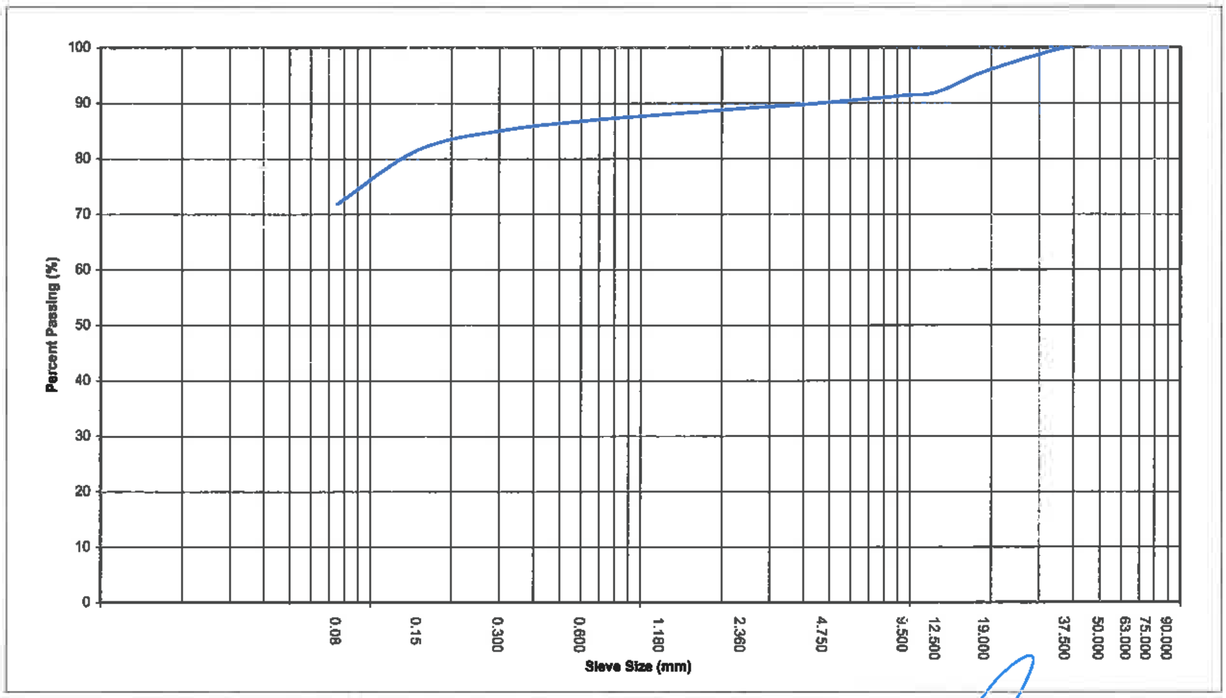
BRUNSWICK
Engineering & Consulting Inc.

Soil Sieve Test Result

Sample # S114

Project #:	2062.01	Material Type:	Insitu Material
Date Sampled:	Dec-13	Material:	Insitu Material
Date Tested:	Dec-13	Quarry/ Pit:	BH11 S10

Sieve Size (mm)	% Pass	% Retained	Limits Max	Limits Min
90.000	100.00	0.00		
75.000	100.00	0.00		
63.000	100.00	0.00		
50.000	100.00	0.00		
37.500	100.00	0.00		
19.000	95.74	4.26		
12.500	91.98	8.02		
9.500	91.39	8.61		
4.750	90.03	9.97		
2.360	89.05	10.95		
1.180	87.94	12.06		
0.600	86.80	13.20		
0.300	85.05	14.95		
0.15	81.62	18.38		
0.08	71.82	28.18		



Reviewed By: Stephen Perry, P.Eng.

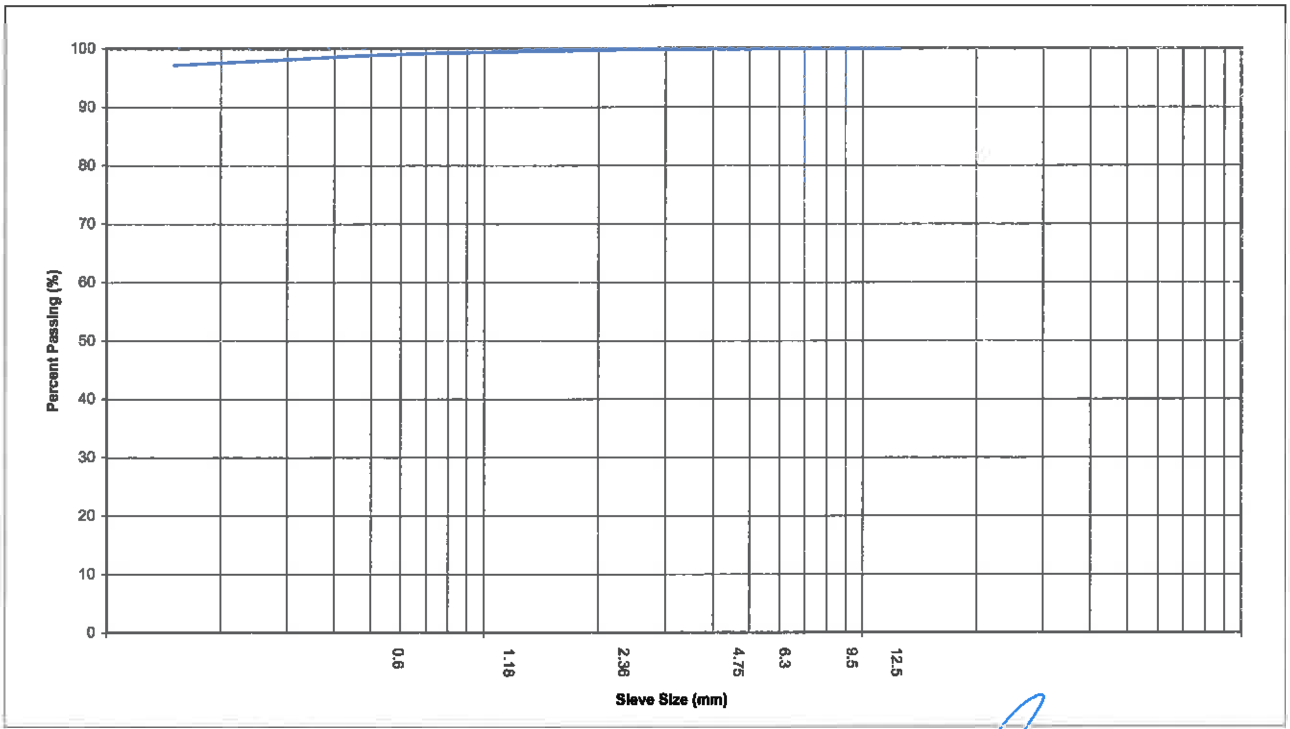
BRUNSWICK
Engineering & Consulting Inc.

Soil Sieve Test Result

Sample # S111

Project #:	2062.01	Material Type:	Insitu Material
Date Sampled:	Dec-13	Material:	Insitu Material
Date Tested:	Dec-13	Quarry/ Pit:	BH 5 S21

Sieve Size (mm)	% Pass	% Retained	Limits Max	Limits Min
12.5	100.00	0.00		
9.5	100.00	0.00		
6.3	100.00	0.00		
4.75	99.95	0.05		
2.36	99.81	0.19		
1.18	99.52	0.48		
0.6	99.06	0.94		
0.3	98.22	1.78		
0.15	97.22	2.78		
0.075	95.92	4.08		



Reviewed By: Stephen Perry, P.Eng.

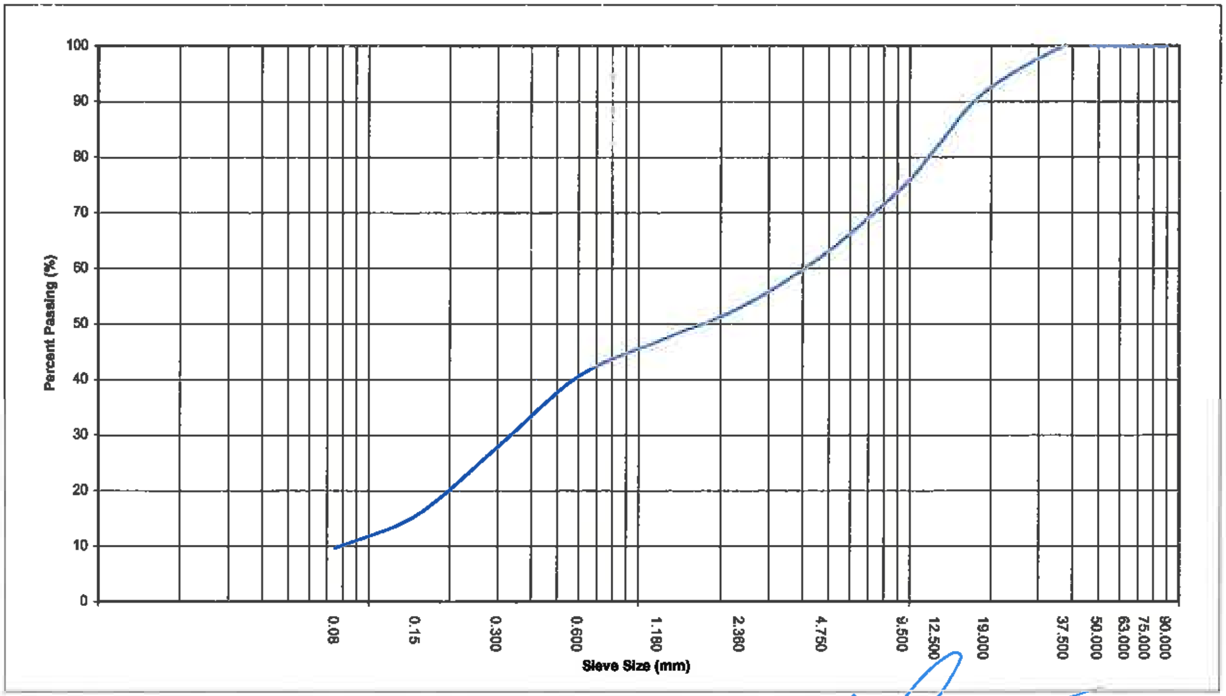
BRUNSWICK
Engineering & Consulting Inc.

Soil Sieve Test Result

Sample # S112

Project #:	2062.01	Material Type:	Insitu Material
Date Sampled:	Dec-13	Material:	Insitu Material
Date Tested:	Dec-13	Quarry/ Pit:	BH5 S5

Sieve Size (mm)	% Pass	% Retained	Limits Max	Limits Min
90.000	100.00	0.00		
75.000	100.00	0.00		
63.000	100.00	0.00		
50.000	100.00	0.00		
37.500	100.00	0.00		
19.000	91.77	8.23		
12.500	81.67	18.33		
9.500	74.84	25.16		
4.750	62.32	37.68		
2.360	52.96	47.04		
1.180	46.88	53.12		
0.600	40.52	59.48		
0.300	27.85	72.15		
0.15	15.52	84.48		
0.08	9.61	90.39		



Reviewed By: Stephen Perry, P.Eng.

APPENDIX D
FROST DESIGN DATA

TABLE 1 – continued

Freezing Indices for Canada – continued

Station	Freezing Index Degree-Days °F	Degree-Days °C
Ontario – continued		
St. Catharines	506	281
St. Thomas	710	394
Sarnia	670	372
Sault Ste. Marie A	1,663	924
Simcoe	751	417
Sioux Lookout A	3,450	1,917
Stratford	1,072	596
Sudbury A	2,401	1,334
Timmins A	3,160	1,756
Toronto	629	349
Toronto A	897	498
White River	3,344	1,858
Windsor A	565	314
Woodstock	929	516
Québec		
Bagotville A	2,867	1,593
Baie Comeau A	2,518	1,399
Chicoutimi	2,536	1,409
Drummondville	1,827	1,015
Gagnon A	4,216	2,342
Gaspé	2,012	1,118
La Malbaie	2,043	1,135
Mont Laurier	2,325	1,292
Montréal A	1,583	879
Québec	1,822	1,012
Québec A	2,059	1,144
Sept-Iles A	2,746	1,526
Sherbrooke	1,581	878
Sorel	1,997	1,109
Tadoussac	2,038	1,132
Three Rivers	2,139	1,188
New Brunswick		
Edmundston	2,219	1,233
Fredericton A	1,561	867
Moncton A	1,397	776
Pennfield Ridge A	1,178	654

Freezing Indices for Canada – continued

Station	Freezing Index Degree-Days °F	Degree-Days °C
New Brunswick – continued		
Sackville	1,174	652
St. George	1,115	619
Saint John	1,002	557
Saint John A	1,137	632
Sussex	1,337	743
Woodstock	1,701	945
Nova Scotia		
Annapolis Royal	593	329
Cheticamp	955	531
Debert A	1,136	631
Greenwood A	815	453
Halifax	556	309
Halifax A	856	476
Ingonish Beach	828	460
Liverpool	453	252
Shearwater A	699	388
Springfield	933	518
Sydney A	811	451
Truro	1,025	569
Yarmouth A	415	231
Prince Edward Island		
Alliston	1,000	556
Charlottetown A	1,201	667
Summerside A	1,242	690
Newfoundland		
Argentia A	475	264
Bonavista	853	474
Buchans A	1,724	958
Churchill Falls A	4,818	2,677
Corner Brook	1,120	622
Gander International A	1,207	671
Goose A	3,268	1,816
Grand Falls	1,394	774
St. John's	648	360
Stephenville A	925	514
Wabush Lake A	4,688	2,604

THESE ARE LONG-TERM AVERAGES
DESIGN = 100+1.29(°DC)

IN CANADA:

- For Technical Information: **1-866-583-BLUE (2583)** (English); **1-800-363-6210** (French)
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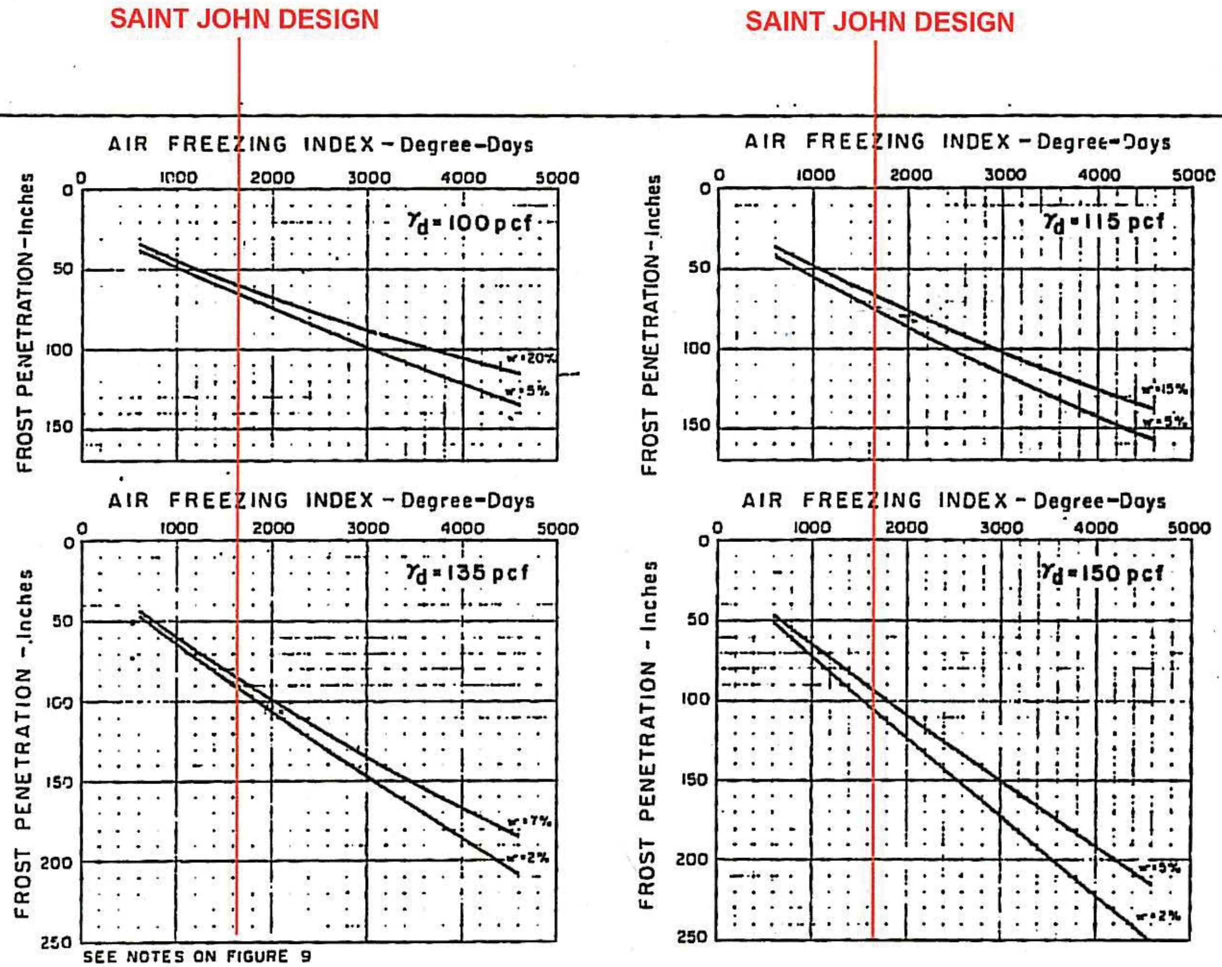
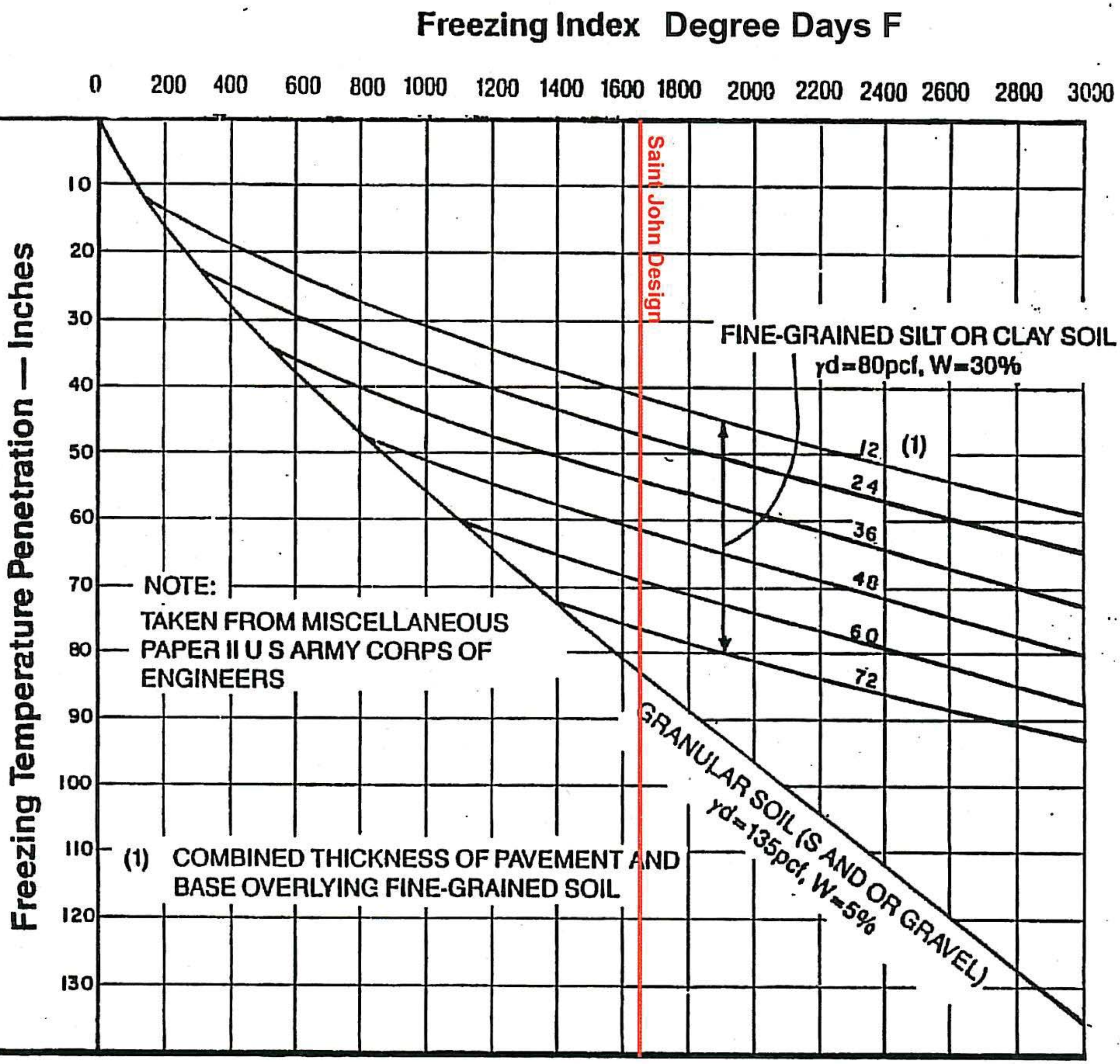


SEE NOTES ON FIGURE 9

RELATIONSHIPS BETWEEN AIR FREEZING INDEX AND FROST PENETRATION INTO GRANULAR, NONFROST-SUSCEPTIBLE SOIL BENEATH PAVEMENTS KEPT FREE OF SNOW AND ICE



Relationship between freezing index and freezing temperature penetration for granular soil underlain by fine-grained soil

90130801.CDR

APPENDIX B
POTENTIAL SAFETY HAZARDS AND CONTROL MEASURES

Table B.1 Potential Safety Hazard and Control Measures

Possible Location or Process	Potential Safety Hazard	Control Measures	Safety Signs
Boiler room	Boiler explosion	Calibrate the safety valves and pressure gauges of boiler in accordance with management requirements for special equipment. Conduct regular internal and external examination in accordance with annual inspection requirements for boiler.	No Fire. Caution! Fire. No Entry.
	Gas fire	Install alarm device for natural gas leakage and calibrate regularly. Provide portable exposimeter and detect regularly. Conduct routine maintenance work to prevent leakage. Analyze and obtain relevant permit before any hot work in the boiler room.	No Fire. Caution! Fire. Provide chromatic circle on natural gas pipeline. Material Safety Data Sheet (MSDS) of Natural Gas
	Electric shock injury	Provide earth leakage protection device. Provide safety ground for equipment and inspect regularly. Train personnel on safe utilization of electricity and first aid.	Danger! Electric Shock
	Scald	Install thermal insulation for high-temperature equipment and pipelines. Monitor and inspect regularly the steam pipelines in accordance with requirements for special equipment. Conduct routine inspection for boiler, valves and pipelines. Conduct routine maintenance work to prevent leakage.	Caution! Scald. Provide chromatic circle on high-temperature pipeline.
	Suffocation or poisoning	Install alarming device for natural gas leakage and calibrate regularly; provide portable explosimeter and detect regularly. Conduct routine maintenance work to prevent leakage.	MSDS of Natural Gas
	Noise injury	Boiler related personnel shall be provided with noise reduction earplugs which must be worn during routine inspection. The operation room of boiler room shall be in line with the noise reduction requirements to meet noise reduction requirements in the operation room.	Wear earplugs
	Mechanical injury	Provide protective cover for rotating equipment. Train personnel on proper operation methods, self-protection and first-aid measures.	Caution! Mechanical Injury
	Fall	Provide rail for 2 metres (m)-high or above operation walkway or stairs. Conduct routine maintenance. Train personnel on proper use of appropriate Personal Protective Equipment (PPE).	Caution! Falling Hazard. Wear PPE.
Water circulation	Mechanical injury	Provide protective cover for rotating equipment. Train personnel on proper operation methods, self-protection and first-aid measures.	Caution! Mechanical Injury

Possible Location or Process	Potential Safety Hazard	Control Measures	Safety Signs
	Slip injury	Clean the water on the floor during routine inspection. Add algaecide into circulating water.	Caution! Slippery
	Electric shock injury	Provide earth leakage protection device. Provide safety ground for equipment and inspect regularly. Train personnel on safe utilization of electricity and first aid.	Danger! Electric Shock
	Noise injury	Install low-noise equipment. Provide noise reduction earplugs to personnel which must be worn during routine inspections.	Wear earplugs
Production process of agricultural raw potassium	Noise injury	Install low-noise equipment. Provide noise reduction earplugs to personnel which must be worn during operation.	Wear earplugs
	Dust injury	Provide anti-dust respirator to personnel, which must be worn during operation. Install ventilation and de-dusting equipment on site.	Wear respirator
	Mechanical injury	Provide protective cover for rotating equipment. Train personnel on proper operation methods, self-protection and first-aid measures.	Caution! Mechanical Injury
	Electric shock injury	Provide earth leakage protection device. Provide safety ground for equipment and inspect regularly. Train personnel on safe utilization of electric power and first aid.	Danger! Electric Shock
	Fire explosion	No flame/fire is allowed at the ammonium nitrate storage facility. Clean area of all combustible materials. Obtain relevant permit and ensure proper fire control measures are in place before hot work.	No fire. MSDS of Ammonium Nitrate
Production process of agricultural potassium nitrate	Mechanical injury	Provide protective cover for rotating equipment. Train personnel on proper operation methods, self-protection and first-aid measures.	Caution! Mechanical Injury
	Fall	Provide rail for 2 m-high or above operation walkway or stairs. Conduct routine maintenance. Train personnel on proper use of appropriate PPE.	Caution! Falling Hazard. Wear PPE
	Electric shock injury	Provide earth leakage protection device. Provide safety ground for equipment and inspect regularly. Train personnel on safe utilization of electricity and first aid.	Danger! Electric Shock
	Noise injury	Install low-noise equipment. Provide noise reduction earplugs to personnel which must be worn during operation.	Wear earplugs
	Object blow	Wear appropriate personal. No stacked debris is allowed on site. Clean area after maintenance and put away maintenance tools. Report and respond immediately to any problems observed during routine inspections.	Caution! Wear appropriate PPE

Possible Location or Process	Potential Safety Hazard	Control Measures	Safety Signs
	Scald	Install thermal insulation for high-temperature equipment and pipelines. Monitor and inspect regularly the steam pipelines in accordance with requirements for special equipment. Conduct routine inspection for valves and pipelines. Conduct routine maintenance work to prevent leakage.	Caution! Scald. Provide chromatic circle on high-temperature pipeline.
	Explosion of container	Monitor the evaporator of agricultural potassium in accordance with the requirements for special equipment. Regularly calibrate the safety valves and pressure gauges. Conduct annual inspections for evaporators.	
Packaging process	Mechanical injury	Provide protective cover for rotating equipment and exposed gear. Train personnel on proper operation methods, self-protection and first-aid measures.	Caution! Mechanical Injury
	Noise injury	Install low-noise equipment. Provide noise reduction earplugs to personnel which must be worn during operation.	Wear earplugs
	Electric shock injury	Provide earth leakage protection device. Provide safety ground for equipment and inspect regularly. Train personnel on safe utilization of electricity and first aid.	Danger! Electric Shock
	Object blow	Stack objects properly and avoid collapses.	Caution!
Air compression station	Noise injury	Install low-noise equipment. Provide noise reduction earplugs to personnel which must be worn during operation.	Wear earplugs
	Mechanical injury	Provide protective cover for rotating equipment and exposed gear. Train personnel on proper operation methods, self-protection and first-aid measures.	Caution! Mechanical Injury
	Electric shock injury	Provide earth leakage protection device. Provide safety ground for equipment and inspect regularly. Train personnel on safe utilization of electricity and first aid.	Danger! Electric Shock
	Explosion of container	Monitor the gas tank in accordance with the requirements for special equipment. Regularly calibrate the safety valves and pressure gauges. Conduct routine and annual inspections for gas tank. Train personnel on proper operation of air-compressor and gas tank.	
Warehouse	Vehicle injury	Train personnel on safe walking within the plant area. Acquaint drivers with safe driving rules in plant area. Conduct routine inspections to avoid possible accidents.	Speed limit sign

Possible Location or Process	Potential Safety Hazard	Control Measures	Safety Signs
	Electric shock injury	Provide earth leakage protection device. Provide safety ground for equipment and inspect regularly. Train personnel on safe utilization of electricity and first aid.	Danger! Electric Shock
	Object blow	Stack objects properly and avoid collapses. Conduct daily inspections and rectify stacked objects with a risk of collapse promptly.	Caution!
	Slips/Trips/ Falls	Wear appropriate PPE. Regular inspect and maintain PPE.	Caution!
Plant area	Vehicle injury	Train personnel on safe walking within the plant area. Acquaint drivers with safe driving rules in plant area. Conduct routine inspections to avoid possible accidents.	Speed limit sign
Maintenance Plant	Electric shock injury	Provide earth leakage protection device. Provide safety ground for equipment and inspect regularly. Train personnel on safe utilization of electricity and first aid. Switch power off during inspection of equipment and follow lock-out/tag-out procedures.	Danger! Electric Shock
	Mechanical injury	Provide protective cover for rotating equipment and exposed gear. Train personnel on proper operation methods, self-protection and first-aid measures.	Caution! Mechanical Injury
	Noise injury	Install low-noise equipment. Provide noise reduction earplugs to personnel which must be worn during operation.	Wear earplugs
	Scald	Install thermal insulation for high-temperature equipment and pipelines. Monitor and inspect regularly the steam pipelines in accordance with requirements for special equipment. Conduct routine inspection for valves and pipelines. Conduct routine maintenance work to prevent leakage.	Caution! Scald. Provide chromatic circle on high-temperature pipeline.
	Object blow	Wear appropriate PPE. No stacked debris is allowed on site. Clean area after maintenance and put away maintenance tools.	Caution!
	Fire explosion	Clean the combustible materials from site. Obtain relevant work permit and ensure fire control measures are in place before conducting hot work.	
	Fall	Provide rail for 2 m-high or above operation walkway or stairs. Conduct routine maintenance. Train personnel on proper use of PPE.	Caution! Falling Hazard. Wear PPE.

Possible Location or Process	Potential Safety Hazard	Control Measures	Safety Signs
	Suffocation or poisoning	Obtain relevant work permit before operating in confined space. Wear appropriate PPE and have relevant training. Conduct an analysis of the workspace prior to entering. Ensure that an on-site monitor is present at all times while work is being conducted in the confined space.	

APPENDIX C
EMERGENCY RESPONSE PLAN OUTLINE

Section I

Draft EIA Addition: Appendix C

Draft Contents of Atlantic Potash Corporation (APC), McAllister Industrial Park Fertilizer Production Facility: Health, Safety, Environment, Emergency Management and Security Planning Document Framework

APC: Saint John N.B. McAllister Industrial Park Fertilizer Facility
Emergency Management and Security Planning Framework
Document Control and Distribution
1.0 Introduction
2.0 Executive Summary Purpose Emergency Management Policy Stakeholder Engagement Authority and Responsibility by Role Risk Based Planning Assumptions Emergency Operations Centres (On-site & Secondary)
3.0 Facility Description
4.0 Supply Chain and Distribution
5.0 Preventative Measures
6.0 Planning Document Interdependencies Environmental Management Plan (EMP) Health and Safety Plan (HSAP) Corporate Security Program (CSP) Marine Facility Security Plan (MFSP)
7.0 Emergency Management Elements Direction and Control Interoperability with Local Responders Communications Life Safety Property Protection Environmental Protection Community Notification Continuity of Critical Services Recovery and Restoration Administration and Logistics
8.0 Reporting, Revision Cycle and Posting Requirement

II. Emergency Management and Security Stakeholder Engagement

Proposed section for addition to AMEC document 4.4 “Stakeholder Input”

It is the intention of Atlantic Potash Corporation (APC) to maintain on-going relations with community emergency management experts, to jointly and transparently, create detailed site emergency planning and security documents. Further, APC looks forward to engaging the community members of Saint John through the development of a structured Community Liaison Group, setting a bi-directional flow of information to assist in creation of the emergency management program.

Over the past eighteen months, Emergency Solutions International (ESI) has been meeting with stakeholders on a regular basis. The purpose of the work was the development of the Atlantic Potash Corporation (APC) McAllister Industrial Park Fertilizer Production Facility *Draft Emergency Management and Corporate Security* planning framework. The stakeholders ESI has been engaged with are listed as follows:

- Saint John Emergency Management Organization
- Saint John Fire Department
- Ambulance New Brunswick
- Saint John Police Force
- City of Saint John Community Planning

- New Brunswick Emergency Measures Organization
- New Brunswick Office of the Fire Marshal
- Port of Saint John
- New Brunswick Environment and Local Government (Region 4 - Saint John Regional Office)
- Industrial Security
- New Brunswick Security Directorate

III. References

An active process of stakeholder engagement ensures that the APC Safety, Security and Emergency Management planning documents will be built upon community requirements and recognized best practices, forming a foundation for a modern and validated, programmatic approach. The following standards and best practices will assist APC and stakeholders to create site-specific documentation.

Canadian Standards Association. 2014. Standard Z1600: Emergency and Continuity Management Program

Major Industrial Accidents Council of Canada (MIACC), Chemical Institute of Canada, 1995. Risk Based Land Use Planning Guidelines

Canadian Standards Association. 2014. Standard Z246: Security Management for Petroleum and Natural Gas Industry Systems.

Government of New Brunswick. 2013. Responsible Environmental Management of Oil and Natural Gas Activities in New Brunswick. "Appendix 12."

ISO 14001 Environmental Management System Standards.

NB Department of Public Safety. 2004. Critical Infrastructure Protection Program (CIPP) Threat Risk Vulnerability Assessment (TRVA) Analysis Guide.

Royal Canadian Mounted Police. 2014. Creating Safer Communities: An Introduction to Crime Prevention Through Environmental Design (*CPTED)* for Architects, Planners and Builders.

Royal Canadian Mounted Police. Suspicious Incident Reporting (SIR) Program

Transport Canada. 2004. Marine Transportation Security Regulation

APPENDIX D
WATERCOURSE PHOTO LOG
HABITAT CHARACTERIZATION
ELECTROFISHING DATA SHEET

Photo 1: Watercourse 1 – Culvert under McIlveen Drive that feeds watercourse

Photo 2: Watercourse 1 – Downstream of perched culvert under decommissioned rail line

Photo 3: Watercourse 1 – Habitat downstream of the railroad culvert

Photo 4: Watercourse 1 – Habitat upstream of Whitebone Way culvert

Photo 5: Watercourse 1 – Downstream end of perched culvert under Whitebone Way

Photo 6: Watercourse 2 – Habitat downstream of culvert under decommissioned rail line and typical of the watercourse

Photo 7: Watercourse 2 – Immediately upstream of culvert under Whitebone Way

Photo 8: Watercourse 2 – Immediately downstream of culvert under Whitebone Way

Photo 9: Watercourse 3 – Looking upstream from culvert along access road

Photo 10: Watercourse 3 – Looking downstream from culvert along access road

Photo 11: Watercourse 3 – Looking downstream into forested habitat

Photo 12: Watercourse 4 – Looking upstream from culvert along access road

Photo 13: Watercourse 4 – Looking at culvert from downstream

Photo 14: Watercourse 4 – Looking downstream into forested habitat

Photo 15: Watercourse 5 – Looking at culvert from downstream

Photo 16: Watercourse 5 – Looking downstream into forested habitat

Photo 17: Watercourse 6 – Looking northwest at culvert of access road

Photo 18: Watercourse 6 – Looking upstream from culvert along access road

Photo 19: Watercourse 6 – Looking downstream along access road

Photo 20: Watercourse 7 – Looking upstream from access road

Photo 21: Watercourse 7 – Looking downstream along access road

Photo 22: Watercourse 8 – Ponded water on access road (no culvert observed)

Photo 23: Watercourse 8 – Ponded water on access road looking upstream

Photo 24: Watercourse 8 – Looking downstream from access road

Photo 25: Watercourse 9 – Hazen Creek looking upstream (no culvert observed)

Photo 26: Watercourse 9 – Hazen Creek looking downstream into Redhead Marsh

Photo 27: Watercourse 10 – Looking upstream from access road

Photo 28: Watercourse 10 – Looking downstream from access road

Photo 29: Watercourse 11 – Looking at culvert from downstream

Photo 30: Watercourse 11 – Looking upstream from access road

Watercourse 1 (WC1)

WP: 038 - Side channel/small Trib
very low flow photo # 413.

11-06

DNR&E / DFO - NEW BRUNSWICK
STREAM SURVEY and HABITAT ASSESSMENT

__of__

River: APC WC-6.
Date: 12 July, 2013
Personnel: Dm/PM
Start Point:
End Point:
Stream/River No.
Stream Order No.

Unit No.	Stream Type	Channel Type	Chainage End	Length (m)	Ave Width (m)		Substrate (%)							Ave Depth – Wet Width (cm)	Undercut Bank 0-50%		Over-Hanging Bank Vegetation 0-50%		Large Woody Debris In-Stream (m)	Embedded (Criteria) 1: < 20% 2: 20 - 35% 3: 35 - 50% 4: > 50%	In-Stream Vegetation	Comments
					Wet	Bank Channel	Bedrock	Boulder	Rock	Rubble	Gravel	Sand	Fines		L	R	L	R				
1	3/2	1	WP 036		~2.0	3.5		5%.	15%	30%.	30%.	15%	5%	0.11	5	5	5	5	12 m.	2.	NA.	From Culvert u/s.
2	3/2	1	WP 037		~1.5	3.5	5%	10%.	15%.	20%	30%.	15%	5%	0,14	0	0	10	10.	>14m.	1	NA	A little steeper than previous.
3	3/8	1	WP 039		~1.0	3.0		5%.	10%	10%	25%.	25%	25%.	0.14	0	0	25	25	>14m	3	NA	Flattens out, more grass.
4	3	1	WP 040		~2.0	4.5		5%.	15%.	30%.	30%.	15%	5%	0.10	0	0	5	10	6 m.	1	NA.	To culvert.
			WP 041																			Top end of Culvert.
5	3/22	1	WP 042	.	1.5	3.0	0	0	5	15	15	30	35	0.22	0	0	10	5	>14m.	4	NA	Bottom end of culvert.
																						The last 20m is all Boulder into culvert.

STREAM TYPE						CHANNEL TYPE	SUBSTRATE	FLOW TYPE	POOL RATING (reverse side)	
FASTWATER		POOLS							CRITERIA (NO)	% OF POOLS IN SITE (LETTER)
1. Fall 2. Cascade 3. Riffle (GR/RB) 4. Riffle (R/B) 5. Riffle (Sand)	6. Sheet (ledge) 7. Chute 8. Run 9. Rapid	10. Midchannel 11. Convergence 12. Lateral 13. Beaver	14. Trench 15. Plunge 16. 17. Bogan	18. Eddy 19. Gabion 20. Log Structure 21. Road Crossing	22. Wood Debris 23. Man-Made Dam 24. Natural Deadwater	1. Main (if measurement refers to main area of river) * 2. Side Channel (water diverted by islands) * 3. Split (if river is split into various different stream types) * 4. Bogan * - Specify Left (L), Right (R) or Middle (M)	1. Bedrock Ledge 2. Boulder = > 461 mm 3. Rock = 180 - 460 mm 4. Rubble = 54 - 179 mm 5. Gravel = 2.6 - 53 mm 6. Sand = 0.06 - 2.5 mm 7. Fines = 0.0005 - 0.05 mm	1. Survey Stream 2. Spring 3. Brook/River Tributary 4. Spring Seep	Pool Depth > 1.5 m 1 - Instream Cover > 30% 2 - Instream Cover < 30% Pool Depth .5 to 1.5m 3 - Instream Cover 5 - 30% 4 - Instream Cover > 30%	a - > 30% b - 10% to 30% c - < 10% a - > 50% b - < 50%

*For different left and right parameters, values are to be written as L/R.

Adobe form developed by Alison Johnson @ AMEC Fredericton

Watercourse 1 (WC1)

River:

Valley Slope L/M/H	Bank Height (m)	Flood Plain Width (m)	Shade (%)	Stream Banks										0^2 (Mg/L)	pH	Water Temperature (°C)	Fish Species	Pool Rating		Pool Tail			Turbulence (%)
				Vegetation (%)				Erosion (%)												Embedded (Criteria) 1: < 20% 2: 20 - 35% 3: 35 - 50% 4: > 50%	Mean Substrate Size(cm)	Fines (%)	
				Bare	Grasses Moss	Shrubs	Trees	Left Bank (0-50%)			Right Bank (0-50%)							No.	Letter				
								Stable	Bare Stable	Eroding	Stable	Bare Stable	Eroding										
M/H	0.5	NA	50%	5	60	5	30	50			50						407 – 409.						
H	0.6	NA	90%	30%	35	5	30	50			50						410 – 412.						
L/M	0.4	NA	30%	0	55	40	5	50			50						414 –						
M	0.4	NA	65%	0	75	5	20	50			50						415 – 416.						
L/M	0.30	NA	50%	10%	30	30	30.	50			50						417 – 421						

NOTE: * For selected site study, these columns (reverse side) should be done for a habitat assessment

WATER FLOW MEASUREMENT

RIFFLE GRADIENT			UNIT No.	STREAM TYPE	WET WIDTH (m)	DEPTH (cm)			AVERAGE DEPTH SUM / 4		COEFFICIENT (0.9 - smooth) (0.8 - rough)	LENGTH (3m)	FLOAT TIME (sec)				FLOW cm/s
LENGTH M	DROP M	GRADIENT %				1/4 way	1/2 way	3/4 way	CENTIMETERS	METERS (m)			1/4 way	1/2 way	3/4 way	AVERAGE	

Formula (CMS) = W____(m) x D____(m) x A____x L_____(m)
T____(sec)

Where: W = width, D = depth, L = length, A is a coefficient for the stream bottom (A= 0.8 for rough bottom; 0.9 for smooth)

CRITERIA:

1. Chute: water depth equal to or greater than channel width
2. Riffle: GR/RB - is a riffle flowing over a gravel and/or rubble bottom
   R/B - is a riffle flowing over & through large substrates (e.g. rock and /or boulder), some of which protrudes the surface
3. Side channels - treat as a separate stream type
4. Undercut Bank - % of bank overhang (above water edge for stream type. Specify left (L) or right (R)
5. Over-hanging Bank Vegetation - % of vegetation overhang for stream type. Specify L or R
6. Visual Embeddedness - % of sands or fines surrounding the larger substrates, up to 100%
7. Woody Debris - total width should be >10 cm in diameter

*For different left and right parameters, values are to be written as L/R.

Adobe form developed by Alison Johnson @ AMEC Fredericton

Watercourse 1 (WC1)

Pg ____ of ____

INDIVIDUAL FISH MEASUREMENTS FORM

Session ID #: ____________

Date : 12 July, 2013 (yyyy-mm-dd)

Water Name: APC WC-6

Site ID #: APC WC-6

Sampling Method: Angling Stocking Netting Trapping [✓ Electofishing] : 68s. Counting Facility Other (specify): 350v; 30Hz; 12%.

Weighing device: Piezola.

Comments: Area: ~6 × 5 m pool @ base of Culvert.

Run/ Sweep Net	Fish ID#	Species Code	Length in mm ☐ Total ☒ Fork	Weight in g	Run/ Sweep Net	Fish ID#	Species Code	Length in mm ☐ Total ☐ Fork	Weight in g	Run/ Sweep Net	Fish ID#	Species Code	Length in mm ☐ Total ☐ Fork	Weight in g
	1	B. Trout	151	39										

BATCH COUNT/WEIGHT DATA BY SWEEP FOR SPECIES IN WHICH INDIVIDUALS WERE NOT MEASURED.

Sweep	Count	Weight	Sweep	Count	Weight	Sweep	Count	Weight	Sweep	Count	Weight

APPENDIX E
LEGISTLATED SPECIES AT RISK LIST

Table E.1 Listed SARA, COSEWIC and NBESA Plant Species at Risk in New Brunswick

Common Name	Scientific Name	Status	Habitat*
Anticosti aster	*Symphyotrichum anticostense*	**SARA**: Schedule 1 - Threatened COSEWIC: Threatened **NBSRA**: Endangered	Fast-flowing rivers in the eroded area between the low-water mark and the boreal forest.
Bathurst aster	*Symphyotricum subulatum*	**SARA**: Schedule 3 – Special Concern COSWEIC: Special Concern **NBSRA**: Endangered	Salt marshes or in saline sands and gravel that occur at or just below sea level.
Beach pinweed	*Lechea maritime*	**SARA**: Schedule 1 - Special Concern COSEWIC: Special Concern **NBSRA**: Special Concern	Atlantic coast in vegetated sand dunes.
Blue felt lichen	*Degelia plumbea*	COSEWIC: Special Concern **NBSRA**: Special Concern	Cool, humid mixed or hardwood forests.
Boreal felt lichen	*Erioderma pedicellatum*	**SARA**: Schedule 1 – Endangered COSEWIC: Endangered **NBSRA**: Endangered	Northerly exposed forested slopes where cool and moist conditions prevail throughout most of the year.
Butternut	*Juglans cinerea*	**SARA**: Schedule 1 – Endangered COSEWIC: Endangered **NBSRA**: Endangered	Rich, moist, well-drained loams on steam bank sites. Shade intolerant. Associated with deciduous forests.
Eastern waterfan	*Peltigera hydrothyria*	COSEWIC: Threatened	Grows attached to rocks at or below water level in clean, clear, cool, partially shaded streams.
Furbish's lousewort	*Pedicularis furbishiae*	**SARA**: Schedule 1 – Endangered COSEWIC: Endangered **NBSRA**: Endangered	River banks of the upper Saint John River. Varied habitat.
Gulf of Saint Lawrence aster	*Symphyotrichum laurentianum*	**SARA**: Schedule 1 – Threatened COSEWIC: Threatened **NBSRA**: Endangered	Brackish sand or mud around pools in dune slacks, on sand flats behind dunes, drier sites in saline marshes, or on sandy beaches in protected coves.
Parker's pipewort	*Eriocaulon parkeri*	COSEWIC: Not at Risk **NBSRA**: Endangered	Tidal portions of rivers, where the fresh water from the river or nearby streams meets the salt water from the tides.
Pinedrops	*Pterospora andromedea*	**NBSRA**: Endangered	Old white pine or white pine-hemlock forests on rich soil.

Common Name	Scientific Name	Status	Habitat*
Prototype quillwort	*Isoetes prototypus*	**SARA**: Schedule 1 – Special Concern COSEWIC: Special Concern **NBSRA**: Endangered	Oligotrophic (nutrient-poor), spring-fed lakes.
Southern twayblade	*Listera australis*	**NBSRA**: Endangered	Bogs and in semi-open areas where the forested wetland grades into the open or treeless centre.
Van Brunt's Jcaob's-ladder	*Polemonium vanbruntiae*	**NBSRA**: Threatened	Wooded swamps, alluvial bottom lands, sphagnous bogs and mossy glades.
Vole-ear lichen	*Erioderma mollissimum*	**SARA**: Schedule 1 – Endangered COSEWIC: Endangered **NBSRA**: Endangered	Humid coastal forests, typically 30 kilometres (km) from the coast, and is limited to elevations of less than 200 metres (m).

Table E.2 Listed SARA, COSEWIC and NBESA Mammal Species at Risk in New Brunswick

Common Name	Scientific Name	Status	Habitat*
Atlantic Walrus	*Odobenus rosmarus rosmarus*	**SARA**: Schedule 1 – Extirpated COSEWIC: Special Concern **NBSRA**: Extirpated	Large areas of shallow, open water (80 m or less), which support an abundant clam community.
Blue Whale (Atlantic pop.)	*Balaenoptera musculus*	**NBSRA**: Endangered	Atlantic Ocean.
Canada Lynx	*Lynx canadensis*	COSEWIC: Not at Risk **NBSRA**: Endangered	Extensive boreal forests in areas where there is dense vegetation and shrubbery that is beneficial to snowshoe hare.
Fin Whale (Atlantic pop.)	*Balaenoptera physalus*	**NBSRA**: Special Concern	Atlantic Ocean.
Gaspe Shrew	*Sorex gaspensis*	**SARA**: Schedule 3 – Special Concern COSEWIC: Not at Risk	Coniferous and mixed forests with rocky and fast moving streams. Confined to the Gaspé Peninsula.
Grey Wolf	*Canis lupus*	**NBSRA**: Extirpated	Wilderness forests and tundra.
Harbour Porpoise (Atlantic pop.)	*Phocoena phocoena*	**NBSRA**: Special Concern	Atlantic Ocean.
Little Brown Myotis	*Myotis lucifugus*	**SARA**: Schedule 1 – Endangered COSEWIC: Endangered **NBSRA**: Endangered	Adapted to human-made structures for resting and maternity sites. Also uses caves and hollow trees. Usually forages in woodlands near water. Over winters in caves, tunnels, abandoned mines and other similar sites.
North Atlantic Right Whale	*Eubalaena glacialis*	**NBSRA**: Endangered	Atlantic Ocean.
Northern Myotis	*Myotis septentrionalis*	**SARA**: Schedule 1 – Endangered COSEWIC: Endangered **NBSRA**: Endangered	Generally associated with forested communities. Hibernates in caves, mines, and tunnels from late fall through early spring.
Tri-colored Bat	*Perimyotis subflavus*	**SARA**: Schedule 1 – Endangered COSEWIC: Endangered **NBSRA**: Endangered	Prefers partly open country with large trees and woodland edges. Avoids deep woods and open fields. Probably roosts in the summer in tree foliage and occasionally in buildings; may use cave as night roost between foraging forays. Usually hibernates in caves and mines with high humidity.
Wolverine	*Gulo gulo*	**NBSRA**: Extirpated	High mountains near timberland and onto tundra.
Woodland Caribou	*Rangifer tarandus caribou*	**NBSRA**: Extirpated	Coniferous forests and muskegs.

Source: *SARPR, 2012

Table E.3 Listed SARA, COSEWIC and NBESA Bird Species at Risk in New Brunswick

Common Name	Scientific Name	Status	Habitat*
Bald Eagle	*Haliaetus leucocephalus*	COSEWIC: Not at Risk **NBSRA**: Endangered	Prefers to nest in large trees near open water.
Bank Swallow	*Riparia riparia*	COSEWIC: Threatened	Open areas near water with cutaway banks.
Barn Swallow	*Hirundo rustica*	COSEWIC: Threatened **NBSRA**: Threatened	Natural nesting sites include caves, holes, crevices and ledges associated with rocky cliff faces. Artificial nesting sites include barns, garages, sheds, boat houses, bridges, road culverts, verandahs and wharfs. Select nesting sites close to open habitats such as farmlands, wetlands, road right-of-way, large forest clearings, cottage areas, islands, and sand dunes.
Barrow's Goldeneye	*Bucephala islandica*	**SARA**: Schedule 1 – Special Concern COSEWIC: Special Concern **NBSRA**: Special Concern	Freshwater lakes and coastal areas.
Bicknell's Thrush	*Catharus bicknelli*	**SARA**: Schedule 1 – Threatened COSEWIC: Threatened **NBSRA**: Threatened	Prefers areas with high elevation, dense and stunted fir/spruce forests.
Bobolink	*Dolichonyx oryzivorus*	COSEWIC: Threatened **NBSRA**: Threatened	Prefers forage crop farm land, pastures, hay fields, wet meadows, grasslands and abandoned land.
Canada Warbler	*Wilsonia canadensis*	**SARA**: Schedule 1 – Threatened COSEWIC: Threatened **NBSRA**: Threatened	Variety of forest types with wet, dense ground cover.
Chimney Swift	*Chaetura pelagica*	**SARA**: Schedule 1 – Threatened COSEWIC: Threatened **NBSRA**: Threatened	Coastal, north or east-facing slopes of a sphagnum-rich, balsam fir forest.
Common Nighthawk	*Chordelles minor*	**SARA**: Schedule 1 – Threatened COSEWIC: Threatened **NBSRA**: Threatened	Rich, moist, well-drained loams on stream bank sites. Shade intolerant. Associated with deciduous forests.
Eastern Meadowlark	*Sturnella magna*	COSEWIC: Threatened **NBSRA**: Threatened	Prefers native grasslands, pastures and savannahs. Can be found in hayfields, weedy meadows, young orchards, golf courses, restored surface mines, grassy roadside verges, young oak plantations, grain fields, herbaceous fencerows and grassy airfields.

Common Name	Scientific Name	Status	Habitat*
Eastern Whip-poor-will	*Antrostomus vociferous (Caprimulgus vociferous)*	**SARA**: Schedule 1 – Threatened COSEWIC: Threatened **NBSRA**: Threatened	Patchy and disturbed forests with pine and oak.
Eastern Wood-pewee	*Contopus virens*	COSEWIC: Special Concern **NBSRA**: Special Concern	Mid-canopy layer of forest clearings and edges of deciduous and mixed forests. During migration a variety of habitats area used, including forest edges.
Eskimo Curlew	*Numenius borealis*	**SARA**: Schedule 1 – Endangered COSEWIC: Endangered **NBSRA**: Endangered	Variety of coastal and terrestrial habitats.
Harlequin Duck	*Histrionicus histrionicus*	**SARA**: Schedule 1 – Special Concern COSEWIC: Special Concern **NBSRA**: Endangered	Brackish sand or mud around pools in dune slacks, on sand flats behind dunes, drier sites in saline marshes, or on sandy beaches in protected coves.
Horned grebe	*Podiceps auritus*	**NBSRA**: Special Concern	Marshy ponds and lakes.
Least Bittern	*Ixobrychus exillis*	**SARA**: Schedule 1 – Threatened COSEWIC: Threatened **NBSRA**: Threatened	Oligotrophic (nutrient-poor), spring-fed lakes.
Olive-sided Flycatcher	*Contopus cooperi*	**SARA**: Schedule 1 – Threatened COSEWIC: Threatened **NBSRA**: Threatened	Edge or open areas of forest with tall trees.
Peregrine Falcon anatum/tundrius	*Falco peregrines anatum/tundrius*	**SARA**: Schedule 1 – Special Concern COSEWIC: Special Concern **NBSRA**: Endangered	Cliff/ledged areas for nesting and open forest/meadows for hunting.
Piping Plover (melodus subspecies)	*Charadrius melodus melodus*	**SARA**: Schedule 1 – Endangered COSEWIC: Endangered **NBSRA**: Endangered	Atlantic coastline beaches.
Red Knot *rufa* subspecies	*Calidris canutus rufa*	**SARA**: Schedule 1 – Endangered COSEWIC: Endangered **NBSRA**: Endangered	During migration can be found in sandflat and mudflat coastal zones. They can also be observed in peat-rich banks, salt marshes, brackish lagoons, mangrove areas, and mussel beds.
Red-necked Phalarope	*Phalaropus lobatus*	COSEWIC: Special Concern	Summers on marshy tundra ponds and winters primarily at sea.
Red-shouldered Hawk	*Buteo lineatus*	**SARA**: Schedule 3 – Special Concern COSEWIC: Not at Risk	Prefers deciduous or mixed-wood forests containing shade-tolerant hardwood trees close to wetland areas.

Common Name	Scientific Name	Status	Habitat*
Roseate Tern	*Sterna dougallii*	**SARA**: Schedule 1 – Endangered COSEWIC: Endangered **NBSRA**: Endangered	Atlantic coastline beaches.
Rusty Blackbird	*Euphagus carolinus*	**SARA**: Schedule 1 – Special Concern COSEWIC: Special Concern **NBSRA**: Special Concern	Boreal forest and wetlands.
Short-eared Owl	*Asio flammeus*	**SARA**: Schedule 1 – Special Concern COSEWIC: Special Concern **NBSRA**: Special Concern	Wide variety of open habitats, including arctic tundra, grasslands, peat bogs, marshes, sand-sage concentrations and old pastures. It also occasionally breeds in agricultural fields.
Wood Thrush	*Hylocichla mustelina*	COSEWIC: Threatened **NBSRA**: Threatened	Second-growth and mature deciduous and mixed forests with saplings and well-developed understory layers.
Yellow Rail	*Coturnicops noveboracensis*	**SARA**: Schedule 1 – Special Concern COSEWIC: Special Concern **NBSRA**: Special Concern	Marshes, floodplains and bogs with little to no standing water.

Table E.4 Listed SARA, COSEWIC and NBESA Herpetile Species at Risk in New Brunswick

Common Name	Scientific Name	Status	Habitat*
Leatherback Turtle	*Dermochelys coriacea*	COSEWIC: Endangered **NBSRA**: Endangered	Off NB coasts during migration between June and October. General located in the continental shelf.
Loggerhead Turtle	*Caretta caretta*	COSEWIC: Endangered **NBSRA**: Endangered	Concentrate in areas were water temperatures are above 22°C.
Snapping Turtle	*Chelydra serpentina*	**SARA**: Schedule 1 – Special Concern COSEWIC: Special Concern **NBSRA**: Special Concern	Prefers slow-moving water with a soft mud bottom and dense aquatic vegetation but can be observed in almost every kind of freshwater habitat.
Wood Turtle	*Glyptemys insculpta*	**SARA**: Schedule 1 – Threatened COSEWIC: Threatened **NBSRA**: Threatened	Found along rivers and streams with sandy or gravely-sandy bottoms and prefers clear meandering watercourses with a moderate current. Nests next to water on open sandy areas, such as high riverbanks, roadsides, rail embankments, and in wetlands.

Table E.5 Listed SARA, COSEWIC and NBESA Invertebrate Species at Risk in New Brunswick

Common Name	Scientific Name	Status	Habitat*
Brook Floater	*Alasmidonta varicose*	**SARA**: Schedule 1 – Special Concern COSEWIC: Special Concern **NBSRA**: Special Concern	Running water with a range of flow conditions from small creeks and stream to large rivers. Moderate to high current speeds and intermediate water depths.
Cobblestone Tiger Beetle	*Cicindela marginipennis*	**SARA**: Schedule 1 – Endangered COSEWIC: Endangered **NBSRA**: Endangered	Almost exclusively among cobblestones and coarse gravel with small patches of sand. Typically found in areas with high, infrequently flooded cobblestone beaches.
Dwarf Wedgemussel	*Alasmidonta heterodon*	**SARA**: Schedule 1 – Extirpated COSEWIC: Extirpated **NBSRA**: Extirpated	Small streams to medium-sized rivers with slow to moderate current and fine sediment, sand or gravel substrates. It has a poor tolerance for suspended silt and requires stream-side vegetation.
Gypsy Cuckoo Bumble Bee	*Bombus bohemicus*	COSEWIC: Endangered	Found in diverse habitats including open meadows, mixed farmlands, urban areas, boreal forest and montane meadows.
Maritime Ringlet	*Coenonympha nipisiquit*	**SARA**: Schedule 1 – Endangered COSEWIC: Endangered **NBSRA**: Endangered	Salt marsh habitat. Generally considered restricted to the salt marshes in Chaleur Bay.
Monarch	*Danaus plexippus*	**SARA**: Schedule 1 – Special Concern COSEWIC: Special Concern **NBSRA**: Special Concern	Abandoned farmland, along roadsides, and other open spaces where milkweed (Asclepius) and wildflowers (such as Goldenrod, asters, and Purple Loosestrife) exist.
Pygmy Snaketail	*Ophiogomphus howei*	**SARA**: Schedule 1 – Special Concern COSEWIC: Special Concern **NBSRA**: Special Concern	Prefers large, clear, fast-flowing, clean rivers that have moderate slopes and pea gravel or sandy bottoms. Prior to laying eggs the adults spend most of their time in the surrounding forest.
Skillet Clubtail	*Gomphus ventricosus*	COSEWIC: Endangered **NBSRA**: Endangered	Big rivers where the larvae burrow in the soft mud of deep pools.
Yellow Lampmussel	*Lampsilis cariosa*	**SARA**: Schedule 1 – Special Concern COSEWIC: Special Concern **NBSRA**: Special Concern	Prefers large river system with moderate flow, low gradient, riffles and sand/gravel bottom.

Table E.6 Listed SARA, COSEWIC and NBESA Fish Species at Risk in New Brunswick

Common Name	Scientific Name	Status	Habitat*
Acadian Redfish – Atlantic Population	*Sebastes fasciatus*	COSEWIC: Threatened **NBSRA**: Threatened	Marine habitat.
American Eel	*Anguilla rostrata*	COSEWIC: Threatened **NBSRA**: Threatened	Marine habitat: abyssal, near shore, pelagic. Estuarine habitat: bay, river mouth, lagoon. Riverine habitat: rocky runs and pools of small to large rivers. Lacustrine Habitat: deep and shallow water.
American Plaice – Maritime Population	*Hippoglossoides platessoides*	COSEWIC: Threatened **NBSRA**: Threatened	Marine habitat.
Atlantic Bluefin Tuna	*Thunnus thynnus*	COSEWIC: Endangered **NBSRA**: Endangered	Marine habitat.
Atlantic Cod – Laurentian South Population	*Gadus morhua*	COSEWIC: Endangered **NBSRA**: Endangered	Marine habitat.
Atlantic Cod – Southern Population	*Gadus morhua*	COSEWIC: Endangered **NBSRA**: Endangered	Marine habitat.
Atlantic Salmon – Gaspe-Southern Gulf of St. Lawrence Population	*Salmo salar*	COSEWIC: Special Concern **NBSRA**: Special Concern	Marine habitat: near shore, pelagic. Estuarine habitat: bay, river mouth. Riverine habitat: rocky runs and pools of small to large rivers. Lacustrine Habitat: deep water.
Atlantic Salmon – Inner Bay of Fundy Population	*Salmo salar*	**SARA**: Schedule 1 – Endangered COSEWIC: Endangered **NBSRA**: Endangered	Marine habitat: near shore, pelagic. Estuarine habitat: bay, river mouth. Riverine habitat: rocky runs and pools of small to large rivers. Lacustrine Habitat: deep water.
Atlantic Salmon – Outer Bay of Fundy Population	*Salmo salar*	COSEWIC: Endangered **NBSRA**: Endangered	Marine habitat: near shore, pelagic. Estuarine habitat: bay, river mouth. Riverine habitat: rocky runs and pools of small to large rivers. Lacustrine Habitat: deep water.
Atlantic Sturgeon	*Acipenser oxyrinchus*	COSEWIC: Threatened **NBSRA**: Threatened	Marine habitat: near shore. Estuarine habitat: bay/sound, river mouth/tidal river. Riverine habitat: medium to large rivers. Primarily a marine species found close to shore.

Common Name	Scientific Name	Status	Habitat*
Atlantic Wolffish	*Anarhichas lupus*	COSEWIC: Special Concern **NBSRA**: Special Concern	Marine habitat.
Blue Shark - Atlantic Population	*Prionace glauca*	COSEWIC: Special Concern **NBSRA**: Special Concern	Marine habitat.
Cusk	*Brosme brosme*	COSEWIC: Endangered **NBSRA**: Endangered	Marine habitat.
Mako Shortfin – Atlantic Population	*Isurus oxyrinchus*	COSEWIC: Threatened **NBSRA**: Threatened	Marine habitat.
Porbeagle	*Lamna nasus*	COSEWIC: Endangered **NBSRA**: Endangered	Marine habitat.
Rainbow Smelt – Lake Utopia Large-bodied Population	*Osmerus mordax*	COSEWIC: Threatened **NBSRA**: Threatened	Lake Utopia.
Rainbow Smelt – Lake Utopia Small-bodied Population	*Osmerus mordax*	**SARA**: Schedule 1 – Threatened COSEWIC: Threatened **NBSRA**: Threatened	Lake Utopia.
Redbreast Sunfish	*Lepomis auritus*	**SARA**: Schedule 3 – Special Concern COSEWIC: Data Deficient	Sandy pools and margins of creeks and small to medium rivers, including tidal freshwater areas; also rocky and vegetated lake margins.
Shortnose Sturgeon	*Acipenser brevirostrum*	**SARA**: Schedule 1 – Special Concern COSEWIC: Special Concern **NBSRA**: Special Concern	Rivers, estuaries, and the sea. Usually they are most abundant in estuaries, generally within a few miles of land when at sea.
Smooth Skate – Laurentian-Scotian population	*Malacoraja senta*	COSEWIC: Special Concern **NBSRA**: Special Concern	Marine habitat.
Spiny Dogfish – Atlantic Population	*Squalus acanthias*	COSEWIC: Special Concern **NBSRA**: Special Concern	Marine habitat.
Striped Bass – Bay of Fundy Population	*Morone saxaillis*	COSEWIC: Endangered **NBSRA**: Endangered	Marine habitat: near shore. Estuarine habitat: bay, river mouth. Riverine habitat: large to medium size rivers. Lacustrine Habitat: deep water.
Striped Bass – Southern Gulf of St. Lawrence Population	*Morone saxaillis*	COSEWIC: Special Concern **NBSRA**: Special Concern	Marine habitat: near shore. Estuarine habitat: bay, river mouth. Riverine habitat: large to medium size rivers. Lacustrine Habitat: deep water.

Common Name	Scientific Name	Status	Habitat*
Thorny Skate	*Amblyraja radiata*	COSEWIC: Special Concern **NBSRA**: Special Concern	Marine habitat.
White Shark – Atlantic population	*Carcharodon carcharias*	COSEWIC: Endangered **NBSRA**: Endangered	Marine habitat.
Winter Skate – Georges Bank – Western Scotian Shelf – Bay of Fundy	*Leucoraja ocellata*	COSEWIC: Special Concern **NBSRA**: Special Concern	Marine habitat.
Winter Skate – Southern Gulf of St. Lawrence Population	*Leucoraja ocellata*	COSEWIC: Endangered **NBSRA**: Endangered	Marine habitat.

*Source: NatureServe Explorer

APPENDIX F
AIR QUALITY DISPERSION MODELLING REPORT

AIR QUALITY DISPERSION MODELING
ATLANTIC POTASH CORPORATION
MCALLISTER INDUSTRIAL PARK
FERTILIZER PRODUCTION FACILITY

Submitted to:

Atlantic Potash Corporation
Saint John, New Brunswick

Submitted by:

AMEC Environment & Infrastructure,

a division of AMEC Americas Limited
Fredericton, New Brunswick

January 2015

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1.0 AIR QUALITY BOUNDARIES

1.1 Temporal Boundaries

The temporal boundaries include all three phases of the Project; construction, operation, and decommissioning. However, no specific work was conducted related to the decommissioning phase as these works are expected to remain within the air impacts associated with the construction phase.

1.2 Spatial Boundaries

The spatial boundaries include the Project site (operation of a potassium nitrate and ammonium chloride plant). Adjacent lands were taken into consideration with respect to potential receptor locations.

1.3 Administrative, Legislative, Technical Boundaries

Table 1.1 shows the applicable provincial objectives relating to ambient air quality.

Table 1.1 Provincial Ambient Air Quality Maximum Permissible Ground Level Concentrations

Pollutant	Averaging Time Period	New Brunswick Maximum Permissible
Nitrogen Dioxide (NO_2) (micrograms per cubic metres (µg/m^3))	1 hour	400
	24 hour	200
	Annual	100
Sulphur Dioxide (SO_2) (µg/m^3)	1 hour	450
	24 hour	150
	Annual	30
Total Suspended Particulate (TSP) Matter (µg/m^3)	24 hour	120
	Annual	70
Particulate Matter less than 2.5 microns ($PM_{2.5}$) (µg/m^3) (1)	24 hour	30 (28)
	Annual	10
Carbon Monoxide (CO) (mg/m^3)	1 hour	35,000
	8 hour	15,000
Potassium Nitrate (KNO_3) (µg/m^3)(2)	24 hour	120
Ammonium Chloride (NH_4Cl) (µg/m^3)(2)	24 hour	120
Ammonia (NH_3) (µg/m^3)(2)	24 hour	100

Notes: (1) Canadian Ambient Air Quality Standards (CAAQS) for $PM_{2.5}$, which considers the average of the 98th percentile of 24-hour averages over a three-year rolling period. New objectives for annual and 24-hour $PM_{2.5}$ have been established for 2015 (28 µg/m^3 for 24-hour and 10 µg/m^3 for annual concentrations).
(2) Ontario Ambient Air Quality Criteria (Ontario Ministry of the Environment (OME), 2014).

Air quality in New Brunswick is regulated pursuant to the Air Quality Regulation 97-133 under the *Clean Air Act*. Regulatory requirements for New Brunswick are designed to cover all sources of air contaminants. All approvals issued by the Minister of Environment contain provisions to ensure that the maximum permissible ground level concentrations are not exceeded.

The Canadian Council of Ministers of the Environment (CCME) have developed a Canada-Wide Standard (CWS) for fine particulate matter ($PM_{2.5}$) which is 30 µg/m^3, based on a 24-hour average over three consecutive years (CCME, 2000). A new annual objective of 28 µg/m^3 has been established for 2015.

Ambient air criteria for potassium nitrate, ammonium chloride and ammonia from Ontario are also included in the Table (Table 1.1) (OME, 2014).

1.4 Threshold for Determination of Significance

A significant adverse air quality effect has been determined to represent a condition where regulatory objectives are regularly exceeded.

2.0 AIR QUALITY EFFECTS

2.1 Construction Air Quality Impacts

The use of equipment to construct the site will result in temporary, short-term emissions of air pollutants that will be restricted to the construction period for the potassium nitrate and ammonium chloride plant will terminate once construction has been completed. These emissions will likely not result in significant adverse impacts to the air quality within the vicinity of the Project Area. Best management practices for fugitive dust mitigation will be followed.

Potassium nitrate and ammonium chloride plant construction activities can generally be categorized into site preparation, potassium nitrate and ammonium chloride plant process construction, and transportation route construction. During construction, activities associated with the potassium nitrate and ammonium chloride plant will include the use of internal combustion engines in various cranes, backhoes, dozers, loaders, pavers, trucks, welders, generators, air compressors, pumps, pile drivers, miscellaneous heavy construction equipment, and worker commuting vehicles will result in emissions of Nitric Oxides (NO_X), SO_2, CO, Particulate Matter less than 10 microns (PM_{10}), $PM_{2.5}$, and volatile organic compound (VOCs).

Fugitive dust emissions from activities such as site preparation, grading and vehicle traffic will occur during construction periods. Prior to paving or revegetation of disturbed soil areas within the Project Area, wind erosion of displaced soil may also generate fugitive dust emissions. APC will use construction Best Practices to minimize the fugitive dust emissions associated with construction of the natural gas liquefaction plant. These measures may include the application of water or other approved dust suppressants on storage piles, unpaved areas and haul roads; covering of haul trucks; use of paved roads to the extent possible; limiting onsite vehicle speed; limiting trackout onto paved sections; and stabilizing disturbed areas.

It is expected that construction activities may last as long as 2 years.

As the site is fairly isolated from highly populated areas, schools and businesses of the area, the impacts to the public from construction activities are expected to be insignificant, approaching background concentrations at off-site locations.

2.2 Operational Air Quality Impacts

In general, emissions from the operation of the potassium nitrate and ammonium chloride plant will be conducted in a manner to meet ambient air quality objectives that fall under the New Brunswick's Air Quality Regulation 97-133.

The Project will consist of the construction and operation of a 60,000 metric tonnes per annum (MTPA) potassium nitrate and ammonium chloride plant. Raw materials used at the site include 46,000 MTPA potassium chloride and 7.75 metric tonnes per hour (t/h) ammonium nitrate solution. The conceptual plan for the Project consists of the following major elements:

- Natural gas boiler that will use 1610 normal cubic metres per hour (Nm^3/hr) of natural gas (54 million British thermal units per hour (MMBTU/hr)).
- 60,000 MTPA processing facility that will include storage warehouses, storage tanks, mixing tanks used to produce potassium nitrate by combining potassium chloride and ammonium nitrate.
- Potassium nitrate drying activities. Part of the process will include the drying of potassium nitrate. Emission from this activity will be controlled by use of a scrubber and/or baghouse.
- Potassium chloride transportation by tandem truck to the Plant: Every year approximately 46,000 MTPA of potassium chloride with be transported to the Plant by an estimated 1533 tandem trucks potentially from Penobsquis, New Brunswick.
- Ammonium nitrate solution transport by ship to Saint John Port and trucks from port to Plant: Ammonium nitrate solution will be stored in a 3000 cubic metre tank that will have a 15 day capacity.
- Hoteling of ships used to supply raw materials and receive final product.

The assessment of air emissions from the operation of the potassium nitrate and ammonium chloride plant included the following:

- An inventory of all combustion emissions and greenhouse gases was developed and compared to the emissions inventory for the Province of New Brunswick.
- An air dispersion modeling study was performed to predict the impacts on air quality in the airshed surrounding potassium nitrate and ammonium chloride plant property.

Air emissions for the Project were assessed based on the following activities:

- Natural Gas Boiler Operation;
- Potassium Nitrate and Ammonium Chloride Plant Operation; and
- raw materials transport.

Table 2.1 provides a summary of the annual air emissions estimated to be produced by the operation at full production of the proposed potassium nitrate and ammonium chloride plant.

Table 2.1 Estimated Annual Emissions – Proposed Potassium Nitrate and Ammonium Chloride Plant (Tonnes/Year)

Activity	CO	NO_X	Particulate Matter (PM)	SO_2	NH_3
Buffer Tank Vent V104	-	-	-	-	2.6
KNO_3 Dryer Scrubber Vent S402	-	-	3.5	-	
Natural Gas Boiler Exhaust Vent B601	18.1	10.7	1.6	0.1	-
Truck Emissions	1.5	1	0.12	0.03	-
Ship Hoteling$^{(1)}$	15.2	160	9.8	59.1	-
Total	**34.8**	**171.7**	**15.0**	**59.2**	**2.6**

Note: (1) Estimate based on ships hoteling at the Saint John Port for 24 hours per day, 4 months of the year.
Odour threshold NH_3 = 5 parts per million (ppm).

It is estimated that the operation, including transportation of raw materials, of the proposed potassium nitrate and ammonium chloride plant will produce 34.8 tonnes of CO, 171.7 tonnes for NO_x, 15 tonnes of total PM, 59.2 tonnes of SO_2, and 2.6 tonnes of NH_3 emissions.

Emissions for trucking assumed 46,000 MTPA of potassium chloride will be transported to the site by tandem truck potentially from Penobsquis and 60,000 MTPA of ammonium nitrate will be transported by heated tanker truck from the Port of Saint John. The round trip distance per truck is 154 kilometres (km) for the transport of potassium chloride and 6 km for the transport of ammonium nitrate.

Emissions from shipping will result from the use of diesel engines during the hoteling of ships at the Saint John Port.

Table 2.2 provides a summary of greenhouse gas (GHG) emissions for the proposed potassium nitrate and ammonium chloride plant.

Table 2.2 Estimated Annual Greenhouse Gas Emissions - Proposed Potassium Nitrate and Ammonium Chloride Plant (Tonnes/Year)

Activity	Methane as CO_2e	CO_2
Buffer Tank Vent V102	-	-
KNO_3 Dryer Scrubber Vent S402	-	-
Natural Gas Boiler Exhaust Vent B601	12	25,765
Truck Exhaust	-	222
Ships Hoteling$^{(1)}$	-	8,354
Subtotal	**12**	**34,341**
Total CO_2e		**34,353**

Note (1) Estimate based on ships hoteling at the Saint John Port for 24 hours per day, 4 months of the year.

In 2010 the estimated GHG emissions generated in New Brunswick was 19,000 kilotonnes of carbon dioxide equiliavalent (kt CO_2e) and 692,000 kt CO_2e for all of Canada. In 2012, the estimated GHG emissions for National Pollutant Release Inventory (NPRI) permitted sources in Saint John was 3,415 kt CO_2e. The Project is expected to generate an estimated 34 kt of carbon dioxide (CO_2), which would result in an increase in CO_2 emissions of approximately 1 % to the NPRI totals for the Saint John Region, 0.18 % to the Provincial levels and 0.005% to the Canadian levels (Environment Canada, 2014).

With reference to climate the change, one of the main contributor to greenhouse gases for the Project will be the 54 MMBTU/hr natural gas boiler, which accounts for approximately 75% of the Projects CO_2 emissions.

Table 2.3 provides a summary of criteria air contaminant (CAC) emissions for all sources in New Brunswick compared to the total estimated CAC emissions for the proposed potassium nitrate and ammonium chloride plant.

Table 2.3 Comparison of Annual Project Emissions with Provincial Totals (Tonnes/Year)

Category	TPM	SO_2	NO_x	CO	NH_3
Total Project Emissions for APC	15	59.2	171.7	34.8	2.6
New Brunswick Total CAC Emissions (2012)	483,044	34,291	38,198	212,969	3,796

Source: Environment Canada, 2014a.

A comparison of total CAC emissions in the Province with estimated emissions from the potassium nitrate and ammonium chloride plant determined that the operation of the facility will increase provincial emissions of particulate matter by 0.003%, SO_2 by 0.17%, NO_x by 0.45%, NH_3 by 0.07% and CO by 0.016%.

3.0 AIR DISPERSION MODELING METHODOLOGY

Air quality impacts to both environment and human health are assessed by comparing ground level concentrations of priority pollutants to New Brunswick ambient air quality objectives, Ontario Ministry of the Environment ambient air quality criteria and the CCME CWS. Each of these organizations provide regulatory values for different averaging periods including 1 hour, 24 hour and annual. The emission rates developed in the previous sections were used in an air dispersion model computer simulation program to predict ground level concentrations for a 20 km Cartesian grid around the site.

The specific air pollutants emitted from some or all of these units that have been evaluated for their impacts consist of the following:

- NO_x, total particulate matter, $PM_{2.5,}$ and CO generated from natural gas combustion from a boiler located onsite;
- NH_3 from the buffer tank; and
- total particulate matter emissions from the drying of potassium nitrate.

3.1 Model Description

The AERMOD dispersion model was selected for use in this study. AERMOD was designed to replace the United States Environmental Protection Agency (USEPA) regulatory model ISCST3 (USEPA, 2014). In 2005, AERMOD was adopted by USEPA and promulgated as their preferred regulatory model. It is applicable to rural and urban areas, flat and complex terrain, surface and elevated releases, and multiple sources (including, point, area and volume sources).

The specific model inputs for the dispersion model include meteorological data, terrain and building inputs and the various source emissions data.

The model was configured to assess the operation of the facility during normal operations.

Five years of sequential hourly meteorological data were used in the AERMOD modeling. A five-year dataset of meteorology statistically covers all wind speed and stability conditions that are anticipated to occur in the modeled area. The dataset used for the modeling is from the Saint John Airport and Point Lepreau weather stations for the years from 2007 to 2012 (Environment Canada, 2014b).

3.2 Meteorological Data

AERMOD requires hourly surface meteorological data for calculating downwind concentrations. The data required for each simulation are:

- wind speed;
- wind direction;

- dry-bulb temperature;
- cloud cover;
- ceiling height;
- station pressure; and
- vertical profiles of temperature, pressure and relative humidity.

The proposed site does not have an on-site station. Therefore, meteorological data used in the analysis consists of 5 years (2007-2012) of hourly surface observations taken at Saint John Airport weather station. The Saint John Airport weather station is located approximately 9 km northeast of the Atlantic Potash Corporation (APC) site. The distance from the site supports its spatial representativeness since it places it in the same general synoptic flow regime as well as most mesoscale systems. This is the station located closest to the APC property that monitors most of the meteorological parameters required for the AERMOD model. The Saint John Airport station collects the following information: wind direction, wind speed, dry bulb temperature, relative humidity, station pressure, ceiling height and cloud opacity. The meteorological file was supplemented with precipitation data from the Point Lepreau weather station which is located 65 km to the west of the Saint John Airport weather station (Environment Canada, 2014b).

The aforementioned meteorological data are processed using the AERMET pre-processor program along with the definition of the surface characteristics within the modeling domain. These surface characteristics of albedo (ie. ratio of reflected to incident solar radiation), Bowen ratio (ie. ratio of sensible latent heat fluxes from the earth's surface) and surface roughness length (ie. height above ground at which the mean wind speed becomes zero) are specified by season as a function of distance and direction from the potassium nitrate and ammonium chloride plant based on land use information and the AERMOD User's Guide recommended values of these parameters.

Upper air sounding data was developed by the Preprocessor AERMET. The specific parameters obtained from the station are provided in Table 3.1.

Table 3.1 Meteorological Stations

Type of Station:	Surface Station	Surface Station
Station Name:	Saint John Airport	Point Lepreau
Location:	Saint John, New Brunswick	Point Lepreau, New Brunswick
Years:	2007-2012	2007 – 2012
Parameters:	Wind Speed Wind Direction Temperature Pressure Relative Humidity Ceiling Height Cloud Cover	Precipitation

Source: Environment Canada, 2014b

3.3 Emissions Source Data

The source data required to run the model include the following parameters for each source: the physical location of the emission point, physical stack height, stack inside diameter, stack gas exit velocity, stack gas temperature and the mass emission rates of each pollutant.

The parameters for the source exhaust stacks used in the modeling study are presented in Table 3.2.

Table 3.2 Source Parameters for Potassium Nitrate and Ammonium Chloride

Location	Source UTM X Coordinate (m)	Source UTM Y Coordinate (m)	Stack Base Elevation (m)	Stack Diameter (m)	Stack Height (m)	Gas Velocity (m/s)	Gas Temperature (K)
Buffer Tank Vent V102	265064	5016288	39.05	0.065	3	1	333
KNO_3 Dryer Scrubber Vent S402	265070	5016360	35.68	0.5	10	1	318
Natural Gas Boiler Exhaust Vent B601	265104	5016277	41.01	1.5	15	9.2	443

Note (1) (m) denotes metres; (m/s) denotes metres per second; and (K) denotes Kelvin; all velocity values are in actual m/sec.

Source data (Table 3.3) for the Project was provided by APC and was typically based on the operation of existing plants in China.

Table 3.3 Emission Rates for Potassium Nitrate and Ammonium Chloride

Location	PM (grams per second (g/s))	NO_2 (g/s)	CO (g/s)	SO_2 (g/s)	$PM_{2.5}$ (g/s)	NH_3 (g/s)
Buffer Tank Vent V102	-	-	-	-	-	0.0013(2)
KNO_3 Dryer Scrubber Vent S402	0.11(2)	-	-	-	-	-
Natural Gas Boiler Exhaust Vent B601	0.000052(3)	0.34(3)	0.57(3)	0.0000041(3)	0.000052(3)	-

Notes: (1) "-" denotes not available.
(2) Emission rates provided by APC.
(3) Emission rate calculated using USEPA AP-42 emission factors for natural gas fired boilers.

3.4 Terrain Data

The area surrounding the immediate site can be characterized as industrial in nature. The Project site is located approximately 40 metres above sea level (masl). The proposed Project site is located in McAllister Industrial Park, which appears to be 50% occupied by existing industrial/commercial businesses, with the remainder of the park undeveloped. The City of Saint John is located approximately 5 km to the west of the Project site and Saint John harbour is located approximately 1.5 km to the south. The land to the east is relatively undeveloped with tree cover. Nearby hills are prominent to the east, and terrain elevations reach 120 m at a distance of 2 km from the Project site, which is the highest elevation within 20 km of the site.

The modeling domain in terms of receptor grid development is selected such that the impacts of both the low level and elevated facility emissions are correctly estimated and are relevant for the analysis. The topography of the Project site and modeling domain are obtained using digital topographic data for the site region.

The Universal Transverse Mercator (UTM) coordinate system is used to generate a Cartesian receptor grid starting at the centre of the liquefied natural gas (LNG) facility and extending out to a distance as needed such that the maximum air impacts are captured by the modeling runs. A grid spacing of 1000 m was used from the APC property boundary out to a distance of 10 km each direction so that a 20 km Cartesian grid was developed. Sensitive receptors were placed at the following closest residential areas:

- Residence along Old Black River Road located approximately 1 km to the north of the Project site.
- Subdivision located approximately 1.5 km to the north of the Project site.
- Residence/Subdivision in Harbourview located approximately 600 m to the south of the Project site.
- The Champlain Heights subdivision located approximately 2.2 km to the northwest of the Project site.

In addition, impacts were predicted at other sensitive receptors including the closest hospital (4 km northwest of the Project site) and correctional centre (500 m north of the Project site).

The topographic elevations for the receptors in the modeling domain are developed using the AERMAP pre-processor along with Digital Elevation Model equivalent terrain files covering the modeling domain.

3.5 Building Downwash

The model was configured to evaluate the effects of aerodynamic wakes and eddies that can be formed by a building on exhaust plume dispersion. The building downwash program was used to calculate direction-specific building wake effect concentrations on plumes exiting the stacks onsite. The program determined dominant downwind structures and maximum projected widths for each dominant structure for a 10-degree radial wind direction increment. All buildings with stacks were included in the model. Table 3.4 provides a summary of building dimensions for each source.

Table 3.4 Building Characteristics

PM	Quantity	Dimensions
KCL Warehouse	1	130 m (L) x 90 m (W) x 8 m (H)
Process Building #1	1	60 m (L) x 30 m (W) x 20 m (H)
Process Building #1	1	60 m (L) x 30 m (W) x 20 m (H))
KNO_3 Drying	1	90 m (L) x 30 (W) x 8 m (H)
Boiler House	1	20 m (L) x 14 m (W) x 18 m (H)
KNO_3 Packaging	1	60 m (L) x 45 m (W) x 10 m (H)
KNO_3 Warehouse	1	100 m (L) x 100 m (W) x 8 m (H)
NH_4Cl Warehouse #1	1	100 m (L) x 80 m (W) x 8 m (H)
NH_4Cl Warehouse #1	1	130 m (L) x 60 m (W) x 8 m (H)

4.0 AIR DISPERSION MODELING RESULTS

Table 4.1 provides a summary of predicted air dispersion modeling maximum ground level concentration results for receptors located around the site. These results are compared to the New Brunswick ambient air quality objectives.

Table 4.1 Dispersion Modeling Results

Pollutant	Averaging Time Period	Highest Predicted Ground Level Concentrations (GLC)	New Brunswick Objectives
NO_2 (µg/m^3)	1 hour	5.5 (264940,5016162)	400
	Annual	0.4 (264940,5016162)	100
SO_2 (µg/m^3)	1 hour	0.00007 (264940,5016162)	450
	24 hour	0.00004 (264940,5016162)	150
	Annual	0.00001 (264940,5016162)	30
CO (µg/m^3)	1 hour	9.2 (264940,5016162)	15,000
	8 hour	5.8 (264940,5016162)	35,000
TSP Matter (µg/m^3)	24 hour	4.4 (264940,5016162)	120
	Annual	0.8 (264940,5016162)	70
$PM_{2.5}$ (µg/m^3)	24 hour	4.4 (264940,5016162)	30(1)(28)
	Annual	0.8 (264940,5016162)	10
NH_3 (µg/m^3)	24 hour	0.11 (264940,5016162)	100

Note: (1) CCME Canada Wide Standard.

A comparison of maximum ground level concentrations (GLCs) results with New Brunswick objectives indicates that all results are well within the objectives for NO_2, SO_2, CO and TSP and the CWS for $PM_{2.5}$.

The odour threshold of ammonia is 5 ppm or 3482 µg/m^3. The highest predicted GLC for a 1 hour averaging period is 1.4 µg/m^3, well below the odour threshold for ammonia.

5.0 CUMULATIVE IMPACTS ASSESSMENT

An assessment of cumulative impacts on air quality was performed by adding the predicated dispersion modeling results from the location with the highest predicted annual average ground level concentration to the air monitoring data obtained from New Brunswick Department of Environment and Local Government air quality monitoring network 2009 and 2010 results for Saint John for the NO_2, SO_2, and $PM_{2.5}$ parameters, and then comparing the calculated values to the New Brunswick ambient air quality objectives. Refer to Table 5.1 for a summary of estimated cumulative impacts for locations with the highest average annual GLCs.

Table 5.1 Assessment of Cumulative Effects

Pollutant	Averaging Time Period	Saint John Monitoring Results (A)	Highest Annual GLCs (B)	Cumulative Impacts (A) + (B)	New Brunswick Annual Objectives
NO_2 (µg/m^3)	Annual	5.1(1)	5.5(1)	10.6	100
SO_2 (µg/m^3)	Annual	3.1(1)	0.00007(1)	3.10007	30
$PM_{2.5}$ (µg/m^3)	Annual	7.2(2)	0.8(2)	8	10
CO (mg/m^3)	1 hour	NA	-	NA	NA

Note: (1) Annual average for NO_2 and SO_2 are from the Champlain Heights air monitoring location for the Year 2009. The data is calculated based on monthly averages from the 2009 New Brunswick Department of Environment report *Ambient Air Monitoring Results*. http://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/Air-Lair/2009AirQualityReport.pdf

(2) Annual averages for $PM_{2.5}$ is from the Champlain Heights air monitoring location for the Year 2010.

A comparison of the calculated cumulative impact concentrations with New Brunswick annual objectives indicate that all values are lower than the objectives.

6.0 MITIGATION

Fugitive dust emissions from activities such as site preparation, grading and vehicle traffic will occur during construction periods and similar emissions will occur during the decommissioning phase, which will also include demolition activities. Operation of potassium nitrate and ammonium chloride plant will result in impacts to the airshed from exhaust emissions from the natural gas boiler, buffer tanks, potassium nitrate drying facility and transport of raw and processed materials to and from the facility.

6.1 Construction Phase

In conducting site construction operations, APC will:

- Conduct periodic inspections of all work areas particularly during dry and windy conditions.
- Require contractors meet all provincial air quality regulations and emission standards applicable to their equipment. All construction equipment to be properly maintained to ensure exhaust emissions are typical for each piece of equipment; and apply water or approved dust suppressants to disturbed areas, as necessary, to reduce vehicle traffic dust.
- Cover open hauling trucks with tarps, as necessary.
- Use paved roads for construction vehicle traffic, wherever practical.
- Reduce and remediate track-out to paved areas as required.
- Limit vehicle speeds as required to reduce dust generation.
- Respond promptly to any significant particulate emission concerns that occur during construction by evaluating the source of emissions and ensuring all practicable mitigation measures are being implemented.
- Upon completion of construction activity, stabilize disturbed areas.

6.2 Operation Phase

During operation of the facility, APC will implement the following measures to minimize air quality effects:

- All equipment used onsite and offsite is to be properly maintained to ensure exhaust emissions meet manufacturer specifications for each piece of equipment.
- Conform to current and proposed regulated emissions standards for state of the art natural gas combustion boilers.
- As part of the facility design, use particulate emission controls such as scrubbers or a baghouse for the potassium nitrate drying facility.
- Conform to normal industry practices that are known to reduce emissions such as the use of auxiliary engines for container vessel hoteling. It is noted that the International Marine Organization has developed such limits for nitrogen oxides, sulphur oxides and

volatile organic compounds. In 2016, marine diesel engines are required to reduce NO_x levels by 80% compared to the levels that marine engines emit prior to 2010.

6.3 Decommissioning

Air impacts during decommissioning would be expected to be comparable to construction-related air impacts. Mitigation measures proposed for the construction phase therefore also apply to the decommissioning phase.

7.0 MONITORING

7.1 Construction Phase

Respond promptly to any significant particulate emission concerns that occur during construction by evaluating the source of emissions and ensuring all practicable mitigation measures are being implemented.

7.2 Operation Phase

Dispersion modeling predicted that the cumulative offsite impacts for all modeled parameters were below their respective ambient air quality objectives. No additional operational mitigation measures will be required.

7.3 Decommissioning

The approach to air monitoring during the decommissioning phase will be similar to that proposed for the construction phase.

8.0 RESIDUAL EFFECTS

Residual effects on air quality during the Project's construction and operation phase are not expected to be significant. It is noted that over the last 20 years regulations on internal combustion engines have become increasingly strict, resulting in a significant lowering of priority pollutants in engine exhaust. This trend is expected to continue. The Project will use state of the art equipment that will conform to industry emissions standards, as these standards are developed in the future with the intention to further reduce emissions as new emissions reducing technologies become available.

9.0 REFERENCES

Canadian Council of Ministers of the Environment (CCME). 2000. Canadian Wide Standards for Particulate Matter (PM) and Ozone. June, 2000. Accessible: http://www.ccme.ca/assets/pdf/pmozone_standard_e.pdf.

Environment Canada (EC). 2014a. Facility & Substance Information – 2013 NPRI Data. Last modified: June 5, 2014. Available: http://ec.gc.ca/inrp-npri/donnees-data/index.cfm?do=facility_substance_summary&lang=en&opt_npri_id=0000003394&opt_report_year=2012.

Environment Canada (EC). 2014b. Climate – Accessing the Data. Last Modified: April 16, 2014. Available: http://climate.weather.gc.ca/

Ontario Ministry of the Environment (OME) Standards Development Branch. 2014. Ontario's Ambient Air Quality Criteria, accessed November 2014. http://www.airqualityontario.com/downloads/AmbientAirQualityCriteria.pdf.

United States Environmental Protection Agency (USEPA). 2014. Technology Transfer Network. Emission Factors & AP 42, Compilation of Air Pollutant Emission Factors, accessed November, 2014. http://www.epa.gov/ttnchie1/ap42/.

Wartsila. 2012. Ship Power Technology. Wartsila Engines Product Guide. July 2012.

Wartsila. 2013. Wartsila Environmental Product Guide. January 2013.