NORONT

EAGLE'S NEST PROJECT

A Federal/Provincial Environmental Impact Statement/Environmental Assessment Report - Draft Copy

December 20, 2013




Volume 2

EIS/EA REPORT

Noront Resources Ltd.
Suite 400 - 110 Yonge Street
Toronto, ON M5T 1T4

Knight Piésold
CONSULTING
www.knightpiesold.com

Section 1

Introduction

Knight Piésold
CONSULTING
www.knightpiesold.com

TABLE OF CONTENTS

PAGE

TABLES

FIGURES

1 – INTRODUCTION

1.1 THE PROPONENT

Noront Resources Ltd. (Noront) is a Canadian mining company focused on the development of the Eagle's Nest Mine, a nickel, copper, and platinum group element deposit in the Ring of Fire region of northern Ontario. Noront is a publicly traded company on the Toronto Venture Exchange (TSXV: NOT). The Company is the sole proponent of the Eagle's Nest Project (the Project) and holds a 100% interest in all of the underlying claims. Noront Resources Ltd. is the legal entity that will develop, operate and manage the Eagle's Nest Mine. Table 1.1-1 provides a summary of Noront's information.

The primary contacts for the Project are:

Mr. Paul Semple, P.Eng.
Chief Operating Officer
Paul.Semple@norontresources.com

Mr. Mark Baker, P.Eng.
Vice President, Projects
Mark.Baker@norontresources.com

Table 1.1—1 Proponent Information

Proponent Name	**Noront Resources Ltd.**
Head Office Address	110 Yonge Street, Suite 400 Toronto, Ontario, Canada M5C 1T4
Telephone	(416) 367-1444
Fax	(416) 367-5444
Website	http://www.norontresources.com
Jurisdiction Where Formed	Ontario
Stock Exchange and Stock Symbol	TSX-V: NOT
Affiliations and Associations	Mining Association of BC Mining Association of Canada Ontario Mining Association Ontario Chamber of Commerce

Noront's corporate and management structure, as it relates to the implementation of the Project, is presented in the environmental management system in Section 1 of Volume 4.

Noront has several policies and mechanisms that will apply to the project, including:

- Aboriginal Policy
- Code of Business Conduct and Ethics
- Environmental Policy
- Workplace Health and Safety Policies

Noront holds as a core value the health and safety of all employees and the integrity of the environment in which they work. The Safety, Health, and Environment Policy has the following guiding principles that will be integrated into the Project:

- The company's Chief Operating Officer ("COO") shall be the lead contact for all safety, health and environmental issues
- The company is committed to compliance with all existing laws and regulations pertaining to safety, health, and the environment
- The company is committed to reducing and ultimately eliminating all accidents and incidents of work related ill health
- The company is committed to minimizing the impact of their activities on the environment and the communities in which we work
- The company will evaluate the health, safety and environmental risks inherent to the business on a continuous basis
- The company shall provide adequate training to employees in order to increase awareness of potential health and safety risks associated with their work and to raise awareness of the potential impact to the environment of our activities
- The company shall ensure adequate emergency plans are developed and communicated to all employees

Regarding insurance and liability management, Noront will comply with legal requirements and will require contractors to be adequately insured and bonded. Insurance coverage may include, but not be limited to:

- General Liability
- Commercial Automotive
- Workers Compensation and Employers Liability
- Employee Practice Liability
- General Property Insurance
- Financial assurance for mine closure as required by the Ontario Mining Act and outlined in an approved Mine Closure Plan

Noront has been operating exploration activities in the Ring of Fire since 2007 and began environmental baseline data collection in the region in 2009. The company has maintained its exploration camp in a manner that ensures the integrity of the environment.

Noront has been engaging with the First Nation communities in the Project area since 2010. The engagement activities have included community open houses, meetings with Chief and Council, and regular correspondence with the communities. In addition to the engagement activities carried out by Noront, the company has hired a number of First Nation employees for exploration and baseline data collection programs. The Company has demonstrated its support for local First Nations communities by the sponsorship of innovative activities such as the Mining Matters Movie Making Camps for local youth, the Ring of Fire Christmas Fund, the Mikawaa Scholarship as well as other educational community initiatives.

Noront has entered into partnerships with Matawa Tribal Council (through their employment and training services provider KKETS) and Confederation College. The aim of both programs is to build a productive local workforce that will enable Aboriginal jobseekers to develop and ultimately utilize their skills for future employment opportunities at the Noront's Eagle's Nest Mine or at businesses supporting the mine. In March 2013, Noront, KKETS, and Confederation College signed a Memorandum of Understanding (MOU) thereby creating the Ring of Fire Aboriginal Training Alliance. This agreement reinforces the desire and commitment by Noront to work in partnership with Matawa Tribal Council and Confederation College to develop a highly skilled Aboriginal workforce (Confederation College, 2013).

In 2013, Noront became a member of the Mining Association of Canada (MAC). As a member of MAC, Noront is proud to subscribe to the mandatory requirements of MAC's Towards Sustainable Mining (TSM) initiative.

The TSM Guiding Principles outline MAC's and its members' commitment to support advocacy, stewardship, and collaboration on behalf of Canada's mining and mineral-processing industry. Developed in collaboration with communities of interest and key stakeholders, these principles are mandated across the industry to help MAC's members meet society's needs for minerals, metals and energy products in the most conscientious way possible, conducting all facets of the mining business effectively, transparently and accountably. The Guiding Principles of TSM are described on the MAC website (MAC, 2004).

TSM Performance Indicators are used to implement the TSM Guiding Principles by setting down specific measurement criteria in six key areas of operational performance:

- Safety and health
- Aboriginal and community outreach
- Crisis management planning
- Tailings management
- Energy and greenhouse gas emissions management
- Biodiversity conservation

MAC members are also working to develop specific indicators to address mine closure.

Members of MAC must measure and report on their performance in these areas annually. Findings are outlined in MAC's yearly Towards Sustainable Mining Progress Report. When measuring performance, MAC employs social, economic and environmental indicators to provide the most in-depth analysis possible. Such indicators demonstrate how the mining industry is responding to concerns; what we are doing successfully; and where we can continue to improve. The TSM initiative has been integrated into Noront's Environmental Management System, described further in Section 10. Additional information on TSM is displayed prominently on MAC's website at www.mining.ca. Noront is the first non-producing mining company to adopt the TSM principles.

1.2 PROJECT OVERVIEW

The Project involves the construction, operation and closure of a proposed underground mine, processing facility, and associated ore transportation and handling infrastructure. Eagle's Nest deposit is a vertically-oriented ore body containing mineable quantities of nickel (Ni), copper (Cu), platinum (Pt), and palladium (Pd). The deposit contains approximately 11.1 million tonnes (Mt) of proven and probable reserves and nearly 9 Mt of inferred resources (Noront, 2013). The deposit is located at 52^{o} 44' 29" N latitude and 86^{o} 17' 45" W longitude (Figure 1.2-1).

LEGEND:

- ☆ MINE SITE AND TRANS-LOAD FACILITY
- ● COMMUNITY
- WATER
- RING OF FIRE CLAIM AREA
- CANADA
- USA

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N.
3. ACTIVE CLAIM BOUNDARIES BY OTHERS WERE PROVIDED BY THE MINISTRY OF NORTHERN DEVELOPMENT AND MINES (AUGUST 2012).

SCALE 100 50 0 100 200 300 400 500 km

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

PROJECT LOCATION MAP

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 1.2-1 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	RAC	SWK	SRA	RAM

SAVED: I:\102\00390\01\A\GIS\Figs\A166_rA.mxd; Dec 12, 2013 2:29 PM; asimpson

Based upon the proven and probable ore reserves, the proposed mine and associated infrastructure will operate for 11 years at an ore production rate of 2,960 tonnes per day (t/d). The processing facilities at the mine will produce a nickel-copper-platinum-palladium concentrate at a rate of approximately 420 t/d. Tailings from the processing will be stored underground as paste backfill in ore stopes and aggregate stopes. The aggregate from the aggregate stopes will be crushed and used for the constructing roads and other surface infrastructure. The nickel-copper-PGE concentrate will be shipped by truck from the mine site to a rail transfer facility (trans-load facility) located near the community of Savant Lake, a distance of approximately 550 km. At the trans-load facility, the ore will be offloaded from the trucks and loaded onto rail cars for shipment to existing smelting/processing facilities located in eastern Canada via the existing Canadian National (CN) railway.

The Project under assessment includes the following components (Figure 1.2-2):

- A mine site
- A transportation corridor
- A trans-load facility

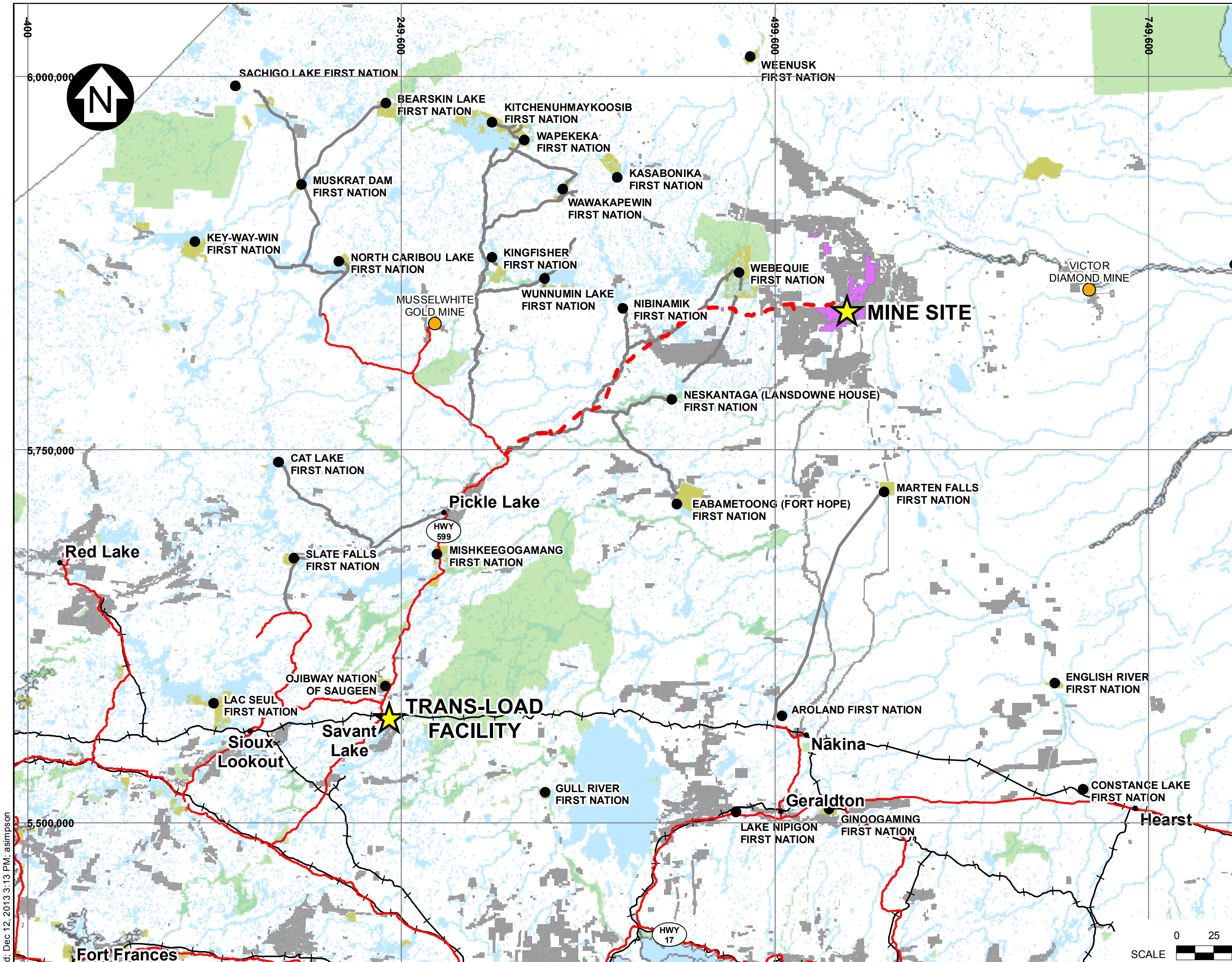
An additional description of each component is provided below.

1.2.1 Mine Site

The mine site will consist of the following components:

- Underground mine
- Underground processing facility
- Underground tailings management and storage
- Surface concentrate storage and transfer facilities
- Surface supporting infrastructure (e.g., accommodations buildings, services complex, and access portals)
- Diesel power generation facilities
- Fuel storage areas
- Waste and water management facilities
- Aggregate rock stockpile and crusher
- Explosives handling and storage facilities
- Site roads

Noront has decided to locate several key mine site components underground, including the processing facility and permanent disposal areas for waste rock and tailings. This will minimize the Project's environmental footprint, as well as reduce the aggregate requirements and the cost associated with establishing surface infrastructure.



SAVED: I:\1102\00390\01\A\GIS\Figs\A184_rA.mxd; Dec 12, 2013 3:13 PM; asimpson

LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- COMMUNITY
- OPERATING MINE
- EXISTING ALL-SEASON ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- EXISTING WINTER ROAD
- RAILWAY
- WATER
- PARK
- FIRST NATIONS RESERVE
- MINERAL CLAIMS HELD BY NORONT
- MINERAL CLAIMS HELD BY OTHERS

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORATION CORRIDOR PROVIDED BY KIEWIT INFRASTRUCTURE ENGINEERS (NOVEMBER 26, 2013).
4. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).
5. ACTIVE NORONT CLAIM BOUNDARIES WERE PROVIDED BY NORONT RESOURCES LTD. (MAY 23, 2013).
6. ACTIVE CLAIM BOUNDARIES BY OTHERS PROVIDED BY MINISTRY OF NORTHERN DEVELOPMENT AND MINES (AUGUST 2012).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	RAC	SWK	SRA	RAM

NO

E

LOCAT

Knight P

CON

Noront plans to utilize a local airstrip for the movement of personnel and supplies to and from the mine site. The airstrip has been permitted and partly constructed by a First Nation group. The airstrip is located north of the mine site on the east side of the Muketei River and will service the Eagle`s Nest Project, as well as other mineral exploration and development projects in the region.

1.2.2 Transportation Corridor

Access to the Project site will be developed to transport concentrate to market and to supply the equipment and materials required to build and operate the mine. The preferred alternative for the transportation corridor is shown on Figure 1.2-3 and summarized below:

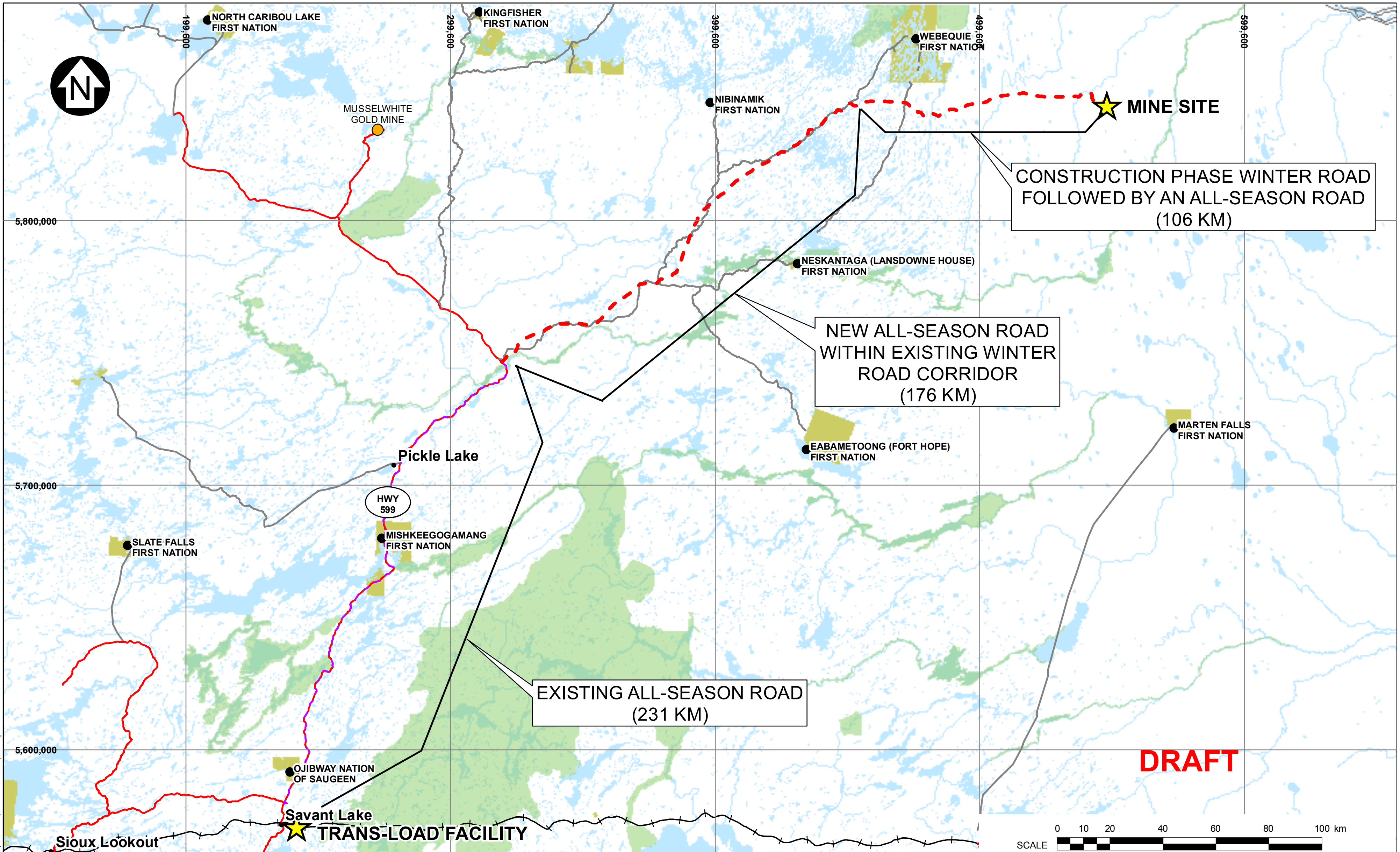
- A 282 km all-season road will be constructed from the Pickle Lake North Road (formerly Highway 808) north of Pickle Lake to the mine site. The new road will primarily follow an existing winter road alignment for the first 200 km.
- The existing Pickle Lake North Road and Highway 599 will be used to connect the new all-season road to the proposed trans-load facility located near the community of Savant Lake. This segment of the proposed corridor will be approximately 230 km in length.

Concentrate will be trucked along the transportation corridor to a trans-load facility where it will be off-loaded and transferred into rail cars and taken for further processing at an existing smelter facility in Canada.

1.2.3 Trans-load Facility

The trans-load facility will be located approximately 5 km east of the community of Savant Lake on the CN Mainline. The facility will utilize a brownfield site that was formerly a rail siding used by the forestry industry. The trans-load facility will consist of the following components:

- Concentrate handling, storage and railcar loading facilities
- Administration and security buildings
- Power transmission lines
- Fuel storage areas
- Backup diesel power generation facilities
- Equipment storage and maintenance facilities
- Waste and water management facilities



LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- COMMUNITY
- OPERATING MINE
- RAILWAY
- EXISTING ALL-SEASON ROAD
- CONCENTRATE HAUL ROUTE
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- EXISTING WINTER ROAD
- STEAM/RIVER/DRAINAGE
- PARK
- FIRST NATIONS RESERVE
- WATER

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORATION CORRIDOR PROVIDED BY KIEWIT INFRASTRUCTURE ENGINEERS (NOVEMBER 26, 2013).
4. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

PROPOSED TRANSPORTATION CORRIDOR

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 1.2-3 | REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	RAC	SWK	SRA	RAM

SAVED: I:\1102\00390\01\A\GIS\Figs\A203_rA.mxd: Dec 16, 2013 2:24 PM; asimpson

1.3 PROJECT SCHEDULE AND PHASES

The current Project life is expected to be 16 years. The Project will comprise the following four phases and approximate durations:

- Construction (3 years)
- Operation (11 years)
- Closure (2 years)
- Post-closure (a minimum of 5 years)

The post-closure monitoring phase that is expected to be a minimum of 5 years or until mine closure objectives are achieved. In the event that the current inferred resources at Eagle's Nest are developed, the operational mine life will be extended by a further nine years.

Additional details on the scheduling of activities within each of the Project phases are provided below.

1.3.1 Construction Phase

The construction phase will consist of all activities leading to the development and construction of the mine, processing facility, transportation corridor and trans-load facility.

The construction phase will begin with establishing the new winter road to connect the mine site with the existing annual winter road network. This will allow for the staging of equipment and supplies needed for the development of the mine site and the construction of the all-season road. The road construction execution plan includes the establishment of quarries and borrow sources. Temporary construction camps will be established along the road alignment, positioned at key locations such as aggregate sources and major bridge crossings. The all-season road will be constructed over a three year period. Rock extracted from the underground aggregate stopes at the mine site may also be used for construction on the east end of the road. Noront is the current proponent of the road; however, it may be built as a Public-Private-Partnership (P3) venture involving First Nations.

Construction at the mine site will begin by establishing the laydown areas, site roads, and the development of the mine portal and ramp. Due to the lack of available construction material at surface, aggregate for construction will be sourced from rock mined during the underground development. The aggregate rock will originate from granodiorite adjacent to the ore body. The laydown areas used for construction equipment and materials will be the same as those used during the operation of the mine. A sedimentation pond will be constructed as soon as possible to receive groundwater pumped from the underground during development of the mine.

During initial construction, the existing exploration camp ("Esker Camp") will be utilized to support mine site construction activities. During the second year of construction, the accommodation facilities that are needed to support operations will be established at the mine site. Water supply wells and the sewage treatment plant at Esker Camp will be used until the new facilities are prepared. New wells to support operations will be drilled and a sewage treatment plant for the accommodation facilities will be installed and commissioned.

Construction of the trans-load facility will be undertaken concurrently with the mine site and road construction. The trans-load facility site is a brownfield area and surface preparation requirements (clearing and grubbing) will be limited. Construction activities at the trans-load facility will include modifying the existing railway siding, installation of a power line from Savant Lake to the facility, and establishing the truck unloading and rail car loading facilities. Construction at this location will also include all supporting offices and other required infrastructure.

The construction phase of the Project is expected to last three years.

1.3.2 Operations Phase

The operations phase will consist of mining and processing of ore to produce a concentrate and the transport of the concentrate along the transportation corridor to the trans-load facility.

The underground mining operation will use electric powered equipment to the greatest extent possible, meaning that most mobile equipment will run on electricity rather than on diesel. This will reduce the ventilation requirements of the mine, heating of the ventilated air, and overall diesel fuel consumption at the mine. Processing of the ore will occur underground and waste rock will be used for construction purposes or disposed of underground. Tailings generated by the processing facility will be thickened and converted into cemented and un-cemented paste backfill. The cemented paste backfill tailings will be used to backfill the ore stopes and the un-cemented paste tailings will be used to backfill the aggregate stopes. No surface disposal of tailings will occur.

The mine operations will be a net consumer of water. Water will be recycled from mineral processes and will be generated by groundwater inflows into the underground openings. As such, discharge from the mine process is not expected. The surface sedimentation pond will collect runoff from surface infrastructure. Additional make-up water will be supplied by groundwater wells.

A permanent fly-in/fly-out accommodation complex will house workers. Potable water will be sourced from groundwater wells, and sewage will be treated in a package treatment plant and discharged to a local wetland that reports to the Muketei River. Personnel will be moved in and out of the camp using a local airstrip, which has already been permitted and will be constructed by a First Nation group.

The all-season road will be used to bring in materials and supplies and to export concentrate and waste materials. Approximately 12 - 35 tonne capacity trucks will transport concentrate to the trans-load facility each day. Additional trucks will deliver supplies to the mine site and dispose of solid waste to off-site licensed facilities.

The mine is expected operate for a total of 11 years.

1.3.3 Closure and Post-Closure Phases

Closure and post-closure activities will start immediately following the end of operations, with monitoring occurring throughout the closure and post-closure phases. It is expected that active closure will take approximately 2 years, and the site will be monitored annually during the post-closure phase for a minimum of 5 years.

The closure phase includes activities to ensure that the Project development areas are left in a physically and chemically stable manner that is consistent with adjacent land uses. A Mine Closure Plan will be prepared in accordance with Ontario Regulation (O.Reg.) 240/00, which will require First Nations consultation and approval by the Ministry of Northern Development and Mines (MNDM).

At the mine site, closure activities will include the removal of all surface infrastructure and all hazardous materials from the underground. The underground workings will be allowed to flood, and the portal will be blocked with a concrete cap in accordance with O.Reg. 240/00. Development areas will be scarified and either re-vegetated or allowed to re-vegetate naturally, as site conditions and climate allow.

It is expected that the all-season road supporting access to the communities in the region and other resource projects will remain and will be operated by either the province or the local communities. If other users do not come forward to assume responsibility for the final 106 km of the road it will be decommissioned as part of the Mine Closure Plan. Culverts and bridges will be removed and natural drainage restored. At closure, the road bed will be scarified and allowed to naturally re-vegetate.

Equipment and materials at the trans-load facility will be removed to be either salvaged for re-use elsewhere, or be disposed of in a licenced landfill. Hazardous materials will be managed separately and will be contained and transported to a licensed hazardous waste disposal facility. Following an investigation of contamination and remediation if necessary, the site will be restored to its current condition as a former industrial site.

1.4 REGIONAL SETTING

1.4.1 Biophysical Setting

The mine site is located at the boundary between the James Bay Lowlands and the Canadian Shield. Spruce boreal forest and expansive wetlands dominate the landscape in the region. The terrain is generally low gradient with large wetland areas, several lakes and ponds, and slow flowing, often meandering streams and rivers. Upland areas are common along river banks and associated with glacial till deposits. These areas, with contrasting vegetation due to much better drained soils, constitute a relatively low percentage of the landscape in the area of the mine site. Poplar trees dominate upland glacial till deposits, while dense spruce trees typically dominate on stream and river banks.

The mine site area is part of the Muketei River watershed which drains north into the Attawapiskat River. The Otoskwin/Attawapiskat River Provincial Park is located approximately 20 km to the east along the Attawapiskat River.

The all-season transportation corridor transitions from a wetland dominated environment near the mine site to Canadian Shield boreal forest approximately 100 km west of the mine site. The trans-load facility is located at a previously cleared site with exposed sandy soil and shrub type vegetation. The surrounding land-cover is predominantly mixed Boreal forest.

1.4.2 Socioeconomic Setting

The Project is located in a remote part of northern Ontario that has seen little or no development. The mine site and proposed all-season road are located within the First Nation traditional lands and the communities closest to the mine include the Webequie First Nation (80 km to the west), Marten Falls First Nation (130 km to the southeast) and Neskantaga First Nation (80 km to the southwest). Other communities in proximity to the mine site and all-season road corridor include Nibinamik First Nation, Eabametoong First Nation, Mishkeegogamang First Nation, and Pickle Lake. The

Attawapiskat First Nation, a member community of the Mushkegowuk Tribal Council, is located approximately 250 km to the east and downstream of the mine site.

The trans-load facility is located near the community of Savant Lake, as well as the Ojibway Nation of Saugeen, a politically independent First Nation community.

Most of the above communities are remote and are accessible year-round by scheduled and chartered aircraft. A network of winter roads connects the communities to the Northern Ontario Resource Trail northeast of Pickle Lake. The communities have a proud First Nation heritage and rely to some degree on subsistence activities including fishing, hunting and trapping.

Other regional land use activities in the area include recreational activities, consisting mainly of tourist lodges and fly-in hunting and fishing camps. The Otoskwin/Attawapiskat River Provincial Park is used for water sport activities, such as rafting and canoeing. More recently, the Ring of Fire area has been recognized for its mineral potential and exploration has become a prominent activity over the last decade.

Thunder Bay is the closest major regional centre, located approximately 530 km to the southwest of the mine site and 370 km from the trans-load facility.

1.4.3 Ring of Fire Exploration Activities

Exploration activities in the region have been ongoing for several decades. Diamond exploration in the 1990s and into the early 2000s led to the discovery of the McFauld's Lake copper-zinc volcanogenic massive sulphide deposits in 2002. This discovery started a staking rush that defined the "Ring of Fire". Several significant new geological discoveries have been made in the Ring of Fire over the past several years, including chromite, nickel, copper, zinc, gold and kimberlite. At one time, up to 35 companies held claims in the area, though the Government of Ontario reported that as of February 2013, 21 companies held claims in the area (MNDM, 2013). The mineral claim map for the Ring of Fire area is shown on Figure 1.4-1.

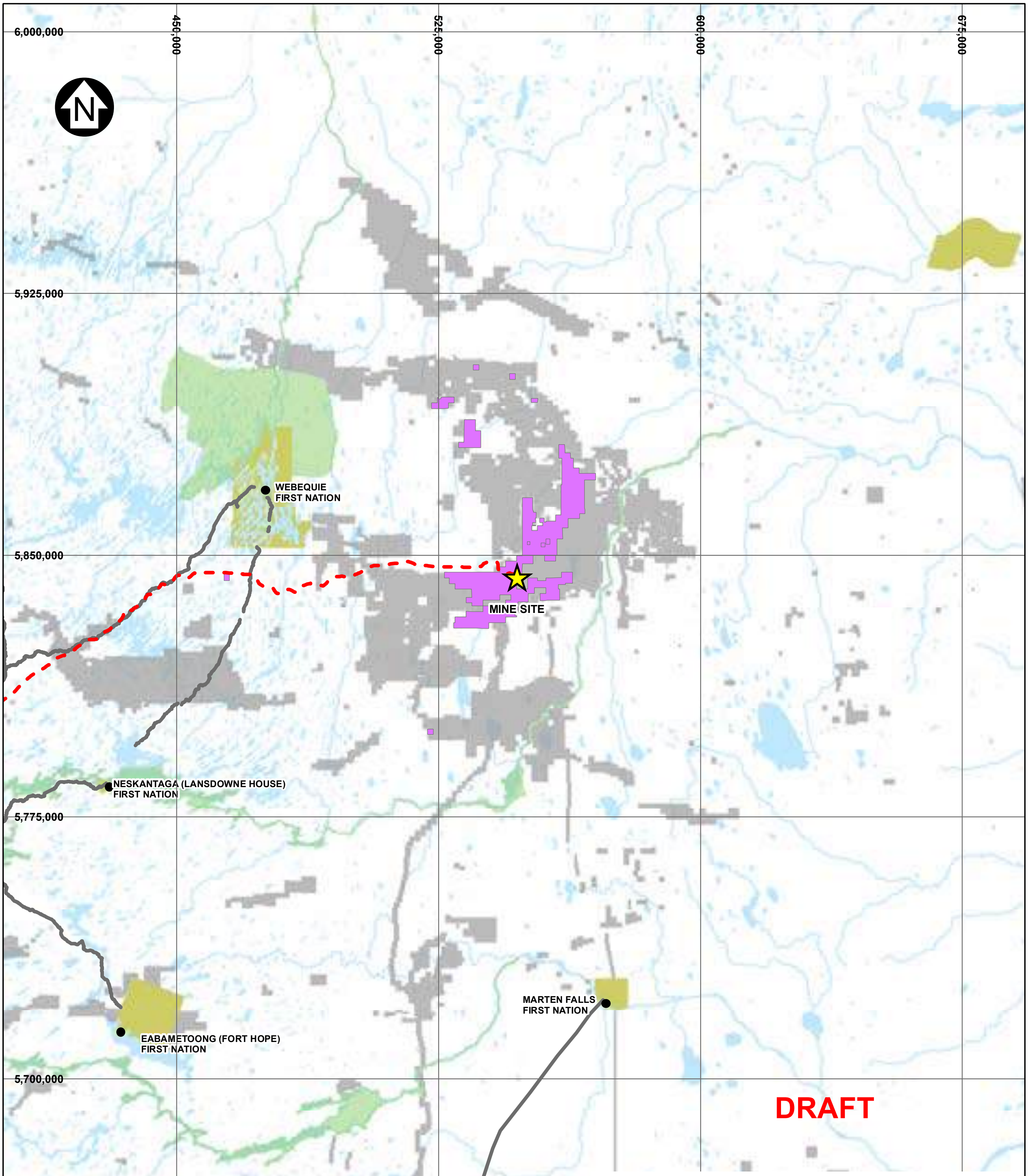
In August 2007, drilling by Noront yielded one of the highest-grade discovery holes in Canadian history, heralding the discovery of the Eagle's Nest nickel, copper platinum and palladium deposit. Since then, the company has invested over $200 million in exploration. In addition to Noront's flagship Eagle's Nest Project, the company has discovered nearby deposits, including the Eagle Two and AT12 nickel, copper, platinum, and palladium deposits, the Blackbird 1 and Blackbird 2 chromite deposits, and Thunderbird iron-titanium-vanadium deposit. .

Over the same period of time, Cliffs Natural Resources, through its predecessor Freewest Resources Ltd., discovered the Black Thor chromite deposit, which is currently in an advanced stage of exploration and has entered the federal and provincial environmental assessment processes.

1.4.4 Mineral Claims Held by Noront

Noront is one of the major claim holders in the Ring of Fire. Figure 1.4-2 shows the location of Noront's Eagle's Nest deposit in relation to the mineral claims. Table 1.4-1 summarizes Noront's deposits, commodity types, claim numbers and coordinates.

Noront anticipates converting a portion or all of the area covered by its mining claims to lease, which will provide Noront with the necessary surface rights to construct and operate the mine.



SCALE 15 7.5 0 15 30 45 60 75 km

LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- COMMUNITY
- EXISTING WINTER ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- RIVER/STREAM/DRAINAGE
- WATER
- PARK
- FIRST NATIONS RESERVE
- MINERAL CLAIM HELD BY NORONT
- MINERAL CLAIM HELD BY OTHERS

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORATION CORRIDOR PROVIDED BY KIEWIT INFRASTRUCTURE ENGINEERS (NOVEMBER 26, 2013).
4. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).
5. ACTIVE NORONT CLAIM BOUNDARIES WERE PROVIDED BY NORONT RESOURCES LTD. (MAY 23, 2013).
6. ACTIVE CLAIM BOUNDARIES BY OTHERS PROVIDED BY MINISTRY OF NORTHERN DEVELOPMENT AND MINES (AUGUST 2012).

A	20DEC'13	ISSUED WITH REPORT	RAC	SWK	SRA	RAM
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

NORONT RESOURCES LTD.

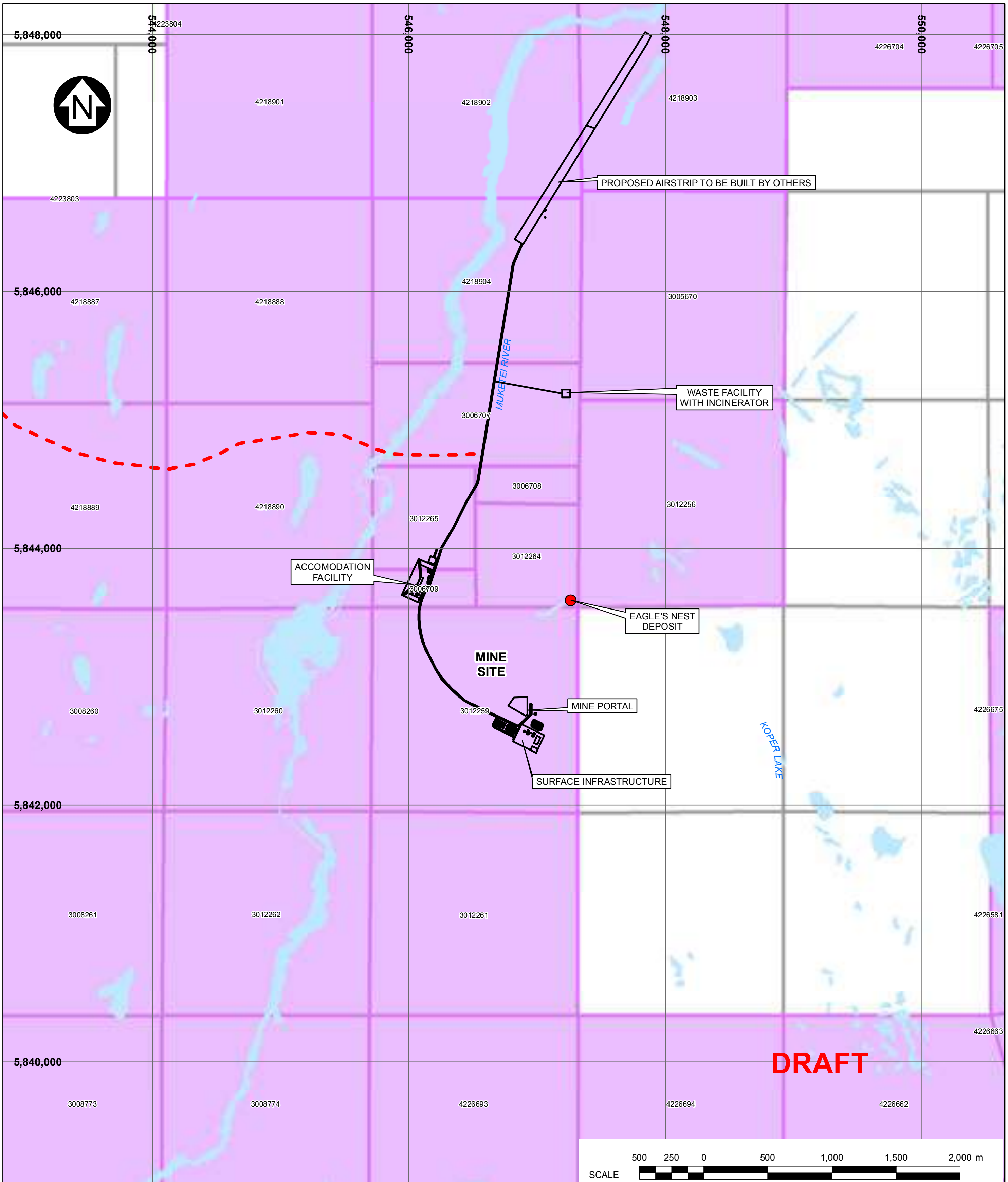
EAGLE'S NEST PROJECT

RING OF FIRE EXPLORATION AREA

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34
FIGURE 1.4-1	REV A

SAVED: I:\1\02\00390\01\A\GIS\Figs\A170_rA.mxd; Dec 17, 2013 4:56 PM; spenfold



LEGEND:

- EAGLE'S NEST DEPOSIT
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- PROPOSED INFRASTRUCTURE
- RIVER/STREAM/DRAINAGE
- WATER
- MINERAL CLAIM HELD BY NORONT
- MINERAL CLAIM HELD BY OTHERS

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORATION CORRIDOR PROVIDED BY KIEWIT INFRASTRUCTURE ENGINEERS (NOVEMBER 26, 2013).
4. ACTIVE NORONT CLAIM BOUNDARIES WERE PROVIDED BY NORONT RESOURCES LTD. (MAY 23, 2013).
5. ACTIVE CLAIM BOUNDARIES BY OTHERS PROVIDED BY MINISTRY OF NORTHERN DEVELOPMENT AND MINES (AUGUST 2012).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	RAC	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

NORONT'S EAGLE'S NEST MINERAL CLAIMS

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 1.4-2 REV A

SAVED: I:\1\02\00390\01\A\GIS\Figs\A172_rA.mxd; Dec 17, 2013 2:37 PM; spenfold

Table 1.4—1 Noront Deposits and Claims

Deposit Name	Mineral(s)	Claim Number	UTM Coordinates (NAD83, Zone 16)	
			Easting	Northing
Eagle's Nest	Ni-Cu-PGE	3012259, 3012264	547262	5843633
AT2 (Eagle Two)	Ni-Cu-PGE	3012259, 3012261	547262	5843633
AT12	Ni-Cu-PGE	3008266	553772	5850769
Blackbird One	Chromite (Cr)	3012259	546100	5845100
Blackbird Two	Chromite (Cr)	3012259	546865	5842405
Thunderbird	Fe-Ti-V	3011022	558000	5851000

1.4.5 Current Infrastructure

Exploration in the Ring of Fire area is supported by several exploration camps. Noront's exploration camp, Esker Camp, includes accommodation, administration, storage and maintenance buildings, kitchen and staff service facilities, potable water supply and sewage treatment facility, diesel generator and a fuel storage area.

Esker Camp is currently accessed by helicopter from a float plane base at Koper Lake, which is approximately 3 km east of the camp. Nakina, located 300 km to the south, and Pickle Lake located 300 km west southwest are the current main air hubs providing access for site personnel to Koper Lake. Nakina and Pickle Lake have paved airstrips and are accessible by all-season roads and rail (Nakina).

1.5 PURPOSE AND RATIONALE OF PROJECT

The purpose of the Project is to extract, process, and ship approximately 150,000 tonnes per year (Mt/a) of nickel-copper-platinum-palladium concentrate over an 11 year period. All of the Project will be completed in an environmentally and socially sustainable manner, while providing a competitive rate of return to Noront's investors and lenders, and sharing Project benefits directly with the local First Nation communities.

The rationale for proceeding with the Project at this time is as follows:

- As a junior mining company, it is Noront's obligation to its shareholders to advance the Project forward in a timely manner. Until the Project is developed, Noront has very little source of revenue and is financing activities by borrowing or dilution of equity.
- While commodity prices are generally lower relative to peak prices over the last couple of years, global demand for the metals are expected to remain strong over the life of the Project
- The Project is relatively small and therefore will not have a meaningful effect on global supply of the metals produced by the Project, thus the impact on metal prices will be slight.

- The Project can be constructed in an innovative manor that will result in a small surface footprint and that minimizes environmental impacts.
- The Environmental Assessment work has been completed in a thorough and professional manner and is ready to be submitted in draft form for review.
- The development of the Project has the potential to generate many socio-economic benefits to local First Nation communities. These benefits include, but may not be limited to, direct and indirect employment opportunities, additional funding to support community programs and investments in regional infrastructure that will contribute to several communities realizing year round access and grid power. In 2012, the Province of Ontario signed a Memorandum of Understanding with the Marten Falls to work together to realize the benefits of responsible mineral development in the Ring of Fire (Government of Ontario, 2012a). The Province of Ontario also signed a Memorandum of Co-operation with Webequie First Nations, which commits the province to work with Webequie to advance discussions with the federal government to ensure communities are prepared to fully participate in Ring of Fire developments (Government of Ontario, 2012b).
- The Government of Ontario has publicly stated that it supports responsible mining developments in the Ring of Fire (Government of Ontario, 2012c). The province called the Ring of Fire "one of the most promising mineral development opportunities in Ontario in almost a century" (OMF, 2013).
- The Government of Canada has demonstrated its support for mineral exploration through initiatives, such as the Mineral Exploration Tax Credit and, more specifically to the Ring of Fire, the Federal Economic Development Initiative for Northern Ontario (CMF, 2013). This demonstrates the federal government's commitment to sustainable mining that benefits the Canadian economy and local communities.

Each of the proposed Project components (the mine, transportation corridor and trans-load facility) is necessary for the local and regional economies to be realized. The mine location is based on the deposit, and year-round access to the mine is critical for the Project to succeed, as the transportation of concentrate over a winter road season is not economically viable. Construction of a new smelter for this Project is also not economically viable, but sufficient processing capacity exists elsewhere. Trucking the ore to smelting facilities elsewhere in the province is also not economically viable, which is why the trans-load facility and use of the CN railway is critical to the Project.

1.6 REGULATORY FRAMEWORK AND THE ROLE OF GOVERNMENT

The Project will be subject to federal and provincial legislation, as described in the subsequent sections. The Project is located outside of municipal boundaries, including the trans-load facility which is located within an unorganized township.

This Environmental Impact Statement/Environmental Assessment Report (EIS/EA Report) has been prepared for the Project with the objective of meeting both the provincial requirements for an Individual Environmental Assessment and the federal requirements for a Comprehensive Study Environmental Assessment.

1.6.1 Provincial Environmental Assessment Process

In Ontario, environmental assessment is an important planning and decision making process which has its authority in the *Ontario Environmental Assessment Act* (*OEAA)* to provide for the protection, conservation, and wise management of Ontario's environment. In Ontario, projects may be subject to an Individual EA, or to a Class EA. Class EAs are for projects that are carried out routinely, and have predictable and mitigatable environmental effects.

While there are no requirements in Ontario for a proposed mining project to undertake a provincial individual EA, there are components of the Project which may trigger either provincial Individual EAs or Class EAs, including:

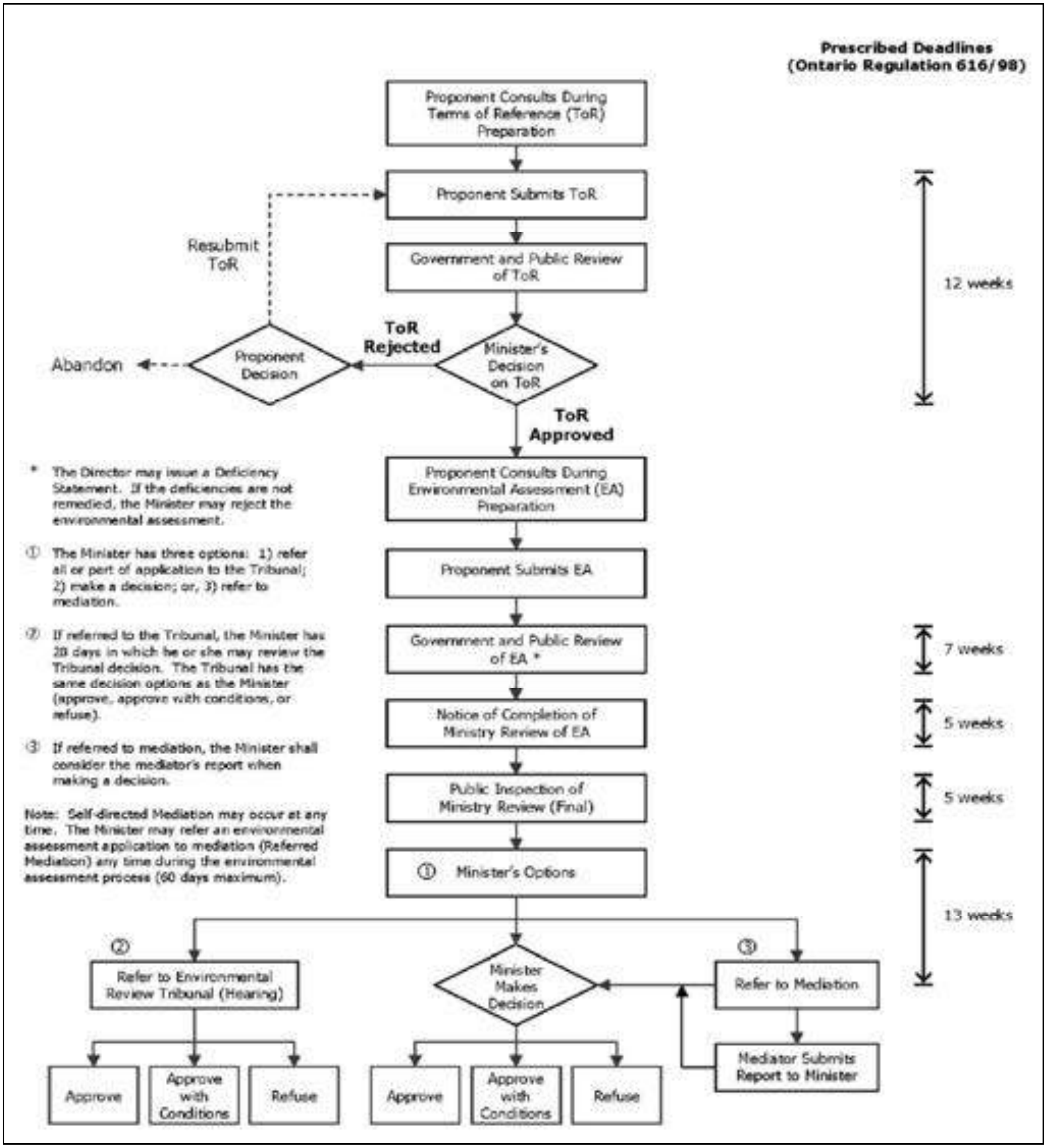
- The construction of a 25 MW diesel-fuelled power generation plant (Ontario's Electricity Projects Regulation; MOE, 2011)
- The Disposition of Rights to Crown Resources for Project infrastructure development occurring on Crown Land (A Class EA for MNR Resource Stewardship and Facility Development Projects; MNR, 2003)
- Construction of an all-season road along the east-west transportation corridor (A Class EA for MNR Resource Stewardship and Facility Development Projects; MNR, 2003)

Of the above, a 25 MW diesel-fired power generation facility triggers the requirement for an Individual EA under O. Reg. 116/01. Any potential Class EAs could be elevated to an Individual EA by the Minister, if unforeseen conditions or significant concerns are raised. In such a situation, the review process would need to be restarted.

Because of the provincial Class EAs required, and the need for an Individual EA for the power generation plant, Noront voluntarily entered into a written agreement under Section 3.0.1 of the *OEAA* to have the *OEAA* apply to the whole Project. Noront believes that it will be more efficient for the Company, government agencies, and First Nation communities to coordinate a single provincial EA coordinated with the federal comprehensive study for the Project, rather than conducting a separate federal EA and multiple Class EAs. The MOE granted Noront's request and confirmed the voluntary agreement on September 9, 2011 (MOE, 2012a).

Figure 1.6-1 outlines the steps and timelines for the provincial individual environmental assessment approval process. A key step in the provincial EA process is the development and approval of a Terms of Reference (ToR). The ToR lays out a clear assessment process and work plan for the EA of the Project. The ToR for the Eagle's Nest Project was approved by the MOE on (***DATE***). The ToR requires that the EA include the:

- Identification of the purpose of the study or undertaking
- Description and rationale for the undertaking
- Description and rationale for a range of alternatives to be assessed
- Description of the environment and potential effects
- Assessment and evaluation of the alternatives, including identification of criteria, indicators and an evaluation method
- Plan for consultation with potentially affected communities, governments and the public during the preparation of the EA
- Selection of a preferred alternative to the undertaking and alternative methods



NOTES:

1. SOURCE: ONTARIO MINISTRY OF THE ENVIRONMENT (2009).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

PROVINCIAL INDIVIDUAL EA PROCESS

Knight Piésold CONSULTING

P/A NO.	REF. NO.
NB102-390/1	34

FIGURE 1.6-1 REV A

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	JSP	ALR	RAM

The ToR approved by the MOE and a table of concordance of the EIS/EA Report to the ToR are provided in Appendices A-1 and A-2, respectively.

1.6.2 Federal Environmental Assessment Process

The Project is also subject to a Comprehensive Study Environmental Assessment (CSEA) pursuant to the *Canadian Environmental Assessment Act* (*CEAA*). The *CEAA* and the associated federal environmental assessment process are administered by the Canadian Environmental Assessment Agency (CEA Agency). The Act applies to the Project because specific federal decisions and approvals are required to permit the project to move forward. While CEAA was substantially revised in 2012, this environmental assessment is being assessed under the terms and requirements of the former *CEAA* (1992) including its 2010 amendments (*CEAA 1992; amended in 2010)*.

Under Section 5 of the *CEAA 1992; amended in 2010*, an environmental assessment is required because:

- Natural Resources Canada may take action in relation to Paragraph 7(1)(a) of the *Explosives Act* for a proposed explosives manufacture facility at the mine site
- Fisheries and Oceans Canada may take action in relation to Subsection 35(2) of the Fisheries Act in relation to the potential requirement for an authorization for the harmful alteration, disruption or destruction of fish habitat (HADD) associated with road construction
- Transport Canada may take action in relation to Section 5 of the Navigable Waters Protection Act for in-water structures that may potentially affect navigation

Health Canada, Environment Canada, and Aboriginal Affairs, and Northern Development Canada have indicated that they possess expert information that could be useful to the EA. The Major Projects Management Office is also engaged in this Project as it is considered a Major Resource Project under the Major Resource Project Regulatory Improvement Initiative.

During the scoping phase of the assessment, the CEA Agency determined that the Project is described by the following sections of the Comprehensive Study List Regulations under the Act:

- 10. The proposed construction, decommissioning or abandonment of a facility for the extraction of 200,000 m^3/a or more of ground water or an expansion of such a facility that would result in an increase in production capacity of more than 35 percent
- 30(c). The proposed construction or decommissioning of an all-season runway with a length of 1,500 m or more

The airstrip trigger under the Comprehensive Study List Regulations no longer forms part of the Project, since a permitted airstrip near the mine is being proposed by others. There are no other triggers for the Project since the Project is not located on federal lands, including First Nation Reserve lands, and no federal agency or authority is the proponent or is providing funding for the Project.

The principal steps in the *CEAA* process typically include:

1. Preparation of a Project Description for review by potentially involved federal authorities.
2. Pre-consultation with federal and provincial authorities, and also with members of the general public and First Nations that could potentially be affected by the Project.
3. Determination of the level of review by CEA Agency, whether Screening, Comprehensive Study Report, Mediation or Panel.
4. Development of the Environmental Impact Statement (EIS) Guidelines by the CEA Agency to define those aspects of the Project that should be included in the EA, the focus and boundaries of the EA, stakeholders in the *CEAA* process (affected and interested parties, including government agencies, First Nations, and members of the general public, possibly including non-governmental organizations - NGOs), consultation needs, and the extent of coordination with provincial regulatory requirements.
5. Consultation by Noront with provincial government agencies, affected First Nations, and potentially members of the general public and interest groups on the scope of the EA.
6. Preparation of a Comprehensive Study EA (CSEA), if this is the level of review determined by CEA Agency.
7. Review of the CSEA and related materials by federal and provincial regulators, local First Nations, and interested stakeholders.
8. Response by Noront to comments received from government agencies, First Nations and other stakeholders.
9. Preparation of a draft Comprehensive Study Report (CSR) taking into consideration comments on the CSEA from First Nations and other stakeholders.
10. Preparation of a final CSR.
11. Publication of the final CSR for the mandatory public review period.
12. Ministerial decision on the CSR and the adequacy of the proponent's obligations under the *CEAA* process.

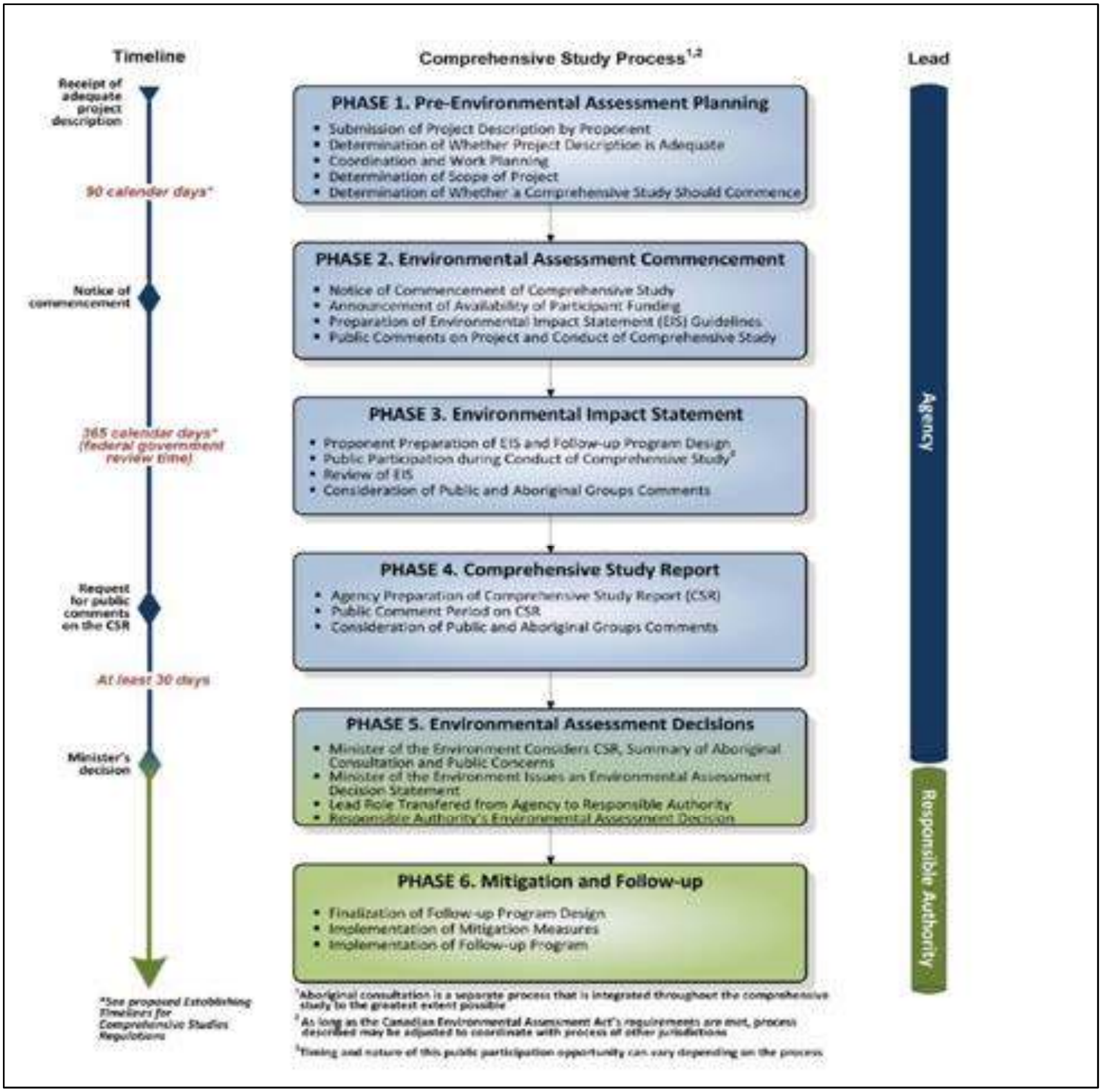
Figure 1.6-2 outlines the steps and timelines in the federal comprehensive study environmental assessment process.

The EIS Guidelines specify the nature, scope and extent of the information required to support the comprehensive study. The comprehensive study will include:

- A full and complete assessment of the potential environmental effects associated with all components of the Project at all phases
- Meaningful public participation
- Integration of Aboriginal concerns into the EA process
- Consideration of the physical and biological environment

The EIS Guidelines (Step 4 above) outline the minimum federal information requirements while providing Noront with flexibility in selecting methods to compile data for the EIS.

The CEA Agency issued final EIS Guidelines to Noront in January 2012 (CEA Agency, 2012). The EIS Guidelines have been reviewed by the public and are posted on the CEA Agency`s Canadian Environmental Assessment Registry (CEAR) website. The EIS Guidelines and a table of concordance of this EA/EIS Report to the EIS Guidelines are provided in Appendices B-1 and B-2.



NOTES:

1. SOURCE: CANADIAN ENVIRONMENTAL ASSESSMENT AGENCY (2012).

A	20DEC'13	ISSUED WITH REPORT	JSP	ALR	RAM
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

FEDERAL COMPREHENSIVE STUDY EA PROCESS

Knight Piésold CONSULTING

P/A NO.	REF. NO.	
NB102-390/1	34	
FIGURE 1.6-2		REV A

While the *CEAA* process is underway, Noront may make submissions to the federal government on required federal authorizations, approvals and licenses for the Project. This will be done with the understanding that any such authorizations, approvals and licenses would not be fully reviewed or granted until after the *CEAA* process has been completed.

1.6.3 Coordinated Environmental Assessment Process

The steps in an EA required by the MOE and by the CEA Agency are somewhat different. This requires a coordinated approach to meet the requirements of both federal and provincial legislation. Canada and Ontario entered into an agreement in 2004 (*Canada-Ontario Agreement on Environmental Assessment Cooperation* (2004)). For this Project, the two levels of government have indicated a willingness to follow the coordinated EA process and produce one body of documentation. The single EIS/EA Report will address the requirements of both the provincial ToR and the federal EIS Guidelines.

The coordinated EA process is summarized in the following five steps, and is illustrated on Figure 1.6-3:

1. Pre-EA planning, including signing of the voluntary agreement, development of the ToR and the EIS Guidelines
2. EA commencement
3. Environmental baseline studies and preparation of the EIS/EA Report
4. EA decision
5. Monitoring and follow-up

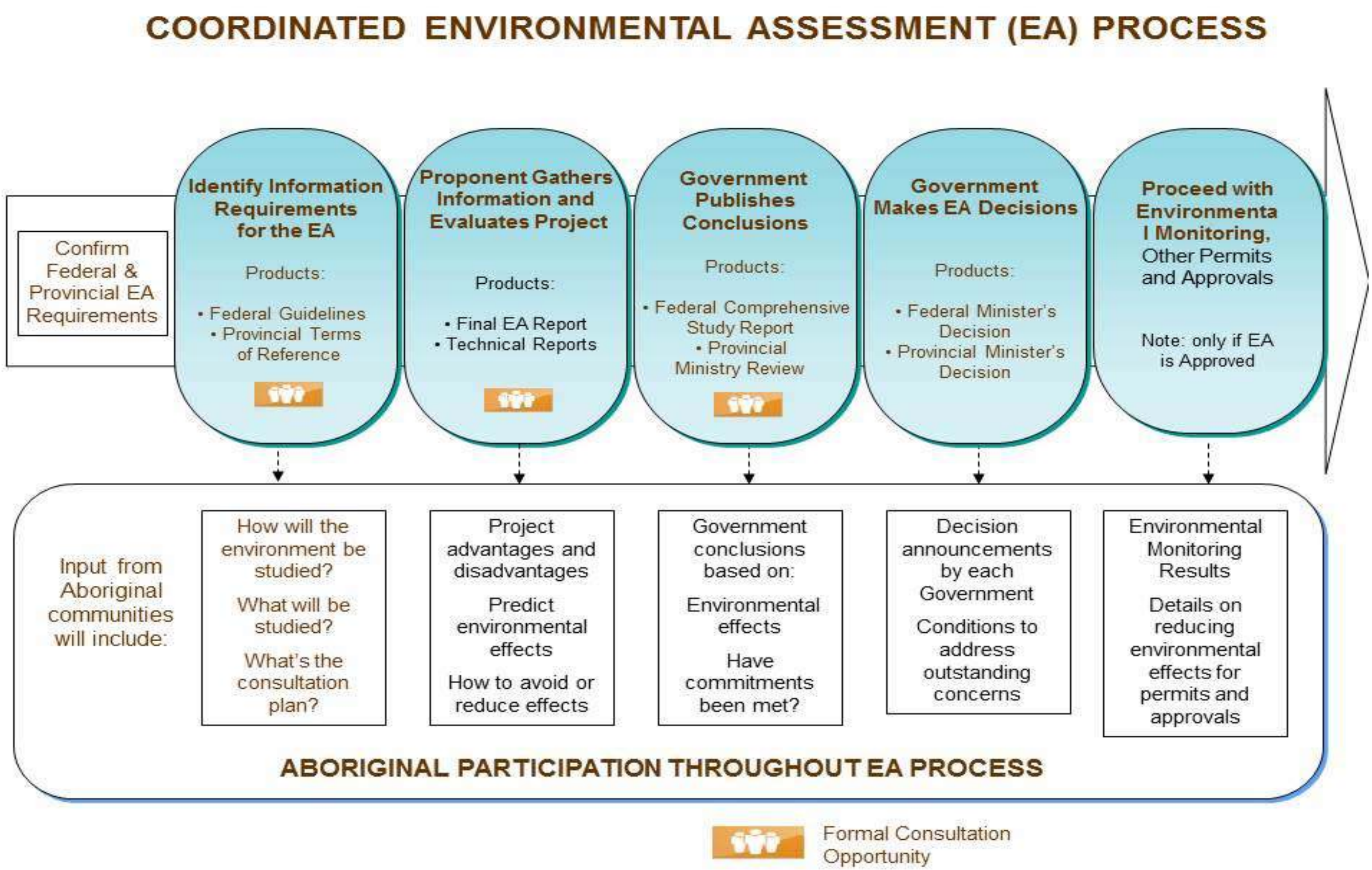
On August 3, 2011, the CEA Agency accepted the Project Description and initiated the 90-day pre-environmental planning period. Noront entered into a written agreement with the Ministry of the Environment under Section 3.0.1 of the *Ontario Environmental Assessment Act* (*OEAA*) on September 9, 2011 to make the Project subject to the requirements of the *OEAA*. Pre-EA activities have been discussed in multiple meetings with federal and provincial agencies and Noront. Final EIS Guidelines were issued by the CEA Agency to Noront in January 2012, and the EA commenced with the approval of the ToR on (***DATE***).

Baseline environmental studies were completed and Noront prepared the EA report for federal, provincial and public review. Following the review period, the federal and provincial Ministers will provide a decision on the EA. Follow-up will confirm that significant adverse effects will not occur, or will be mitigated, and any potential effects are as predicted. Following the approval of the EA, the follow-up and monitoring programs will be finalized.

1.6.4 Aboriginal Treaties, Policies and Guidelines

The Project is located within the James Bay Treaty, commonly referred to as Treaty 9, in a region that has overlapping traditional lands. Marten Falls, Webequie and Neskantaga First Nations all state that they have used the area from time immemorial. Other communities also indicate that their traditional lands will be impacted to some degree by the Project.

The Ojibway Nation of Saugeen First Nation, located near to the trans-load facility, has identified itself as a politically independent First Nation since 1995. Though a signatory to Treaty 3, Saugeen is not a member of the Grand Council of Treaty 3.



NOTES:

1. SOURCE: CANADIAN ENVIRONMENTAL ASSESSMENT AGENCY (2011).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

COORDINATED EA PROCESS

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF. NO. 34

FIGURE 1.6-3

REV A

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	JSP	ALR	RAM

To Noront's knowledge, none of the First Nations in the vicinity of the Project have specific written policies or guidelines around development. However, Noront has been active in negotiating Memorandums of Understanding with the First Nations most likely to be affected by the Project.

It is Noront's policy to respect Aboriginal culture, lands and traditions and will continue to improve its understanding of the goals and aspirations of these communities. Noront's vision is to be industry leaders in developing mutually beneficial relationships with Aboriginal communities and their members. Their vision is to engage in sincere and forthright consultation about its projects and operations including opportunities in training and education, employment, procurement, business development, and community investment. The principles of Noront's aboriginal policy are as follows:

- Establish community engagement processes and monitor their effectiveness
- Support community based initiatives that enhance and maintain wellness and culture
- In accordance with Noront's environmental policy, protect the integrity of the environment over the long term
- Foster sustainable economic development and business opportunities as a result of Noront's activities
- Respect traditional land use practices and provide regular cross-cultural awareness sessions for company employees and directors
- Create opportunities for employment and further skill development through mentoring, on the job training, and apprenticeships

1.6.5 The *Far North Act* and Community-Based Land Use Planning

Development in the Far North, including the Eagle's Nest Project, is governed by the *Far North Act*, 2010. The *Far North Act* sets out a process for community-based land use planning in the Far North that:

- Sets out a joint planning process between the First Nations and Ontario
- Supports the environmental, social, and economic objectives for land use planning for the peoples of Ontario
- Is completed in a manner that is consistent with the recognition and affirmation of existing Aboriginal and treaty rights in Section 35 of the Constitution Act, 1982, including the duty to consult

Community-based land use plans will establish land use designations and permitted uses for planning areas identified by the First Nations. Land use plans will require joint approval by First Nations and the Ontario Ministry of Natural Resources.

The Objectives of the *Far North Act* include:

- Ensuring a significant role for First Nations in planning
- The protection of areas of cultural value, and the protection of ecological systems by including at least 225,000 km^2 of the Far North in an interconnected network of protected areas designated in community based land use plans
- The maintenance of biological diversity, ecological processes and ecological functions, including the storage and sequestration of carbon in the Far North
- Enabling sustainable economic development that benefits the First Nations

Under Section 12 of the *Far North Act,* the following activities are prohibited where community-based land use plans do not exist:

- Opening a mine in the prescribed circumstances
- Commercial timber harvest
- Oil and gas exploration and production
- Constructing or expanding an electrical generation facility that uses wind or water as a source and any other infrastructure that is associated with it
- Constructing or expanding electrical transmission and distribution systems and electrical transmission and distribution lines in accordance with the definitions of “transmission system”, “transmit” and “distribute” in the Electricity Act, 1998, and any other infrastructure that is associated with them, including all weather transportation infrastructure
- Construction or expanding any infrastructure that is prescribed
- Any other land use or activity that is prescribed

Currently, there are no approved community-based land use plans established within the area of proposed Project development, though work has begun. The MNR is supporting First Nations community-based land use planning in the Ring of Fire. This includes providing support for background information collection, documenting traditional knowledge, and building capacity in the community to prepare the land use plans. Several communities will be issuing their terms of reference for the land use plans in the summer and early fall of 2013.

1.6.6 Permits, Licences and Approvals

In addition to the environmental assessment requirements under the *OEAA* and the *CEAA,* as well as the *Far North Act,* the development of the Project will also require a variety of additional federal, provincial and municipal permits and approvals. A preliminary list of the anticipated licences, permits and approvals that may be required prior to mineral development and/or construction activities is provided in Table 1.6-1 and Table 1.6-2.

Table 1.6—1 Key Federal Permits

Federal Approval, Permit and/or Authorization	Rationale
Environmental Assessment Approval	An environmental assessment approval is required from CEA Agency in order for the Project to proceed to construction and development.
Explosives Permit	Use of explosives will be required during construction and mine operation therefore it is necessary to obtain an explosives permit.
Licence for Explosives Magazine	On site storage of explosives will be required on site to ensure a sufficient supply of explosive materials is available for Project activities.
Fish Habitat Authorization	Authorization under the *Fisheries Act* will be required for construction of the transportation corridor.
Navigable Waters Approval	Navigable Waters Approval will be required for construction of the transportation corridor.

Table 1.6—2 Key Provincial Permits

Provincial Approval, Permit and/or Authorization	Rationale
Individual EA Approval (Ontario Ministry of the Environment)	An environmental assessment approval is required from the MOE in order for the Project to proceed to construction and development.
Environmental Compliance Approval for all site related emission, discharges, and wastes under the *Environmental Protection Act* (Ontario Ministry of the Environment)	An ECA is required for stationary source emissions, discharges and waste related to the Project, including air emissions, noise emissions, effluent discharges to water, stormwater management.
Permit to Take Water under the *Ontario Water Resources Act* (Ontario Ministry of the Environment)	A permit to take water is required for instances where groundwater or surface water is taken at a rate of 50,000 L/d, or more. As it pertains to the proposed development a permit to take water may be needed for dewatering of the underground mine and for the development of groundwater well(s) for the supply of potable water.
Work Permit under the *Public Lands Act* (Ontario Ministry of Natural Resources)	A work permit is required for construction on Crown Land, including buildings, dams, drainage channels, roads, culverts and bridges, and for dredging and filling of wetlands.
Land use permit under the *Public Lands Act* (Ontario Ministry of Natural Resources)	A land use permit is required to construct buildings on Crown Land.
Timber Cutting Licence (Ontario Ministry of Natural Resources)	A timber cutting licence is required to remove trees on Crown Land.
Lakes and Rivers Improvement Act Approval (Ontario Ministry of Natural Resources)	A permit is required to construct water retaining structures.
Burning Permit (Ontario Ministry of Natural Resources)	A burning permit will be required to burn any removed vegetation.
Aggregate Permit/Licence under the *Aggregate Resources Act* (Ontario Ministry of Natural Resources)	An aggregate permit/licence will be required for the removal of aggregate from the mine (and any potential quarry locations along the transportation corridor) for construction.
Generator Registration Report (Ontario Ministry of the Environment)	Project activities will involve the transportation and storage of hazardous waste, therefore requiring a generator registration report.
Waste Audit and Reduction Plan (Ontario Ministry of the Environment)	Construction projects require a waste audit and reduction plan, therefore Noront will be required to develop a waste audit and reduction plan.
Water Well Installation (Ontario Ministry of the Environment)	Wells will be drilled at the mine site for water supply and ground water monitoring and will require water well installation approval.

Provincial Approval, Permit and/or Authorization	Rationale
Building/Land Use Permit (Ontario Ministry of Transportation)	Required for building near highways.
Entrance Permit (Ontario Ministry of Transportation)	Requirement for a new or upgraded road entrance onto a provincial highway.
Encroachment Permit (Ontario Ministry of Transportation)	Activities within 45 m of the highway may be controlled for safety considerations.
Acceptation of Closure Plan Completion (Ontario Ministry of Northern Development, Mines and Forestry)	Noront will be required to complete a Closure Plan for the Eagle's Nest Mine.
Notice of Project Status (Ontario Ministry of Northern Development and Mines)	Public notification of the status of the Project.
Pre-development Review Process (Ontario Ministry of Labour)	Require safety and procedures review of the Project prior to development.

1.7 PARTICIPANTS IN THE ENVIRONMENTAL ASSESSMENT

In addition to Noront, participants in the environmental assessment process are Aboriginal Communities, federal, provincial and municipal governments, interested members of the public and non-governmental organizations. A summary description of each group of participants is provided below.

1.7.1 Aboriginal Communities

During the scoping phase of the assessment (i.e., during development of the federal EIS Guidelines and the provincial ToR), Noront together with the federal and provincial agencies identified nine First Nation communities that may potentially be directly affected by the development of the Eagle's Nest Project. The nine communities are:

- Aroland First Nation
- Attawapiskat First Nation
- Eabametoong First Nation
- Marten Falls First Nation
- Mishkeegogamang First Nation
- Neskantaga First Nation
- Nibinamik First Nation
- Ojibway Nation of Saugeen
- Webequie First Nation

The initial scoping considered two potential transportation corridors to access the mine site: Noront`s proposed east-west transportation corridor which would intersect and follow the existing winter road and connect to the all-season Northern Ontario Resource Trail (formerly Highway 808); and a north-south transportation corridor proposed by Cliffs Natural Resources Inc. to service its proposed Cliffs Chromite Project. Aroland First Nation is a key stakeholder for a north-south route because rail loading facilities (for both the Eagle`s Nest Project and Cliffs Chromite Project) would be located in close proximity to the First Nation. Though Noront's proposed project does not include the use of a north-south transportation corridor and associated trans-load facility, the Company understands that Aroland First Nation maintains a strong interest in the Project. On this basis, the Company continues to consult with the Aroland First Nation and include the community in the list of potentially affected communities.

Other First Nation communities in the region that may be potentially indirectly affected by the development of the Project are also considered participants in the environmental assessment process. The communities include:

- Bearskin Lake First Nation
- Constance Lake First Nation
- Fort Albany First Nation
- Ginoogaming First Nation
- Kasabonika Lake First Nation
- Kashechewan First Nation
- Kingfisher Lake First Nation
- Kitchenuhmaykoosib Inninuwug
- Long Lake #58 First Nation
- Muskrat Dam First Nation
- North Caribou Lake First Nation
- Peawanuck First Nation
- Sachigo Lake First Nation
- Wapekeka First Nation
- Wawakapewin First Nation
- Wunnumin Lake First Nation

The identified communities are encouraged to comment on the EA/EIS report prepared for the Eagle's Nest Project.

1.7.2 Federal Government

The Canadian Environmental Assessment Agency (CEA Agency) is the lead federal authority involved for the environmental assessment process for the Eagle's Nest Project. CEA Agency coordinates the review of the EA/EIS report with other federal departments that may have an interest in the Project, including:

- Aboriginal Affairs and Northern Development Canada
- Department of Fisheries and Oceans
- Environment Canada
- Health Canada
- Natural Resources Canada
- Transport Canada

1.7.3 Provincial Government

The Ministry of Northern Development and Mines (MNDM), through the Ring of Fire Secretariat, has the overall lead for proposed developments in the Ring of Fire and plays a coordinating role with respect to environmental assessments and Aboriginal engagement. Due to the provincial Individual and Class Environmental Assessments applicable to the Project, the Ministries of Environment and Natural Resources each have a mandate to review the EA/EIS Report and provide a recommendation to Ontario's Minister of the Environment as to whether to approve the Project.

1.7.4 Municipal Government

The Project will not require the approval of municipal governments, being solely situated on Crown Land. Nonetheless, the following municipalities have been identified by Noront as key stakeholders likely to participate in the environmental assessment process:

- City of Thunder Bay
- Township of Pickle Lake
- Municipality of Greenstone

1.7.5 Public and Non-governmental Organizations

The general public, as well as non-governmental organizations (NGOs), have the opportunity to participate in the environmental assessment process. Participation can take place at public meetings, through the online environmental registry (during the comment period), and through direct contact with Noront. NGOs that have been identified as participants include:

- Wildlands League (a chapter of the Canadian Parks and Wilderness Society - CPAWS)
- Mining Watch
- Ecojustice
- Wildlife Conservation Society Canada

1.8 GOVERNMENT POLICIES, RESOURCE MANAGEMENT, PLANNING OR STUDY INITIATIVES

A number of federal and provincial agreements, policies, guidelines and study initiatives are potentially relevant to the undertaking. For example, the MOE has many guidelines and policies that are too numerous to summarize. Noront has identified the key ones that are expected to directly affect the Project.

1.8.1 Ring of Fire Secretariat

The Ring of Fire Secretariat works and consults with Aboriginal peoples, northern Ontarians and the mining industry to encourage responsible and sustainable economic development in the region.

The MNDM, through the Ring of Fire Secretariat, works with all levels of government, industry and Aboriginal peoples to encourage responsible and sustainable economic development in the region.

Staff headquartered at the Ring of Fire Secretariat's Thunder Bay, Sudbury and Toronto offices are responsible for:

- Helping to develop the strategic vision and framework to facilitate successful development of the Ring of Fire initiative
- Promoting economic opportunities for Northern Ontario and Aboriginal communities
- Partnering with other ministries to develop creative solutions that meet the interests of Northern Ontarians, Aboriginal communities and the mining industry, while achieving government business objectives

1.8.2 Other Government Policies, Resource Management, Planning or Study Initiatives

A number of government policies will impact the Project. In addition, the province has developed a number of wildlife strategies, and study initiatives on a number of species in the Far North are ongoing. Table 1.8-1 summarizes the additional policies, resource management, planning and study initiatives identified, and their implications to the Project.

Table 1.8—1 Policies, Resource Management, Planning or Study Initiatives and their Implications to the Project

Policies/Planning or Study Initiatives	Description	Implications to the Project
Canada-Ontario Agreement on Environmental Cooperation	Provides an administrative framework in which the federal and provincial governments can cooperatively exercise their respective powers and duties established by the *CEAA* and *OEAA*.	Basis for coordinated EA process.
Federal Policy for the Management of Fish Habitat (1986)	Outlines the policy, goals and strategies for the management of fish habitat supporting Canada's marine and freshwater fisheries.	Applicable to Project interactions with fish and fish habitat; will define the basis of an authorization under the *Fisheries Act*, if required.
Growth Plan for Northern Ontario (2011)	Guides provincial decision-making and investment now and in the future to strengthen the northern Ontario economy. Identifies mining and associated supply and services as a priority economic sector.	The Project is consistent with this economic plan.
Ontario Biodiversity Strategy (2011)	Aims to protect genetic, species and ecosystem diversity in Ontario.	The Project needs to be consistent with the strategy.
Endangered Species Act – administrative changes effective July 1, 2013	Building on the act, standardized rules are being implemented.	The new rules will affect how the Act applies to the Project, mostly administratively. Additional species are included.
Ontario Moose Management Policy (2009)	Sustainable management of moose populations.	The Project needs to be consistent with the policy.
Ontario Woodland Caribou Conservation Plan (2009)	Aims to maintain self-sustaining, genetically-connected local populations of Woodland Caribou where they currently exist, improve security and connections among isolated mainland local populations, and facilitate the return of caribou to strategic areas near their current extent of occurrence.	The Project must be consistent with the conservation plan.

Policies/Planning or Study Initiatives	Description	Implications to the Project
Peregrine Falcon Habitat Management Guidelines (1987)	Generally apply to existing nest sites.	Applicable if Peregrine Falcon nests are encountered in close vicinity to the Project.
Water Management, Policies, Guidelines: Provincial Water Quality Objectives of the Ministry of the Environment (1994; reprinted 1999)	Outlines surface water quality objectives in Ontario, and guidance on dealing with water quality that is better or worse than the objectives.	Provides key guidance on water management as well as thresholds for water quality.
MNR Environmental Guidelines for Access Roads and Water Crossings (1988)	Establishes guidelines for the construction, maintenance and abandonment of access roads including water crossings.	Provides best practices guidance on the construction and operation of roads for the Project.
Various Wildlife Study Initiatives by the MNR	Including: • All Species Biodiversity Study - intensive species inventory of large area plots focussing on numerous taxonomic groups. • Caribou Distribution and Habitat Studies - identifying the number of caribou range boundaries; continuing with habitat ecology studies. • Caribou, Wolves, moose - species interactions and habitat ecology in the Pickle Lake area. • Wolverine - Distribution and conservation status. • Birds - Spatial Forest Ecology and Songbirds Monitoring Project. • Moose Ecology Project. • Vegetation - Evaluating Far North Landcover Mapping with Field Data.	Relevant source of baseline data to support the terrestrial effects assessment.

1.9 THRESHOLDS AND COMPLIANCE TARGETS

Table 1.9-1 presents the guidelines and standards have been adopted in the establishment of thresholds in the assessment, and/or as recognized compliance targets during the life of the Project.

Table 1.9—1 Selected Thresholds and Compliance Targets

Environmental Component	Guideline/Standard
Air quality	O.Reg. 419/05, Air Pollution - Local Air Quality. Ontario Ambient Air Quality Criteria (MOE, 2012b)
Noise	Publication NPC-232 - Sound Level Limits for Stationary Sources in Class 3 Areas (Rural) (MOE, 1995)
Surface/groundwater quality	Provincial Water Quality Objectives (PWQOs; MOE 1999)
Drinking water	*Safe Water Drinking Act*, O. Reg. 169/01 (2002) - Ontario Drinking Water Quality Standards
Mine Contact Water Discharges	Metal Mining Effluent Regulations, *Fisheries Act*
Sewage effluent discharges	*Ontario Water Resources Act* (S53) Design Guidelines for Sewage Treatment Works, Ministry of the Environment (MOE, 2008) Procedure F-5-1, Determination of Treatment Requirements for Municipal and Private Sewage Treatment Works Discharging to Surface Waters (MOE, 1994)

1.10 KEY CONTRIBUTORS TO THE EIS/EA REPORT

The key personnel engaged in developing the EIS/EA report included staff from Noront, as well as its supporting team of consultants, engineers, and scientists. The names and roles of key individuals involved in the preparation of the EA/EIS report and their professional affiliations are provided in Table 1.10-1.

Table 1.10—1 Key Contributors to the EIS/EA Report

Name	Affiliation	Role
Noront Resources Ltd.		
Paul Semple, P.Eng.	Chief Operating Officer	Overall day-to-day responsibility for the Eagle's Nest Project
Mark Baker, P.Eng.	Vice President, Projects	Project manager of EIS/EA and engineering/technical studies
Glenn Nolan	Vice President, Aboriginal Affairs	Aboriginal consultation and engagement
Leanne Hall	Vice President, Human Resources	Training partnerships and the Human Resources Management Plan
Scott Jacob	Manager, Community Relations	Aboriginal consultation and community engagement
Kaitlyn Ferris	Manager, Corporate Responsibility	Corporate responsibility practices including community outreach
Neil Westoll, Ph.D.	Environmental Advisor	Advisor to Noront on the development of the EA/EIS; liaison with government regulators
Pauline Cornell		Consultation records database

Name	Affiliation	Role
Consultant Team		
Steve Aiken, P.Eng.	Knight Piésold Ltd.	EIS/EA manager, geochemistry lead
Andrew Rees, Ph.D.		EIS/EA primary author, climate and hydrology lead
Anna Hutchison, MES		EIS/EA co-author, socio-economics
Jason Plamondon, B.Sc.		EIS/EA co-author, socio-economics, water quality
Peter Quinby, Ph.D.		Terrestrial environment lead
Dale Klodnicki, CET		Aquatic environment lead, water quality
Cathy Safadi, M.A.Sc., P.Eng.		Hydrogeology lead
Tolga Olcay, P.Eng.		Air quality and acoustics lead
Richard Cook, B.Sc.		EIS/EA technical oversight, review
Rob Mercer, Ph.D.		EIS/EA senior review
Elliot Segal	Intrinsik Inc.	Human health risk assessment
Doug Brubacher	Brubacher Development Strategies Inc.	Socio-economics technical oversight
John Pollock , Ph.D.	Woodland Heritage Services	Archaeology

Section 2

Environmental Assessment Methodology

TABLE OF CONTENTS

TABLES

FIGURES

2 – ENVIRONMENTAL ASSESSMENT METHODOLOGY

2.1 SCOPE OF THE PROJECT

The scope of the Project has been described in both a provincial Terms of Reference ("ToR"; KP, 2012), and federal Guidelines for the Preparation of an Environmental Impact Statement for the Eagle's Nest Project ("EIS Guidelines"; CEA Agency, 2012).

The ToR was prepared by Noront and approved by the Ontario Ministry of the Environment (MOE). The EIS Guidelines were prepared by the CEA Agency pursuant to the *Canadian Environmental Assessment Act* (*CEAA;* Canada, 1992; amended in 2010). Both the ToR and the EIS Guidelines were prepared based on an approved Project Description Report developed by Noront (KP, 2011).

The scope of the Project is the construction, operation, closure and post-closure monitoring of an underground multi-metal mine expected to operate for 11 years at a production rate of 2,960 tonnes per day. The Project involves the following physical works and activities:

- An underground mine with surface portal, and aggregate, topsoil, and peat stockpiling
- An underground ore processing facility
- Support facilities and infrastructure at the mine site, including water supply and treatment, waste management, and laydown storage facilities
- Ancillary facilities and buildings, such as administrative offices, service buildings, fuel storage
- Explosives manufacture and storage
- Diesel power supply and local distribution lines
- An all-season access road to permit concentrate to be shipped from the mine and supplies to be brought to the mine
- A concentrate load out facility at the southern end of the access road on a rail line to enable concentrate to be loaded onto railcars for transportation to a smelter

The scope of the Project includes all phases of the components and activities described above, including construction, operation, decommissioning/closure, and post-closure monitoring. The above scope has changed from that described in the Project Description Report, ToR and EIS Guidelines as follows:

- A concentrate pipeline and winter road between the mine site and Webequie Junction is no longer proposed, in favour of an all-season road to the mine site
- An all-season airstrip is no longer part of the scope of the Project. A First Nation company has successfully permitted an airstrip nearby and has expressed intent to construct and operate the airstrip to support the Eagle`s Nest and other mining and exploration activities in the region.
- A transmission line supplying power to the mine from Webequie Junction is no longer proposed by Noront, in favour of on-site diesel power generation

The supporting rationale for the above changes to the Project scope is outlined in the alternatives analysis (Section 4).

2.1.1 Factors to be Considered

The Eagle's Nest Project is subject to the provisions of the *CEAA* (Canada, 1992; amended in 2010). In assessing the environmental effects of the Project, the EIS Guidelines direct Noront to apply the following definitions of environment and environmental effect according to the *CEAA (1992)*:

"*Environment*" means the components of the Earth, and includes:

a) Land, water and air, including all layers of the atmosphere,
b) All organic and inorganic matter and living organisms, and
c) The interacting natural systems that include components referred to in paragraphs (a) and (b).

"*Environment*" in the context of the Ontario Environmental Assessment Act (OEAA) similarly encompasses:

a) Air, land or water
b) Plant and animal life, including human life, the social, economic and cultural conditions that influence the life of humans or a community
c) Any building, structure, machine or other device or thing made by humans
d) Any solid, liquid, gas, odour, heat, sound, vibration, or radiation resulting directly or indirectly from human activities
e) Any part or combination of the foregoing and the interrelationships between any two or more of them

"*Environmental effect*" means, in respect of a project:

a) any change that the Project may cause in the environment, including any change it may cause to a listed wildlife species, its critical habitat or the residences of individuals of that species, as those terms are defined in subsection 2(1) of the Species at Risk Act;

b) any effect of any change referred to in paragraph (a) on:
   (i) health and socio-economic conditions,
   (ii) physical and cultural heritage,
   (iii) the current use of lands and resources for traditional purposes by aboriginal persons, or
   (iv) any structure, site or thing that is of historical, archaeological, paleontological or architectural significance, or

c) any change to the Project that may be caused by the environment

whether any such change or effect occurs within or outside Canada.

Each of the provincial and federal environmental assessment acts provide direction to Noront regarding the factors to be considered in the assessment. Paragraphs 16(1)(a) to (d) and subsection 16(2) of the *CEAA* (1992; amended in 2010) require that the environmental assessment includes a consideration of the following factors:

a) The environmental effects of the Project, including the environmental effects of malfunctions or accidents that may occur in connection with the Project and any cumulative environmental effects that are likely to result from the Project in combination with other projects or activities that have been or will be carried out;

b) The significance of the effects referred to in paragraph (a);

c) Comments from the public that are received in accordance with this Act and the regulations;

d) Measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the Project, and

e) any other matter relevant to the screening, comprehensive study, mediation or assessment by a review panel, such as the need for the project and alternatives to the project, that the responsible authority or, except in the case of a screening, the Minister after consulting with the responsible authority, may require to be considered.

Four additional factors are required pursuant to paragraph 16(2) of the *CEAA* (1992; amended in 2010):

a) The purpose of the Project;
b) Alternative means of carrying out the Project that are technically and economically feasible and the environmental effects of any such alternative means;
c) The need for, and the requirements of, any follow-up program in respect of the Project; and
d) The capacity of renewable resources that are likely to be significantly affected by the Project to meet the needs of the present and those of the future.

The EIS Guidelines provide further information on each of these requirements.

Similarly, the *OEAA* Sections 6(2)(a) and 6.1(2) outline the provincial requirements for the EIS/EA Report:

a) A description of the purpose of the undertaking;
b) A description of and a statement of the rationale for,
   i. The undertaking,
   ii. The alternative methods of carrying out the undertaking, and
   iii. The alternatives to the undertaking;
c) A description of:
   i. The environment that will be affected or that might reasonably be expected to be affected, directly or indirectly,
   ii. The effects that will be caused or that might reasonably be expected to be caused to the environment, and
   The actions necessary or that may reasonably be expected to be necessary to prevent, change, mitigate or remedy the effects upon or the effects that might reasonably be expected upon the environment by the undertaking, the alternative methods of carrying out the undertaking and the alternatives to the undertaking;
d) An evaluation of the advantages and disadvantages to the environment of the undertaking, the alternative methods of carrying out the undertaking and the alternatives to the undertaking; and
e) A description of any consultation about the undertaking by the proponent and the results of the consultation

The provincial ToR provides further information on the above requirements.

2.1.2 Incorporation of Aboriginal Perspectives and Traditional Knowledge

An important element of the environmental assessment has been and will continue to be a two-way flow of information between Noront and the First Nation communities potentially affected by the

Project. Noront's consultation efforts and a summary of key issues or concerns raised are described in Section 9.

Aboriginal traditional knowledge (ATK) makes an important contribution to an environmental assessment. ATK refers to the broad base of knowledge held by individuals and by communities that may be based on teachings, personal observation and experience, or passed on from one generation to another through oral and/or written traditions (CEA Agency, 2012). Recognizing that ATK is proprietary information that belongs to its holders, Noront endeavoured to carry out an ATK study specific to the Project in the following potentially affected First Nation communities:

- Webequie
- Aroland
- Attawapiskat
- Eabametoong First Nation
- Marten Falls First Nation
- Neskantaga First Nation
- Nibinamik First Nation
- Mishkeegogaming First Nation
- Ojibway Nation of Saugeen

Efforts are ongoing regarding the collection and incorporation of ATK from the above communities. To date, Noront has conducted ATK collection sessions in Webequie, though approval from the Webequie First Nation to use the information is forthcoming. Noront has sought to negotiate memorandums of understanding (MOUs) with the potentially affected communities regarding their participation in the Project, including the collection and use of ATK. Such a process can be lengthy and complex, affected by other pressing priorities of the communities. Within the ROF, potentially affected First Nations until recently have been dealing with multiple proponents in the region with varying project proposals, community land use planning, along with negotiations with the Government of Ontario.

As available, ATK was utilized in the environmental assessment in several ways:

- To understand current land and resource use for traditional purposes by Aboriginal persons, so that the effects of the Project on Aboriginal land and resource use could be predicted
- To assist in the selection of valued ecosystem components (VECs) on the basis of community importance, including traditional use plants and wildlife species of harvest importance through hunting or trapping
- To support the understanding of wildlife ecology including trends in abundance over time, distribution and key habitats for wildlife VECs
- To potentially identify any areas of cultural or spiritual importance in the vicinity of the Project
- To obtain Aboriginal perspectives on potential effects of the Project as well as mitigation strategies to avoid or reduce effects

Available ATK at this stage relies mainly on anecdotal information provided by First Nations employed by Noront to work at the site or on environmental baseline studies. To compensate for the lack of ATK to direct aspects of the environmental assessment, Noront has taken a conservative approach. For example, Noront has been more inclusive in its selection of VECs so as to not exclude traditional use plants or wildlife species that may be of particular importance to the communities.

Noront remains committed to the ongoing negotiations to achieve signed MOUs with the potentially affected First Nations regarding their participation in the Project, including ATK collection and use by the Project.

2.1.3 Sustainable Development and the Precautionary Approach

Sustainable Development is defined by the CEAA 1992; amended in 2010 as "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*". The EIS Guidelines (CEA Agency, 2012) directed Noront to include in the EIS/EA Report the extent to which the Project contributes to sustainable development by considering the following:

- The extent to which biological diversity may be enhanced or affected by the Project;
- The capacity of renewable resources that are likely to be affected by the Project to meet the needs of present and future generations; and
- The extent to which the Project will enhance the long-term environmental, social and economic viability of the community.

Effects on biological diversity and the capacity of renewable resources affected by the Project to meet future needs of present and future generations are discussed throughout Section 6. The Project's long-term enhancement of local communities is addressed in Section 7. The EIS/EA Report Summary (Section 14) provides a high-level assessment of the Project's sustainability against the above criteria.

The precautionary principle encourages government decision-makers to take a cautionary approach, or err on the side of caution, especially where there is a large degree of uncertainty or high risk. Noront considered the five general principles of application and the five principles for precautionary measures, as outlined by the Government of Canada (2003). Within this guidance document, the Government of Canada applies the "application of precaution", "the precautionary principle", and "the precautionary approach" interchangeably as "*recognizing that the absence of full scientific certainty shall not be used as a reason for postponing decisions where there is a risk of serious or irreversible harm*". Application of the principles allows for addressing risks associated with the lack of full scientific certainty so that governments may proceed in their decision-making mandates. The EIS Guidelines directed Noront to apply the precautionary approach as described by the Government of Canada (2003) through the application of the following, during the preparation of the EIS/EA Report and in execution of the Project:

- Demonstrate that all aspects of the Project have been examined and planned in a careful and precautionary manner in order to ensure that they would not cause serious or irreversible damage to the environment, especially with respect to environmental functions and integrity, considering system tolerance and resilience, and/or the human health of current or future generations
- Outline and justify the assumptions made about the effects of all aspects of the Project and the approaches to minimize these effects

- Ensure that alternative means of carrying out the Project are evaluated and compared in light of risk avoidance, adaptive management capacity and preparation for unexpected events
- Ensure that in designing and operating the Project, priority has been and would be given to strategies that avoid the creation of adverse effects
- Identify any proposed follow-up and monitoring activities, particularly in areas where scientific uncertainty exists in the prediction of effects
- Present public and Aboriginal views on the acceptability of all of the above

In practical terms, Noront has completed the following in its assessment to incorporate a precautionary approach:

- Where uncertainty exists in effects assessment predictions or in the expected effectiveness of identified mitigation measures, this has been identified
- Monitoring programs have been identified to follow-up on assessment predictions and identify the need for adaptive management
- Adaptive management measures have been identified and committed to, where appropriate adaptive management measures are available

Ongoing consultation prior to and following the submission of this draft EIS/EA Report will solicit feedback from the public and Aboriginal stakeholders to ensure that Noront follows the precautionary approach described above.

2.1.4 Application of an Ecological Risk Assessment Framework

A standard ecological risk assessment framework was applied to the ecological assessment that categorizes the levels of detail and quality of the data required for the assessment as follows:

- Tier 1: Qualitative - includes expert opinion, traditional and local knowledge, literature review, and existing site information.
- Tier 2: Semi-qualitative - measured site-specific data and existing site information.
- Tier 3: Quantitative - recent field surveys and detailed quantitative methods.

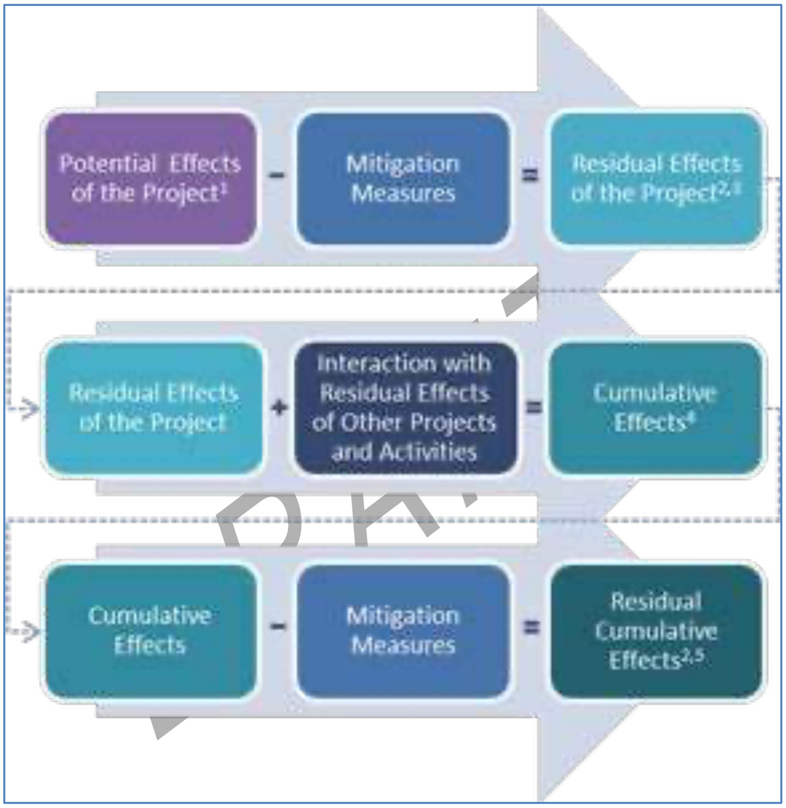
The assessment completed utilized the Tier 1 qualitative approach in establishing the degree of ecological risk of the Project.

2.2 EFFECTS ASSESSMENT METHODOLOGY

The assessment of the effects of Project components and activities on the environment is based on a comparison of the biophysical and socio-economic environments between the predicted future conditions with the Project and the predicted future conditions without the Project. Where public and Aboriginal perspectives on Project effects have been obtained, these perspectives have been noted and considered in the effects assessments.

The effects assessment identifies potential effects of the Project, proposes mitigation measures, assesses the significance of residual effects, and carries forward any predicted residual effects of the Project into a cumulative effects assessment. The Project effects assessment methodology is illustrated on Figure 2.2-1.

Figure 2.2—1 Project Effects Assessment Methodology



NOTES:

1. POTENTIAL EFFECTS OF THE PROJECT ARE POTENTIAL CHANGES TO THE EXISTING BASELINE CONDITIONS FOR EACH VEC RESULTING FROM THE EAGLE'S NEST PROJECT.
2. IF RESIDUAL EFFECTS ARE PREDICTED, THE SIGNIFICANCE OF THE PREDICTED EFFECT IS CHARACTERIZED.
3. IF THERE ARE NO RESIDUAL EFFECTS, NO FURTHER STEPS ARE REQUIRED.
4. IF THERE ARE NO CUMULATIVE EFFECTS, NO FURTHER STEPS ARE REQUIRED.
5. IF THERE ARE NO RESIDUAL CUMULATIVE EFFECTS, NO FURTHER STEPS ARE REQUIRED.

The framework considered in each discipline to complete the effects assessment for each VEC is as follows:

- Step 1: Select valued ecosystem components and provide rationale
- Step 2: Describe background conditions and setting
- Step 3: Define the spatial boundaries of the Project effects assessment
- Step 4: Define the temporal boundaries of the Project effects assessment
- Step 5: Identify any interaction(s) between a Project component or activity
- Step 6: Identify potential Project effects
- Step 7: Propose mitigation measures to reduce potential Project effects

If there is a residual effect:

- Step 8: Describe and assess significance of the residual effect
- Step 9: Describe and assess significance of cumulative effects

Steps 1 through 8 are described in detail in the following sections. The methodology applied in Step 9, the assessment of cumulative effects, is based on the CEA Agency (1999) methodology. The cumulative effects assessment (CEA) is presented as a standalone assessment in Volume 3, as required by the EIS Guidelines.

2.2.1 Selection of Valued Ecosystem Components

The federal environmental assessment process applies the concept of valued ecosystem components (VECs) to focus the effects assessment on key species or topics. VECs are aspects of the environmental, economic, social, heritage or health setting considered important by the Proponent, the public, Aboriginal groups, or government agencies involved in the EA process. Importance may be determined on the basis of Aboriginal interests, scientific concern, regulatory concern, biodiversity concern, or sensitivity to Project effects.

The EIS Guidelines direct Noront to select and substantiate its selection of VECs. The EIS Guidelines direct that VEC selection is to be guided by the identification of effects of the Project that are *measurable*. Noront interprets measurable to refer to effects that are discernible or non-negligible, as opposed to effects that cannot be quantified. The EIS Guidelines also acknowledge that the culture and way of life of the people using the area affected by the Project may themselves be VECs.

The provincial environmental assessment process, which does not rely on VECs specifically, generally follows the same approach of evaluating effects on environmental components where these effects are measurable and believed to be important to the province and its constituents.

Noront has given careful consideration to the selection of VECs for its assessment. The following scoping activities contributed to VEC selection:

- Discussions with First Nation communities, including available ATK
- Discussions with federal and provincial government agencies, including the development of the draft and final federal EIS Guidelines and the provincial ToR
- Completion of environmental and socio-economic baseline studies, which included literature reviews, discussions with government and non-governmental researchers, and project-specific data collection

The VECs selected by Noront and the rationale for the selections are summarized in Table 2.2-1. The key indicators that will be used to evaluate effects on the VECs are also provided. In some instances, the selected VECs are groups of species, or key indicator species that have been identified to focus the assessment.

Table 2.2—1 Valued Ecosystem Components, Key Indicators, and Rationale for Selection

Environmental Component	VEC	Rationale
Selected Valued Ecosystem Components		
Atmospheric Environment	• Air quality • Ambient light	The atmospheric environment was selected as a VEC because mining activities such as fuel consumption, vehicle movement, and material transfer generate air emissions that could cause deterioration of ambient air quality. Fugitive dust and particulate matter may affect receptors such as rare vegetation, wildlife, surface water quality, and soil. Light emissions may have an effect on wildlife.
Acoustic Environment	• Sound levels	Use of heavy equipment and machinery and increased human presence in the area will increase existing sound levels. Increased noise levels could affect wildlife.
Water Quality	• Surface water quality • Groundwater quality	Water quality forms one of the vital links between the abiotic and biotic aquatic systems and is the foundation to supporting and maintaining healthy ecological processes fish, wildlife, and humans.
Water Quantity	• Surface hydrology • Physical hydrogeology	The Project will interact with streams and wetlands along the transportation corridor and there is potential for effects to flows and water levels. There are potential effects to groundwater in the local project area due to water supply and dewatering of the underground workings.
Fish and Fish Habitat	• Fish habitat • Indicator species	The Proposal will assess the potential effects of the proposed Project on aquatic habitat loss and alteration, and lethal and sub-lethal effects on fish and other aquatic organisms. Fish have ecological, cultural, recreational and commercial value as they support various fisheries, and constitute a fundamental role in aquatic ecosystem functioning.

Environmental Component	VEC	Rationale
Vegetation	• Upland ecosystems • Wetland ecosystems • Rare plant species	Vegetation was selected as VEC due to the potential change in abundance because of direct loss within the Project footprint, and the effect on vegetation health from fugitive dust. Sensitive ecosystems such as wetlands and boreal forests, peat bogs, and fens, along with rare plants are considered an indicator of Project effects on vegetation.
Wildlife and Wildlife Habitat	• Birds • Mammals • Species listed under the *Species at Risk Act* • Provincially listed species under Ontario's *Endangered Species Act* • Species list by the Committee on the Status of Species at Risk in Ontario	The Project will interact with wildlife through potential effects to individuals and populations, and their habitats. Wildlife are important because of their value to local people who rely on wildlife as a subsistence and economic resource, and for their intrinsic value as a symbol wilderness and a healthy ecosystem. Potential effects of the proposed Project on wildlife are primarily loss of available habitat due to the Project footprint; sensory disturbance from mine related activities; and mortality due to increased hunter access, collisions with vehicles, and destroying animals as a result of human-wildlife conflict. The assessment of the proposed Project's potential effect is focussed on a number of key indicators, including woodland caribou, wolverine, moose, carnivores, harvested furbearers, bird species of conservation concern, and waterfowl.
Social Environment	• Community Dynamics	Community dynamics was selected as a VEC since the Project will interact with current community initiatives and plans. This VEC also includes a population demographics discussion as the construction, operation and closure of the Project may cause a change in community demographics.

Environmental Component	VEC	Rationale
	• Human Health and Well-being	New project-related income and work schedules could affect social and behavioural and therefore affect the well-being of individuals, families, and communities. The Project may cause changes to food availability and dietary decisions, as well as effect traditional food use potentially affecting human health.
Economic Environment	• Training, Employment and Income	Training, Employment and Income was selected as a VEC to discuss the potential effects of the Project on education levels and experience of study area residents and the employment and income opportunities of study area residents. Construction and operations of the proposed Project will create employment and income opportunities for residents, which will require various levels of education and training.
	• Local and Regional Economy	Construction, operations, and closure of the proposed Project would generate employment, income and business opportunities throughout the LSA and RSA. Local and Regional Economy was chosen as a VEC, since Project development would result in increased activity within the local and regional economies.

Environmental Component	VEC	Rationale
Built Environment	• Community Infrastructure and Public Services	Community Infrastructure and Public Services was selected as a VEC to capture concerns expressed by First Nations and communities in the study area. The potential effects of the proposed project on community's infrastructure and services in the study region will ultimately depend on the extent to which proposed Project activities and Project-related population growth will result in increased demands on infrastructure and services, and the ability of the local infrastructure to cope with increasing demands. This VEC also evaluates the potential for some regional infrastructure development as a result of the proposed Project.
Cultural Environment	• Cultural Resources	Cultural Resources and Aboriginal Resource and Land Use were selected as VECs to address the potential of the proposed Project to affect traditional activities and culture and existing heritage and land resources.
	• Aboriginal Resource and Land Use	
	• Current Use of Crown Lands and Resources for Recreational Purposes	Current Use of Lands and Resources for Recreational Purposes and Navigable Waters were selected as VECs due to the potential interactions of the Project with other land users in the area. The various land uses include: Parks and Protected Areas, Trapping and Guide Outfitting, Hunting and Fishing, Recreation and Tourism, Permits and Licenses, Mining and Mineral Claims, Forestry, Transportation and Access.
	• Navigable Waters	

Environmental Component	VEC	Rationale
Excluded Valued Ecosystem Components		
Soils and Terrain	• Soil type • Soil chemistry • Terrain	Soil was not selected as a VEC as it is assessed as an intermediate component of the effects pathways for vegetation. Terrain was not selected as a VEC as it is considered in the assessment of terrestrial ecosystems. Soil and surficial sediments are described separately to support soil salvage and reclamation efforts.

2.2.2 Establishing Baseline or Pre-development Conditions

Background or baseline information is the foundation for the effects assessment, forming the point of reference for the evaluation of potential effects of the Project. Baseline conditions include the effects of past and existing projects and activities (CEA Agency, 1994).

The Ring of Fire area is a remote and relatively unstudied part of Ontario. As such, it was necessary to undertake a number of environmental, socio-economic, ATK, cultural heritage and health baseline studies to support the environmental assessment, as outlined in Table 2.2-2.

Table 2.2—2 Baseline Study Components

Subject	Description
Socio-economics and human health	Demographics; workforce experience; health; social services; youth; education; economic development; opinions and perceptions.
Physical and Cultural Heritage	Features of historical, archaeological, paleontological, architectural or cultural importance.
ATK	Land and resource use and traditional activities; identification of lands, waters and resources of specific social, economic, archaeological, cultural or spiritual value; culturally important plants; wildlife; lands, perspectives on the mine development including potential effects on future traditional activities and mitigation strategies.
Physical Environment	Includes climate, air, noise, surface and groundwater, waste rock characterization, soils.
Biological Environment	Includes terrestrial wildlife and wildlife habitat (e.g., caribou and carnivores), birds (e.g., raptors, geese, loons, shorebirds and songbirds), freshwater fish and fish habitat, vegetation, habitats, and biodiversity.

The objectives of the baseline studies included:

- Defining existing social and environmental conditions
- Identifying potential social and environmental concerns and sensitivities
- Providing information for Project design

Baseline studies were conducted using:

- Literature review
- Site investigations and surveys
- Consultation with First Nations, government, non-governmental organizations and other stakeholders
- Aboriginal traditional knowledge (ATK) studies

Baseline environmental and socio-economic conditions are summarized in Section 3 and are described in detail in the Technical Support Documents (TSDs) listed in Table 2.2-3.

Table 2.2—3 List of Technical Supporting Documents

TSD No.	Description
1	Climate and Hydrology Baseline TSD
2	Air Quality Baseline and Modelling TSD
3	Acoustic Baseline and Modelling TSD
4	Terrain and Soils TSD
5	Geochemistry Baseline TSD
6	Hydrogeology Baseline TSD
7	Surface Water Quality Baseline TSD
8	Aquatic Environment Baseline TSD
9	Terrestrial Baseline - Vegetation TSD
10	Terrestrial Baseline - Birds TSD
11	Terrestrial Baseline - Mammals TSD
12	Terrestrial Baseline - Wolverine TSD
13	Terrestrial Baseline - Caribou TSD
14	Socio-economic Baseline
15	Human Health Risk Assessment TSD
16	Navigable Waters TSD
17	Hydrogeology Modelling TSD
18	Habitat Suitability TSD

The above TSDs accompany to the EIS/EA Report.

2.2.3 Spatial Boundaries

Spatial boundaries are established to focus baseline data collection as well as the assessment of potential effects of the Project. The starting point for defining study areas was the delineation of the physical extent of the Project's activities, including the mine site, transportation corridor, and trans-load facility. Spatial boundaries for the effects assessment were determined individually for each VEC based on the following considerations:

- The anticipated zone of influence of project effects
- Traditional and local knowledge
- Current and proposed land use by Aboriginal groups
- Ecological, socio-economic and cultural considerations

Regional study areas (RSAs) and local study areas (LSAs) have been identified by VEC or VEC groupings (i.e., aquatic resources, potentially affected communities) as follows:

- The LSA is the zone where there is a reasonable potential for immediate interaction between Project components and the VEC. The LSA is generally the Project footprint, which includes the mine and associated infrastructure, with a buffer of varying distances, depending on the VEC.
- The RSA is defined as the zone in which direct and indirect effects are anticipated to occur (CEA Agency, 1999).

The LSA and RSA boundaries for each VEC are described within the respective impact assessments in Sections 6, 7 and 8.

2.2.4 Temporal Boundaries

The temporal boundaries for the assessment are defined based on the timing and duration of Project activities that could induce environmental, economic, social, heritage, and health effects. The purpose of a temporal boundary is to identify when an effect may occur in relation to specific Project phases and activities. Effects are identified with reference to activities occurring in one or more of the Project phases:

- Construction (3 years)
- Operation (11 years)
- Closure (2 years)
- Post-closure (a minimum of 5 years)

The current expected Project life is 16 years, inclusive of the construction, operation, and closure phases. If all or a portion of the existing inferred resources (approximately 9 Mt) can be converted to proven or probable reserves the mine life will increase. A post-closure monitoring phase will follow the first three Project phases and will be at least 5 years in duration. The post-closure phase will end when closure objectives can be demonstrated to have been achieved. With respect to this Project, the post-closure phase considers the time required for the underground workings to flood and reach steady state conditions with respect to groundwater levels and quality.

2.2.5 Identification of Potential Interaction(s) between the Project and VECs

The next step in the EA is to identify the mechanism by which a VEC may be affected by various Project components or activities. An interaction matrix is used to identify the likelihood of direct or indirect interactions between Project components or activities and a VEC. Table 2.2-4 is an example of the tables that will be used to summarize the potential interactions between Project components/activities and VECs. For each VEC, the cause-effect pathway, or mechanism of interaction, indicating how the Project component interacts with the VEC is identified. Where the Project and VEC is not anticipated to have an interaction, a rationale is provided. Potential mechanism(s) of interaction between the Project components and activities and the VEC are carried forward into the assessment by characterizing the potential effect(s).

Table 2.2—4 Potential Interactions between the Project and VECs

Project Components and Activities	Project Phase[1]	Potential Interaction	Mechanism of Interaction
Description of components and activities	(C, O, CL)	(Yes/No)	Rationale for interaction[2]

NOTES:

1. C (CONSTRUCTION), O (OPERATION), AND CL (CLOSURE) REPRESENT THE PROJECT PHASES WHEN THE POTENTIAL INTERACTIONS BETWEEN THE PROJECT AND VALUED COMPONENTS ARE ANTICIPATED TO OCCUR.
2. POTENTIAL MECHANISM(S) OF INTERACTION BETWEEN THE PROJECT COMPONENTS AND ACTIVITIES AND THE VEC ARE CARRIED FORWARD INTO THE ASSESSMENT BY CHARACTERIZING THE POTENTIAL EFFECT(S).

A detailed explanation as to how interactions were derived is provided in the text, discussing any underlying assumptions, data, or calculations leading to the results shown in the interact matrices (CEA Agency 1999). Based on the particular VEC, the discussion may include:

- Measurable parameters to quantitatively or qualitatively evaluate the potential effect
- Community knowledge
- Predictions and models results
- Applicable associated legislation, guidelines, policies and thresholds

All potential interactions identified are carried forward to the next step of the effects assessment, where mitigation measures are identified and residual effects are assessed.

2.2.6 Assessment of Potential Effects

The assessment of potential effects on VECs for each of the Project phases includes consideration of direct effects from Project components or activities, and effects arising from direct effects on other VECs on the selected VEC (indirect effects) for each Project phase. The assessment uses the following approach to identify direct and indirect effects on a selected VEC for each Project phase:

- Interpretation of baseline information for each VEC
- Identification of Project components or activities that potentially interact with the VEC and the mechanisms by which the interaction could occur
- Identification of Project-related effects on other VECs that interact with the VEC of interest

- Identification of mitigation measures for each effect, including those considered in the design of the Project, and those developed through the EA process
- Assessment of the potential for residual effects, taking into account mitigation measures identified

Noront has used best practice methods to predict the nature and extent of effects that might result from Project implementation. For each effects assessment, relevant references, analyses and explanations appropriate to the resource theme being analyzed are included. This supporting information will be used to define:

- How scientific, engineering, ATK and local knowledge were used in the assessment
- Data collection methods and limitations
- Model assumptions and study methodologies
- Study and model outputs, calculations, support analyses, and explanation of results
- Reference literature or other information sources for any contributions

Additional technical studies were carried out to support development of the effects assessments. Wherever possible these studies included statistical analyses or mathematical modelling to support effects predictions with quantitative analyses. These studies are presented as TSDs (see Table 2.2-3) and include the following:

- **Air Quality Modelling** - A Project air emissions inventory was developed based on the feasibility study and applying local meteorological data and representative baseline air quality conditions. A steady state numerical model was used to predict worst case air quality conditions in regional study area which includes mine site and transportation corridor during the operation phase of the Project.
- **Noise Modelling** - A Project noise emission inventory was also developed based on the feasibility study and representative baseline noise levels. A numerical modelling program was used to predict worst case noise levels in and around the mine site, transportation corridor and trans-load facility during daytime and nighttime for the operation phase of the Project.
- **Groundwater Inflow Modelling** - Numerical modelling was used to predict the volume of water that will be removed from the underground workings during the construction and operation phases of the Project. The model was also used to estimate the time required for the underground workings to fill with groundwater at the completion of mining activities. Model inputs were derived from measured hydraulic conductivities in both the bedrock and overburden.
- **Habitat Suitability Modelling** - Maps were developed showing the habitat distribution for terrestrial wildlife VECs using Ontario Ministry of Natural Resources (MNR) land cover mapping and wildlife habitat information from the literature. These maps were used to establish the relative quality of terrestrial wildlife habitat within both the RSA and LSAs.
- **Resource Selection Function (RSF) Modelling** - Noront used the results of RSF modelling conducted by the Ontario Woodland Caribou Resource Selection Function Working Group (Golder Associates Ltd., MNR, and Knight Piésold) that predicts the probability of caribou occurrence throughout the caribou RSA based on recent satellite collar data.

Within each TSD, the authors outline the assumptions underlying the model(s), the quality of the data, and the degree of certainty of the predictions.

2.2.7 Identification of Mitigation Measures

Under *CEAA* (Canada, 1992; amended in 2010), mitigation: *"means, in respect of a project, the elimination, reduction or control of the adverse environmental effects of the project, and includes restitution for any damage to the environment caused by such effects through replacement, restoration, compensation or any other means."*

Mitigation of environmental effects can be achieved through project design ("mitigation by design"), in which effects are avoided or reduced at the source. This includes the modification of the project design and/or the relocation of Project components. Noront has employed a precautionary approach in the design of its Project by locating infrastructure underground and by applying mine waste disposal techniques that are integrated into the mine development plan and that do not require dedicated waste management facilities at surface (e.g., a tailings storage facility).

Mitigation measures incorporated into the design will be applied to the Project to avoid, reduce or control environmental effects ("post-project mitigation"). In some instances, mitigation has been identified to address a specific impact at a specific location. Other mitigation measures include standard and project-specific practices, policies and commitments that will be applied to the Project as standard practice across the Project. For example, Noront will apply the same standard mitigation measures for protecting fish and fish habitat when constructing or rehabilitating stream crossings along the access road. Where specific sensitivities exist, additional site-specific mitigation measures may be prescribed.

Where mitigation measures have been identified in relation to species and/or critical habitat listed under the *Species at Risk Act*, the mitigation measures have been designed to be consistent with any applicable recovery strategy and action plans.

Certain mitigation measures consist of some form of compensation for unavoidable adverse residual effects. These compensation measures have been identified in cooperation with other users and relevant authorities. For example, socio-economic effects to local First Nations for the Project's infringement on traditional lands will be addressed in an Impact and Benefit Agreement (IBA) or similar agreement, and unavoidable impacts to fish and fish habitat will be addressed through the development of a conceptual fish and fish habitat offsetting plan negotiated with the Department of Fisheries and Oceans Canada (DFO) under the *Fisheries Act*.

In all cases, effective mitigation measures have been identified that are technically and economically feasible. Where multiple mitigation options exist, Noront has evaluated the options in terms of effectiveness, cost and reliability. This evaluation provided the framework for the identification of the preferred mitigation method. Where mitigation measures are proposed to be implemented for which there is little experience or for which there is some question as to their effectiveness, the potential risks and effects to the environment are identified and described. The probability of mitigation success for all measures identified is characterized as low, medium or high.

Volume 4 presents Noront's Environmental Management System (EMS), the Company's primary tool for tracking the implementation of mitigation measures and monitoring of their effectiveness. The Plan provides Noront's corporate policies and overall perspective on how potentially adverse effects will be minimized and managed over time, and how beneficial socio-economic effects will be promoted. The environmental management commitments identified in the EIS/EA Report are summarized in an Implementation Plan that describes the affected VEC, proposed mitigation measure(s), schedule and responsibilities. Finally, the EMS also describes the mechanisms Noront will employ to require its contractors and sub-contractors to comply with the Company's commitments and policies.

2.2.8 Determination of the Significance of Residual Effects

Residual effects are those that remain after mitigation measures have been applied (CEA Agency, 1994). The CEA Agency (1994) provides guidance in deciding whether the Project is likely to cause significant effects based on the following criteria, also consistent with the approved ToR:

- **Direction:** the long-term trend of the effect. Adverse effects show a reduction in conditions from baseline values; beneficial effects show an improvement in conditions from baseline values.
- **Magnitude:** the severity of the effect. Low magnitude effects may have no impact, while high magnitude effects may have an impact. Magnitude may be based on quantitative or qualitative criteria. Quantitative thresholds or relevant guidelines and standards are preferred when assessing the potential effects on a VEC. Where thresholds or standards are not available or where it is not possible to quantify the magnitude of an effect, qualitative ratings are assigned based on professional judgement, and experience with similar projects.
- **Geographical Extent:** the extent of change over the geographic area of the Project. The geographic extent of effects can be local or regional. Local effects may have a lower impact than regional effects.
- **Duration:** the length of time the effect lasts. The duration of an effect can be short term, medium term, long term or permanent.
- **Frequency:** how often an effect is expected to occur (may be described as frequent or infrequent).
- **Reversibility:** the degree to which the effect is reversible (the ability of the VEC to return to its original state once the stressor is removed). Effects can be reversible or irreversible. Reversible effects may have lower impact than irreversible or permanent effects.
- **Context:** the resiliency of the existing background, or the ability of the biophysical, economic, or social environment to accept change.
- **Likelihood:** the relative probability that a residual effect will occur following implementation of the mitigation measure.

The general ratings associated with each of the criteria for characterizing the significance of residual effects are shown in Table 2.2-5. Specific significance rating criteria and definitions vary by VEC. For example, within the Economic, Social, Heritage, or Health assessments, it may be necessary to revise some of the criteria and definitions to better characterize the VEC. In these cases, the revised criteria and definitions are presented in the relevant VEC assessment in Sections 6 through 8.

Table 2.2—5 Criteria Definitions for Characterizing the Significance of Residual Effects

Criteria	Rating	Definition
Direction	Adverse	A negative effect on baseline conditions or values
	Beneficial	An improvement relative to baseline conditions or values
Magnitude	Low	• Within the range of baseline variability • Below applicable standards • Limited to a few individuals, usually in the immediate vicinity of the impact that are not expected to result in population-level changes
	Medium	• Different from baseline conditions but below or equal to threshold/acceptable level • Exceedance of up to 10-times the applicable standard • Population-level changes may occur, but are not expected to be beyond the normal range of fluctuations of population size or density for those species; populations are expected to possess compensatory responses sufficient to recover from these changes
	High	• Substantially different from baseline, beyond threshold/acceptable level • Exceedance of more than 10 times the applicable standard • Population-level changes may occur that are expected to result in changes in population size or density beyond the normal range of fluctuations for those species; it is uncertain whether populations would possess compensatory responses sufficient to recover from these changes
Geographical Extent	Local	Within the LSA as defined for the VEC
	Regional	Within RSA as defined for the VEC
	Country	Effect felt across the country (socio-economic only)
Duration	Short Term	Up to 3 years (e.g., the construction phase)
	Medium Term	Life of Project (11 years)
	Long Term	Beyond the life of the Project, or permanent
Frequency	Infrequent	Occurs occasionally
	Frequent	Occurs often or continuously

Criteria	Rating	Definition
Reversibility	Reversible	Pre-Project conditions will return following the cessation of the potential residual effect
	Irreversible	Pre-Project conditions will not return following the cessation of the potential residual effect
Context	Low	The VEC has low resilience to imposed stresses, or will not easily adapt to the effect
	High	The VEC has a high resilience to imposed stresses, or will easily adapt to the effect
Likelihood	Low	Low probability that the predicted effect will occur
	High	High probability that the predicted effect will occur
Significance	Not Significant	Defined by VEC discipline
	Significant	Defined by VEC discipline

2.2.8.1 Determination of the Significance

Using the residual effects criteria, the significance of residual effects are evaluated by considering each criterion based on available Project-specific data, relevant literature, and professional judgement.

The overall significance of an effect is derived from the experience and professional judgment of the environmental practitioners who prepared the assessment, considering the rankings of the contributing attributes of significance. While substantially based on professional judgment, the following are general rules of thumb applied in determining significance:

- The magnitude of an effect is a primary criterion and is heavily weighted in the determination of significance. If the magnitude of the effect is low, then the predicted effect is considered "not significant," recognizing that magnitude includes consideration of sensitive species, habitats or populations.
- If the geographic extent of the effect is confined to the LSA, then the predicted effect is likely to be "not significant"
- If the extent of a negative socio-economic effect is limited to individuals who also receive a corresponding positive benefit, then the predicted effect is likely to be "not significant"
- If the effect has a moderate to high reversibility, the predicted effect is likely to be "not significant"
- If the duration of the effect is short term (e.g., construction period only) then the effect prediction is also likely to be "not significant"

2.3 BENEFITS TO CANADIANS

Noront has described how the EA process for the Project has provided a benefit to Canadians utilizing the following factors:

- **Maximized Environmental Benefits** - Identifying the environmental benefits created as a result of the Project going through the EA process.
- **Contributions of the EA to Support Sustainable Development** - Identifying how the EA process for the Project contributed to the concept of sustainable development for a healthy environment and economy.
- **Aboriginal Consultation and Public Participation** - Identifying how Aboriginal consultation and public participation during the EA influenced the Project design and the environmental effects analysis.
- **Technological Innovations** - Describing any new technologies developed to address environmental impacts that could be used for other projects.
- **Increases in Scientific Knowledge** - Describing any new scientific information collected through the EA that could benefit the assessment of other projects.
- **Community and Social Benefits** - Describing any changes in Project design that resulted in benefits to communities and/or social benefits.

The benefits of the Eagle's Nest EIS/EA Report and associated processes are described in Section 13.

TABLE OF CONTENTS

PAGE

TABLES

FIGURES

3 – EXISTING ENVIRONMENT

3.1 CLIMATE AND ATMOSPHERIC ENVIRONMENT

This section provides a description of the existing climate and atmospheric environment baseline conditions for the Eagle's Nest Project. The supporting technical documents that provide additional details regarding the study methods, results, and discussion are available in Appendix 1 and 2.

3.1.1 Study Areas

The spatial boundaries for the assessment of climate and atmospheric environment were defined as geographic areas within which there is a reasonable expectation that the Project could have an effect on ambient conditions. The study areas were selected based on the location of the emission sources, potential receptor locations, and the extent of transport, propagation, and dispersion of any air contaminants.

A local study area (LSA) was defined by a 5 km wide band surrounding the mine site and a 1 km wide band along the transportation corridor, as these two Project components are expected to have the greatest potential effect on air quality. The size of the LSA is based on experience from similar industrial developments where there are no local receptors. The regional study area (RSA) was defined by a 20 km boundary from the mine site and a 2 km boundary from the transportation corridor, where concentrations of compounds may be quantifiable but would be lower than Provincial air quality criteria or National objectives.

The trans-load facility was not considered to be part of the transportation corridor study area as there will be no emissions at the facility other than from the transportation of concentrate and use of mobile equipment. The transfer and stockpiling of concentrate will take place inside a self-contained building with dust control measures.

3.1.2 Background

The Project lies within the James Bay Lowlands Region of Northern Ontario. The James Bay Lowlands are at an elevation of approximately 170 m above sea level at the mine site and slopes down to James Bay at an average of 4 ft/mile (0.7 m/km). The James Bay Lowlands is an extensive wetland covering approximately 25% of Ontario. Bogs and fens dominate the region with occasional forest stands on areas of higher ground formed on glacial materials like eskers or beside rivers or natural levees. Shallow lakes and ponds are found throughout the region and are interlaced by rivers and streams. The landscape has been shaped by the many meandering rivers including the larger Otoskwin/Attawapiskat, Muketei and Albany and their numerous tributaries. River levels reach their maximum during spring runoff in late April to early May. Water levels usually drop during the summer months and increase prior to freeze-up in the late fall.

The mine site and transportation corridor are located in the Far North Region of northern Ontario. The trans-load facility is located approximately 80 km south of the Far North Boundary. The climate of the region is classified as a sub-polar boreal climate with the following general characteristics:

- Severe cold winters and short and cool summers
- Typically three months with mean temperature exceeding 10°C

- Annual precipitation typically ranges from 500 to 800 mm
- Climate controlled by North American landmass. Lands near the coast influenced by Hudson Bay and James Bay, which cools and adds to the atmosphere.

In summer, the position of the Arctic front is driven by the cold waters of Hudson Bay, which generates persistent onshore summer winds and land-sea breezes that lower temperatures, increase fog and reduce evapotranspiration rates. The cool moist climate contributes to the growth and stability of wetlands and peatlands in the region. Continuous permafrost is present in within 50 to 100 km of Hudson Bay, while discontinuous or sporadic discontinuous permafrost are possible in the region around the Project.

The mine site is the northernmost component of the Project. The transportation corridor runs southwest approximately 350 km from the mine site to the community of Pickle Lake. From there it runs south for approximately 135 km to the trans-load facility near the community of Savant Lake. The general climate of the mine site and the northern portion of the transportation corridor are expected to be similar. The southern portion of the transportation corridor is expected to have a similar climate as the trans-load facility, which is located approximately 400 km southwest of the mine site.

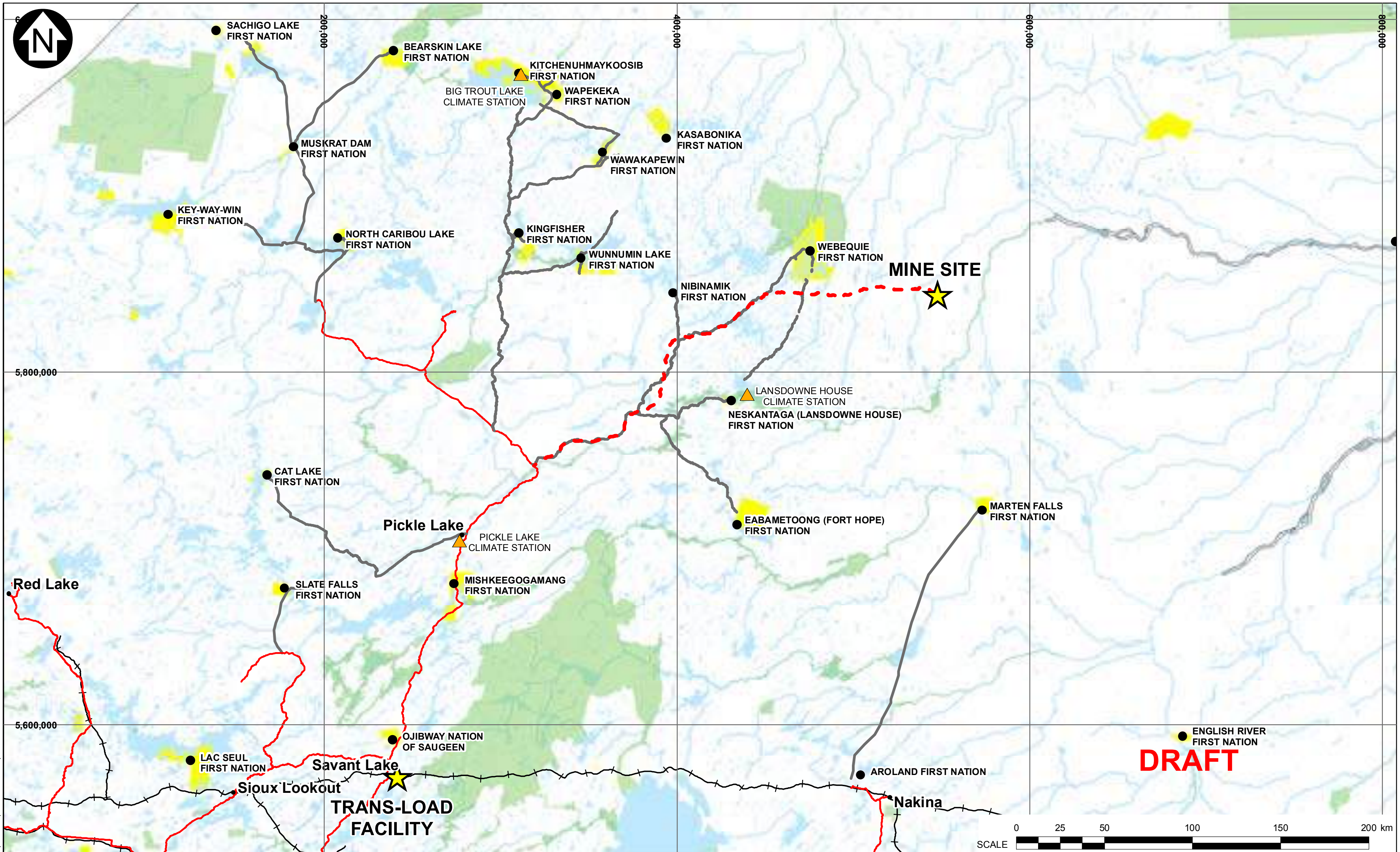
Regional climate data are available from climate stations that are operated and maintained by Environment Canada (EC). Most stations provide a long term record of the following meteorological parameters:

- Temperature
- Precipitation
- Wind speed and direction
- Relative humidity
- Snow on ground

There are several EC climate stations in northern Ontario (Figure 3.1-1). In order to characterize the climate in the study area, the closest stations to the Project with a minimum of a 20 year data record were chosen. The closest EC station to the mine site with is located at Lansdowne House (Neskantaga First Nation), which is 125 km southwest of the mine site. The Lansdowne House station has a 21 year data record available from EC (EC, 2013a). The EC station at Pickle Lake has an 82 year data record and is located along the transportation corridor, approximately 305 km southwest of the mine site and 135 km north of the trans-load facility. The climate data available from the two stations are summarized in Table 3.1-1.

Table 3.1-1 Regional Climate Station Summary

Station Name	Station ID	Latitude	Longitude	Elevation (m)	Distance to mine site	Period of Record	Years of Record
Pickle Lake (AUT)	6016525	51.54	-90.21	386	310 km ENE	1930-2013	82
Lansdowne House	6014353	52.20	-87.94	253	130 km ENE	1992-2013	21



LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- COMMUNITY
- ENVIRONMENT CANADA CLIMATE STATION
- RAILWAY
- EXISTING ALL-SEASON ROAD
- EXISTING WINTER ROAD
- UPDATED PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- WATER
- PARK
- FIRST NATIONS RESERVE

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED. KOPER LAKE BASE MAP PROVIDED BY SNC-LAVALIN GROUP INC. (2010).
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).
4. CLIMATE STATIONS PROVIDED BY ENVIRONMENT CANADA (DECEMBER 5, 2013).
5. INFRASTRUCTURE INFORMATION AND PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

ENVIRONMENT CANADA CLIMATE STATIONS

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.1-1 REV A

A	20DEC'13	ISSUED WITH REPORT	DKK	SWK	SRA	RAM
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

SAVED: I:\102\00390\01\A\GIS\Figs\A657_rA.mxd; Dec 20, 2013 2:16 PM; skozmick

3.1.3 Project Meteorological Station

In 2009, a meteorological station was established near the mine site at Koper Lake (Figure 3.1-2). The climate station is located in an open area away from tree cover and is representative of land cover in the area. The station was established and operated in consideration of the EC guidelines for climatological autostations (EC, 2004) and the World Meteorological Organization Guide to Meteorological Instruments and Methods of Observation (WMO, 2008).

The Project station consists of a free standing tower equipped with a rain gauge, temperature sensor, relative humidity sensor, incoming shortwave pyranometer, relative humidity sensor, and a wind speed (anemometer) and direction sensor. The rain gauge measures liquid precipitation only and not snowfall.

Data were recorded at the Project station at hourly intervals and the station was downloaded seasonally. Data were collected starting in 2009 and the station remains in operation. Some data gaps exist due to technical issues with instrumentation or the data logger.

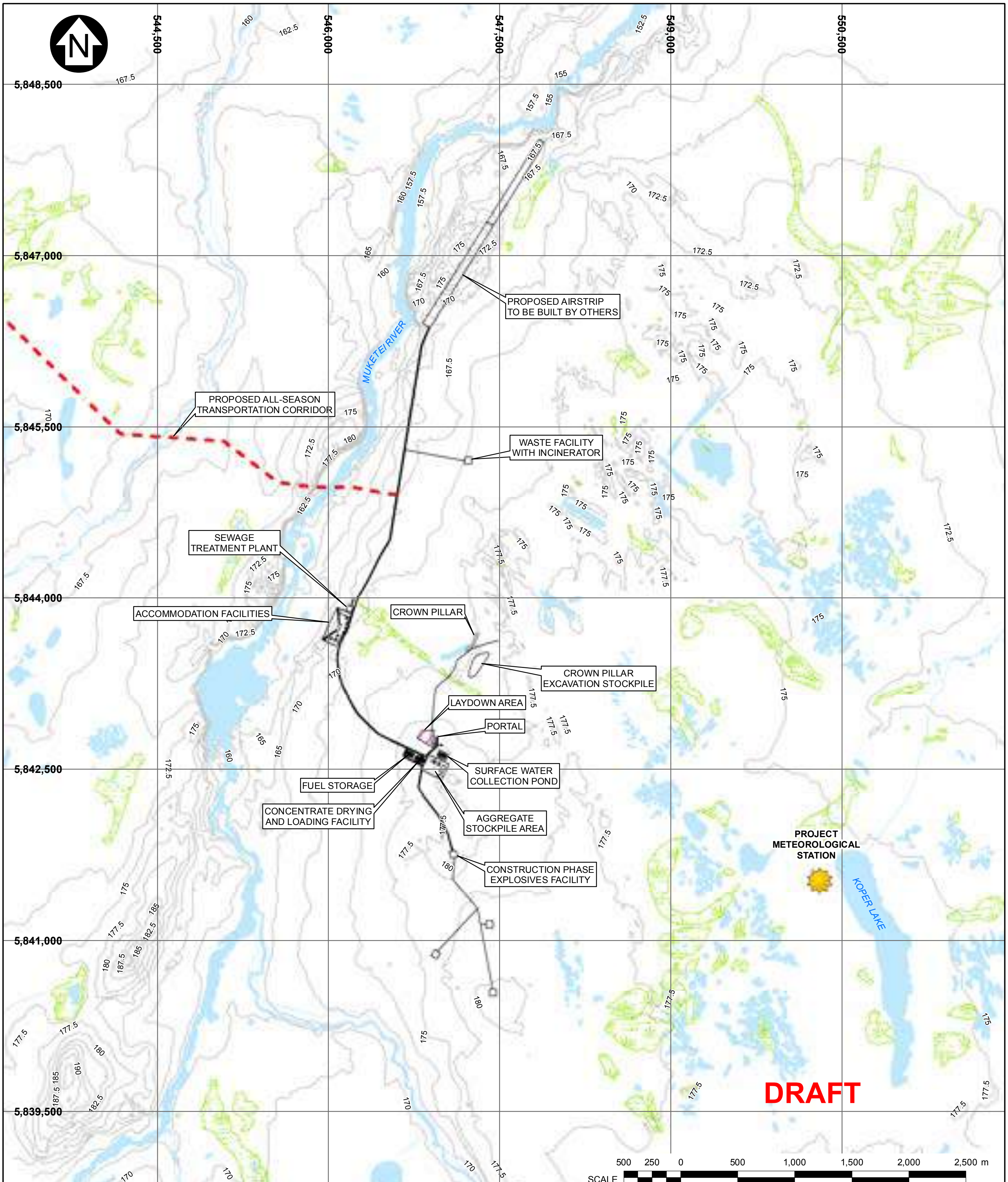
3.1.3.1 Temperature

Mean monthly temperature values recorded at the Project station is summarized in Table 3.1-2. Mean monthly temperature values from the Pickle Lake and Lansdowne House stations are summarized in Table 3.1-3.

Table 3.1-2 Measured Mean Monthly Temperature at the Project Station

Year	Mean Monthly Temperature (°C)												Mean Annual Temp (°C)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2009						13	14	13	13	1.0	-1	-17	-
2010	-17	-16	-4										-
2011		-18	-14	-0.9	7		18	16	11	11		-16	-
2012	-19	-14	-7	-0.1	7	16	18	15	10	2	-7	-18	0.1

NOTES:
1. MEAN MONTHLY TEMPERATURE REPORTED FOR MONTHS WITH COMPLETE DATA RECORD.



LEGEND:

- PROJECT METEOROLOGICAL STATION
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- PROPOSED INFRASTRUCTURE
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- CROWN PILLAR
- LAYDOWN AREA

NOTES:

1. BASE MAP PROVIDED BY SNC-LAVALIN GROUP INC. (2010).
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 2.5 METRES.
4. INFRASTRUCTURE INFORMATION AND PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

PROJECT METEOROLOGICAL STATION LOCATION

Knight Piésold CONSULTING

P/A NO.	REF NO.	
NB102-390/1	34	
FIGURE 3.1-2		REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	DKK	SWK	SRA	RAM

SAVED: I:\102\00390\01\A\GIS\Figs\A658_rA.mxd; Dec 20, 2013 2:22 PM; skozmick

Table 3.1-3 Long-term Mean Monthly Temperature at the Regional Stations

Station	Elev (masl)	Years	Mean Monthly Temperature (°C)												Mean Annual Temp (°C)
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Pickle Lake	386	1934-2012	-20	-70	-9	0	8	15	18	16	10	3	-7	-16	0.1
Lansdowne House	253	1992-2013	-21	-18	-11	-1	7	14	17	16	10	2	-7	-17	-0.75

NOTES:

1. DATA OBTAINED FROM ENVIRONMENT CANADA STATIONS AT PICKLE LAKE (6016525) AND LANSDOWNE HOUSE (6014353).

Temperature is warmest in July and coldest in January at the Project station and regional stations. The data collected at the Project Station summarize the conditions at the mine site over a relatively short period of time. As such, the long-term temperature record from the Lansdowne House, which is the closest EC station to the mine site, was used to develop a long-term synthetic series of monthly temperature values for the Project station. The Lansdowne House temperature data were correlated to the temperature data for the mine site station from the concurrent period of record. An ordinary least squares regression was used to define the linear relationship between the monthly temperatures at the two stations. There is a strong relationship between the monthly temperatures at Lansdowne House and the Project station for the concurrent period of record, with a coefficient of determination (r^2) of 0.99. A long-term synthetic record was generated for the mine site using the linear relationship with the Lansdowne House data using the following equation:

Monthly Mean Temperature at the Mine Site = 0.99(Lansdowne House Monthly Temperature) - 0.39.

The mine site mean monthly temperature from the long-term synthetic data record is shown in Table 3.1-4.

Table 3.1-4 Long-term Monthly Mean Temperature at the Mine Site

Station	Elev (masl)	Years	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Year
Mine Site Long-Term Synthetic	171	1992-2013	-22	-18	-11	-1.2	6.6	14	16	15	9.0	1.4	-8.7	-18	-1.3

NOTES:

1. LONG-TERM SYNTHETIC TEMPERATURE RECORD DERIVED FROM 1992-2013 LANSDOWNE HOUSE DATA RECORD (6014353).

The long-term mean annual temperature for the mine site is estimated to be -1.3°C. The mean July temperature at the mine site is estimated to be 16°C and the mean January temperature is estimated to be -22°C.

The extreme maximum and minimum temperatures recorded at the Lansdowne House station were 36°C on July 30, 1975 and – 48°C on January 19, 1943. Similar extreme temperatures are expected at the mine site due to the proximity to Lansdowne House.

The Pickle Lake data are considered to be representative of the temperature along the transportation corridor and at the trans-load facility.

3.1.3.2 Precipitation

Rainfall data were collected at the Project station using a tipping bucket rain gauge. It is widely recognized that gauge-measured precipitation is subject to a systematic bias caused by wind-induced under-catch, wetting losses, and evaporation losses, especially in northern environments (Yang et al., 2005). To address this, the Climate Research Division of EC has developed adjusted precipitation datasets for several stations in Canada. The data are adjusted on a station by station basis to compensate for widely recognized systematic bias in gauge measured precipitation (Mekis and Vincent, 2011). The daily rainfall data were adjusted using a regional underestimation correction factor of 1.08, which is proposed by Mekis and Vincent (2011). The mean monthly rainfall measured at the Project station is summarized in Table 3.1-5.

Table 3.1-5 Project Station Mean Monthly Measured Precipitation

Year	Mean Monthly Rainfall (mm)					
	May	Jun	Jul	Aug	Sep	Oct
2009			95.7	149.8	74.8	56.5
2010						
2011	25.2		55.8	75.2	95.6	37.6
2012	112.2	65.8	27.2	86.3	25.1	54.4

NOTES:
1. MEAN MONTHLY RAINFALL REPORTED FOR ONLY MONTHS WITH COMPLETE DATA RECORD.

Long-term precipitation for the Project was obtained from the Pickle Lake adjusted precipitation dataset. No other regional stations are included in the EC adjusted precipitation dataset. The mean monthly and annual precipitation from the Pickle Lake station is shown in Table 3.1-6.

Table 3.1-6 Mean Monthly Precipitation at the Pickle Lake Station

Station	Years	Mean Monthly Precipitation (mm)												Mean Annual Precip (mm)
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Pickle Lake	1975-2012	46	35	44	46	71	98	104	91	95	70	71	50	821
Percent snowfall		99%	94%	85%	65%	19%	0%	0%	0%	4%	41%	80%	98%	29%

NOTES:
1. MEAN MONTHLY PRECIPITATION REPORTED FROM PERIOD OF RECORD WITH COMPLETE DATA (1975-2012).

The mean monthly precipitation at the Project and the Pickle Lake stations is greatest during the summer months (June to September) and lowest during the winter months (December to April). Most of the precipitation from November to March falls as snow. Mixed rain and snow conditions are common from April to October.

The long term adjusted precipitation record from the Pickle Lake station was used as the basis for generating a long-term synthetic series of monthly precipitation for the mine site. The concurrent monthly precipitation records were plotted using a double-mass curve. As the Project station is not equipped to measure snowfall, only the precipitation records for the months of May through September were considered in the analysis. It is assumed that any snow that fell during these months was captured in the rain gauge, melted and was recorded as rainfall.

There is a strong relationship between the monthly precipitation at the two locations (r^2 = 0.99). The slope of the relationship shows that the precipitation at the Project Station was 1.06 times higher than at the Pickle Lake station. As mentioned, this relationship was established using only rainfall data as snowfall was not measured at the Project station. It was assumed that a similar relationship exists during winter months. The long-term estimated mean monthly and annual precipitation for the mine site is summarized in Table 3.1-7.

Table 3.1-7 Long-term Monthly Mean Precipitation at the Mine Site

Station	Elev (m asl)	Years	Mean Monthly Precipitation (mm)												Mean Annual Precip (mm)
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Mine Site Long-Term Synthetic	171	1975-2012	49	37	47	49	75	104	110	97	100	74	75	53	870
Percent Annual Precipitation			6%	4%	5%	6%	9%	12%	13%	11%	12%	8%	9%	6%	100%
Percent Snowfall			99%	94%	85%	65%	19%	0%	0%	0%	4%	41%	80%	98%	29%

NOTES:

1. MEAN MONTHLY AND ANNUAL PRECIPITATION FOR THE MINE SITE DEVELOPED FROM THE RELATIONSHIP WITH THE ADJUSTED PRECIPITATION DATA FROM THE PICKLE LAKE STATION.
2. RELATIONSHIP DEVELOPED USING MAY TO OCTOBER PRECIPITATION. RELATIONSHIP WAS ASSUMED TO BE SIMILAR FROM DECEMBER TO APRIL.

The long-term mean annual precipitation at the mine site is estimated to be 870 mm, of which approximately 618 mm (71%) is rainfall and 222 mm (29%) is snowfall. The mean annual precipitation throughout the RSA is expected to be relatively similar as there is a relatively small difference in precipitation between the mine site and Pickle Lake. In addition, the majority of the precipitation in the fall, winter, and spring months is associated with regional scale frontal weather systems. Convectional precipitation occurs more frequently during the summer months and results in localized high intensity rainfall. However, this type of precipitation is widespread throughout northwestern Ontario and there are no areas that receive preferentially higher or lower amounts of rainfall. The Atlas of Canada also suggests that the Annual Mean Total Precipitation in the RSA is relatively homogenous and ranges from 600 to 800 mm per year (Figure 3.1-3).

Environment Canada has developed return period rainfall values for Pickle Lake. The return period 24-hour extreme rainfall values are shown in Table 3.1-8.

The 24-hour rainfall depths range from 44 mm for a 2-year return period to 100 mm for a 100-year return period. The maximum 24-hour rainfall recorded at the mine site Project station was 50.6 mm on May 25, 2012, which corresponds to a return period of between 2 and 5 years at Pickle Lake. The maximum 24-hour rainfall from the Pickle Lake 1970-2000 climate normals was 108 mm on July 7, 1974 (EC, 2013b), which is greater than the 100-year return period rainfall.

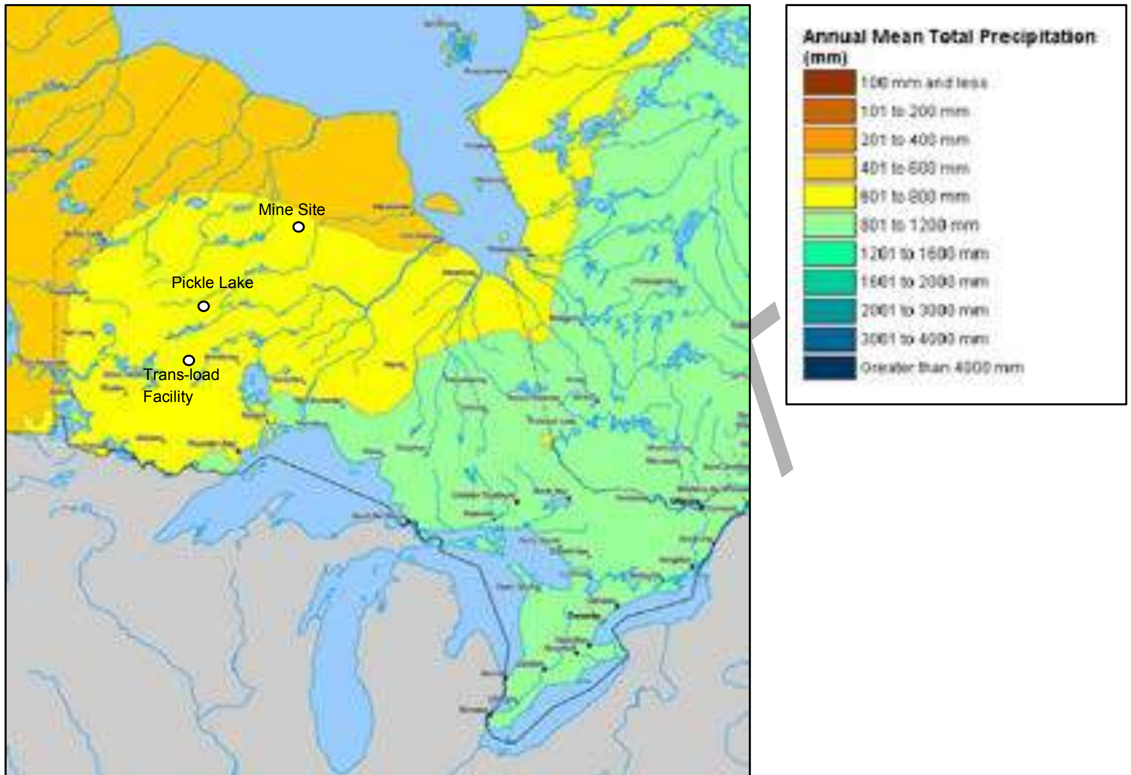


Figure 3.1-3 Atlas of Canada Annual Mean Total Precipitation

NOTES:

1. SOURCE: ATLAS OF CANADA (2009).

Table 3.1-8 Extreme 24-Hour Rainfall for Pickle Lake

Climate Station	Return Period (years)	24-hour Rainfall (mm)
Pickle Lake (6016525)	2	44
	5	59
	10	69
	25	82
	50	91
	100	100

NOTES:

1. 24-HOUR RAINFALL OBTAINED FROM ENVIRONMENT CANADA SHORT DURATION RAINFALL INTENSITY-DURATION-FREQUENCY DATA.

3.1.3.3 Sublimation

Sublimation is the process by which moisture is returned to the atmosphere directly from snow and ice without passing through the liquid phase (Sturm and Liston, 2003). Sublimation can play a significant role in the annual hydrologic water balance in areas where winter precipitation comprises a large proportion of annual precipitation. Interception by vegetation and sublimation of snowfall result in reduced ground snow pack depth when compared to open areas with similar snowfall (Lundberg et al., 2004). The amount of sublimation in forested areas depends on several factors such as topographic relief, type of forest, season, and climate (Geflan et al., 2004). Experimentally derived sublimation rates show that mature forests can return 13 – 40% of the seasonal snowfall to the atmosphere (King et al., in Armstrong and Brun, 2008).

Wind erodes snow from open and sparsely vegetated areas and deposits it in areas of dense vegetation or leeward features (Essery and Pomeroy, 2004). Sublimation in an open area is driven by blowing snow fluxes and is estimated to be around 20% of the snowfall (Pomeroy et al., 1997). However, sublimation rates vary depending on the landscape. For example, the rate of sublimation is greater in areas that are exposed to wind and lower in leeward areas where snow is deposited.

The landcover in the RSA is predominantly boreal forests of varying density and open areas that typically are covered by shrubs or tall grass. As such, the loss of snowfall from sublimation is expected to be similar to forested areas and not impacted to a large extent by blowing snow processes. The rate of sublimation also varies over time and depends on the nature of snowfall events. For example, the loss of snow by sublimation is greater if precipitation falls as several small snowfalls rather than a single large snowfall event. In addition, snow that falls early in the season is subject to a greater amount of sublimation than snow that falls at the end of the season. Wind events without snow accelerate the process of sublimation (Essery and Pomeroy, 2004).

The potential loss of snowfall by sublimation was estimated for the mine site by assuming an average sublimation rate of 25 %. The mean monthly snowfall at the mine site was corrected for loss through sublimation and is shown in Table 3.1-9.

Table 3.1-9 Mean Monthly Mine Site Snowfall Corrected for Sublimation

Data	Years	Mean Monthly Snowfall (mm)												Mean Annual Snowfall (mm)
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Mine Site Long-Term Synthetic Precipitation	1975-2012	49	35	40	32	14	0	0	0	4	30	60	52	316
Sublimation Loss		25%	25%	25%	25%	25%	0	0	0	25%	25%	25%	25%	25%
Snowfall Corrected for Sublimation		37	26	30	24	10	0	0	0	3	22	45	39	236

3.1.3.4 Snow Cover

<u>Regional Snow Cover Properties</u>

Snowfall begins to accumulate in the region during October and snow remains on the ground until April or May. The rate and amount of snow accumulation varies mainly based on land cover type. For example, water bodies are often un-frozen in October and early season snow melts immediately as it hits the water. As the ice cover begins to form, snow accumulates and is subject to wind-redistribution during winter. Blowing snow process are dominant on lakes and in most northern landscapes, snow on lakes is typically thinner and denser than on adjacent land (Strum and Liston, 2003, Rees et. al., 2013). Blowing snow processes also occur in open areas, however, the land cover in the region is predominantly coniferous boreal forest interspersed with areas of open land that is either sparsely treed grassland or peat dominated wetlands. The vegetation cover traps blowing snow and limits the wind fetch and snow transport distances. In forested areas, tree canopies intercept falling snow and the snowfall trapped in the canopy is removed by sublimation and/or melt at a much greater rate than on the adjacent ground (Hedstrom and Pomeroy, 1998).

At a landscape scale, the snow cover properties in the region are heterogeneous. However, snow cover tends to be relatively similar within land cover types. For example, in open areas, snow is redistributed by wind and as a result has a lower snow depth and a higher density. In the lee of slopes or on the edges of open areas, blowing snow accumulates and the depth increases. In forested areas the snow is less dense than open areas as it is not re-worked by wind. In open forests the snow depth is typically greater than in open areas. Under dense forest canopies, the snow is typically shallower due to higher interception and loss from the canopy due to sublimation.

<u>Mine Site Snow Survey</u>

Snow depth and density are typically used to characterize snow cover properties. Snow water equivalent (SWE) is calculated from snow depth and density and is used for estimating snowmelt runoff, evaluating climate models, and the detection of trends related to snow mass. Estimates of pre-melt snow depth and SWE are commonly used to characterize snow cover at both local and regional scales.

An end of winter snow survey was conducted at the mine site in March of 2012 to characterize the pre-melt snow cover properties in different land cover types. Sampling locations were selected in representative land cover types (dense forest, open forest, open wetland, and lakes). The sampling locations were chosen to best represent the surrounding terrain and snow cover conditions. When possible, extremely localized features, such as small depressions or areas of non-representative micro-topography were avoided.

At each site, a manual snow probe was used to obtain 30 depth measurements randomly taken in a circular pattern around the site. Each depth measurement was approximately 3 metres apart. Five snow cores were taken at random locations using an ESC 30 (30 cm^2 cross sectional area) snow corer. The weight of each core was measured using a hanging Pesola spring scale. Snow density and SWE were directly calculated from the ESC 30 measurements using the snow depth and the mass of the core. The snow depth, density, and SWE from the snow survey are shown in Table 3.1-10.

The snow survey at the mine site shows that there are some general differences in snow cover properties between the forested, lake, and wetland sites. The snow depth was lowest and the density highest on lakes. Snow density in forested areas was less than in on lakes or wetlands. The wetland sites had similar SWE as open forests. The wetlands are predominantly open areas but the vegetation is tall enough to limit the entrainment and transport of blowing snow.

Table 3.1-10 Mine Site Snow Cover Properties

	Snow Depth (cm)			Snow Density (kg/m^3)			SWE (mm)		
Site Type	AVG	STDEV	CV	AVG	STDEV	CV	AVG	STDEV	CV
Dense forest	47	9	0.19	0.170	0.014	0.08	80	19	0.24
Lake	36	10	0.29	0.210	0.013	0.06	76	26	0.34
Open Forest	47	10	0.21	0.180	0.023	0.12	83	12	0.14
Wetland	43	9	0.22	0.195	0.012	0.17	84	24	0.30

NOTES:
1. AVERAGE (AVG), STANDARD DEVIATION (STDEV) AND THE COEFFICIENT OF VARIATION (CV) CALCULATED FOR EACH SITE TYPE.

Snowmelt

Snowmelt in the region typically begins in late March or April. Melt rates are higher in open areas than in forests. In dense forests, the effect on melt duration is suppressed by the lower pre-melt accumulation (Geflan et al., 2004). Snowmelt surveys were conducted in March and April of 2012. The surveys confirmed that melt rates in open areas were much faster than in the forests and snow remained in the dense forests for several weeks after open areas. The melt observed in 2012 was abnormally rapid due to above average temperatures. Under these conditions, a large part of the snowmelt runoff occurred when the streams and other water bodies were still ice covered.

3.1.3.5 Atmospheric Pressure

Atmospheric pressure is greatest at sea level and decreases with increasing elevation. Typically the pressure difference for a given elevation is relatively small (typical low pressure of 980 mb to a typical high pressure of 1020 mb). In addition, the distance separating these high and low pressure centres can be very large (up to 3,000 km). As such, atmospheric pressure throughout the region is assumed to be relatively similar at any given time. Variations in atmospheric pressure are a product of changes in regional weather systems and large scale changes in atmospheric conditions from season to season. The monthly average atmospheric pressure from the Project Station during 2012 is summarized in Table 3.1-11. The data from 2012 were used as there were no gaps in the data record.

The monthly mean atmospheric pressure at the Project Station was relatively consistent throughout the year. Slightly higher pressures are evident in the winter months as cold air is denser than warm air and cold conditions often result in higher surface pressure.

Table 3.1-11 Project Station Monthly Average Atmospheric Pressure

Year	Mean Monthly Station Pressure (mb)												Mean Annual
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2012	990.2	992.9	993.0	996.0	992.2	986.8	989.8	988.9	989.1	990.8	995.8	993.3	991.6

NOTES:
1. STATION PRESSURE NOT CORRECTED FOR ELEVATION.

3.1.3.6 Wind

Surface wind direction between 30 and 60 degrees latitude in the northern hemisphere is predominantly from the west to southwest direction. These prevailing winds are referred to as the westerlies and are generally stronger in winter than in summer. The long-term regional wind direction and speed are summarized in the Pickle Lake and Lansdowne House 1970-2000 climate normals (Table 3.1-12 and Table 3.1-13).

Table 3.1-12 Pickle Lake Wind Speed and Direction

Parameter	Mean Monthly Wind Data												Annual Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Speed (km/h)	11.9	11.9	12.2	11.8	12.1	12.6	12.1	12.3	13.6	14.6	13.3	12.2	12.5
Most Frequent Direction	W	W	W	NE	NE	W	W	W	W	W	W	W	W
Max. Hourly Speed	56	69	69	61	65	59	77	65	59	63	56	59	-
Date (yyyy/dd)	1987 /14	1988 /28	1986 /22	1971 /11	1977 /01	1986 /12	1956 /01	1983 /19	1981 /27	1971 /31	1982 /21	1997 /30	-
Max. Gust Speed	85	78	96	91	104	87	91	102	89	89	89	91	-
Date (yyyy/dd)	1987 /13	1988 /28	1986 /22	1984 /27	1977 /01	1981 /18	1988 /28	1983 /19	1979 /17	1988 /09	1981 /08	1982 /03	-
Direction of Max. Gust	W	W	W	NE	W	W	NW	W	W	NW	NW	W	W

The regional long-term data show that the predominant wind direction is from the west during the winter and fall. During spring, the winds are more from the north and northeast. During summer the winds in Pickle Lake are from the west and in Lansdowne House are from the southwest. Wind speed is generally consistent throughout the year. Slightly higher monthly average wind speeds occur during fall months. Maximum wind gusts occur during summer, likely associated with thunderstorm activity.

The annual wind data from 2012 at the Project station were plotted in a windrose and are shown in Figure 3.1-4. Monthly windrose plots are included in Appendix 1.

Table 3.1-13 Lansdowne House Wind Speed and Direction

Parameter	Mean Monthly Wind Data												Annual Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Speed (km/h)	14.5	13.1	13.2	13.9	13.1	14.2	13.6	13.4	14.8	17	16.1	14.1	14.2
Most Frequent Direction	W	W	NW	NW	NE	SW	SW	SW	SW	NW	NW	W	NW
Max. Hourly Speed	58	55	59	63	63	54	80	61	61	59	65		-
Date (yyyy/dd)	1962/26	1971/05	1986/28	1965/29	1977/01	1953/20	1982/08	1957/02	1959/07	1954/04	1984/02	1980/28	-
Max. Gust Speed	78	70	78	80	78	89	117	87	78	81	83	80	-
Date (yyyy/dd)	1982/10	1988/23	1986/22	1985/15	1987/13	1986/13	1987/07	1984/21	1980/22	1980/07	1981/08	1980/17	-
Direction of Max. Gust	NW	NW	W	N	S	W	SW	SW	W	NW	W	NW	SW
Days with Winds ≥52 km/h	0.7	0.2	0.5	0.3	0.3	0.7	0.8	0.7	0.9	0.6	0.5	0.8	6.8
Days with Winds ≥63 km/h	0.1	0	0	0.1	0.1	0.2	0.1	0	0.1	0	0.1	0.2	0.9

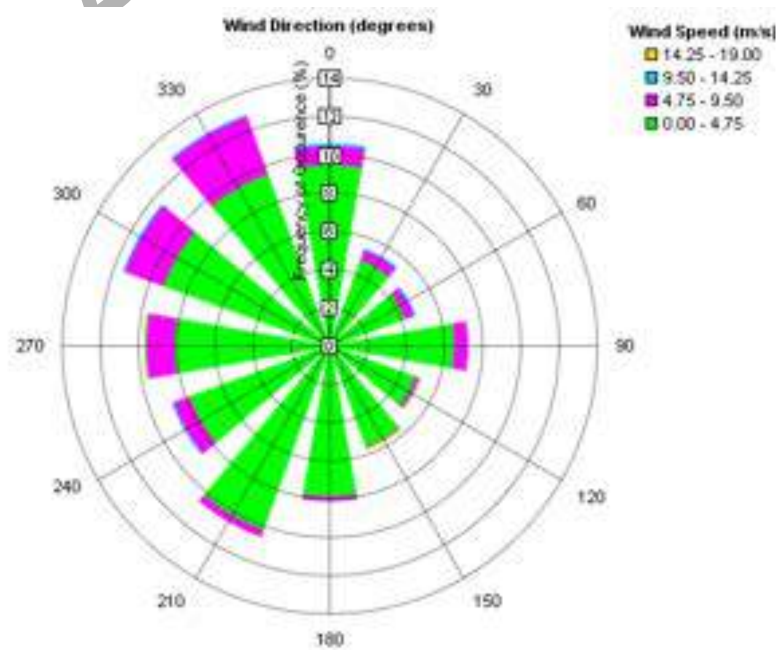


Figure 3.1-4 Hourly Wind Observations during 2012 at the Project Station

The annual and monthly windroses show that wind is predominantly from west during several months of the year. During March, April, and May the wind was predominantly blowing from the north. During June and October, there was no predominate wind direction. High wind speeds were observed more frequently during June and October.

3.1.3.7 Relative Humidity

Relative humidity (RH) is the amount of water vapour in the air compared to the maximum amount of water vapour that the air can hold at a given temperature. As air warms, the RH decreases and as air cools, the RH increases. As such, there is a diurnal cycle in RH anywhere that daytime temperature is different than nighttime temperature. Changes in RH also occur with changes in season.

The monthly mean RH from the Project station are shown in Table 3.1-14. The RH data from 2012 were used as there were no gaps in the data record. The monthly mean RH from the Pickle Lake 1970 - 2000 climate normals are shown in Table 3.1-15.

Table 3.1-14 Project Station Monthly Mean Relative Humidity

Time	Relative Humidity (%)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
0600h	84.3	82.7	81.0	82.3	87.6	86.9	89.3	92.8	90.6	94.4	89.6	86.1	87.4
1500h	77.6	68.0	66.5	48.9	58.8	55.3	51.9	63.3	61.1	85.4	85.2	84.9	67.3

Table 3.1-15 Pickle Lake Monthly Mean Relative Humidity

Time	Relative Humidity (%)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
0600h	80.9	82.9	81.9	78.9	81.4	84.1	87.1	90.2	89.8	88.4	87.2	83	87.4
1500h	76.3	72.7	63.4	51.2	47.5	52.7	54.4	58.5	63.7	71.8	79	79	64.2

The RH at the mine site and Pickle Lake follows a similar pattern throughout the year. The early morning (0600h) RH is generally consistent throughout the year and is slightly higher from May to October. An inverse trend is seen in the daytime (1500h) RH. During summer, the air is warmer and has a greater capacity to hold moisture, as such daytime RH is relatively lower. As the temperature cools at night during the summer, the capacity of the air to hold moisture decreases, and the RH increases. In winter there is less of a diurnal contrast in RH, however, night temperatures are generally still colder than daytime, which results in higher daytime RH. The daytime and nighttime RH is most similar in December as there is the least difference between daytime and night time temperature.

The similarity of the Project station RH with the Pickle Lake climate normals suggests that there is little difference in RH throughout the region and among different years.

3.1.3.8 Evapotranspiration

Evapotranspiration is the combination of evaporation from water and soil surfaces and the release of water to the atmosphere through transpiration by vegetation. When water is not limited, evapotranspiration occurs at a potential rate that is dependent on meteorological conditions.

When water is limited, the amount of evapotranspiration will be less than the potential and is referred to as actual evapotranspiration (AET). The potential evapotranspiration (PET) can be estimated using empirical equations. For example the Thornthwaite method is commonly used an employs mean temperatures and an adjustment factor for latitude to estimate PET (Gray, 1970).

Actual evapotranspiration depends on antecedent soil moisture conditions and the ability of the vegetation to draw water from the soil though capillary action. The soil in wetland areas is assumed to be saturated during the whole year and AET will be equal to PET. The soil is not saturated throughout the year in non-wetland areas. During summer, moisture becomes limited AET is lower than PET.

Monthly PET was estimated using the Thornthwaite equation described in Gray, 1970, and the synthetic long-term monthly temperature record for the mine site. Singer and Cheng, 2002 provide a summary of climatological statistics recorded at various meteorological stations throughout northern Ontario and estimates of PET and AET for several locations, including Lansdowne House. The ratio of PET to AET for Lansdowne House was used to estimate AET at the mine site. The evapotranspiration data for the mine site are presented in Table 3.1-16.

Table 3.1-16 Mean Monthly Evapotranspiration

	Mean Monthly Evapotranspiration (mm)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
PET	0	0	0	0	49	106	120	117	69	12	0	0	473
% of Annual PET					10%	22%	25%	25%	15%	3%			
AET	0	0	0	0	49	106	105	96	65	12	0	0	433
% of PET					100%	100%	86%	78%	94%	100%			

NOTES:

1. PET ESIMATED FROM LONG-TERM MINE SITE SYNTHETIC MEAN MONTHLY TEMPERATURE USING THE THORNTHWAITE METHOD, WHICH ASSUMES THAT WHEN MEAN MONTHLY TEMPERATURE IS BELOW ZERO, PET IS ZERO.
2. ESTIMATED AET BASED ON LANSDOWNE HOUSE DATA IN SINGER AND CHENG, 2002.

The PET is not expected to vary significantly east to west throughout the region. The PET is expected to be greater in the southern part of the region because of greater insolation and higher mean monthly temperatures.

3.1.3.9 Solar Radiation

Solar radiation describes the amount of incoming shortwave solar radiation or insolation and is expressed in watts per square metre. At the top of the atmosphere, the earth receives a theoretical maximum of 1,367 W m^{-2} (the solar constant). Solar radiation is absorbed, reflected and/or transmitted as it travels through the atmosphere and these processes are responsible for the distribution of temperature throughout the atmosphere.

The amount of solar radiation received at the surface of the earth depends on location (latitude), time of day, time of year, and atmospheric conditions (gas, droplet, and particle composition). The Project station measures incoming solar radiation using an upward looking shortwave pyranometer. Reflected solar radiation from the surface is not measured.

The monthly peak incoming solar radiation recorded at the Project station during 2012 are shown in Table 3.1-17. The data from 2012 were used as there were no gaps in the data record.

Table 3.1-17 Mine Site Monthly Peak Incoming Solar Radiation

	Incoming Shortwave Radiation (W/m²)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly Peak	367	548	709	927	1003	1129	1055	1049	785	717	371	334

The incoming solar radiation depends on latitude and will be generally consistent throughout the region. The trans-load facility is approximately two degrees of latitude south of the mine site. As such, it will receive slightly more incoming solar radiation.

The amount of radiation absorbed at the surface depends on the surface albedo, which is the ratio of incoming solar radiation that is reflected by an object. In northern Ontario, surface albedo changes seasonally as boreal forests have a low albedo and snow has one of the highest albedos of all natural surfaces. However, albedo does not remain constant during winter. Snow intercepted in the forest canopy rapidly increases the surface albedo. As the snow sublimates or melts from the canopy, the albedo drops rapidly. As such, in forested areas the amount of solar energy absorbed in winter can vary considerably (Betts and Ball, 2012).

3.1.4 Climate Change

The Canadian Centre for Climate Modelling and Analysis (CCCMA) has developed a number of climate models to study climate change and variability and to understand the various processes which govern the climate system. The models are also used to make quantitative projections of future long-term climate change on time scales ranging from seasons to decades (given various greenhouse gas and aerosol forcing scenarios) (EC, 2013c). Global climate models utilize atmospheric and oceanic general circulation models (GCM) to understand climate and project climate change scenarios. However, the typical spatial resolution of GCMs ranges from 1 to 5 degrees latitude or longitude and their projections are more suitable for forecasting climate at a continental scale. Regional climate models (RCM) are used to simulate smaller-scale atmospheric features and respond in a consistent way to different external forcing (e.g., changes in atmospheric chemistry).

The CCCMA has developed several versions of the Canadian Regional Climate Model (CRCM) for forecasting regional scale climate in Canada. The latest version is the CRCM 4.2.3, which is described in Music and Caya (2007). In the CRCM 4.2.3, climate is modelled for the 1961 to 2100 period, with past climate conditions being typically used for model validation. The validation of the CRCM 4.2.3 simulations with past climate show that biases in the model vary over regions and seasons within Ontario (Ouranos, 2010). For example, daily mean, minimum and maximum temperatures are well simulated but the daily diurnal temperature range, especially in the fall, is not well simulated in northern Ontario. In addition, the model tends to overestimate and underestimate the precipitation amounts in spring and fall, respectively, for the Far North Region. Nonetheless, the CRCM is expected to provide the most reliable estimate of future climate change for the Project.

To provide a forecast of potential changes in climate, the results from the CRCM 4.2.3 simulations were obtained for the 45 km horizontal grid cell closest to the mine site. The simulations were obtained for years 1961 to 2100 and were driven by the CGCM3.1/T47, following the Intergovernmental Panel on Climate Change (IPCC) observed 20th century 20C3M scenario for years 1961 to 2000 and the SRES A2 scenario for years 2001 to 2100 (CCCMA, 2013).

The CRCM 4.2.3 estimates of temperature and precipitation for the mine site are summarized in Table 3.1-18.

Table 3.1-18 Summary of CRCM Estimates of Mine Site Temperature and Precipitation

Date Range	January Mean Temperature	July Mean Temperature	Total Annual Precipitation
1961-2000	No significant trend	Positive trend (Slope: 0.04)	No significant trend
2000-2100	Positive trend (Slope: 0.08)	Positive trend (Slope: 0.06)	Positive trend (Slope: 0.85)
2015-2029	No significant trend	No significant trend	No significant trend

The CRCM results from 1961 to 2000 show no significant trend in January mean temperatures or total annual precipitation. However, the observed temperature and precipitation data from Lansdowne and Pickle Lake showed significant positive trends over the same time period.

The CRCM forecasts in temperature and precipitation for 2000 to 2100 show significant positive trends in January and July mean temperatures and total annual precipitation. The January mean temperatures are forecasted to increase by eight degrees, the July mean temperatures by six degrees, and the total annual precipitation by 85 mm from 2000 to 2100. These forecasted changes in temperature are double the observed trend in mean January temperature from the 1941-2012 Lansdowne House data and over double the observed trend in January temperature from the 1934-2012 Pickle Lake data. No temperature trends were evident in the observed Pickle Lake or Lansdowne House July mean temperature so the forecasted increase of six degrees is quite different than what has been observed. The forecasted increase in total annual precipitation is less than one third of the observed trend in the 1934-2011 Pickle Lake total annual precipitation data. As such, the forecasted increase in precipitation is expected to occur at a slower rate than has been observed in the past.

The CRCM forecasts over the construction and operation phases of the mine (2015 to 2029) were analysed. No significant trends in temperature or precipitation were observed. Despite the forecasted long-term change in climate, little change in climate is expected over the life of the Project.

3.1.5 Climate Trends

Short-term variability in seasonal or annual climate is expected to have a greater influence on the Project than long-term trends that occur more gradually. Short-term variability in regional climate are typically be driven by decadal scale processes, such as the North Atlantic Oscillation (NAO), which is defined by surface pressure difference between the north Atlantic and the subtropical Atlantic. When the NAO is in a warm phase the air pressure in the north Atlantic is reduced relative to the subtropical Atlantic and there is less chance that polar air will move southward. When the NAO is in a cold phase, polar pressures are increase and cold air moves further southward. The NAO exhibits considerable inter-seasonal and inter-annual variability, and prolonged periods (several months) of both positive and negative phases of the pattern are common. The wintertime NAO also exhibits significant multi-decadal variability (Bell and Chelliah, 2006).

Trends in climate were assessed through an examination of long-term precipitation and temperature records and are discussed in the following sections.

3.1.5.1 Trends in Surface Temperature

Surface temperature has been measured since the mid-1600s in Europe and since the mid-1800s at a global scale. Several stations in Canada have been recording temperature and precipitation since the mid-1800s to early 1900s. Long term climatological records often contain systematic variations in the data due to changes in station location, exposure, instrumentation, observing procedures and/or observer (Vincent et al., 2002). As a result, variations in the data may not be solely related to changes in climate. The Climate Research Division of EC has developed homogenized monthly mean surface air temperature data sets to remove or minimize systematic variation and render the data more suitable for climate trend analysis. The temperature data from over 300 stations across Canada are subject to rigorous examination and are adjusted to correct for any data problems. I some cases, data records are extended by joining co-located stations, especially during the early 1940s when many rural stations were relocated to airports and the mid-1990s when many stations ceased human observations (Vincent et al., 2012).

The homogenized monthly mean surface air temperature dataset are summarized by Vincent et al., 2012 and show that the annual mean temperature in Canada has increased by approximately 1.5°C from 1950 to 2010. The warming is more pronounced in the daily minimum (nighttime) temperature than in the daily maximum (daytime) temperature. A greater warming is evident over winter, with a positive trend of 2.3°C from 1950 to 2010. Winter trends occurred mainly in western, southern and northern Canada, while decreasing trends were evident on the east coast.

Homogenized surface air temperature data are available for Lansdowne House from 1941 to 2012 and for Pickle Lake from 1934 to 2012. To detect a linear trend in the temperature data, a widely used nonparametric Mann-Kendall statistical test was applied (Mann, 1945; Kendall, 1975). The Mann-Kendall test is preferred over standard parametric tests such as regression because it does not assume the data follow a specific distribution, does not require data to be normally distributed, and it is less sensitive to extreme or missing values. The magnitude of the trend was calculated using Sen's Slope, which calculates the slope of the trend as a change in measurement per change in time (Sen, 1968). The significance of the trend is determined by whether or not the Sen's slope is statistically different from zero (Gocic and Trajkovic, 2013).

The trends in Lansdowne House and Pickle Lake homogenized monthly mean surface air temperature for June and July and the mean annual surface air temperature are summarized in Table 3.1-19. The trends in surface temperature were evaluated for the entire data record and for the 1980 to 2012 period.

A positive trend is evident in the mean January temperatures and the mean annual temperatures at the Lansdowne House and Pickle Lake over the entire data record. No significant trends were observed in the mean July temperatures at either station. The data from 1980 to 2012 at both stations show considerably more variability in the mean annual temperature than during the entire period of record. Although many have suggested that temperatures have been rising at a greater rate in the last several decades (REF), no significant trends were evident in the July, January, or annual mean temperature from 1980 to 2012.

Table 3.1-19 Summary of Trends in Surface Air Temperature

Station	Mean January Temperature	Mean July Temperature	Mean Annual Temperature
Lansdowne House 1941-2012	Positive trend (Slope: 0.04)	No significant trend	Positive trend (Slope: 0.01)
Lansdowne House 1980-2012	No significant trend	No significant trend	No significant trend
Pickle Lake 1934-2012	Positive trend (Slope: 0.03)	No significant trend	Positive trend (Slope: 0.02)
Pickle Lake 1980-2012	No significant trend	No significant trend	No significant trend

3.1.5.2 Trends in Precipitation

The measurement of precipitation in Canada was initiated in the mid-1800s and a variety of precipitation gauges have been used since (Metcalfe et al., 1997). Detailed documentation of the instruments, including their type, location and environment, is crucial for time series analysis since measurements can be affected by several types of change during a station's history. In the mid-1990s the first generation of adjusted precipitation data for Canada was developed to account for changes in station parameters and to provide for a more accurate estimate of trends. For each type of raingauge, corrections were applied to account for wind undercatch, as well as evaporation and wetting losses from within gauges. Snowfall data were adjusted to correct for density bias and an adjustment was performed to account for trace observations of both rain and snow. Data from neighbouring stations were sometimes joined and adjustments were applied based on a simple ratio computed using available periods of overlapping data (Mekis and Hogg, 1999). A second generation dataset was developed to include several improvements in the correction procedures and stations with longer periods of observation (Mekis and Vincent, 2011). The proper adjustment of precipitation data is important as bias correction can change the magnitude and/or direction of a trend, which are independent of changes in climate (Ding et al., 2007).

Mekis and Vincent (2011) summarize the linear trends in annual and seasonal rainfall and snowfall throughout Canada. Annual rainfall in Canada has increased by about 12 % from 1950 to 1990. Positive trends are noted across the country, including northern regions. The greatest increase in rainfall has occurred during the spring and during the summer, the pattern of change is less consistent. Annual snowfall in Canada has increased by about 4% from 1950 to 2009. However, the change is not spatially of temporally consistent.

The trends in Pickle Lake adjusted precipitation dataset (snowfall, rainfall, and total annual precipitation) were evaluated using the Mann-Kendall test and Sen's slope. The trend analysis is shown in Appendix 1 and summarized in Table 3.1-20.

Table 3.1-20 Summary of Trends in Precipitation

Station	Annual Snowfall	Annual Rainfall	Total Annual Precipitation
Pickle Lake 1934-2011	Positive trend (Slope: 1.5)	Positive trend (Slope: 2.1)	Positive Trend (Slope: 3.3)
Pickle Lake 1980-2011	No significant trend	Positive trend (Slope: 8.0)	Positive trend (Slope: 9.7)

The trends in the Pickle Lake adjusted precipitation data show that annual snowfall, rainfall, and total annual precipitation has increased from 1934 to 2011. The strongest positive trend is evident in the total annual precipitation, especially during the 1980 to 2011 period. The increase in total annual precipitation from 1980 to 2011 appears to be driven by an increase in the annual rainfall as there was no significant trend in annual snowfall during this period.

3.1.5.3 Trends in Snowcover

Snow is an important component of climate as several fundamental properties of snow modulate energy exchange between the surface and the atmosphere. The most important properties are the way in which snow changes the surface albedo, the thermal insulating properties of snow, and the latent heat exchanged when snow changes state (Armstrong and Brun, 2008). Snow cover has implications to climate change as snow cover extent and temperature are negatively correlated through the snow-albedo feedback mechanism, with the strongest feedbacks occurring during the spring melt period (Chapin et al., 2005).

Satellite data suggest that snow cover extent in the Northern Hemisphere has decreased by about 5% over the 1966 to 2004 period (IPCC, 2007). Climate warming impacts on snow cover would result in an earlier spring melt, shorter snow cover season, lower peak snow accumulations and higher potential for rain-on-snow and thaw events. As such, changes to snow cover are expected to have the greatest effect on water resources, most notably the reduction in spring runoff and the increased potential for evaporation. However, the snow cover response to warming temperatures is complicated by projected increases in precipitation, especially over northern latitudes. The response to warming could vary with latitude and elevation, with potential for increased accumulation sufficient to offset reductions in the length of the snow cover season (Raisanen, 2007).

Trends in snow cover over large spatial and temporal domains are hard to quantify, especially from in-situ data. Brown and Mote (2009) summarize trends in Northern Hemisphere snow cover from climate station data, satellite data, modelled datasets, and snow water equivalent climatology. The results of their analysis suggest a complex response of snow cover to a climate change of increasing temperature and precipitation. Snow cover duration is expected to have the strongest sensitivity to warming, although snow cover changes are expected to be slower over the continental interiors, including northern Ontario.

3.1.6 Ambient Air Quality

3.1.6.1 Overview

The Project is located in a remote part of northwestern Ontario. There are no significant nearby sources of anthropogenic air emissions and no significant emissions from current activities in the RSA. In general, air quality in the RSA is expected to be excellent. Air quality has the potential to be influenced by long range transport of emissions from the south, and from natural sources, such as forest fires (MOE, 2010a). Localized dust and exhaust emissions are present from vehicular traffic on the unpaved section of the existing Pickle Lake North Road. Similarly, exhaust emissions are also present from vehicular traffic along Highway 599 between Pickle Lake and the Savant Lake trans-load facility location.

Baseline air quality for the Project includes the collective concentration of pollutants such as gases, vapours, or solid particulate substances within the RSA. At concentrations above their normal ambient levels, it is assumed that these substances have the potential to produce a measurable effect on humans, animals, vegetation, and that they may cause damage to property and/or the environment. It is also assumed that contaminants from urban area sources (e.g., transportation, ore smelters, other industrial processes, and residential heating) could be carried into the Project airshed (MOE 2010a).

As per Section 9.1.2.4 of the EIS Guidelines, no Project specific background air quality monitoring was required. Baseline air quality was estimated from provincial and federal data sources.

3.1.6.2 Regional Data Sources

<u>Provincial Data</u>

The Environmental Monitoring and Reporting Branch (EMRB) of the MOE monitors air quality at 40 stations throughout Ontario as part of the Air Quality Index (AQI) program. These stations continuously measure concentrations of six common air pollutants: ground-level ozone (O3), particulate matter (PM), nitrogen dioxide (NO2), carbon monoxide (CO), and sulphur dioxide (SO2). The monitoring program informs the public about Ontario’s ambient air quality, evaluates long-term trends, provides the basis for air policy/program development, and is used to determine impacts from United States and Canadian sources on Ontario’s air quality (MOE, 2011). These stations are routinely inspected and maintained to ensure a high standard of quality control and the validity of the data collected.

The MOE air quality monitoring stations are typically located in areas where air quality is expected to be a concern, such as urban environments or areas near large emitters. As such, most stations are located in southern Ontario and are influenced by regional emissions and in some cases transboundary emissions. To establish baseline air quality in the Project area, MOE data for the most northern monitoring stations were considered (Table 3.1-21).

In terms of data interpretation, it is assumed that the higher concentration values recorded at these stations are a reflection of local sources and an urban environment. In contrast, the lower concentrations values recorded at these stations are assumed to be indicative of conditions where anthropogenic sources do not have as much influence (e.g., under northerly air flow conditions).

Table 3.1-21 MOE AQI Station Summary

Station Name	Station ID	Year[1]	Air Intake (m AGL)[2]	Type[3]	O_3	PM	NO_2	CO	SO_2
North Bay, ON	75010	1979	4	A/RS	X	X	X	-	-
Sault Ste. Marie, ON	71078	2004	8	A	X	X	X	X	-
Sudbury, ON	77219	2004	3	A/C	X	X	-	X	-
Thunder Bay, ON	63203	2004	15	A/RS/C	X	X	X	-	-

NOTES:
1. YEAR - FIRST YEAR OF DATA COLLECTION.
2. mAGL REFERS TO METERS ABOVE GROUND LEVEL.
3. "TYPE" REFERS TO THE TYPE OF MONITORING STATION, WHERE A = AMBIENT, RS = ROAD-SIDE, C = CANADA WIDE STANDARDS (CWS).

Federal Data

The Canadian Air and Precipitation Monitoring Network (CAPMoN) is operated by Environment Canada and studies the regional patterns and trends of atmospheric pollutants. CAPMoN is an air quality monitoring network with siting criteria that is designed to ensure that the air monitoring locations are regionally representative of non-urban areas (i.e., not affected by any local sources of air pollution). As of 2010, there were 33 CAPMoN stations across Canada, predominantly located in central and eastern Canada. Measurements reported from the CAPMoN stations typically include:

- Wet only precipitation (24 hour integrated sample)
- Particle and trace gas concentrations - Non-size selective filter (24 hour integrated sample)
- Mercury in precipitation (7 day integrated sample)
- Continuous ground level ozone (hourly averages reported)
- Continuous total gaseous mercury (hourly averages reported)
- Reactive nitrogen (hourly averages reported)
- Coarse and PM2.5 mass (24 hour integrated samples on a 1 day in 3 schedule)

The closest Ontario-based CAPMoN stations to the Project are located at Bonner Lake, Pickle Lake and the Experimental Lakes Area (ELA), near Kenora Ontario.

The National Air Pollution Surveillance Program (NAPS) was established in 1969 to provide accurate and long-term air quality data of a uniform standard across Canada. The sites in the NAPS network were selected based on the requirements for distribution, location, separation and spatial scale of representativeness. Depending on the specific reasons and purpose for monitoring, some or all of the air quality criteria pollutants may be monitored at each station. In addition, some stations are part of the CaPMoN stations and/or are used by provincial jurisdictions for air quality index (AQI) reporting. NAPS stations in northern Ontario include North Bay, Sudbury, Thunder Bay, and the ELA. Due to the urban locations of most NAPS stations in Ontario, the NAPS stations in Fort Chipewyan, Alberta, and Fort Liard, NWT were selected to represent remote northern areas.

The CAPMoN and NAPS stations closest to the Project are listed in Table 3.1-22. The mean annual concentrations from the 2011 NAPS data were used as they are the most recent data available online.

Table 3.1-22 CAPMoN and NAPS Station Summary

Station Name	Type	CAPMoN	NAPS	O_3	PM	NO_X	CO	SO_2
Bonner Lake, ON	Undeveloped	X	X	X				
Pickle Lake, ON	Undeveloped	X	X	X				
Experimental Lakes Area, ON	Forest	X	X	X				
North Bay, ON	Residential		X	X	X	X		
Sault Ste. Marie, ON	Industrial		X	X	X	X		X
Sudbury, ON	Commercial		X	X	X			X
Thunder Bay, ON	Residential		X	X	X	X		
Fort Chipewyan, AB	Undeveloped		X	X	X	X		X
Fort Liard, NWT	Residential		X	X	X	X		X

Given the remote location of the Eagle's Nest Project, it is assumed that ambient air concentrations will be similar to those reported at stations classified as undeveloped.

3.1.6.3 Ambient Air Quality Concentrations

Nitrogen Oxides

Nitrogen oxide emissions occur as a result of high-temperature combustion processes. There are several forms of nitrogen oxides, of which nitric oxide (NO) and nitrogen dioxide (NO2) are the most common forms found in air emissions. Nitrogen oxides in the atmosphere are expressed as equivalent mass concentration of NO2. Nitrogen dioxide is considered a harmful air contaminant that can combine with anthropogenic or natural volatile organic compounds (VOCs) to form photochemical smog. A summary of mean monthly NO2 values from regional stations is presented in Table 3.1-23.

Due to its remote non-urban location, the average annual concentration of 1 ppb at Fort Chipewyan is assumed to be most representative of long-term ambient conditions in the Project RSA.

Table 3.1-23 Mean Monthly Ambient NO2

Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Stdv
North Bay, ON	14	14	10	8	5	5	5	5	5	6	7	7	7	8
Sault Ste. Marie, ON	8	8	6	5	4	4	4	4	3	4	7	7	5	5
Thunder Bay, ON	12	12	12	10	7	6	5	5	6	7	10	10	9	7
Fort Chipewyan, AB	3	2	1	0	0	1	0	0	1	1	1	2	1	2

NOTES:
1. CONCENTRATION OF NO2 IN PARTS PER BILLION (ppb).
2. MONTHLY DATA SUMMARIES FROM 2011 NAPS DATA.

Sulphur Dioxide

Sulphur dioxide is a colourless gas with a pungent odor, which in the presence of water vapour can be readily transformed to sulphuric acid. SO2 can be oxidized to form acid aerosols and is the precursor to sulphates, which are a main component of respirable particles in the atmosphere. The majority of the SO_2 emitted in Ontario comes from smelters and other utilities (MOE, 2013). SO_2 is typically associated with fuel burning activities, including diesel power generation. A summary of mean monthly SO_2 from regional stations is presented in Table 3.1-24.

Table 3.1-24 Mean Monthly Ambient SO2

Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Stdv
Sault Ste. Marie, ON	1	1	0	1	1	1	1	0	0	1	1	1	1	3
Sudbury, ON	1	1	1	1	1	0	2	1	1	2	3	2	1	5
Fort Chipewyan, AB	1	0	1	0	0	0	0	0	0	0	0	0	0	1
Fort Liard, NWT	0	0	0	0	1	0	1	0	1	0	0	0	0	1

NOTES:
1. CONCENTRATION OF SO2 IN ppb.
2. MONTHLY DATA SUMMARIES FROM 2011 NAPS DATA.

The average concentration of 0 ppb at Fort Chipewyan and Fort Liard are assumed to be most representative of long-term ambient conditions for the Project study areas. These data are similar to the SO_2 concentrations of 0.04 to 0.11 ppb for remote areas published by Alberta Environment (AE, 2003).

Particulate Matter

Particulate matter is the general term used to describe a mixture of solid particles and liquid droplets in the air. It typically includes aerosols, smoke, fumes, dust, ash, and pollen. Particulate matter is characterized according to its size. PM10 refers to inhalable particulate matter, PM2.5 refers to respirable particulate matter, and TSP refers to particulate matter with an aerodynamic diameter less than 44 µm. In Ontario, PM2.5 is typically composed of elemental and organic carbon, soil, and sulphate and nitrate particles (MOE, 2013).

Ambient PM concentrations in the atmosphere are a function of both natural and anthropogenic sources and are generally defined as the PM that would be observed in the absence of anthropogenic emissions and precursor emissions of VOC, NOx and SO_2. The magnitude of background PM for a given location is difficult to determine because of the potential for long range transport of anthropogenic particles and precursors.

A summary of mean monthly PM2.5 from regional stations is presented in Table 3.1-25.

Table 3.1-25 Mean Monthly Ambient PM2.5

Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Stdv
North Bay, ON	3	4	4	3	4	5	8	4	4	4	4	3	4	4
Sault Ste. Marie, ON	3	4	3	3	4	5	8	5	4	5	5	3	4	5
Sudbury, ON	2	4	3	3	4	5	7	5	4	4	3	3	4	4
Thunder Bay, ON	3	4	4	5	4	6	7	5	5	5	5	4	5	5
Fort Chipewyan, AB	2	2	3	2	6	18	2	2	2	1	2	2	3	15
Fort Liard, NWT	3	3	5	3	6	8	5	5	4	-	3	4	5	4

NOTES:

1. CONCENTRATION OF PM2.5 IN ug/m_3.
2. MONTHLY DATA SUMMARIES FROM 2011 NAPS DATA.

The average monthly concentrations of PM2.5 are similar at most stations in Ontario. However, the concentrations can be affected by local conditions. For example, the June data from the Fort Chipewyan station show a much greater concentration than at any other station. The hourly data from the station show that the maximum concentration of PM2.5 peaked at over 300 ug/m^3 on June 1, 2011, which is a concentration well above the AACQ of 30 ug/m^3. The high concentration of PM2.5 was due to forest fire smoke in the area.

The Project is located in a region that commonly experiences forest fires during spring and summer. The flat regional topography increases the potential for the long-range transport of smoke. The seasonal spatial and temporal distribution of forest fires are difficult to predict. As such, the long term average concentrations from any of the stations could be considered to be representative of the baseline conditions in the Project study areas.

Of the regional stations presented, inhalable particulate matter (PM10) was only measured at the Fort Liard station. The data from 2011 are only 63 % complete, so the data from 2010 were used and are presented in Table 3.1-26.

The highest daily maximum PM10 in 2010 was 64.7µg/m3, which was recorded in April and was the only exceedance of the 24-hour standard (50µg/m3). Elevated PM10 readings were measured at Fort Liard during the snow-free months (April to September). The elevated PM10 at this location are attributed to the presence of gravel roads and are consistent with data from previous years (ENR, 2011).

Table 3.1-26 Mean Monthly Ambient PM10

Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Stdv
Fort Liard, NWT	6	6	6	20	18	13	14	12	8	4	5	5	10	14

NOTES:
1. CONCENTRATION OF PM10 IN ug/m^3.
2. MONTHLY DATA SUMMARIES FROM 2010 NAPS DATA.

The presence of road dust in Fort Liard may contribute to higher concentrations of PM10 than are expected in the Project study areas. Health Canada (1998) reports that the annual or long term background PM10 concentrations for remote sites in North America typically range from 4 µg/m3 to 11 µg/m3.

Carbon Monoxide

Carbon Monoxide is a colourless, odourless gas, which is poisonous at high concentrations. CO is produced primarily by the incomplete burning of fossil fuels. In Ontario, approximately 87 percent of the CO emitted is from the transportation sector (MOE, 2013).

The highest concentrations of CO are typically recorded in urban centres as a result of vehicle emissions. In 2011, the highest one-hour maximum CO value of 3.77 parts per million (ppm) and the highest eight-hour maximum CO value of 1.46 ppm were measured at the Windsor Downtown site. The one-hour (30 ppm) and eight-hour (13 ppm) AAQC for CO in Ontario were not exceeded at any of the monitoring sites in 2011.

CO is not monitored at any of the regional stations in northern Ontario and most stations in Canada that do monitor CO are located in urban environments. The typical monthly mean concentrations of CO at most stations throughout Canada ranges from 0 to 0.3 ppm.

Ozone

Ozone is found in the upper regions of the atmosphere and at ground level. Both types of ozone have the same chemical composition (O3). Upper atmosphere ozone filters out harmful radiation, while ground level ozone is the primary component of smog. Ground level ozone is not emitted directly into the air; it is created by three main mechanisms: 1) photochemical ozone formation, which is created by the chemical reaction between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight, 2) long-range transport, and 3) intrusion from the upper atmosphere (stratosphere).

Photochemical ozone formation is the primary source of ground level ozone urban environments and occurs during daylight hours in summer month, especially during hot sunny and typically stagnant weather conditions. The transport of ozone over long distance occurs in several areas of Canada, primarily in southern Ontario, where photochemical ozone is transported from large cities in the United States. The intrusion of stratospheric ozone can occur under certain conditions and has been identified as the primary source of ground level ozone in northern Canada (CCME, 2003).

A summary of mean monthly O3 from regional stations is presented in Table 3.1-27.

Generally, ozone concentrations are lower in urban areas because ozone is reduced through the reaction with NO emitted by vehicles and other local combustion sources. Ground-level ozone concentrations in Ontario frequently exceed the provincial one-hour ambient air quality criterion (AAQC) of 80 ppb. In 2011, Ontario's one-hour AAQC for ozone was exceeded at 28 of the 40 AQI stations for at least one hour. All of the exceedances occurred between May and September. The maximum one-hour ozone concentrations ranged from a low of 60 ppb recorded in Thunder Bay to 115 ppb recorded at Grand Bend (MOE, 2011). Higher numbers of one-hour ozone exceedances are generally recorded in southwestern Ontario (on the eastern shore of Lake Huron and the northern shore of Lake Erie) than recorded in over central and eastern Ontario. There were no ozone exceedances in northern Ontario during 2011.

Table 3.1-27 Mean Monthly O3

Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Stdv
Bonner Lake, ON	29	33	37	39	33	26	20	15	16	20	22	26	26	12
Pickle Lake, ON	32	37	39	42	36	34	26	21	23	24	25	29	31	10
ELA, ON	35	41	41	44	37	33	28	26	27	28	27	28	33	10
North Bay, ON	24	29	33	35	33	26	28	22	22	22	23	23	27	12
Sault Ste. Marie, ON	28	32	37	39	32	28	28	21	23	25	20	22	28	11
Sudbury, ON	28	33	38	39	32	28	29	23	23	23	23	24	29	11
Thunder Bay, ON	26	30	32	35	32	27	23	19	19	20	19	21	25	12
Fort Chipewyan, AB	28	32	36	36	37	32	24	21	23	22	25	28	29	9

NOTES:

1. CONCENTRATION OF O3 IN ppb.
2. MONTHLY DATA SUMMARIES FROM 2011 NAPS DATA.

Health Canada provides a summary of O3 concentrations at 15 sites that are not influenced by anthropogenic pollution (Health Canada, 1999). Monthly 1-hr average background ozone for the Project is expected to range from 25 to 40 ppb.

3.2 ACOUSTIC ENVIRONMENT

This section provides a description of the existing acoustic environment baseline conditions for the Eagle's Nest Project.

3.2.1 Study Area

Noise and vibrations generated from Project activities have the potential to affect receptors via airborne sound and vibration propagation. Attenuation of noise and vibration is dependent on atmospheric conditions such as wind speed, wind direction and relative humidity as well as absorbent surfaces such as buildings and topography.

The spatial boundaries for the assessment of the acoustic environment were defined as geographic areas within which there is a reasonable expectation that the Project could have an effect on ambient conditions. The study areas were selected based on the location of the emission sources, potential receptor locations, and the extent of transport, propagation, and dispersion of any air contaminants.

The regional study area (RSA) was defined by a 10 km radius surrounding the mine site, a 5 km wide band along the transportation corridor, and a 5 km radius around the trans-load facility. The local study area (LSA) was defined by a 5 km radius from the centre of the mine site, a 1 km wide band along the transportation corridor, and a 1 km radius around the trans-load facility.

3.2.2 Background

The proposed mine is located in an undisturbed area where there are no anthropogenic noise sources. The noise sources are resulting from natural events such as wind and rain; therefore it can be considered as pristine in terms of noise levels. The area is considered a rural area (Class 3) according to the classification in Ontario's noise guidelines. Based on research conducted by the Environment Council of Alberta, the average rural ambient sound level in Alberta is about 35 dBA Leq at night (ERCB 2007). This involves a natural area that might have a dwelling but no industrial presence. Since the Project area is considered to be in a wilderness area, the background noise levels would be equal to or less than the rural ambient sound levels considered in the research.

Baseline monitoring surveys were performed at similar locations in northern Ontario. At a relatively close location to the Project, the ambient sound levels were monitored for 24 hours at 3 stations, located in a wilderness area where no dwelling exists. The results indicate that sound levels vary between 28 dBA to 29 dBA and 24 dBA to 27 dBA during daytime and nighttime, respectively (AMEC 2009).

The literature search and regional monitoring results indicate that the ambient noise levels would be between 25 dBA and 35 dBA beyond the mine Project boundary. The mine site levels were expected to be higher than these levels because of the exploration and feasibility studies being conducted in the area.

3.2.3 Existing Noise Levels

In order to determine the existing noise levels at the mine site, noise surveys were conducted at the proposed portal location and near the exploration camp. The noise survey at the proposed portal location was conducted on June 25 to 26, 2012 for 24 hours. The obtained data show the 24-hr LAeq is 37 dBA, which indicates low sound levels although there are feasibility works in the area. The other statistical data are shown in Table 3.2-1.

Table 3.2-1 Station S01 Sound Levels (dBA)

S01, 24-Hour Monitoring	L_{AS}		L_{AF}		L_{Aeq}
	Min	**Max**	**Min**	**Max**	**Ave**
Sound Level (dBA)	22.3	59.7	22	63	37

Another noise survey was conducted within the mine boundary to augment the level of baseline information at the mine site. The monitor was located at a wetland area east of the proposed portal and south of the existing Esker camp on July 1 to 2, 2012 for 24 hours. The obtained data show 24-hr LAeq is 46.7 dBA which indicates sound levels are slightly higher than rural areas (Table 3.2-2). The minimum and maximum levels occurred in the morning (7 AM to 8 AM).

Table 3.2-2 Station S02 Sound Levels (dBA)

S02, 24-Hour Monitoring	L_{AS}		L_{AF}		L_{Aeq}
	Min	**Max**	**Min**	**Max**	**Ave**
Sound Level (dBA)	21.1	78.1	20.5	81	46.7

As a summary, the Project area including the transportation corridor, is considered a wilderness area, which requires compliance with NPC-232 guidelines which was developed for rural areas. The literature suggests 35 dBA or lower ambient noise levels for rural, or undisturbed, areas. Since baseline surveys conducted in similar conditions within northern Ontario support the suggested literature-based noise levels, the ambient noise level conditions at Project site are considered to be 25 dBA to35 dBA, depending on natural variations such as wind or rain.

The mine site area is not considered a public or a wilderness area, because there are no public access roads or natural wildlife passages or habitants. Noise levels at the mine site are regulated by noise exposure limits outlined in Ontario Health and Safety Guideline in the Project boundary (or within the fenceline). The surveys conducted at S01 and S02, located within the mine site, indicate low noise levels for the mine site.

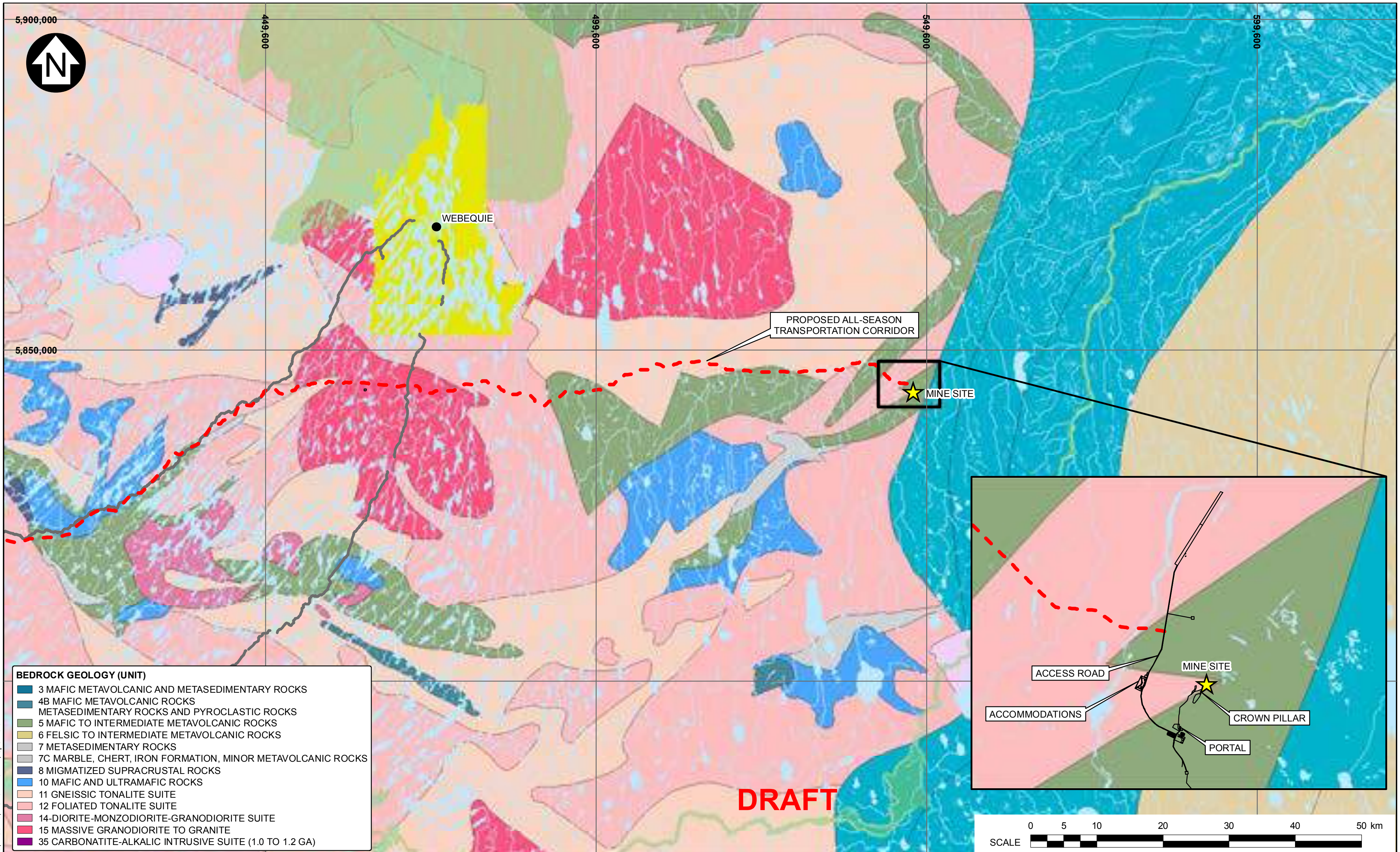
3.3 GEOCHEMISTRY

This section provides a description of the existing geochemistry baseline conditions for the Eagle's Nest Project. The supporting technical document that provides additional details regarding the study methods, results, and discussion is available in Appendix 3.

3.3.1 Introduction

The baseline geochemistry program was initiated in 2010. Based on the types of mine materials and homogeneity of the rock, 91 samples were obtained from the ore body, aggregate rock, and scavenger tailings for geochemical analysis. The data from static testing provide estimates for the total potential of metal leaching and acid rock drainage of mine rock based on geochemical properties of individual samples. Figure 3.3-1 shows the mine site regional bedrock geology. Figures 3.3-2 and 3.3-3 show the transportation corridor bedrock geology.

Tailings and waste rock are the two types of material that will be produced from the mining operation. During the operations phase, all tailings will be stored underground as either un-cemented paste backfill or cemented paste backfill. Waste rock is defined as rock not suitable for use as aggregate (construction material) due to acid rock draining (ARD) and metal leaching (ML) concerns. Rock of this nature is expected to be limited and associated only with the development of the ore body.



LEGEND:

- COMMUNITY
- PROPOSED INFRASTRUCTURE
- EXISTING WINTER ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- RIVER/STREAM/DRAINAGE
- WATER
- FIRST NATIONS RESERVE
- PROVINCIAL PARK

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. INFRASTRUCTURE INFORMATION AND PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.
4. PROPOSED CULVERTS AND BRIDGE LOCATIONS WERE CREATED FROM OPTION 1 OF THE PART 2 OF 3 ACCESS ROAD PLAN FROM TETRA TECH. (MARCH 15, 2012).
5. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).
6. ONTARIO GEOLOGICAL SURVEY 2006. 1:250 000 SCALE BEDROCK GEOLOGY OF ONTARIO; ONTARIO GEOLOGICAL SURVEY, MISCELLANEOUS RELEASE—DATA 126 – REVISED.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	AMB	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

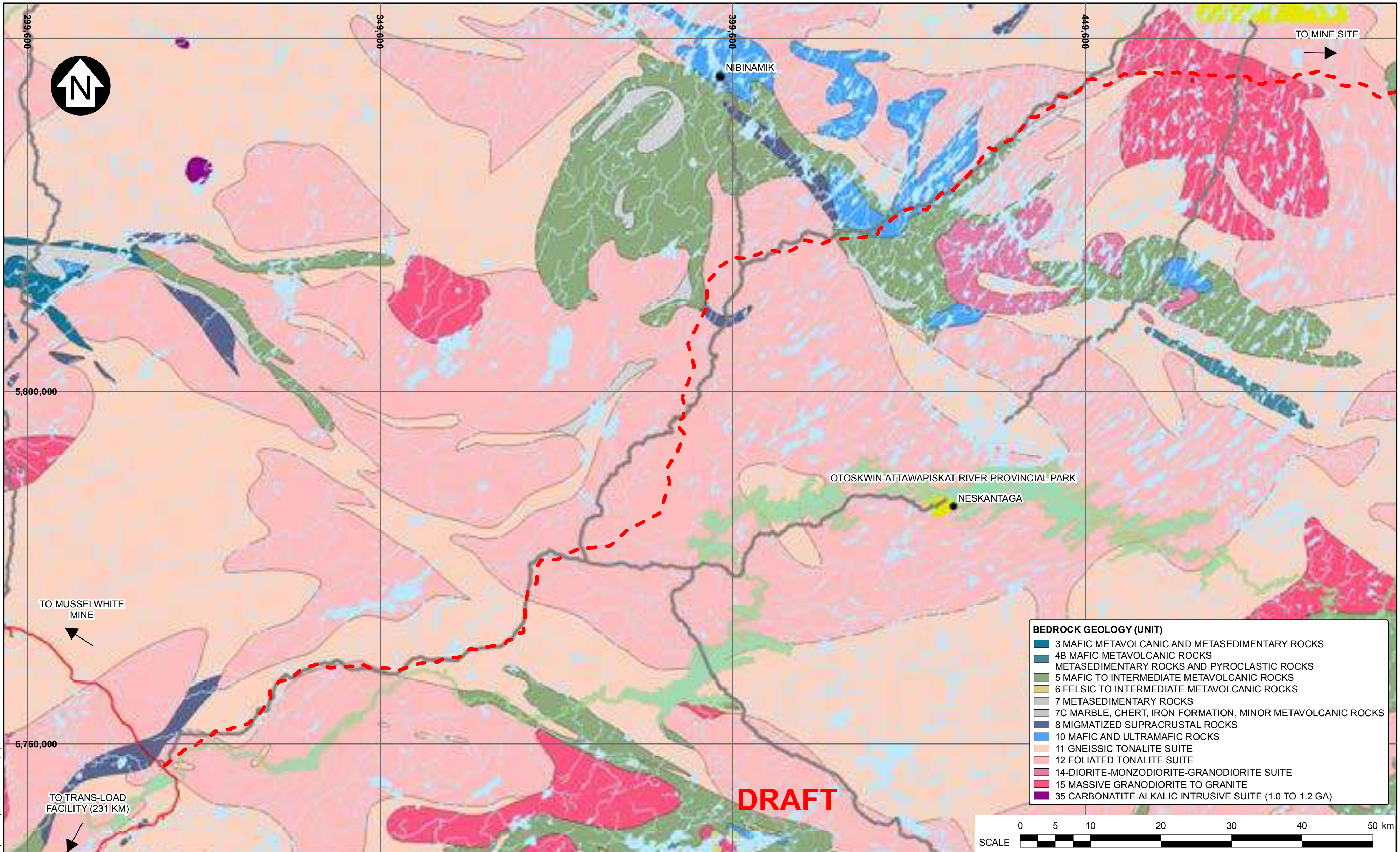
MINE SITE
REGIONAL BEDROCK GEOLOGY

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 3.3-1 | REV A

SAVED: I:\1102\00390\01\A\GIS\Figs\A659_rA.mxd; Dec 20, 2013 2:18 PM; spenfold



SAVED: I:\1\02\00390\01\A\GIS\Figs\A660_rA.mxd; Dec 20, 2013 2:25 PM; spenfold

LEGEND:

- COMMUNITY
- EXISTING ALL-SEASON ROAD
- EXISTING WINTER ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- RIVER/STREAM/DRAINAGE
- WATER
- FIRST NATIONS RESERVE
- PROVINCIAL PARK

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	AMB	SWK	SRA	RAM

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. INFRASTRUCTURE INFORMATION AND PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.
4. PROPOSED CULVERTS AND BRIDGE LOCATIONS WERE CREATED FROM OPTION 1 OF THE PART 2 OF 3 ACCESS ROAD PLAN FROM TETRA TECH. (MARCH 15, 2012).
5. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).
6. ONTARIO GEOLOGICAL SURVEY 2006. 1:250 000 SCALE BEDROCK GEOLOGY OF ONTARIO; ONTARIO GEOLOGICAL SURVEY, MISCELLANEOUS RELEASE—DATA 126 – REVISED.

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

BEDROCK GEOLOGY AND PROPOSED TRANSPORTATION CORRIDOR FROM PICKLE LAKE NORTH ROAD TO WEBEQUIE JUNCTION

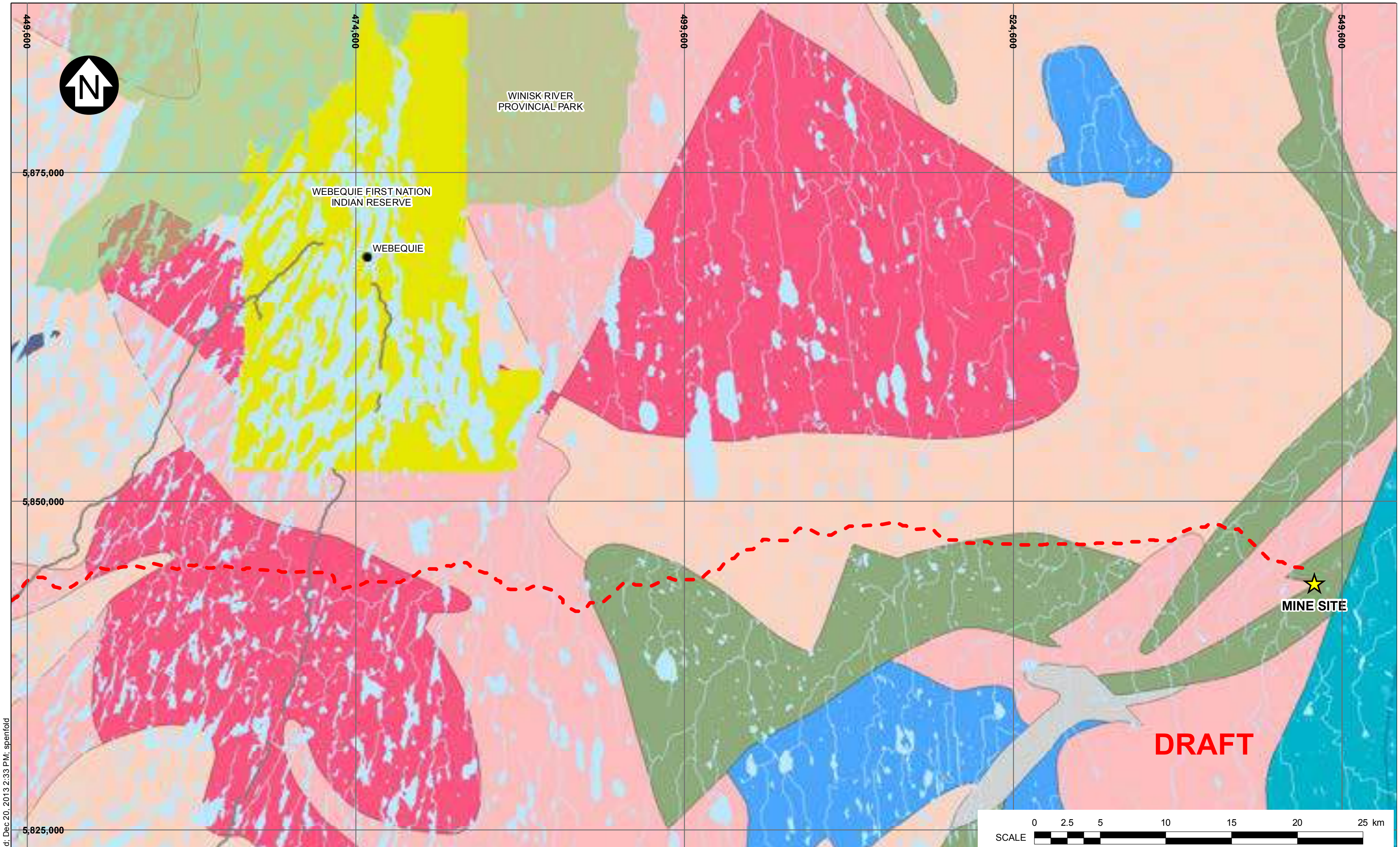
Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF NO. 34

FIGURE 3.3-2

REV A



LEGEND:

- MINE SITE
- COMMUNITY
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- EXISTING WINTER ROAD
- RIVER/STREAM/DRAINAGE
- WATER
- FIRST NATIONS RESERVE
- PROVINCIAL PARK

BEDROCK GEOLOGY (UNIT)

- 5 MAFIC TO INTERMEDIATE METAVOLCANIC ROCKS
- 7 METASEDIMENTARY ROCKS
- 8 MIGMATIZED SUPRACRUSTAL ROCKS
- 10 MAFIC AND ULTRAMAFIC ROCKS
- 11 GNEISSIC TONALITE SUITE
- 12 FOLIATED TONALITE SUITE
- 15 MASSIVE GRANODIORITE TO GRANITE
- 55E CHURCHILL RIVER GP.
- 55F BAD CACHE RAPIDS GP.

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. INFRASTRUCTURE INFORMATION AND PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.
4. PROPOSED CULVERTS AND BRIDGE LOCATIONS WERE CREATED FROM OPTION 1 OF THE PART 2 OF 3 ACCESS ROAD PLAN FROM TETRA TECH. (MARCH 15, 2012).
5. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).
6. ONTARIO GEOLOGICAL SURVEY 2006. 1:250 000 SCALE BEDROCK GEOLOGY OF ONTARIO; ONTARIO GEOLOGICAL SURVEY, MISCELLANEOUS RELEASE—DATA 126 – REVISED.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	AMB	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

BEDROCK GEOLOGY AND PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR FROM WEBEQUIE JUNCTION TO THE MINE SITE

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.3-3 REV A

SAVED: I:\1\02\00390\01\A\GIS\Figs\A661_rA.mxd; Dec 20, 2013 2:33 PM; spenfold

The ore body is known to contain sulphide bearing rocks and it is expected that the tailings will have the potential for ARD/ML. Aggregate will be obtained at the mine site from the granodiorite which surrounds the ore body. The granodiorite is expected not to be acid generating, but the potential for ARD/ML has been assessed. Construction material from aggregate quarries along the transportation corridor will be sourced from rock that is not expected to be acid generating. However, since the final quarry locations have not been assessed, the general potential for ARD/ML in the regional bedrock will be assessed.

3.3.2 Study Areas

The spatial boundaries of the study were defined as areas where rock will be extracted and acid rock drainage (ARD) and metal leaching (ML) are a concern. This includes the underground mine and aggregate quarry locations along the transportation corridor. The geochemical characterization program was focused on determining the acid generation and metal leaching behaviour of the ore, tailings, and aggregate source material within the study area.

The mine site study area includes locations where handling and storage of mine materials, including waste rock, ore, tailings, and potential construction material have the potential for acid rock drainage and/or metal leaching.

Regarding quarries along the transportation corridor, specific locations of study have not been delineated as aggregate source locations have only recently been finalized. Once final aggregate source locations can be assessed, appropriate baseline geochemistry investigations will take place following the protocol described below.

3.3.3 Background

The Project study areas are located in the Superior Province of the Canadian Shield, which is underlain by Precambrian (Archaean) rock up to several billion years old. In the James Bay Lowlands where the Eagle's Nest deposit is located, there are some Palaeozoic cover rocks overlying the Archaean basement. There have been no systematic geochemistry data collection programs in the region due to its remote location and absence of historical mining development. General synopses of geochemistry are available for typical Canadian Shield rock; however, they lack the adequate detail to assess potential impacts from the Project.

3.3.4 Methods

The sample selection, collection, analytical testing and interpretation of results were consistent with international guidelines (Price 1997; MEND 2009; GARD 2009). The baseline studies are also consistent with the requirements listed in Regulation 240/00 of the *Ontario Mining Act*.

Laboratory testing included: Modified Sobek Acid Base Accounting (ABA), Net Acid Generation (NAG) pH, Reitveld X-Ray Defraction (XRD), Whole Rock Analysis (WRA), Total Metals Concentrations, Non-acid generating (NAG) Leachate, Synthetic Precipitation Leaching Procedure (SPLP) 1312, and Shake Flask Extraction (SFE).

In order to effectively sample the ore deposit and surrounding rock, samples from all rock types and depths were collected for geochemical characterization. The samples collected were spatially and geochemically representative of the deposit and surrounding country rock. They were selected from core made available through previous exploration program drillholes.

Sample collection was not undertaken along the proposed transportation corridor because the final quarry locations had not been determined until November 2013. Regional geology suggests that the majority of the area is composed of granodiorite similar to that which been tested at the Eagle's Nest mine site.

3.3.4.1 Sampling Programs

The number of samples required to characterize the ARD/ML potential depends primarily on the extent and homogeneity of the mine materials being studied. The sampling program was defined based on a review of the drill records and the general stratigraphy of the ore body and surrounding rock. As the project moves towards development, it will be necessary to sample and complete the geochemical analysis needed to confirm design parameters and closure strategies.

In order to effectively sample the ore deposit and surrounding rock, samples from all rock types and depths were collected for geochemical characterization. The samples were spatially representative of the entire deposit, both vertically and laterally, using available exploration drillholes. The samples were selected to be representative of the expected range in geochemical characterization of the mine rock.

The geochemical characterization and testing program was initiated in 2010. Sampling programs include:

- Aggregate samples obtained by Golder Inc. in 2010. Laboratory tests on 20 samples included: modified ABA, NAG pH and 2 short term leach tests. All samples were tested for ABA, but only a select few were tested for leaching potential. Detailed results of the testing program are available in Golder, 2010b, 2010c, 2010d and 2010e.
- Scavenger tailings were sampled and tested for modified ABA and NAG pH testing (SGS, 2012). The samples included 4 tails and 4 cleaner tails.
- Aggregate samples and Ore and Host Rock samples were obtained by Knight Piésold in 2012. A total of 63 samples were collected from eight rock types for geochemical characterization (20 samples of aggregate rock and 43 samples of mine rock).

During the 2012 program, samples were collected from 32 existing exploration drillholes. The samples consisted of material collected from short discrete sections (1-2 m) of split and whole drillhole core that were selected to be representative of individual rock lithologies. The number of samples collected per rock type was roughly based on the relative volume of each rock type within the proposed mine area. Selected photos of the samples are provided in the photo log in Appendix 3.

Based on the types of mine materials and homogeneity of the rock, 91 samples were obtained from the ore body, aggregate rock, and scavenger tailings for geochemical analysis (Table 3.3-1).

Table 3.3-1 Summary of Geochemical Samples

Mine Material	Rock Types	Number of Samples
Ore and Host Rock	Gabbro	3
	Limestone/Dolostone	3
	Mafic Dykes	5
	Massive Sulphide	3
	Mineralized Peridotite	7
	Peridotite	5
	Pyroxenite	12
	Xenolithic Granodiorite	5
Aggregate	Granodiorite	40
Scavenger Tailings	Tails and cleaner tails	8

It should be noted that following the completion of the field program and data analysis, the lithology names were reclassified to the following categories:

- Ultramafic rocks: massive sulphide, mineralized peridotite, peridotite and pyroxenite
- Mafic rocks: gabbro and mafic dykes
- Intermediate rocks: not tested, minor rock type
- Felsic rocks: granodiorite
- Mixed rocks (breccias): xenolithic granodiorite
- Paleozoic sedimentary rocks: limestone/dolostone

Sample collection was not undertaken along the proposed transportation corridor because the final quarry locations have not been determined. Regional geology suggests that the majority of the area is composed of granodiorite similar to what has been tested at the Eagle's Nest mine site.

3.3.4.2 Test Procedures

All laboratory testing was carried out at the SGS Canada Inc. (SGS) analytical laboratory located in Lakefield, Ontario. Laboratory testing included:

- Modified Sobek Acid Base Accounting (ABA)
- Net Acid Generation (NAG) pH
- Reitveld X-Ray Defraction (XRD)
- Whole Rock Analysis (WRA)
- Total Metals Concentrations
- NAG Leachate
- Synthetic Precipitation Leaching Procedure (SPLP) 1312
- Shake Flask Extraction (SFE)

The methodologies for each of these laboratory tests are provided in Appendix 3.

3.3.5 Results

3.3.5.1 Ore Body and Host Rock Results

Modified Acid Base Accounting (ABA)

Minerals with a high sulphide concentration have a higher susceptibility to generate acid. Samples with a sulphide concentration greater than 0.3% (w/w) are considered PAG. The following results were observed for the 43 Ore and Host Rock samples:

- One of the three gabbro sample (ARD-16) was predicted to be likely acid generating, with a sulphide content of 6.46% (w/w) (Figure 3.3-4).
- All three of the massive sulphide samples (ARD-33, ARD-58 and ARD-61) were predicted to be likely acid generating, with sulphide contents of 29.6%, 25.4% and 26.9% (w/w), respectively.
- Five of the seven mineralized peridotite samples (ARD-32, ARD-37, ARD-46, ARD-21 and ARD-2) were predicted to be likely acid generating, with sulphide contents of 0.6%, 0.63%, 2.27%, 6.88% and 5.59% (w/w), respectively.
- One of the five peridotite sample (ARD-6) was predicted to be likely acid generating, with a sulphide content of 0.77% (w/w).
- Five of the 12 pyroxenite samples (ARD-22, ARD-31, ARD-36,, ARD-52 and ARD-55) were predicted to be likely acid generating, with sulphide contents of 0.59% 3.02%, 0.49%, 0.84% and 0.35%(w/w), respectively.
- One of the five xenolithic granodiorite was predicted to be likely acid generating, with a sulphide content of 0.39% (w/w).
- The remaining 27 samples were classified as likely non-acid generating based on a sulphide content of <0.3% (w/w). The samples with acid generating capacity containing between 0.01 and 0.3% (w/w) sulphide and an NP/AP ratio of less than 4 are characterized as being uncertain, due to the material being primarily composed of minerals that have poor acid neutralizing capacities.

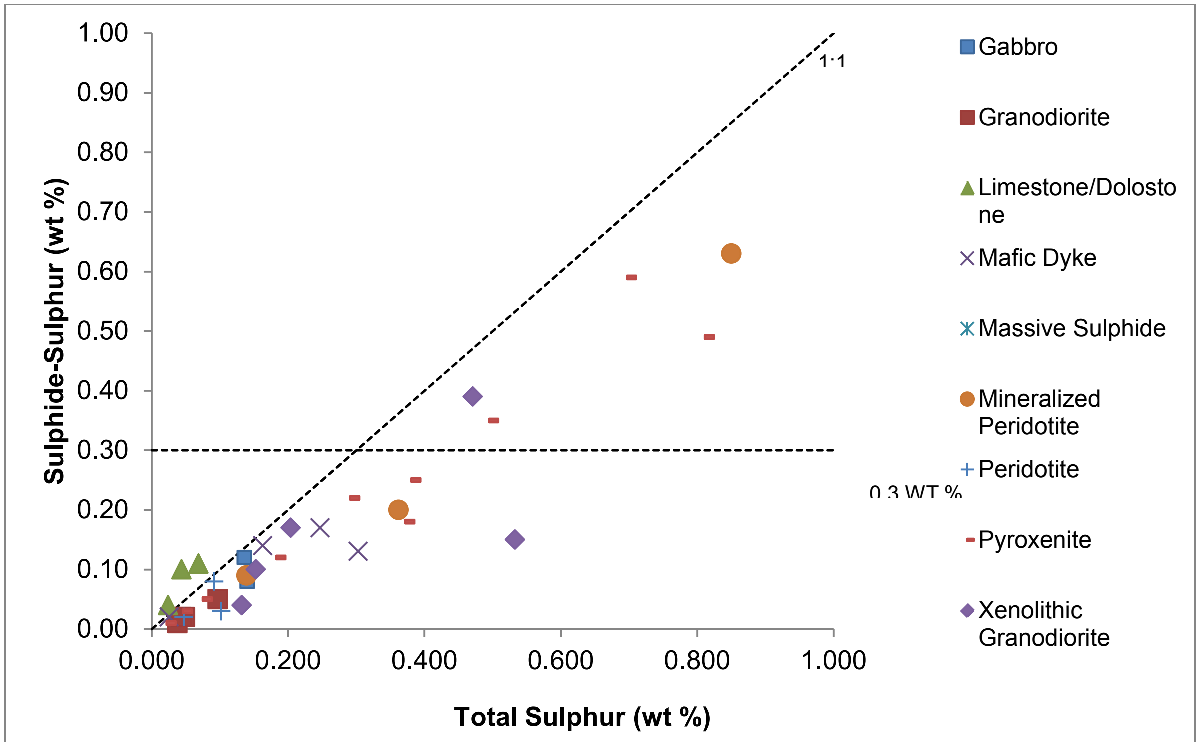


Figure 3.3-4 Sulphide-Sulphur vs. Total Sulphur

NOTES:

1. MOST SAMPLES FALL BELOW 0.3 WT % SULPHIDE AND ARE LESS LIKELY TO GENERATE ACID THAN SAMPLES ABOVE 0.3 WT%.
2. VALUES BELOW METHOD DETECTION LIMITS HAVE NOT BEEN INCLUDED DUE TO UNCERTAINTY.
3. SAMPLES WITH SULPHIDE CONCENTRATIONS ABOVE 1% ARE NOT SHOWN.
4. ONLY 2012 DATA IS PLOTTED.

The comparison of Carbonate Neutralizing Potential (CaNP) to NP shows that the majority of the samples lie below the 1:1 ratio reference line (Figure 3.3-5). This indicates that NP is not primarily made up of CaNP (carbon input). Samples that lie above the 1:1 ratio reference line may have an alternative source of carbon and samples that lie on the reference line have NP that is primarily made up of CaNP.

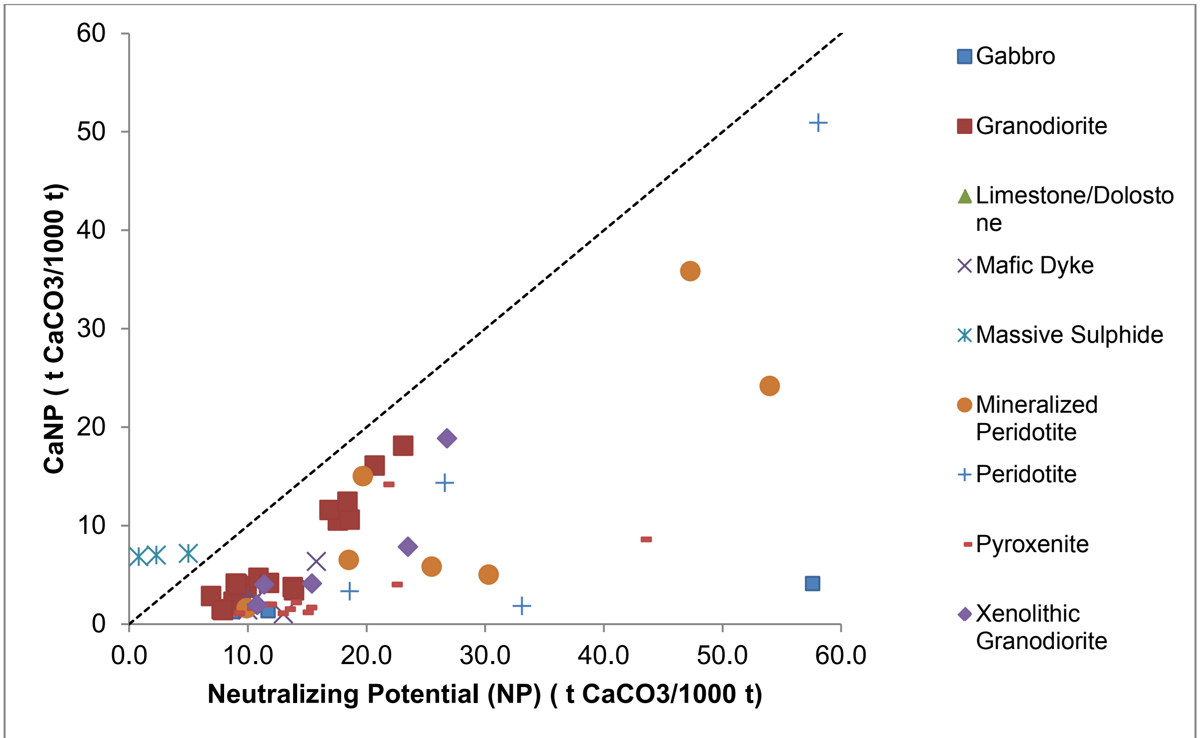


Figure 3.3-5 CaNP vs. Total NP

NOTES:

1. VALUES THAT ARE ON OR NEAR THE 1:1 RATIO HAVE NP VALUES THAT CONSIST ALMOST ENTIRELY OF CaNP.
2. ONLY 2012 DATA IS PLOTTED.

Figure 3.3-6 illustrates the relative amounts of sulphates versus sulphides in the samples. Most of the samples are sulphide-rich. Elevated sulphate concentrations are expected to increase acid generation. One sample (ARD-63, xenolithic granodiorite) indicated elevated sulphate concentrations relative to sulphide concentrations.

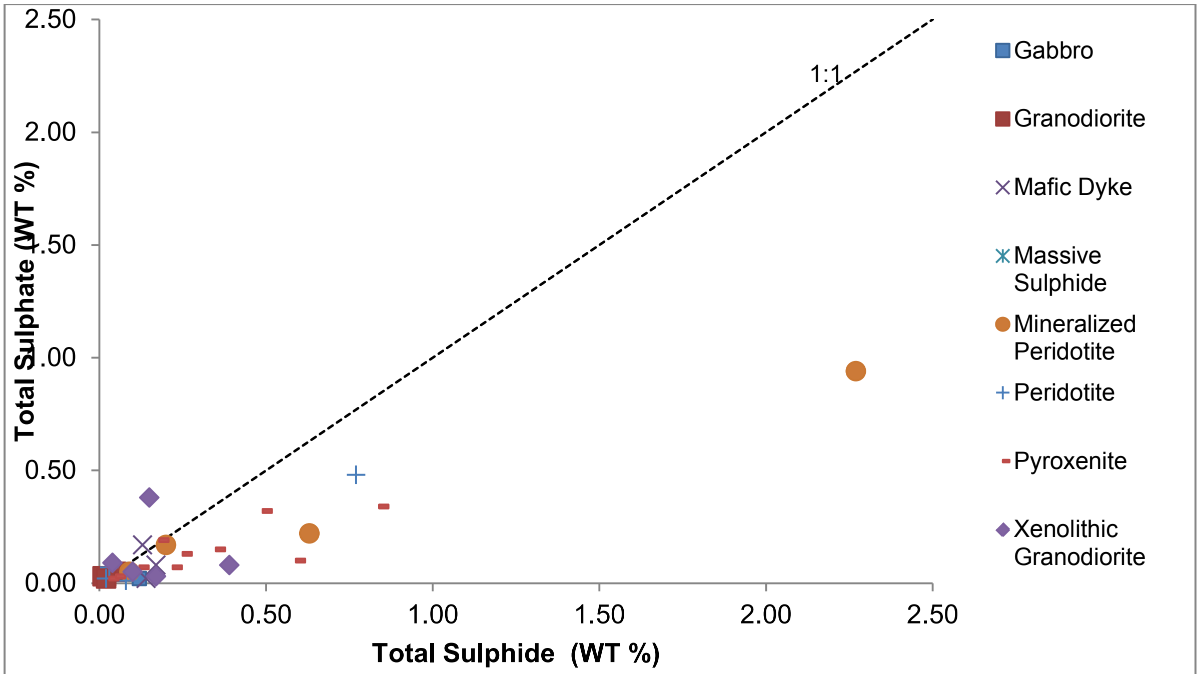


Figure 3.3-6 Sulphate vs. Sulphide

NOTES:
1. VALUES BELOW METHOD DETECTION LIMITS HAVE NOT BEEN INCLUDED DUE TO UNCERTAINTY.
2. SULPHATE (SO4) IS CONSIDERED A STRONGER ACID GENERATING AGENT THAN SULPHIDE. RELATIVE WT% SHOWS THAT MOST SAMPLES HAVE A LOW SULPHATE TO SULPHIDE RATIO.
3. ALL SULPHATE VALUES FOR LIMESTONE/DOLOSTONE WERE BELOW DETECTION LIMITS AND ARE NOT INCLUDED ON THIS PLOT.
4. ONLY 2012 DATA IS PLOTTED.

Figures 3.3-7 and 3.3-8 summarize each sample's potential for acid generation. Three categories can be recognized. Samples that have a Net NP of over 20 and an NP/AP ratio of 4:1 or greater are considered to be non-acid generating. Samples that are below a Net NP of 20 and have an NP/AP ratio of less than 4:1 are considered potentially acid generating. Samples that have Net NP < 20t$CaCO_3$/1000t or have NP/AP ratio < 4:1, but not both, are considered uncertain.

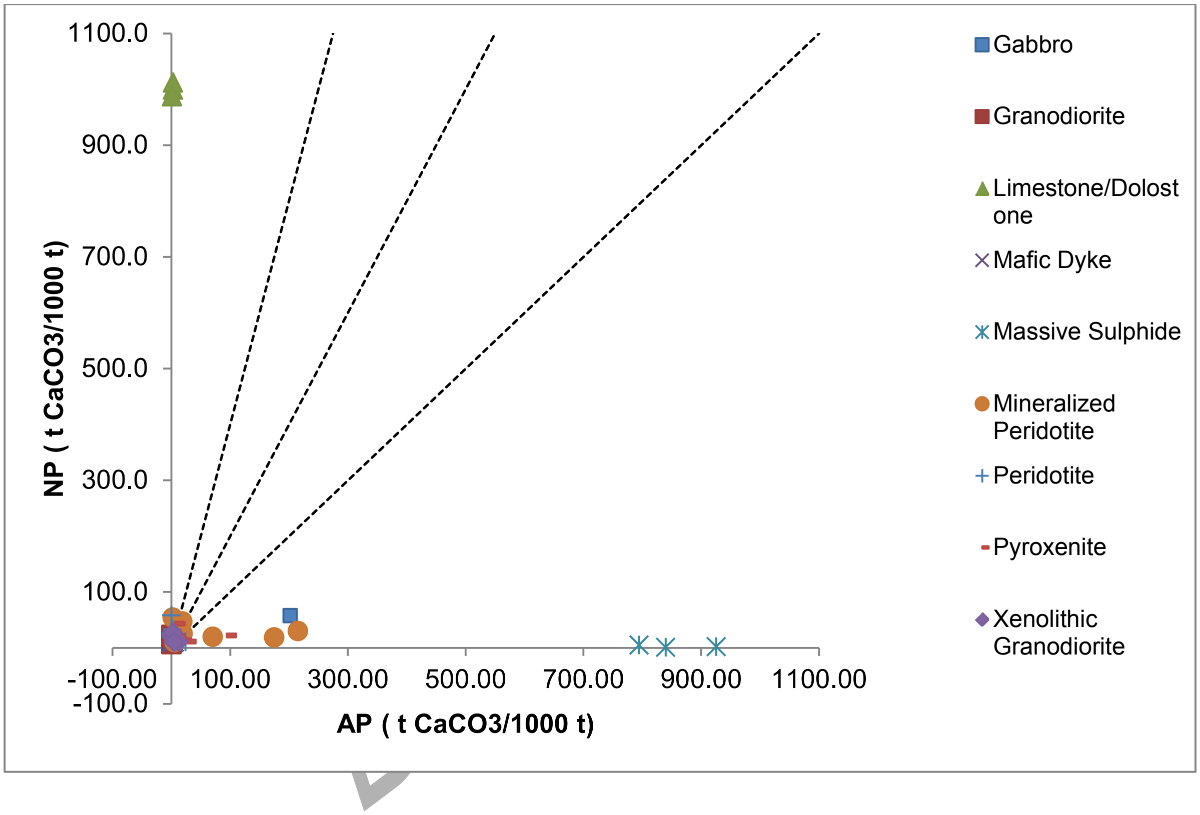


Figure 3.3-7 NP vs. AP Ratio Based on Price, 1997

NOTES:

1. INSET AREA CAN BE FOUND IN FIGURE 3.3-8.
2. ONLY 2012 DATA IS PLOTTED.

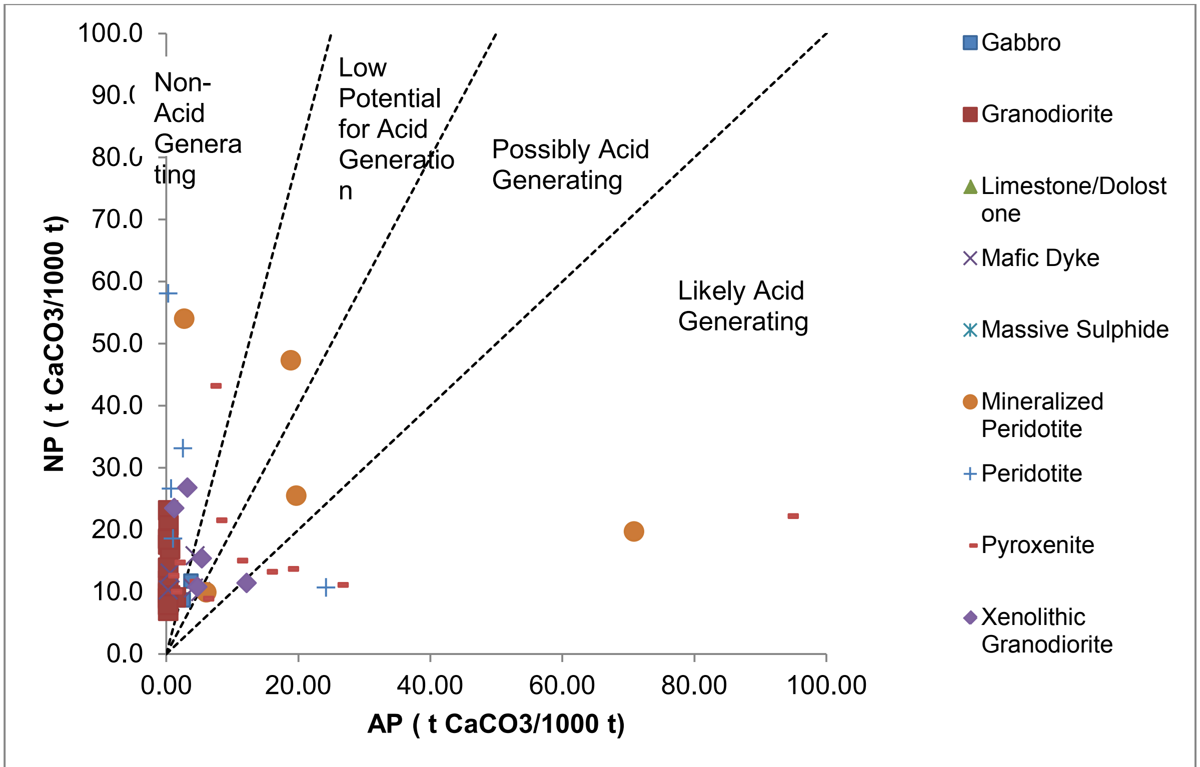


Figure 3.3-8 NP vs. AP Ratio Based on Price, 1997

NOTES:

1. INSET OF FIGURE 3.3-7.
2. ONLY 2012 DATA IS PLOTTED.

The following results are summarized from these relationships:

- 23% (10/43) of the samples are considered non-acid generating.
- 60.5% (26/43) of the samples thus far are considered likely acid generating (< 1:1 ratio).
- 16.5% (7/43) of the samples fell into the uncertain category for acid generation or neutralization potential.

Rock types that are split amongst multiple groups or samples that fall within the uncertain categories will require further investigation. In particular, more testing is needed to better classify the peridotite, pyroxenite and xenolithic granodiorite units.

Net Acid Generation (NAG) pH Results

Rock types that had individual test results with a NAG pH less than 4.5 were as follows:

- Gabbro
- Massive Sulphide
- Mineralized Peridotite
- Peridotite
- Pyroxenite
- Xenolithic Granodiorite

Samples with acid generating capacity have a NAG pH less than 4.5. In order to improve prediction confidence from ABA results, a comparison can be made between the ABA and NAG pH results (GARD Guide, 2009). Figure 3.3-9 shows the relationship of samples with a NAG pH of less than 4.5 and a NP/AP ratio of less than 1.0. These samples are considered to be PAG. The acid generating potential of a sample with a NP/AP ratio of less than 1.0 and a NAG pH greater than 4.5 is considered to be Uncertain.

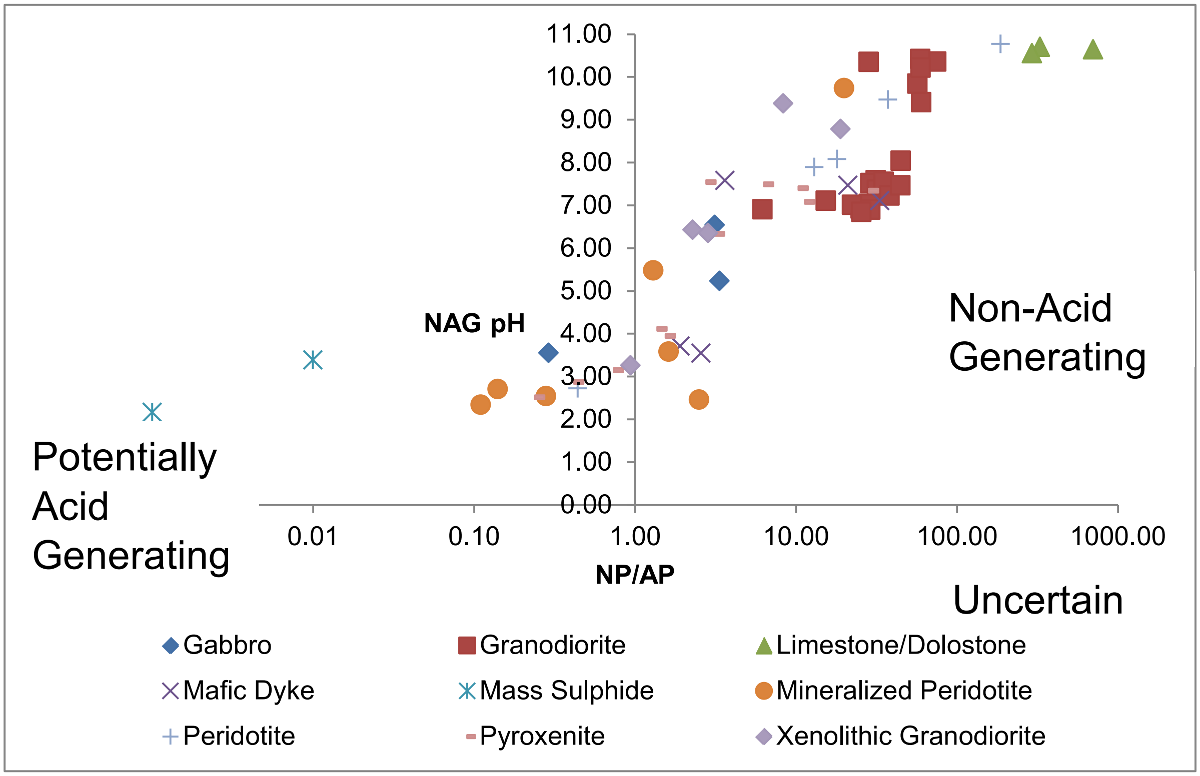


Figure 3.3-9 NAG pH vs. NP/AP Results

NOTES:

1. SAMPLES WITH A NAG pH LESS THAN 4.5 AND AN NP/AP VALUE LESS THAN 1 ARE CONSIDERED POTENTIALLY ACID GENERATING (GARD GUIDE, 2010).
2. ONLY 2012 DATA IS PLOTTED.

Given the above criterion, the following is concluded:

- 54% of the Ore and Host Rock samples are considered Non-PAG
- 30% of the Ore and Host Rock samples are considered PAG
- 16% of the Ore and Host Rock samples are considered Uncertain

These results demonstrate the same level of uncertainty as the ABA results did, however the amount of PAG rock has been reduced by half.

Metal Leaching

Total Metal concentrations within Ore and Host Rock sample which exceed the PWQO limits include: silver, bismuth, cobalt, chromium, copper, nickel, sulphur, selenium and zinc. Aggregate samples that contained elements greater than 10 times the crustal average include: bismuth and molybdenum. This indicates that there is likely a high natural abundance of these elements in this area.

SPLP test results indicate that aluminum, chlorine, chromium, cobalt, copper, iron, nickel, sulphate, vanadium and zinc within Ore and Host Rock samples had relatively elevated concentrations (compared to other parameters) under pH conditions similar to natural rainfall. These metals were found to be susceptible to leaching at levels higher than PWQOs, but were not found to exceed MMERs. Generally, the pattern of metal leaching reflects the metal abundances reported in the elemental and whole rock analyses.

3.3.5.2 Scavenger Tails and Cleaner Tailings Results

The mine plan involves the underground placement of tailings as a paste and cemented paste backfill. The tailings test results presented below are for un-modified scavenger and cleaner tailings. Of the eight samples analyzed for modified ABA test:

- All samples had sulphide concentrations greater than 4.3%
- All samples had an NP/AP ratio less than 0.29
- All samples had negative Net NP values

The eight tailings samples were also tested for NAG pH. Of the eight samples, all had a NAG pH less than 3.8. All samples also produced acid when titrated to a pH of 4.5 and 7. It should be noted that due to the high concentration of sulphides in these tailings samples, the amount of acid that was produced during the single NAG test is not typical of the total acid potential that is available from the tails. Sequential NAG testing would be required to quantify the total net acid generation from the tailings.

3.3.5.3 Aggregate Test Results

ABA Results

2010 and 2012 ABA results indicate that grandodiorite samples are not considered acid-generating based on sulphide content, NP/AP ratios and NAG pH values (Table 3.3-2). Results also suggest that aggregate rock will provide some net neutralization over time.

Table 3.3-2 Combined Aggregate Sample ABA Results

	2010 and 2012 Aggregate Samples		
	Min	Max	Mean
Paste pH	9.0	12.2	10.6
Sulphide Weight Percent (%w/w)	<0.01	0.07	0.04
Neutralizing Potential (NP) t $CaCO_3$/1000t	6.6	41.0	14.0

	2010 and 2012 Aggregate Samples		
	Min	**Max**	**Mean**
Acid Potential (AP) t $CaCO_3$/1000t	0.30	2.20	0.52
NP/AP Ratio	4.16	134	37.2

Metal Leaching

Results of SPLP tests show that aluminum, cobalt, iron and sulphate were prone to leaching in Aggregate samples. Shake flask extraction results support that these metals are susceptible to leaching, along with chlorine, boron, copper and vanadium. Generally, the pattern of metal leaching reflects the metal abundances reported in the elemental and whole rock analyses. NAG leach tests from 2010 also concur with the SPLP and SFE test results, stating that sulphate and chlorine in all samples, aluminum, iron and vanadium in most samples, and cobalt, copper, nickel and zinc in some samples are relatively high and may have the potential to leach into the environment. While the leached concentrations should not be considered as being representative of actual rock drainage water quality, they do provide an indicator of metals that may be prone to leaching.

3.3.6 Conclusions

3.3.6.1 Risk of Acid Generation

The results indicate that limited quantities of PAG materials are present within the mine area based on the samples tested. In summary:

- Ore and Host Rock Samples:
  - All tailings samples that were tested are considered PAG based on sulphide content, NP/AP ratios and NAG pH values.
  - 16 of the 43 2012 samples (37%) are considered PAG either because they had a NAG pH less than 4.5 and a NP/AP ratio of < 1:1, or they had sulphide content >0.3% (w/w).
  - 11 of the 43 2012 samples (26%) are considered uncertain because they had sulphide content between 0.01 to 0.3% (w/w) and an NP/AP ratio of < 4:1, or NAG pH less than 4.5 and a NP/AP ratio greater than 1:1.
  - 16 of the 43 2012 samples (37%) are considered Non-PAG because they had low sulphide content and because they had a NAG pH greater than 4.5 and a NP/AP ratio of >4:1.
  - Ore and Host Rock samples were rich in feldspar, quartz, amphiboles, carbonates and sulphides and contain trace amounts of micas, feldspar, carbonates, pyroxene, amphibole and sulphides. Sulphides were found as pyrrhotite, pentlandite and chalcopyrite in varying amounts throughout the Ore and Host Rock samples (26% of samples). Most of the Ore and Host Rock samples contain ore and therefore will be milled, processed and become part of the cemented and paste tailings.
- Aggregate Samples:
  - No 2010 or 2012 granodiorite samples are considered PAG based on sulphide content, NP/AP ratios and NAG pH values.

- 20 of the 20 2012 samples (100%) are considered Non-PAG because they had low sulphide content and because they had a NAG pH greater than 4.5 and a NP/AP ratio of >4:1. Aggregate samples were rich in quartz and plagioclase feldspar and contain trace amounts of micas, carbonates, phyllosilicates, amphiboles, silicates and pyroxenes. No sulphides were found in these samples.

Based on rock type, the following can be concluded:

- Granodiorite and limestone/dolostone are Non-PAG.
- Mafic dyke, mineralized peridotite and pyroxenite all had samples which are considered uncertain regarding their acid-generating potential.
- All tailings, massive sulphide, along with some gabbro, mineralized peridotite, pyroxenite and xenolithic granodiorite are considered PAG.

3.3.6.2 Net Neutralizing Potential

Of the 10 rock types that were assessed, only the granodiorite and the limestone/dolostone appear to be net neutralizing. Limestone/dolostone samples indicated they have very high NP. The limestone/dolostone along with imported carbonate rich rock can be used as a means of acid neutralization within the mine rock. The granodiorite, which constitutes the Aggregate rock, will provide some net neutralization over time.

3.3.6.3 Metal Leaching

Total Metal concentrations within Ore and Host Rock sample which exceed the PWQO limits include: silver, bismuth, cobalt, chromium, copper, nickel, sulphur, selenium and zinc. Aggregate samples that contained elements greater than 10 times the crustal average include: bismuth and molybdenum. This indicates that there is likely a high natural abundance of these elements in this area.

Results of SPLP tests show that aluminum, cobalt, iron and sulphate were prone to leaching in Aggregate samples. Aluminum, chlorine, chromium, cobalt, copper, iron, nickel, sulphate, vanadium and zinc within Ore and Host Rock samples were relatively elevated concentrations (compared to other parameters) under pH conditions similar to natural rainfall.

If the effects of dilution are removed, then leaching of cobalt, chromium, copper, nickel and vanadium was found to be more pronounced at pH 4.2 than at pH 5.5, which would be expected due to the greater acidity. Generally, the pattern of metal leaching reflects the metal abundances reported in the elemental and whole rock analyses.

Overall the results of the short term leach tests mirror the total metal analysis results with the most abundant metals showing the greatest risk of leaching. Additionally, the SFE tests also mirror these results, with chlorine, boron, copper and vanadium also showing leaching potential in Aggregate samples.

While the leached concentrations should not be considered as being representative of actual rock drainage water quality, they do provide an indicator of metals that may be prone to leaching.

3.3.7 Future Sample Selection and Testing Protocol

3.3.7.1 Further Static Testing

As the Project moves towards development, additional geochemical analysis may be required to confirm design parameters. For example, additional geochemical analyses may be required along the transportation corridor, if bedrock is to be used as aggregate material for construction. Once the quarry locations can be assessed, a sampling and testing protocol will be implemented to evaluate the ARD/ML potential of the construction material.

The number of samples that will be required for testing will depend on both the complexity of the geology, as well as the amount of rock that will be displaced. Price (1997) indicates that for a quantity of disturbed rock that is less than <10,000 metric tonnes, a minimum number of three (3) samples will be required per lithology.

Representative samples will be subject to some or all of the following geochemical testing:

- Modified Sobek Acid Base Accounting (ABA)
- Net Acid Generation (NAG) pH
- Reitveld X-Ray Defraction (XRD)
- Whole Rock Analysis (WRA)
- Total Metals Concentrations
- NAG Leachate
- Synthetic Precipitation Leaching Procedure (SPLP) 1312
- Shake Flask Extraction (SFE)

It is possible that the entire suite of testing will not be required for all samples, however ABA, NAG pH, and short term leaching tests would be conducted on all samples.

If any of the samples are found to have an elevated ARD/ML potential, alternative locations for aggregate material will be selected.

3.3.8 Kinetic Testing

The data from static testing provide estimates for the total potential of metal leaching and acid rock drainage. Kinetic testing provides information on the reaction rates of the chemical processes occurring as a result of weathering. This is an important distinction, since it is both the quantity and the reaction rates which determine the net overall potential impact of acid-generation and metal leaching. Kinetic testing is typically completed on material with acid generating potential (PAG). This testing was not completed at Eagle's Nest, since any PAG material will be stored underground within paste and cemented tailings. As the project moves forward and any PAG material may be temporarily or permanently stored on surface, kinetic testing will be required.

3.4 GEOLOGY

3.4.1 Regional Geology

The Project area forms a part of the "Ring of Fire" (ROF) in Northern Ontario (also known as the McFaulds Lake area). This area is underlain by rocks of the northwestern part of the Archean Superior Province, which is the world's largest continuously-exposed Archean craton. The northwestern Superior Province is composed of a series of major Mesoarchean volcanic and plutonic belts trending from east-west that each formed as separate microcontinents <3.0 Ga, and are separated by younger Neoarchean metasedimentary belts and crustal-scale faults. Lateral transport of the microcontinents through convergence and subduction of the oceanic crust between them eventually led to their collision and amalgamation to form the current geometry of the Superior Province.

The McFaulds Lake area, interpreted to form part of a greenstone belt, lies within the North Caribou terrain of the western Superior Province (Stott et al., 2010; Stott, 2011). The largely Mesoarchean North Caribou terrain is dominated by two major periods of plutonic and metamorphic activity at 2.895 to 2.89 Ga and 2.86 to 2.85 Ga, but subdomains within it contain evidence of Neoarchean magmatism and sedimentation (Stott et al., 2010). It is interpreted that the North Caribou terrain forms a Mesoarchean core upon which subsequent Neoarchean crust was added (Percival et al., 2006; Stott, 2008; Stott et al., 2010).

The Oxford-Stull domain (Thurston et al., 1991; Oxford-Stull Subprovince of Rayner and Stott, 2005), which contains the McFaulds Lake greenstone belt at its eastern limit of exposure, runs east-southeast along the northern margin of the North Caribou terrain from northwestern Manitoba to north-central Ontario where it extends under the Paleozoic cover rocks of the James Bay Lowlands. U/Pb zircon analyses of volcanic and plutonic rocks near the James Bay Lowland region give ages from 2.813 Ga to as young as 2.683 Ga (Rayner and Stott, 2005; Stott, 2008; Stott et al., 2010).

The southern boundary of the Oxford-Stull domain is defined by a series of major ductile shear zones that separate it from the Island Lake domain and the rest of the North Caribou terrain. In the McFaulds Lake area this boundary is called the Stull-Wunnummin fault. The northern boundary of the domain is the North Kenyon fault, a major ductile strike-slip deformation corridor that separates the entire North Caribou terrain from the Hudson Bay terrane to the north, which is recognized as another older (>3.0 Ga) continental fragment (Stott et al., 2010).

Due to the near-total absence of outcrops, no greenstone belt was recognized in the McFaulds Lake area until 1999 (Percival et al., 1999), and a comprehensive understanding of the tectonic history of the McFaulds Lake greenstone belt has yet to be established. The rare outcrops are predominantly found along water courses and are mostly erosion-resistant granitoids. The oldest known rock within 100 km of McFaulds Lake is a tonalite-granodiorite gneiss with an igneous emplacement age of 2.813 +/- 0.004 Ga (Rayner and Stott, 2005). Ages of rocks in the McFaulds Lake greenstone belt, close to or within Noront's Project areas (see section below), have comparable ages to other Neoarchean dates from the northwestern Superior Province. To date, details of the local geology of the McFaulds Lake greenstone belt are limited to observation from geophysical surveys and diamond drilling.

3.4.2 Lithological Descriptions

3.4.2.1 Introduction

Previous studies at the Eagle's Nest Project focussed on understanding the original rock types (protoliths) related to the mineral deposit to aid exploration of the area. They did not recognize the current state of alteration of these rocks, which is critical information for mining purposes and environmental assessment.

For the purposes of the EA and future mining operation, the lithological descriptions herein describe present-day lithology with references to protolithology, where appropriate.

3.4.2.2 Rock Ages

There is limited U-Pb geochronology information available for major rock units in the McFaulds Lake area. Rock ages are summarized as follows in order of age and by lithology:

- **Felsic Volcanic Rock** - Located immediately south of the Ring of Fire (ROF) Intrusive on Noront claims, this rock type has an age of 2,782.2 +/- 5.2 Ma (Riku Metsaranta, pers. comm.). This age predates the ROF Intrusive and is similar, within error, to the age of the host felsic plutonic rocks.
- **Tonalitic Host Rock** - Similar to the granodiorite surrounding the Eagle's Nest Blackbird Complex, this rock was dated at 2,773.37 +/- 0.86 Ma (Mungall et al., 2010), suggesting that the large felsic plutonic host was emplaced around this time
- **Biotite Tonalite Rock** - Similar to the granodiorite surrounding the Eagle's Nest - Blackbird Complex) near Eagle Two, this rock revealed an age of 2,772.36 +/- 0.73 Ma (Riku Metsaranta, pers. comm.). This age is identical to the one obtained for similar felsic plutonic rocks near Eagle's Nest by Mungall et al. (2010).
- **Volcanic Arc-Related Rhyolites** - Southwest of the Eagle's Nest - Blackbird Complex, revealed an age of 2,770.7 +/- 0.8 Ma (Jim Mungall, pers. comm.)
- **Dacitic Tuff Metavolcanic Rock** - This rock is associated with the McFaulds Lake Volcanic Massive Sulphide (VMS) deposits was dated at 2,737 +/- 7 Ma by Rayner and Stott (2005)
- **The Eagle's Nest - Blackbird Complex** - The Complex itself (and the ROF Intrusive) revealed an age of 2,734.5 +/- 1.0 Ma (Mungall et al., 2010)

These dates reveal a few key points:

- The Eagle's Nest - Blackbird Complex (and ROF Intrusive) ultramafic package was emplaced around 2,735 Ma into older felsic plutonic rocks (2,772 to 2,773 Ma)
- The felsic plutonic rocks that host the ROF Intrusive have a similar age to surrounding felsic volcanic rocks (between 2,770 and 2,782 Ma), suggesting that the plutonism and volcanism probably were coeval
- Intermediate volcanic rocks near McFaulds Lake, and those associated with the McFaulds Lake VMS, have an identical age to the emplacement of the ROF Intrusive ultramafic package, suggesting coeval emplacement

In summary, this suggests that felsic volcanism and felsic plutonism occurred first, around 2,770 to 2,782 Ma, and subsequently to that, intermediate volcanism and the intrusion of the ROF ultramafic package occurred around 2,735 Ma, emplacing into the older volcanic and plutonic rocks.

3.4.2.3 Lithological Descriptions

Table 3.4-1 provides a summary of the lithological descriptions.

Table 3.4-1 Lithological Descriptions

Abbreviation	Name	Color	Grain Size	Mineralogy	Accessory Mineralogy	Hardness
Ui	Ultramafic Intrusives					
	Serpentinite	Medium-dark green	Medium-coarse	Serp, plag	Chl, trem/act, bio, talc, carb, sul, mag, cr	Soft (2-4)
	Amphibolite	Grey to grey-green	Fine-coarse	Trem, act, talc, plag	Chl, serp, sul	Soft to medium (2-6)
	Talc-tremolite	Grey, brown, green	Fine	Talc, trem	Chl, bio, carb, cr	Very soft (1-3)
	Talc-chlorite	Grey to green-grey	Coarse	Talc, chl	Bio, carb	Very soft (1-3)
	Talc-chlorite-carbonate	Grey to green-grey	Coarse	Talc, chl, >15% carb		Very soft (1-3)
Mi	Mafic Intrusives					
	Mafic Intrusive Rock	Green to dark green	Fine	Chl, bio, feld	Act, carb, qtz	Medium (5-6)
	Gabbro	Green	Medium-coarse	Plag, pyx, trem, act	Chl, bio, sul, mag, ep, tnt	Medium (5-6)
	Carbonate-chlorite	Green to white-green	Coarse	Carb, chl	Bio, talc	Medium (5-6)
n/a	Intermediate Rocks	Medium grey	Fine	Feld, bio, qtz		Medium (5-6)
Fi	Felsic Intrusives					
	Granodiorite/Tonalite	Grey, pink-grey	Medium-coarse	Feld, qtz, bio, hbl	Carb, act, chl, ser, hem, epi, gar	Hard (>7)
	Granite & Granitic Pegmatite	Light grey to pink-grey	Medium-coarse	Feld, qtz	Ser	Hard (>7)
	Aplite	Light grey to pink-grey	Fine	Feld, qtz	Ser, gar	Hard (>7)
Bx	Breccias (Mixed)					
	Ultramafic Breccia	Fragments of granodiorite in a matrix of serpentinite or amphibolite				
	Mafic Breccia	Fragments of granodiorite in a matrix of mafic intrusives				
n/a	Sedimentary Rocks					
	Limestone	Beige	Fine-medium	Cal, dolo		
	Sandstone	Grey	Sand-sized	Qtz, feld, cal		

NOTES:

1. MINERALOGY CODES: Act = ACTINOLITE; Bio = BIOTITE; Cal = CALCITE; Carb = CARBONATE; Chl = CHLORITE; Cr = CHROMITE; Dolo = DOLOMITE; Epi = EPIDOTE; Feld = FELDSPAR; Gar = GARNET; Hbl = HORNBLENDE; Hem = HEMATITE; Mag = MAGNETITE; Plag = PLAGIOCLASE; Pyx = PYROXENE; Qtz = QUARTZ; Ser = SERICITE; Serp = SERPENTINE; Sul = SULPHIDES; Talc = TALC; Tnt = TITANITE; Trem = TREMOLITE.

The rock types summarized in Table 3.4-1 are described in the following Sections.

3.4.2.4 Ultramafic Rocks

All the ultramafic rocks in the deposit area are intrusive but of varying age, based on observations. However, based on the analysis of similar associated rocks, the bulk of the ultramafic rocks, i.e., those associated with the Eagle's Nest deposit, are believed to be 2734.5 +/- 1.0 Ma old (Mungall et al., 2010).

All of the ultramafic rocks are altered but in some cases retain some textural and geochemical features that indicate their original lithology. Based on these features the protolith of these rocks has been determined to be either dunite, peridotite (lherzolite or harzburgite, olivine pyroxenite, or pyroxenite (ortho- and clinopyroxenite or websterite).

Serpentinite

- Colour is predominantly medium to dark green but can also be grey, green-grey, or black. It is usually medium to coarse grained massive but is brecciated in places.
- Rock strength (UCS) varies from 66.8 to 113 MPa (Golder, 2010) and has a rock hardness grade of R3 to R6 (Golder, 2010)
- The mineralogy is dominated by serpentine with lesser amounts of plagioclase
- Accessory minerals are: chlorite, tremolite/actinolite, biotite, talc, carbonate, sulphides, magnetite and chromite

- Depending on the intensity of past metamorphism and hydrothermal activity this rock can grade into amphibolite, talc-chlorite, chlorite-carbonate, or talc-chlorite-carbonate rock
- A typical analysis is as follows (Wt% (+/-)):
    - Fe: 8.383 (0.401)
    - Cr: 0.450 (0.075)
    - Ni: 0.122 (0.022)
    - Mn: 0.089 (0.04)
    - No significant: Ag, As, Bi, Cu, Cd, Co, Mo, Nb, Pb, Pd, Rb, Sb, Se, Sn, Sr, Ti, V, W, Zn, Zr
    - Not analyzed for elements lighter than Ti

Amphibolite

- Colour is predominantly grey to grey-green
- Grain size is variable ranging from fine to coarse grained, actinolite being coarser than tremolite
- The rock is generally massive but may be locally foliated by the preferred orientation of the amphiboles
- Rock strength (UCS) varies from 47.4 to 54.6MPa (Golder, 2010) and has a rock hardness grade of R3 to R4 (Golder, 2010)
- The mineralogy is dominated by tremolite/actinolite with lesser amounts of talc and plagioclase
- Accessory minerals are: chlorite, serpentine, sulphides
- A typical analysis is as follows (Wt% (+/-)):
    - Fe: 7.032 (0.398)
    - Cr: 0.443 (0.088)
    - Mn: 0.164 (0.054)
    - Ni: 0.093 (0.023)
    - No significant: Ag, As, Bi, Cd, Co, Cu, Mo, Nb, Pb, Pd, Rb, Sb, Se, Sn, Sr, Ti, V, W, Zn, Zr
    - Not analyzed for elements lighter than Ti

Talc-Tremolite Rock

- Colour varies from grey to brown to green
- It is fine grained and usually massive but can be strongly schistose
- No data on rock strength or hardness available but likely comparable to talc-chlorite rock
- The mineralogy is predominantly talc and tremolite
- Accessory minerals are: chlorite, biotite, carbonate, chromite
- A typical analysis is as follows (Wt% (+/-)):
    - Fe: 7.471 (0.357)
    - Ti: 0.237 (0.093)
    - Mn: 0.156 (0.044)
    - Cr: 0.298 (0.062)
    - No significant: Ag, As, Bi, Cd, Co, Cu, Mo, Nb, Ni, Pb, Pd, Rb, Sb, Se, Sn, Sr, V, W, Zn, Zr
    - Not analyzed for elements lighter than Ti

Talc-Chlorite Rock

- Colour is overall grey to green-grey
- It is usually coarse grained and massive and weakly foliated but may be schistose in places
- Rock strength (UCS) varies from 14.8-55.2MPa (Golder, 2010) and has a rock hardness grade of R2 (Golder, 2010).
- The mineralogy is predominantly talc and chlorite but may contain some carbonate and can transition into a talc-chlorite-carbonate rock
- Accessory minerals are: biotite, carbonate
- A typical analysis is as follows (Wt% (+/-)):
  - Fe: 6.998 (0.341)
  - Cr: 0.468 (0.077)
  - Mn: 0.132 (0.044)
  - Ti: 0.139 (0.083)
  - Ni: 0.095 (0.02)
  - No significant: Ag, As, Bi, Cu, Cd, Co, Mo, Nb, Pb, Pd, Rb, Sb, Se, Sn, Sr, V, W, Zn, Zr
  - Not analyzed for elements lighter than Ti

Talc-Chlorite-Carbonate Rock

- Colour is overall grey to green-grey
- It is usually coarse grained and massive and weakly foliated but may be schistose in places
- No data on rock strength or hardness available but likely somewhere between talc-chlorite rock and serpentinite
- The mineralogy is predominantly talc, and chlorite with more than 15% carbonate
- A typical analysis is as follows (Wt% (+/-)):
  - Fe: 6.614 (0.308)
  - Cr: 0.365 (0.065)
  - Mn: 0.184 (0.045)
  - Ni: 0.076 (0.017)
  - No significant: Ag, As, Bi, Cd, Co, Cu, Mo, Nb, Pb, Pd, Rb, Sb, Se, Sn, Sr, Ti, V, W, Zn, Zr
  - Not analyzed for elements lighter than Ti

3.4.2.5 Mafic Rocks

All of the Mafic rocks in the immediate area of the Eagle's Nest deposit are intrusive and of varying age and degree of alteration. Most appear to be younger than the ultramafics with the exception of some of the gabbro which may be the same age, i.e., 2,734.5 +/- 1.0 Ma (Mungall et al., 2010).

Mafic Intrusive Rock

- Colour is green to dark green
- It is usually fine grained and massive but may also be strongly foliated by a preferred orientation of the phyllosilicates
- Rock strength (UCS) varies from 22.4 to 56.6MPa (Golder, 2010) and has a rock hardness grade of R3-R5 (Golder, 2010)

- The mineralogy is variable depending on the degree of alteration but generally it is composed of chlorite, biotite, and feldspar
- Accessory minerals are: actinolite, carbonate, quartz

- A typical analysis is as follows (Wt% (+/-)):
  - Fe: 9.219 (0.464)
  - Sr: 0.74 (0.011)
  - Ti: 0.400 (0.118)
  - Mn: 0.187 (0.048)
  - No significant: Ag, As, Bi, Cd, Co, Cr, Cu, Mo, Nb, Ni, Pb, Pd, Rb, Sb, Se, Sn, V, W, Zn, Zr
  - Not analyzed for elements lighter than Ti

Gabbro

- Color varies from pale grey to green, but is predominantly green
- Generally it is medium to coarse grained and massive, but may be fine grained at the margins
- No data on rock strength or hardness available but likely comparable to granodiorite
- The mineralogy is predominantly plagioclase and pyroxene but may be altered at the margins where it contains tremolite/actinolite
- Accessory minerals are: chlorite, biotite, sulphides, magnetite, epidote, titanite
- A typical analysis is as follows (Wt% (+/-)):
  - Fe: 6.889 (0.327)
  - Ti: 0.425 (0.113)
  - Mn: 0.15 (0.04)
  - No significant: Ag, As, Bi, Cd, Co, Cr, Cu, Mo, Nb, Ni, Pb, Pd, Rb, Sb, Se, Sn, Sr, V, W, Zn, Zr
  - Not analyzed for elements lighter than Ti

Carbonate-Chlorite Rock

- Colour is overall green (white with green layers or mottling)
- It is usually coarse grained and massive, but may be weakly foliated by a preferred orientation of chlorite
- No data on rock strength or hardness available but likely comparable to mafic intrusive rock
- The mineralogy is predominantly carbonate and chlorite
- Accessory minerals are: biotite, talc
- A typical analysis is as follows (Wt% (+/-)):
  - Fe: 10.98 (0.518)
  - Cr: 0.198 (0.053)
  - Mn: 0.172 (0.046)
  - No significant: Ag, As, Bi, Cd, Co, Cu, Mo, Nb, Ni, Pb, Pd, Rb, Sb, Se, Sn, Sr, V, W, Zn, Zr
  - Not analyzed for elements lighter than Ti

3.4.2.6 Intermediate Rocks

The following are all intrusive rocks found cutting the granodiorite, and are therefore younger than 2,770 Ma, but their exact age is unknown.

- They are fine grained but may contain up to 10% medium grained feldspar phenocrysts
- Their colour is medium grey with porphyritic varieties having white feldspar phenocrysts

- No data on rock strength is available but the rock hardness grade is R3 (Golder, 2010)
- The mineralogy is predominantly feldspar, biotite and quartz
- A typical analysis is as follows (Wt% (+/-)):
    - Fe: 2.848 (0.157)
    - Sr: 0.239 (0.018)
    - Ti: 0.203 (0.095)
    - No significant: Ag, As, Bi, Cd, Co, Cr, Cu, Mn, Mo, Nb, Ni, Pb, Pd, Rb, Sb, Se, Sn, V, W, Zn, Zr
    - Not analyzed for elements lighter than Ti

3.4.2.7 Felsic Rocks

All of the felsic rocks in the immediate Eagle's Nest area are intrusive and altered to varying degrees. The felsic pluton which hosts the ultramafic intrusive that contains the Eagle's Nest deposit has been determined to pre-date the ultramafic intrusive by nearly 40 Ma (age determined to be 2,772 to 2,773 Ma, specifically between 2,773.37 +/- 0.86 Ma and 2,772.36 +/- 0.73 Ma).

Granodiorite/Tonalite

- This makes up the bulk of the felsic rocks in the immediate area and has also been called tonalite
- It is usually some shade of grey and occasionally pinkish-grey in colour
- It is usually medium to coarse grained and usually massive
- Rock strength (UCS) varies from 70.7 to 180 MPa (Golder, 2010) and has a rock hardness grade of R3-R6 (Golder, 2010)
- The mineralogy is predominantly feldspar, quartz, biotite and hornblende
- Accessory minerals are: carbonate, actinolite, chlorite, sericite, hematite, epidote, garnet
- A typical analysis is as follows (Wt% (+/-)):
    - Fe: 1.345 (0.099), Sr: 0.143 (0.013)
    - No significant: Ag, As, Bi, Cd, Co, Cr, Cu, Mn, Mo, Nb, Ni, Pb, Pd, Rb, Sb, Se, Sn, Ti, V, W, Zn, Zr
    - Not analyzed for elements lighter than Ti

Granite Pegmatite

- These rocks are younger than the main granodiorite/tonalite units, and commonly intrude them
- The color is usually light grey to pinkish-grey and it is medium to coarse grained and massive
- No data on rock strength or hardness available but likely comparable to granodiorite
- The mineralogy is predominantly feldspar, and quartz
- Accessory minerals are: sericite
- A typical analysis is as follows (Wt% (+/-)):
    - Fe: 0.533 (0.059)
    - Sr: 0.071 (0.008)
    - No significant: Ag, As, Bi, Cd, Co, Cr, Cu, Mn, Mo, Nb, Ni, Pb, Pd, Rb, Sb, Se, Sn, Ti, V, W, Zn, Zr
    - Not analyzed for elements lighter than Ti

Aplite

- These rocks are younger than the main granodiorite/tonalite units, and commonly intrude them
- The color is usually light grey to pinkish-grey and it is fine grained and massive
- No data on rock strength or hardness available but likely comparable to granodiorite
- The mineralogy is predominantly feldspar, and quartz
- Accessory minerals are: sericite, garnet
- A typical analysis is as follows (Wt% (+/-)):
    - Fe: 1.461 (0.103)
    - Sr: 0.112 (0.011)
    - Not analyzed for elements lighter than Ti

3.4.2.8 Breccias (Mixed Rock Types)

Within the previously described rock units are breccia zones, which contain a mixture of some of the aforementioned rock types. The most common mixture is *Granodiorite in Mafic Intrusive*, and less commonly *Granodiorite in Serpentinite or Amphibolite*.

Their exact age is unknown, but since these rocks contain fragments of granodiorite they must be younger than the granodiorite, i.e., <2,772 to 2,773 Ma.

The size of the fragments varies greatly, and for very large fragments the rock can be described in terms of their individual components (e.g., ultramafic, mafic, or felsic rock types listed above). However, for finer breccias, where the size of the fragments is smaller, they can be considered to be separate rock types as follows:

Ultramafic Breccia

- Fragments of granodiorite in a matrix of serpentinite or amphibolite
- The color varies depending on the percentage of granodiorite fragments
- No data on rock strength or hardness is available on this mixture, but it is likely only as strong and hard as the matrix (see serpentinite and amphibolite)
- The mineralogy is the same as granodiorite and serpentinite or amphibolite
- A typical analysis is as follows (Wt% (+/-)):
    - Fe: 4.827 (0.228)
    - Cr: 0.59 (0.083)
    - Ti: 0.235 (0.091)
    - Mn: 0.116 (0.034)
    - Sr: 0.10 (0.01)
    - No significant: Ag, As, Bi, Cd, Co, Cu, Mo, Nb, Ni, Pb, Pd, Rb, Sb, Se, Sn, V, W, Zr
    - Not analyzed for elements lighter than Ti

Mafic Breccia

- This rock consists of fragments of granodiorite in a matrix of mafic intrusive. In the past it has been logged as "Feldspar Porphyry" (note: this is not the same as Intermediate Rocks with white feldspar phenocrysts which have also been logged as "Feldspar Porphyry").
- The color varies depending on the percentage of granodiorite fragments

- No data on rock strength or hardness available on this mixture, but it is likely only as strong and hard as the matrix (see mafic intrusive)
- The mineralogy is the same as granodiorite and mafic intrusive
- No chemical analysis available

3.4.2.9 Supracrustal Rocks

Although metavolcanic and metasedimentary rocks (of Precambrian age) are not found near the Eagle's Nest deposit, nor are they typically encountered anywhere in Noront drill core. They do lie to the south, southwest and east, in what is described as the McFaulds Lake Greenstone Belt (MLGB). As well, a number of VMS occurrences of potential economic interest have been found to exist within the metavolcanic rocks of this belt. Thus, these units are described here, based on observations by the Ontario Geological Survey (Metasaranta and Houlé, 2011).

The two main supracrustal assemblages of the MLGB consist of metavolcanic-dominated rocks, with or without gabbro (both mafic and felsic metavolcanics), and metasedimentary-dominated rocks. Most, if not all, of the supracrustal rocks encountered have been heavily affected by metamorphism and alteration, and thus determining the protolith has proven difficult.

Distinct supracrustal successions in the MLGB are well-defined by gravity gradiometer data and appear to consist of:

- A roughly north-northwest-striking (west-striking further north) package of rocks in the eastern and northern parts of the MLGB
- A northeast-striking package of supracrustal rocks in the central part of the MLGB
- An apparently more structurally complex zone in the western to southwestern part of the map area

In the MLGB area close to the Eagle's Nest - Blackbird ultramafic intrusion, metasedimentary rocks encountered included epiclastic metasedimentary rocks. Metavolcanic rocks included intermediate to felsic tuffaceous metavolcanics (primarily of rhyolitic origin but highly metamorphosed), mafic metavolcanics (primarily of basaltic origin with little to no primary flow-like textures), and banded iron formation (thin cherty iron formation). The ROF ultramafic intrusion crosscuts these supracrustal units.

3.4.2.10 Paleozoic Sedimentary Rocks

Paleozoic sedimentary rocks in the area are generally flat lying thin units (a few metres thick) of Paleozoic age (Ordovician Period, as described by the Ontario Geological Survey). They unconformably overlie all of the Precambrian rocks in the area. Only two types are found in the immediate area, limestone and an older limy sandstone.

Limestone

- The colour of this rock is beige
- It is made up of approximately 15% brachipods (5 to 15 mm long) and 10% crinoid fossils (1 to 3 mm) within a sparry calcite cement with a significant dolomite component
- The rock is very porous, with up to 3-6% pore space
- No rock strength or hardness testing has been done on this rock

- The mineralogy is primarily calcite and dolomite
- A typical analysis is as follows (Wt% (+/-)):
    - Fe: 0.536 (0.056)
    - No significant: Ag, As, Bi, Cd, Co, Cr, Cu, Mn, Mo, Nb, Ni, Pb, Pd, Rb, Sb, Se, Sn, Sr, Ti, V, W, Zn, Zr
    - Not analyzed for elements lighter than Ti

Limy Sandstone

- The colour of this rock is grey
- It is primarily composed of sand sized subrounded quartz grains with subrounded feldspar grains, and limestone fragments, all in a carbonate matrix
- No rock strength or hardness testing has been done on this rock
- The mineralogy is primarily quartz, feldspar, and calcite
- A typical analysis is as follows (Wt% (+/-)):
    - Fe: 0.414 (0.048)
    - No significant: Ag, As, Bi, Cd, Co, Cr, Cu, Mn, Mo, Nb, Ni, Pb, Pd, Rb, Sb, Se, Sn, Sr, Ti, V, W, Zn, Zr
    - Not analyzed for elements lighter than Ti

3.4.3 Weathering Characteristics

Mafic and ultramafic rocks weather relatively easily producing iron oxides and clay. However, weathering is restricted to near surface fault zones as the area has been heavily glaciated, and contains little outcrop. What outcrop that does exist is primarily felsic intrusive in nature.

The weathering characteristics of only the granodiorite and serpentinite are known from studies conducted by Micon in 2012. Micon performed Acid/Base accounting tests, synthetic precipitation leach tests (SPLP), and peroxide oxidation net acid-generating potential tests (NAG) on these rocks.

The following is a quote from that report summarizing the results:

> *"Results of these tests show that the granodiorite and granodiorite with mafic intrusion are not acid generating. Test results show that the granodiorite and mafic intrusion had a neutralization potential of at least 3 times greater than its acid generating potential. Several solid phase metal concentrations were below detection limits including arsenic, bismuth, antimony and selenium. Nickel was present in concentrations of 5.5 to 10 µg/g and copper concentrations ranged from 5.5 to 50 µg/g.*
>
> *"Primary constituents of potential concern are probably arsenic and vanadium from the deeper mafic dyke/granodiorite rock. These two elements currently exceed the Provincial Water Quality Objectives (PWQO) standards in both effluent from the meteoric-water leach test and the NAG test leachate on the deeper rock. Both of these elements can have moderate to high mobility in the environment. Aggregate rock will come from other sources, confirmed by testing of source rock.*
>
> *"Other elements that exceeded the PWQO standards include aluminium, copper, chromium, silver, and hydronium ion (i.e., pH). However, these elements are unlikely to be of actual concern because they are highly reactive in natural environments. Thus,*

little buffering would be required to reduce the pH to below PWQO standards (pH 8.5) and these metals tend to adsorb strongly to mineral surfaces and/or precipitate rapidly at near neutral pH. As a result, contents of these constituents are likely to drop quickly when effluent from this rock encounters soil or aquifer materials."

3.4.4 Depositional Setting

To summarize the depositional setting of the immediate area, a major ultramafic (komatiitic) magmatic event (the ROF Intrusion, 2,734.5 +/- 1.0 Ma) was emplaced into an older suite of subvolcanic tonalitic to granodioritic intrusions (between 2,773.37 +/- 0.86 Ma and 2,772.36 +/- 0.73 Ma) and related arc-related volcanic rocks (2,770.7 +/- 0.8 Ma).

A key feature of the McFaulds Lake area is a prominent linear magnetic high that is continuous for up to tens of kilometers, and forms a semi-circle open to the west, approximately 60 km in diameter from north to south, as seen on the regional airborne magnetic anomaly maps. This prominent linear magnetic high is referred to as the Ring of Fire (ROF). The ROF itself has been interpreted as a regionally extensive iron formation that was deposited along the margins of a regional scale granodiorite pluton, which itself had been intruded into and caused doming of supracrustal rocks of the Oxford-Stull domain (primarily subvolcanic and volcanic felsic units). Along the length of the ROF iron formation, it is generally intercalated with mafic to intermediate lavas and tuffs and intruded by a variety of mafic to intermediate sills and dykes. The high magnetic susceptibility of the ROF is predominantly due to the presence of silicate- and oxide-facies iron formation that locally contains laminated to massive beds of pyrrhotite and pyrite.

At its deepest structural levels, the ROF Intrusion (2,734.5 +/- 1.0 Ma) comprises peridotitic to dunitic dykes of the Eagle's Nest - Blackbird Complex. These ultramafic bodies cut through older tonalitic to granodioritic intrusions (that structurally underlie the ROF iron formation), and then up through the iron formation and into the overlying metavolcanic rocks, settling as sill-like ultramafic bodies (again of the Eagle's Nest - Blackbird Complex) comprising dunite, chromitite, orthopyroxenite, and ferrogabbro. At its highest levels, the complex includes a layered intrusion containing layers of norite, leuconorite, anorthosite, ferrogabbro, and magnetitite (e.g., in the Thunderbird area). Finally, the entire ultramafic complex is structurally overlain by essentially coeval metavolcanics (2,737 +/- 7 Ma) which host the McFaulds Lake Cu-Zn VMS occurrences.

The current theory for the formation of the Eagle's Nest magmatic sulphide deposit, as well as other nearby sulphide and chromite deposits, is that a mantle plume appeared beneath the margin of the North Caribou microcontinent around 2,735 Ma. Passing up through extensional faults, the ultramafic komatiitic parental magma interacted with sulphide-bearing metasediments (including iron formation), causing saturation with sulphide liquid and the collection of massive to net-textured magmatic sulphides in short-lived orthocumulate-textured mush zones at the bases of dykes (Eagle's Nest, Eagle Two, AT12 deposits). In places, these feeders formed into substantial sills, and in these sills, chromite and olivine segregated into layers and lenses from the highly contaminated komatiite magma (Blackbird, Black Creek, Big Daddy, Black Thor, Black Label deposits). The magma residual to the deposition of the sulphide, dunite, chromitite, peridotite and pyroxenite crystallized as a layered intrusion, leading to the deposition of norite, anorthosite, ferrogabbro, and V-rich titanomagnetite layers (Thunderbird deposit). Heat-driven circulation of hydrothermal fluids through the older, pre-existing and overlying sedimentary and volcanic rocks caused the deposition of massive Cu-Zn sulphide mineralization (VMS) where these fluids vented at the sea floor during volcanism. Subsequent metamorphic fluid flow through shear zones caused the formation of mesothermal Au mineralization in the Triple J Gold occurrence directly adjacent to the Blackbird and Eagle Two deposits.

The Eagle's Nest deposit is a subvertically dipping body of massive and net-textured magmatic sulphide minerals (pyrrhotite, pentlandite, and chalcopyrite) and magnetite in the form of a sheet about 200 m long, as much as several tens of metres thick, and at least 1,000 m deep. It strikes northeast-southwest and occupies the northwestern margin of a vertically inclined serpentinized peridotite dyke. Near the surface, the massive sulphides are confined to the northwestern edge of this intrusive body, and are bordered to the south and southeast by thicker zones of net-textured sulphides, which are hosted by serpentinized peridotite. At depth, there are occurrences of massive sulphides further to the east within the dyke, although they tend to be concentrated near the western and northern extremities. The dyke is closed off both at its northern and southern ends and plunges vertically or very steeply to the south.

3.4.5 Alteration Styles

There are three basic types of alteration at Eagle's Nest: metamorphic, hydrothermal, and weathering-oxidation.

Weathering-oxidation results in the alteration of sulphides to iron oxides, the leaching away of any carbonates, alteration of feldspar to clay, and alteration of ferro-magnesian minerals to iron oxides and clay.

Weathering-oxidation is not extensive in the area as it has been heavily glaciated, which removed most preglacial weathered rock. Subsequent sediments and oxygen deficient water have inhibited the development of any significant post glacial alteration. Any significant weathering and oxidation is therefore confined to faults that reach the surface, but even these do not show any significant alteration at depths below 75 m.

The type and grade of metamorphism varies from regional low to medium grade (greenschist to lower amphibolite grade) with the most recent effects being predominantly hydration processes such as serpentinization of olivine, talc alteration of serpentine and pyroxenes, and local carbonatization.

The detailed history of the metamorphic and hydrothermal alteration is not known because of the complicated and long history of the area and because these types can overlap. Therefore the sequence noted in the table below has little chronological significance in terms of the relationship between rock units.

Below is a summary of alteration styles that have been noted in drill core and the likely precursors.

Table 3.4-2 Summary of Alteration Styles

Precursor	Primary Metamorphic Alteration	Further Metamorphic/Hydro-thermal Alteration	Hydrothermal Alteration
Peridotite/Pyroxenite	Serpentinization	Hydration to Talc-Chlorite rock	Carbonatization
Peridotite/Pyroxenite (Ca rich)	Serpentinization	Uralitic &/or Hydration	Carbonatization
Mafic Intrusives	Chloritization	Amphibolite formation	Carbonatization
Felsic Intrusives	Saussuritization	Development of a foliation	Sericitization, Epidotization

3.4.6 Structures

All ultramafic-related nickel/copper deposits are structurally controlled for the following reasons:

- Ultramafic magmas are generated by high degrees of extension in the deep lithosphere, so are located within structurally active tectonic areas
- Ultramafic magmas require a structural plumbing system to get them rapidly from the deep lithosphere where they are generated to the upper crust - they migrate along active faults
- Sulphide melts and silicate magmas have different physical properties, so the sulphides tend to accumulate by gravity in structural traps - this is one reason why the best Ni/Cu deposits are found in “feeder dykes” around ultramafic bodies (e.g., offset dykes at Sudbury)
- Sulphides are remobilised relatively easily during subsequent metamorphism and deformation, and may be removed a significant distance from the parent intrusion along active structures (e.g., Thompson Mine, Manitoba, where sulphide ore bodies are now located within schist host rocks)

The conventional model is that the ultramafic magma travels upwards along a feeder dyke to the main magma chamber, leaving the sulphide behind in the dyke (in a process analogous to sediment load being dropped in a river) while the silicate magma flows on into the magma chamber/main intrusion.

The model proposed here suggests that the Eagle’s Nest sulphides have been concentrated into structural traps - possibly within a dyke feeding the intrusion from below, but also possibly in structures tapping the magma chamber - which could be anywhere around the intrusion where there is an active system of faults. This provides a better explanation for current geometries in many cases than the necessity of having the feeder dyke below the magma chamber at the time of intrusion.

A regional structural history of the surrounding Archean rocks of the Superior Province includes three generations of deformation or deformation events (“D”).

D1:

- North-south shortening
- East-west trending, doubly plunging F1 folds
- Bedding parallel foliation and folding
- Juxtaposition of metavolcanics and metasediments

D2:

- North-south shortening
- East-west trending, doubly plunging F2 folds
- Bedding parallel foliation and folding
- ca. 2,720 Ma (associated with the juxtaposition of the Northern Superior Superterrane (currently termed the Hudson Bay Terrane) and the Oxford Still Domain)

D3:

- Northwest-trending dextral shear zones (Winisk fault)
- <2,704 to >2,692 Ma

Generally speaking, the Superior Province contains major shear zones that trend east-west, approximately parallel to Subprovince margins. These margins define structural domains. The deformational history of the Superior Province is a complex one, with much ductile, brittle, and ductile-brittle folding and shearing and late cross-cutting fault sets.

The ROF area lies between two regional-scale shear zones (domain boundaries) that show right-lateral (dextral) offset - the Winisk Fault to the north, and the Stull-Wunnummin Fault Zone to the south. These two major crustal faults run sub-parallel to the Superior Subprovince margins. The McFaulds Lake Greenstone Belt is spatially coincident with the shear zones and is highly deformed, with evidence of older, deeper ductile deformation (shear zones, foliations, folding) and later higher brittle deformation (fault zones).

According to Metsaranta (2010), the overall structure of the ROF and McFaulds Lake Greenstone Belt area appears to have been influenced most by the granitic batholith lying to the west. Based on previous mapping and geophysical interpretations, the greenstone belt appears to wrap around the batholith forming the prominent semicircular magnetic anomaly dubbed the Ring of Fire. Outcrops found during Metsaranta's 2010 field season displayed a well-developed, subvertical foliation trending at 220 to 230° and a mineral lineation plunging southwest at about 50°. A shear zone along the contact between peridotite and chromitite trended northeast and displayed dextral shear sense indicators. Brittle fractures along the outcrop also showed evidence of right-handed displacements. In diamond drill core, the extent of deformation in the ultramafic complex varies considerably and the rocks vary from narrow mylonitic bands to relatively unstrained, suggesting that much of the overall strain in the intrusion was taken up in narrow shear zones. Within the ultramafic complex, zones of more brittle faulting are also common. The majority of the supracrustal rocks examined were highly deformed and felsic intrusive rocks are typically weakly to moderately deformed.

Major faults that have been identified from geophysics and geology (locally, within the Eagle's Nest - Blackbird area) generally have northeast-southwest and north-south (and to a lesser extent northwest-southeast) orientations, and show mutual offset. Northeast-southwest faults found in the area match with a prominent set of faults (in a major shear zone) at the margin of the McFaulds Lake Greenstone Belt and match the orientation of the contact between the granodiorite and ultramafic units. North-south faults are also occupied by Proterozoic dykes. Minor fault orientations include north-south, east-west and north/northwest-south/southeast, and often offset or terminate against the major faults. Areas of exploration interest thus are between major shear zones. Additionally, due to the ductile nature of the deformation, a certain sygmodial pattern appears in the geophysical fabric of the area, which may indicate the shear sense. This sygmodial pattern is similar to the shape of the Eagle's Nest geometry.

Overall, the majority of the structures recorded during Noront drill programs were striking roughly northeast-southwest and were steeply dipping, which corresponds to the macrostructure of the McFaulds Lake Greenstone Belt and ROF ultramafic intrusive. There are also many north-south trending structures, primarily being faults, joints, veins and mafic dykes throughout the southeast portion of the ROF. It should also be mentioned that there is rare evidence of tops suggesting that most measurements striking southwest are likely to have been overturned. The fold data, which were sparse, do not yet appear conclusive. This may be because the extent of deformation was so strong that all fold hinges were flattened, resulting in the creation of a foliation (and thus destroying fold axes and hinges).

Foliations parallel to the general trend of the ultramafic package and shear zones strike largely northeast-southwest and dip to the northwest. Major joint trends were somewhat scattered, but also retained a northeast-southwest trend, along with minor orientations of northwest-southeast and north-south (again, parallel to major fault orientations).

3.4.7 Seismology

The Ring of Fire and McFaulds Lake area are situated within a stable Precambrian craton (continent), and no major active tectonic zones are known within hundreds of kilometres of the area. Thus, any seismic activity in the area is limited to neotectonics, that being tectonic activity occurring along older, currently non-active, fault systems being caused by tectonics occurring in more active regions elsewhere and spreading to these pre-existing Precambrian faults.

A number of federal governmental agencies record seismic activity, and have records dating back to the 1600s. These records itemise major earthquakes in Canada, areas of earthquake hazard and, from 1985 onwards, include digital data recording every earthquake in Canada. Figure 3.4-1, below, is a map of earthquakes in Canada from 1627 to 2012, coloured and proportional to their magnitude. As can be seen, in the general ROF-McFaulds Lake of Northern Ontario, there have been very few earthquakes in this time, and that their magnitudes were on the order of 3 to 4 on the Richter scale, i.e., quite low.

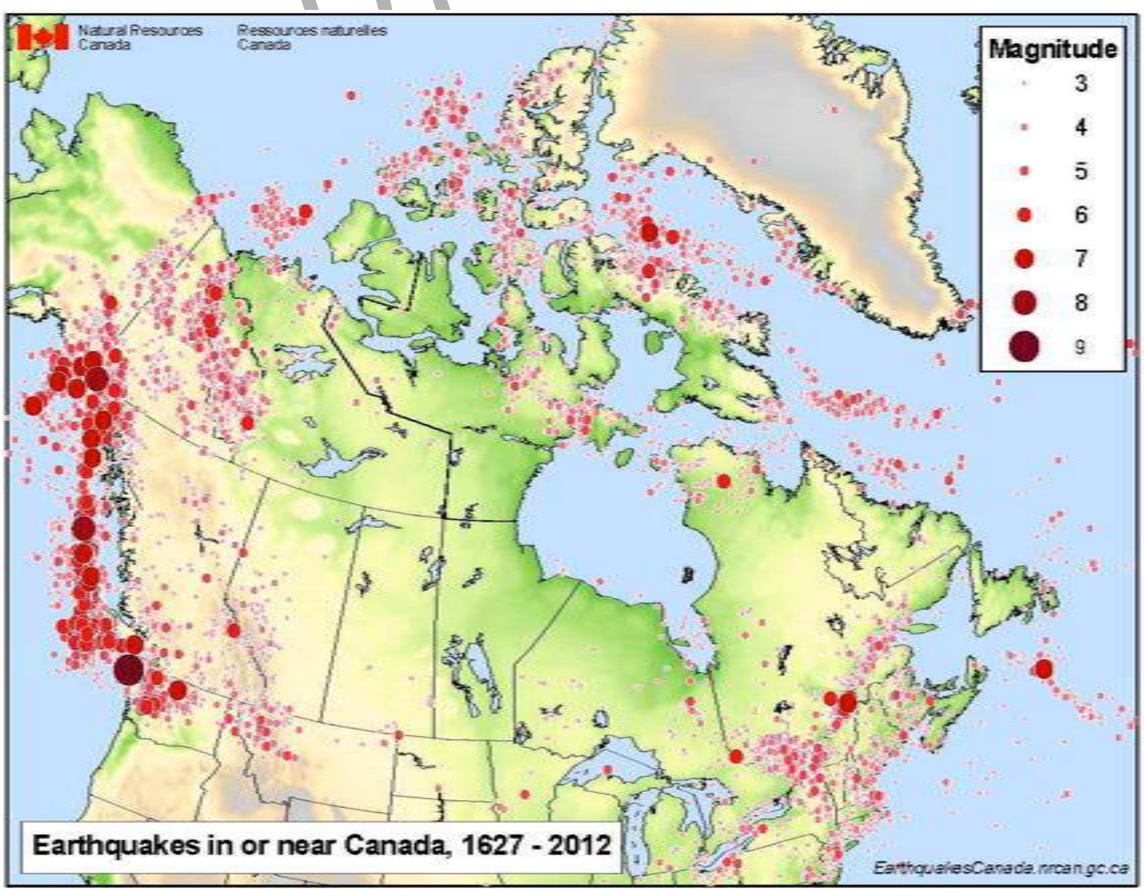


Figure 3.4-1 Earthquakes in or Near Canada, 1627 to 2012 (NRCan, 2013)

Figure 3.4-2, below, is a seismic hazard map for Canada. As can be seen, the ROF-McFaulds Lake area is in a very low hazard area.

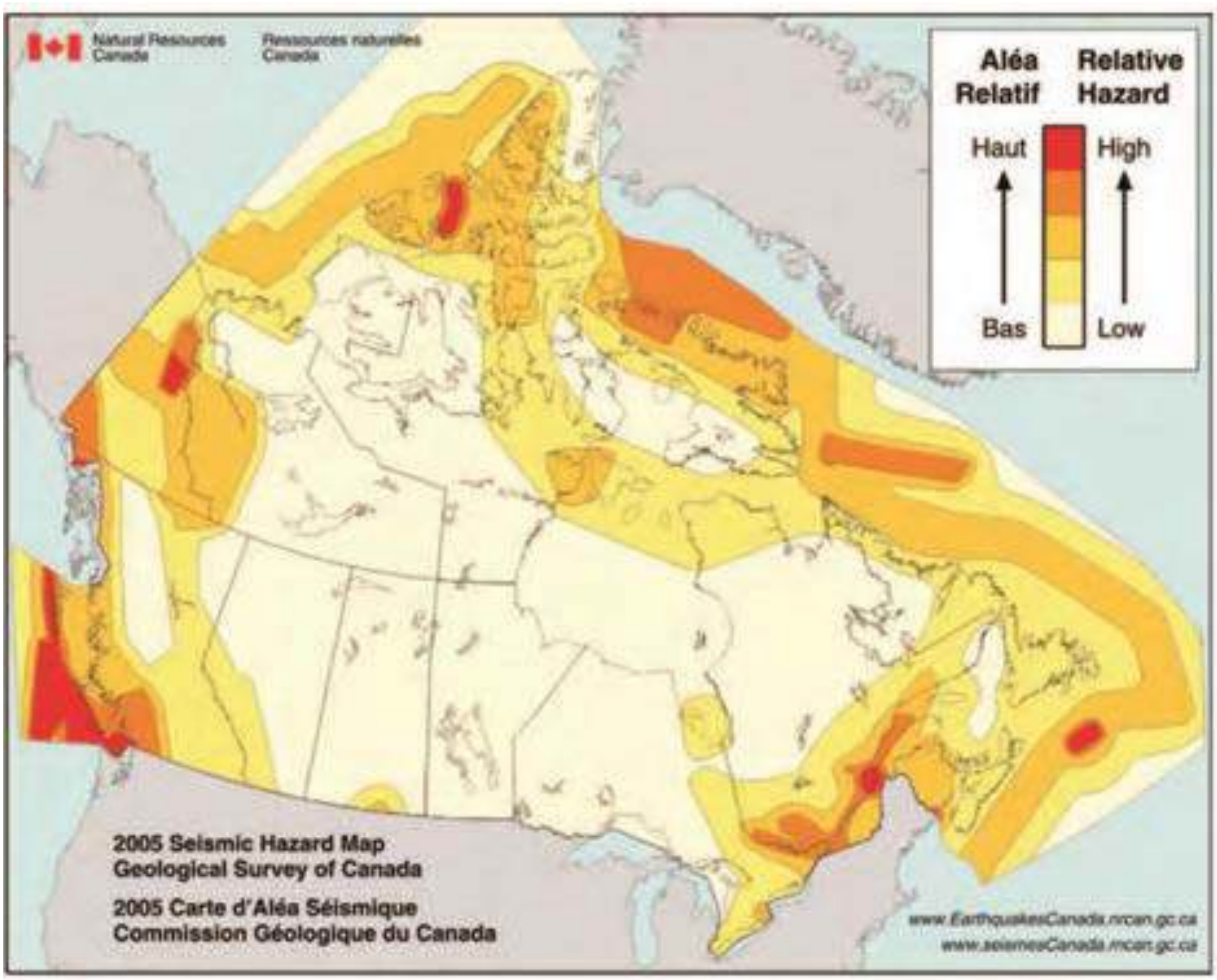


Figure 3.4-2 2005 Seismic Hazard Map of Canada (NRCan, 2013)

Figure 3.4-3, below, is a map showing significant earthquakes in Canada with their dates. Again, there are no major earthquakes recorded in Northern Ontario between the period of 1663 to 2006 (and there have been no major earthquakes in the region up to and including present day).

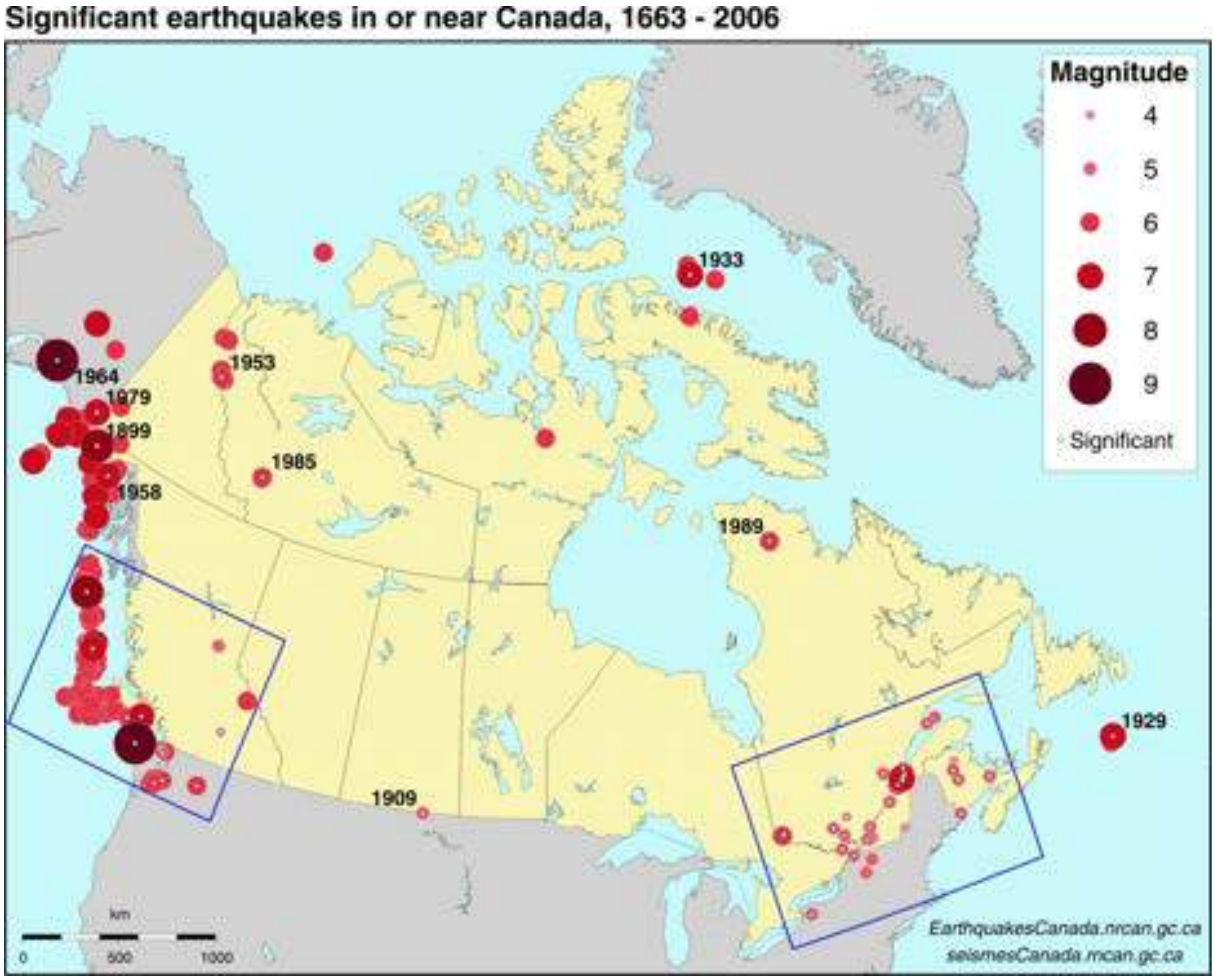


Figure 3.4-3 Significant Earthquakes in or Near Canada, 1663 to 2006 (NRCan, 2013)

As previously mentioned, Natural Resources Canada, through Earthquakes Canada, provides GIS data of all major Canadian earthquakes since the early 1600s, and also provides a database of all recorded seismic events in Canada since 1985. These data were used to create the maps below of the general project area in Northern Ontario.

Figure 3.4-4, below, is taken from NRCAN's major earthquakes database (*earthquakescanada.nrcan.gc.ca*), and clearly shows that no earthquakes greater than magnitude 4.3 have occurred anywhere near the ROF-McFaulds Lake area since the year 1600.

Figure 3.4-4 Major Earthquakes (>4.3) in Northern Ontario Since 1600 (NRCan, 2013)

Figure 3.4-5, below, details all seismic activity in the area since 1985, coloured according to and proportional to the magnitude. The data are taken from NRCAN's earthquakes database (*earthquakescanada.nrcan.gc.ca*), and clearly show that no earthquakes greater than magnitude 4.3 have occurred anywhere near the ROF-McFaulds Lake area since 1985. However, there were three earthquake events that occurred close to the ROF, and are described in the figure below. The three closest had a magnitude of 1.8 in 2005, 20 km north of Eagle's Nest (#2 on map), 1.9 in 2010, 17 km south of Eagle's Nest (#1 on map), and 2.3 in 2012, 65 km northwest of Eagle's Nest (#3 on map).

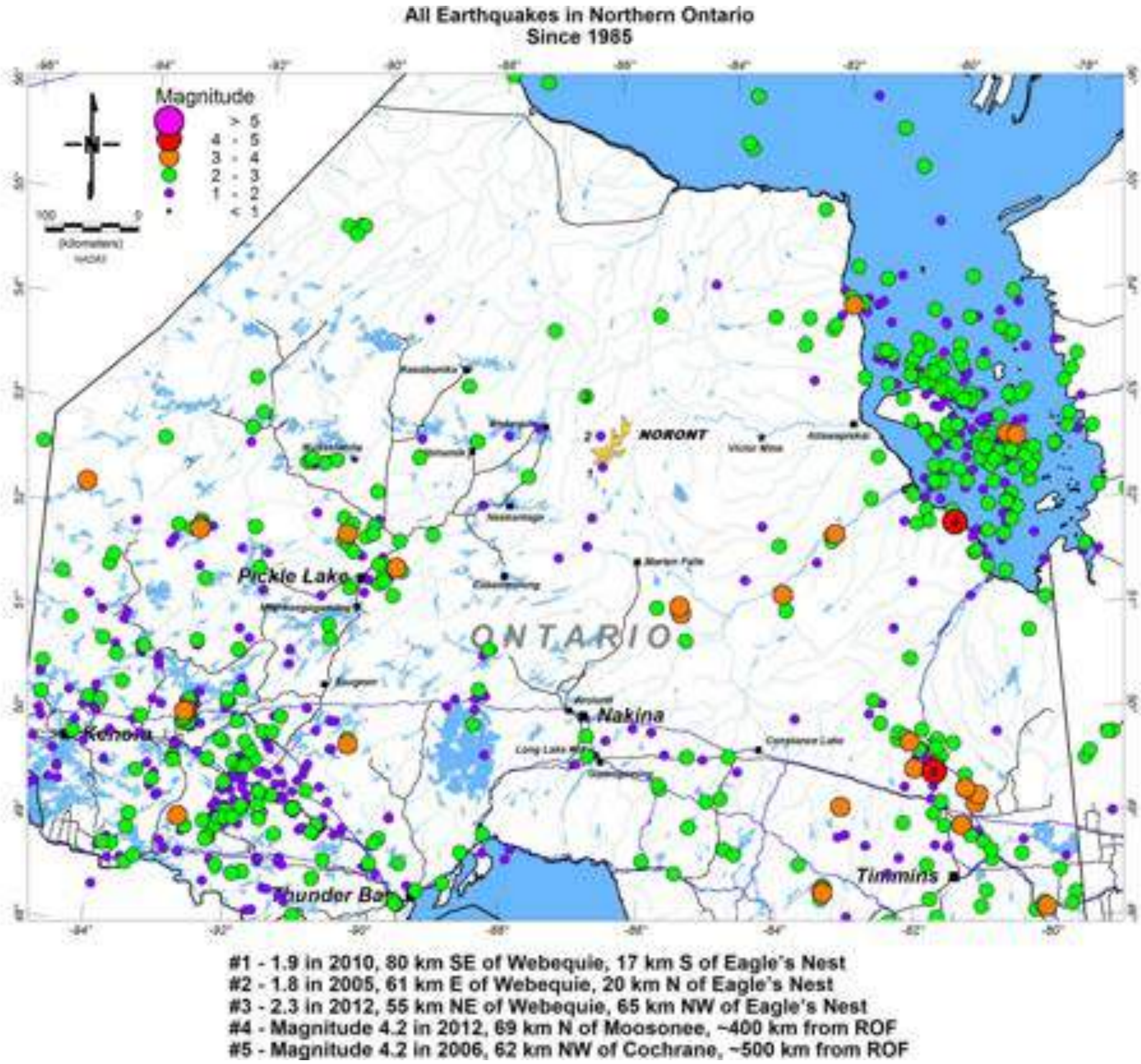


Figure 3.4-5 Earthquakes in Northern Ontario since 1985 (NRCan, 2013)

Thus, despite the fact that there is some seismic activity, as is expected, it is virtually negligible for the Eagle's Nest area and Ring of Fire on the whole.

3.4.8 Ore Mineralogy

Listed Table 3.4-3 are the main ore types. This includes the sheared equivalents found in fault zones. The sheared equivalents do not constitute a significant quantity and are therefore not described separately.

Table 3.4-3 Main Ore Types

Abbreviation	Name	Color	Grain Size	Mineralogy	Hardness
	Sulphide bearing rock				
su1	Massive sulphides	Bronze to golden	Coarse	Pyrrhotite, pentlandite, chalcopyrite	Soft to medium (2-6)
su2	Semi-massive sulphides	Dark green-bronze	Coarse	Pyrrhotite, pentlandite, chalcopyrite, serpentine	Soft to medium (2-6)
su3	Disseminated sulphides	Dark green-black	Coarse	As above w. serpentine, amphiboles	Medium (5-6)
su4	Net texture or semi-massive	Dark green-black	Coarse	As above w. serpentine, amphiboles	Medium (5-6)

The sulphide types summarized in the Table are described in the following Sections.

3.4.8.1 Massive Sulphide

- The colour of this rock is bronze to greenish-gold in colour depending on the amount of chalcopyrite in the ore. It is coarse grained and contains between 75 and 98% sulphides with the remainder usually being serpentine.
- Rock strength (UCS) varies from 49.1 to 104.8 MPa (Golder, 2010) and has a rock hardness grade of R3 to R4 (Golder, 2010)
- The mineralogy is a mix of sulphides made up of approximately 55% pyrrhotite, 20% pentlandite and 10% chalcopyrite
- Accessory minerals are: carbonate, talc, bornite, chalcocite, pyrite, amphiboles, pyroxenes, chromite, magnetite, millerite, olivine, sperrylite, violarite, sphalerite
- A typical analysis is (Wt%, (+/-):
    - Fe: 38.211 (2.277)
    - Ni: 5.114 (0.551)
    - Cu: 0.735 (0.114)
    - Cr: 0.094 (0.047)
    - No significant: As, Bi, Cd, Co, Mn, Mo, Nb, Pb, Rb, Sb, Se, Sn, Sr, Ti, V, W, Zn, Zr
    - Not analyzed for elements lighter than Ti

3.4.8.2 Semi-Massive Sulphide

- The colour of this rock is dark green to bronze to greenish-gold in colour depending on the amount of sulphides in the rock. It is coarse grained and contains between 30 and 75% sulphides with the remainder being predominantly serpentine.
- Rock strength (UCS) varies from 49.1 to 104.8 MPa (Golder, 2010) and has a rock hardness grade of R3 to R4 (Golder, 2010)
- The mineralogy is a mixture of pyrrhotite, pentlandite, chalcopyrite, and serpentine
- Accessory minerals are: carbonate, talc, bornite, chalcocite, pyrite, amphiboles, pyroxenes, chromite, magnetite, millerite, olivine, sperrylite
- A typical analysis is (Wt%, (+/-):
    - Fe: 22.122 (7.410)
    - Ni: 2.759 (0.574)
    - Cu: 2.056 (0.106)
    - Cr: 0.262 (0.040)
    - No significant: As, Bi, Cd, Co, Mn, Mo, Nb, Pb, Rb, Sb, Se, Sn, Sr, Ti, V, W, Zn, Zr
    - Not analyzed for elements lighter than Ti

3.4.8.3 Disseminated Sulphide

- The colour of this rock is variable depending on the rock containing the sulphides
- Grain size can vary from fine to coarse grained
- It contains between 1 and 10% sulphides that is found in almost every rock type. However, generally only the disseminated sulphides associated with the altered ultramafics may contain economically significant quantities of minerals.
- Rock strength (UCS) varies from 97 to 123.6 MPa (Golder, 2010) and has a rock hardness grade of R3 to R4 (Golder, 2010)
- The mineralogy is variable depending on the host rock. However, the dominant sulphides are pyrrhotite, and pyrite with minor pentlandite and or chalcopyrite.
- A typical analysis is (Wt%, (+/-):
    - Fe: 7.891 (0.357)
    - Cr: 0.837 (0.093)
    - Ni: 0.197 (0.026)
    - Mn: 0.158 (0.047)
    - Cu: 0.085 (0.016)
    - No significant: Ag, As, Bi, Cd, Co, Mo, Nb, Ni, Pb, Rb, Sb, Se, Sn, Sr, Ti, V, W, Zn, Zr
    - Not analyzed for elements lighter than Ti

3.4.8.4 Net Textured Sulphide

- The colour of this rock is dark green with bronze mottling
- It is coarse grained and contains between 10 and 30% sulphides with the remainder usually being serpentine or actinolite/tremolite
- Rock strength (UCS) varies from 72.5 to 207.9 MPa (Golder, 2010) and has a rock hardness grade of R3 to R5 (Golder, 2010)
- The mineralogy is a mix of pyrrhotite, pentlandite, chalcopyrite, and serpentine
- Accessory minerals are: carbonate, talc, bornite, chalcocite, pyrite, pyroxene, chromite, magnetite, millerite, olivine
- A typical analysis is (Wt%, (+/-):
    - Fe: 15.756 (0.686)
    - Cu: 2.222 (0.159)
    - Ni: 1.164 (0.095)
    - Cr: 0.475 (0.069)
    - No significant: Ag, As, Bi, Cd, Co, Cu, Mo, Mn, Nb, Pb, Rb, Sb, Se, Sn, Sr, Ti, V, W, Zn, Zr
    - Not analyzed for elements lighter than Ti

3.4.8.5 Mineralogy of the Ore

The following figure is taken from SGS Lakefield Research Ltd. Report (2011), entitled *An investigation by High Definition Mineralogy into the Mineralogical Characteristics of Four Composite Samples from the Eagles Nest Deposit*. A summary of the results is described in Figure 3.4-6.

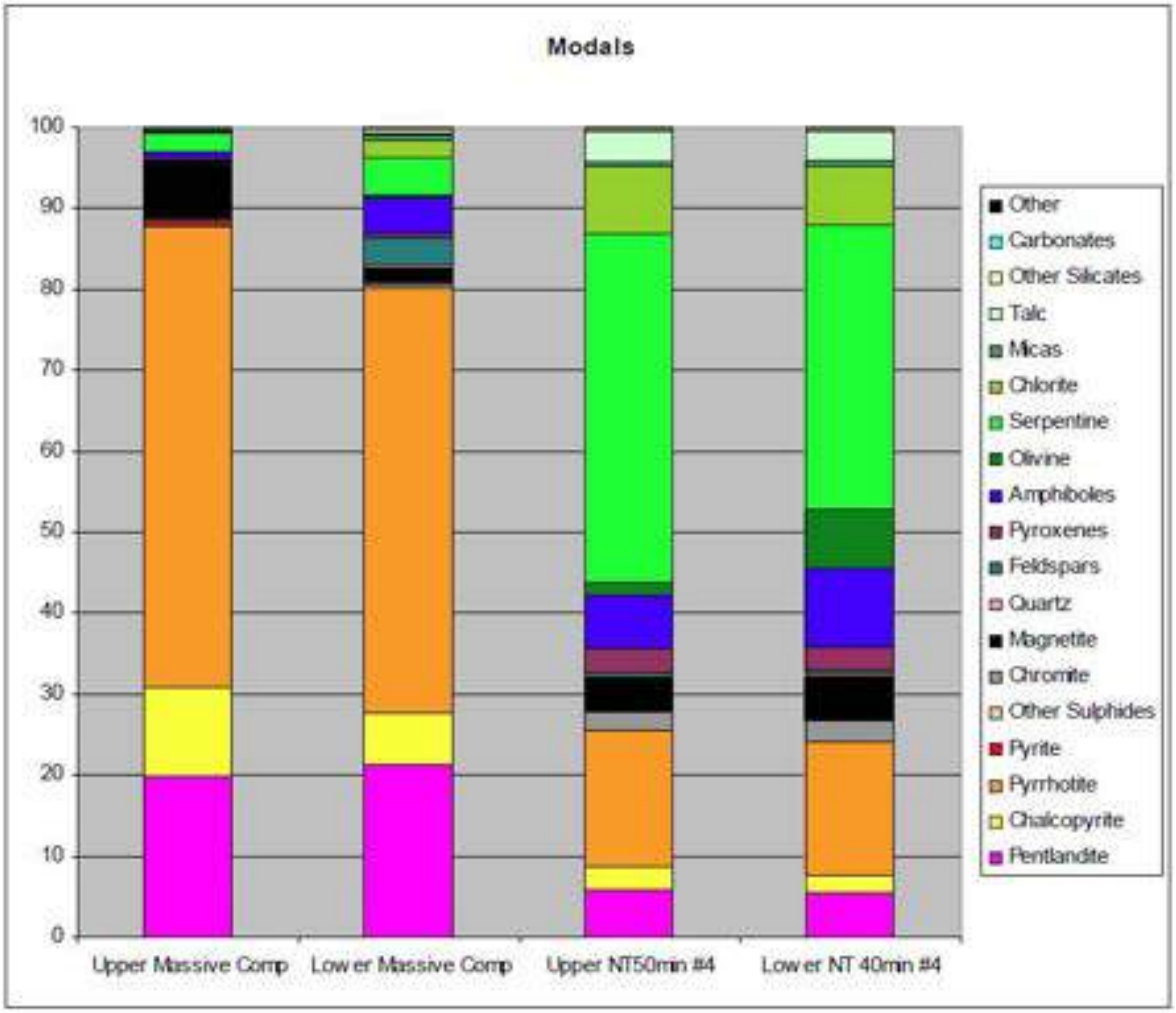


Figure 3.4-6 Composite Sample Mineralogical Characteristics (SGS, 2011)

QEMSCAN and X-ray Diffraction analyses of the four composites established the following mineralogical characteristics.

X-ray Diffraction results indicate:

- In the Upper and Lower Massive Comps monoclinic pyrrhotite is the major crystalline mineral phase. Pentlandite and chalcopyrite occur in moderate abundance and magnetite, quartz, plagioclase, serpentine and amphibole occur in minor to trace abundance.
- In the Upper and Lower NT Comps serpentine is the major crystalline mineral phase. Monoclinic pyrrhotite and magnetite occur in moderate abundance and pentlandite, chalcopyrite, amphibole, olivine, chlorite, chromite, and talc (detected in Lower NT Comp) occur in minor to trace abundance.

QEMSCAN modal results indicate:

- The Upper Massive Comp consists mainly of pyrrhotite (56.9%), pentlandite (19.9%) and chalcopyrite (11.1%) with minor amounts of magnetite (7.2%) and serpentine (2.2%). Trace amounts (<1%) of amphiboles, pyroxenes, pyrite, chlorite, chromite, talc and olivine are also present.

- The Lower Massive Comp consists mainly of pyrrhotite (52.7%) and pentlandite (21.4%) with minor amounts of chalcopyrite (6.2%), serpentine (4.5%), amphiboles (4.4%), feldspars (3.3%), chlorite (2.1%) and magnetite (1.5%). Trace amounts (<1%) of quartz, chromite, pyroxenes, olivine, micas, talc, other silicates and carbonates are also present.
- The Upper NT Comp consists mainly of serpentine (42.6%) and pyrrhotite (16.6%) with minor amounts of chlorite (8.5%), amphiboles (6.7%), pentlandite (6.4%), magnetite (4.3%), talc (3.8%), pyroxenes (3.0%), chalcopyrite (2.9%), chromite (2.2%) and olivine (1.7%). Trace amounts (<1%) of micas and feldspars are also present.
- The Lower NT Comp consists mainly of serpentine (35.0%) and pyrrhotite (16.4%) with minor amounts of amphiboles (9.6%), olivine (7.3%), chlorite (7.2%), pentlandite (5.9%), magnetite (5.6%), talc (3.7%), pyroxenes (3.0%), chromite (2.6%) and chalcopyrite (2.2%). Trace amounts (<1%) of micas and feldspars are also present.

QEMSCAN liberation and association characteristics indicate:

- Free and liberated pentlandite account for 89.5% of the pentlandite mass in the Upper Massive Comp, 85.6% of the Lower Massive Comp, 50.8% of the Upper NT Comp and 61.3% of the Lower NT Comp. The main non-liberated associations in the Massive Comps are in binary association with pyrrhotite and silicates and ternary association with pyrrhotite and chalcopyrite. In the NT Comps, 29 to 40% of the pentlandite is contained in complex particles of two or more minerals, whereas only 1.5 to 2.6% of the pentlandite in the Massive Comps is contained in complex particles.
- Free and liberated chalcopyrite account for 84.8% of the chalcopyrite mass in the Upper Massive Comp, 75.8% in the Lower Massive Comp, 75.0% in the Upper NT Comp and 63.3% in the Lower Massive Comp. The main non-liberated associations are in binary association with pyrrhotite. Most of the complex chalcopyrite particles are contained in the NT Comps (19 to 28%). The Massive Comps contain only 2 to 5% complex particles of chalcopyrite. Cumulative grain size charts illustrate:
    - Serpentine is the finest grained mineral in the Massive Comps while pentlandite is the finest in the NT Comps
    - For the Massive Comps, the P80 of pentlandite is approximately 112 and 143 μm for the Upper and Lower Massive Comps, respectively. The P80 of chalcopyrite is approximately 132 and 171 μm for the Upper and Lower Massive Comps, respectively. Overall particle shows aout 152 μm and 186 μm.
    - For the Net Textured Comps, the P80 of pentlandite is approximately 38 and 43 μm for the Upper and Lower NT Comps, respectively. The P80 of chalcopyrite is approximately 41 and 40 μm for the Upper and Lower NT Comps, respectively. Overall particle shows about 97 and 90 μm.

Electron microprobe analysis indicates:

- A significant amount of Ni is hosted in the pyrrhotite. Notably, the Massive Comps (~0.6% Ni) contain approximately twice as much Ni in pyrrhotite crystal lattice compared with the NT Comps (~0.3% Ni). The silicates host between 0.02 and 0.07% Ni.

- By incorporating the Ni data from EMPA, QEMSCAN Ni deportment data indicates that pentlandite accounts for 95 to 97% of the Ni across all composite samples. Pyrrhotite hosts between 3.2 and 3.7% Ni, magnetite contributes 0.01 to 0.15%, serpentine contributes 0.01 to 0.58%, chlorite contributes up to 0.22% and talc contributes up to 0.06% Ni.

3.4.8.6 Sulphide Reactivity and Neutralization Potential

The Eagle's Nest sulphides are highly reactive, with pyrrhotite rapidly breaking down rapidly in an oxygen-rich environment to iron oxides and sulphuric acid. There is very little potential for neutralization as there is not much carbonate in the host rock.

The following description is from Micon's 2012 Feasibility Study of Eagle's Nest, page 197 and 198:

> *"Screening level environmental testing and chemical analyses were conducted on granodiorite and ultramafic intrusion samples, obtained from diamond drill holes. These tests were conducted to determine whether the aggregate materials sourced from underground will be suitable for construction aggregate. The samples were subjected to standard extraction tests and chemical analyses used to estimate the short and long-term solute release from rock produced by natural weathering.*
>
> *"These included analyses to determine:*
>
> - *"The ultimate potential of this material to generate acidic leachate (based on acid/base accounting (ABA) analyses).*
> - *"The short term potential of this material to produce leachate that contains metals or other regulated solutes at concentrations above regulatory discharge standards (using synthetic precipitation leach tests (SPLP) modified to 1:4 rock:water ratio).*
> - *"The ultimate potential for dissolution of metal and other regulated solute by long term oxidation (using the peroxide oxidation net acid-generating potential (NAG) test).*
>
> *"Results of these tests show that the granodiorite and granodiorite with mafic intrusion are not acid generating. Test results show that the granodiorite and mafic intrusion had a neutralization potential of at least 3 times greater than its acid generating potential."*

Thus, the granodiorite and granodiorite with mafic intrusion will be safe to use an aggregate source.

3.4.9 Metamorphism

The type and grade of metamorphism varies from regional low to medium grade (greenschist to lower amphibolite grade) with the most recent effects being predominantly hydration processes such as serpentinization of olivine, talc alteration of serpentine and pyroxenes, and local carbonatization.

3.5 SURFACE WATER QUALITY

3.5.1 Study Area

The spatial boundaries for the assessment of baseline surface water quality were defined as areas within which the potential impacts on surface water resources may occur from the development, operation or closure of the Project.

3.5.1.1 Regional Study Area

A regional study area (RSA) was defined for the assessment of potential effects of the project on downstream water quality. The three regional watersheds which encompass all components of the Project were used to delineate the RSA (Figure 3.5-1).

3.5.1.2 Mine Site Local Study Area

The mine site is the primary LSA for the assessment of baseline water quality. It encompasses the relevant water bodies and streams around the mine site infrastructure. Several sites were selected to provide reference water quality data upstream and downstream of the mine site at several locations. The mine site LSA is shown on Figure 3.5-2.

3.5.1.3 Transportation Corridor Local Study Area

The transportation corridor LSA extends from the mine site to the junction of the proposed all-season access road and the Pickle Lake North Road (formerly Highway 808) north of Pickle Lake. The transportation corridor continues south of Pickle Lake on Highway 599 to the trans-load facility near Savant Lake. Baseline studies were focussed on the section of the transportation corridor where a new all season access road will be constructed. This was the focus because the greatest potential impact on surface water will occur during the construction of the road. The Northern Ontario Resource Trail and Highway 599 were not included in the baseline water quality studies since there is expected to be negligible impacts on surface water associated with the continued use of these existing roads whish were designed and constructed to facilitate the traffic expected for the Project.

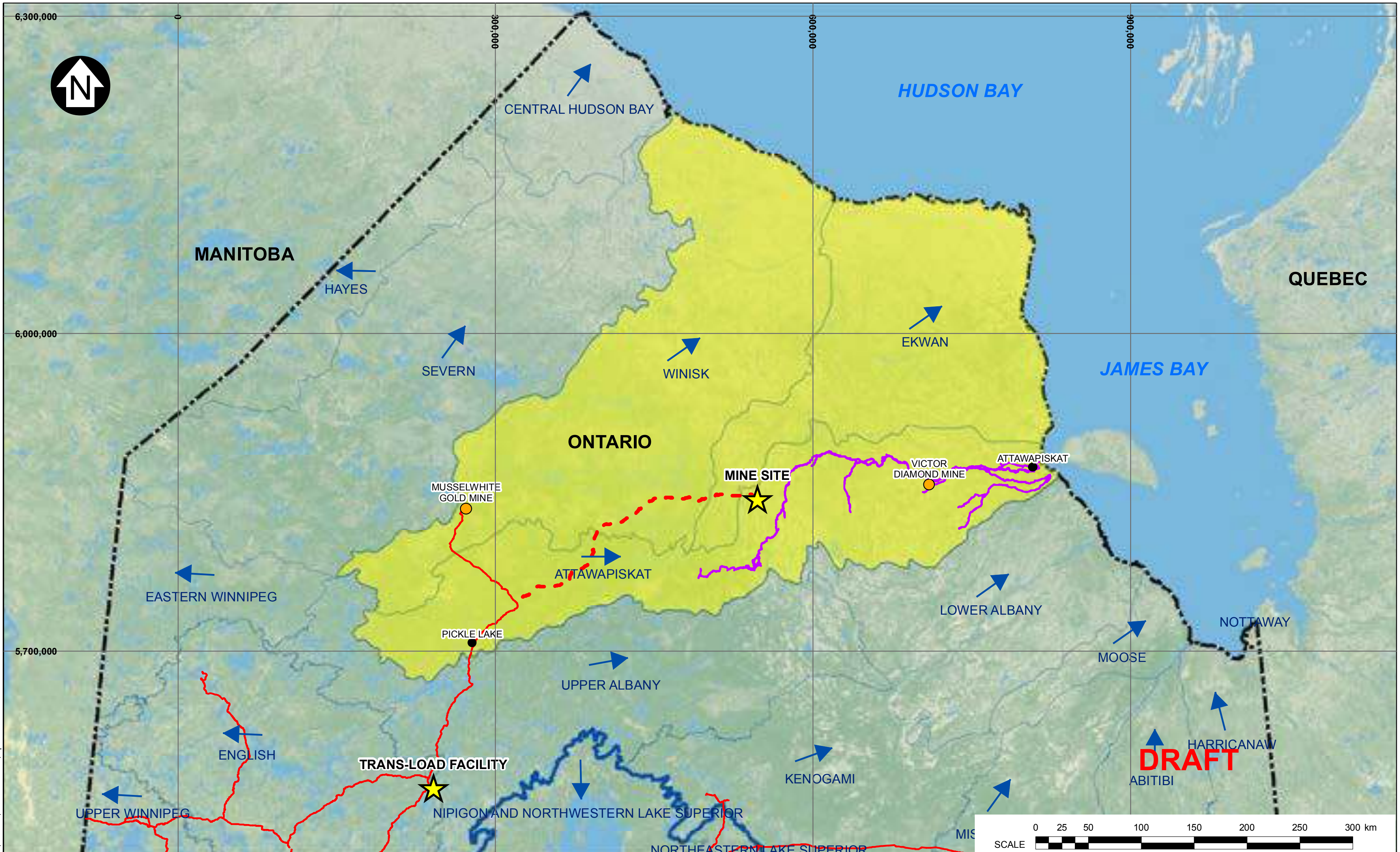
The water quality samples analysed were from stations selected as part of the aquatic environment baseline assessment. They provide a representative sample of water quality at stream crossings along the proposed transportation corridor. The transportation corridor LSA is shown on Figure 3.5-3.

3.5.1.4 Trans-load Facility Local Study Area

The trans-load facility LSA encompasses the water bodies and watercourses that are near the proposed infrastructure and is shown on Figure 3.5-4.

3.5.2 Background

Limited existing surface water data are available for the study areas due to the remote location and lack of previous development. Relevant studies in this region have been completed by the Ontario Ministry of the Environment (MOE), resource development companies and other governmental and non-governmental organizations. These data were not collected near any of the LSAs and do not provide sufficient data to establish baseline conditions in the study areas. As such, it was necessary to collect Project-specific surface water quality data in each of the LSAs.



LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- OTHER MINE PROJECT
- COMMUNITY
- EXISTING ALL-SEASON ROAD
- MAJOR WATERSHED DIVIDE
- ATLANTIC OCEAN - HUDSON BAY DRAINAGE DIVIDE
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- PROVINCIAL BORDER
- ATTAWAPISKAT RIVER
- REGIONAL STUDY AREA
- WATERSHED FLOW DIRECTION

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013).
4. MAJOR WATERSHED DATA PROVIDED BY: NATURAL RESOURCES CANADA.
5. BASE MAP IMAGERY PROVIDED BY ESRI GIS ONLINE (http://www.arcgis.com)

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	DKK	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

REGIONAL STUDY AREA

Knight Piésold CONSULTING

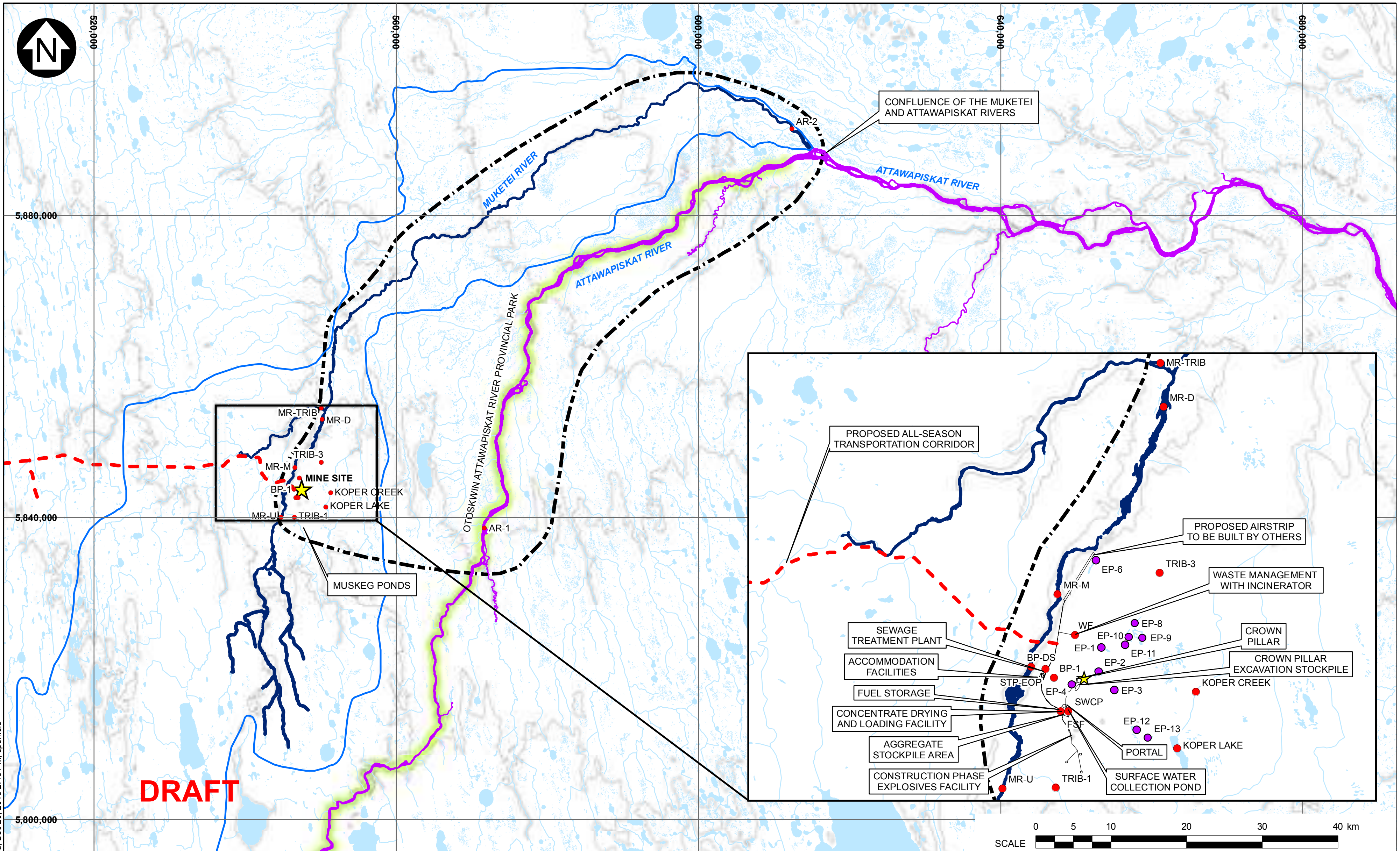
P/A NO. NB102-390/1

REF NO. 34

FIGURE 3.5-1

REV A

SAVED: I:\1\102\00390\01\A\GIS\Figs\A662_rA.mxd; Dec 20, 2013 2:42 PM; spenfold



LEGEND:

- MINE SITE
- AQUATIC ASSESSMENT LOCATION
- SURFACE WATER SAMPLE LOCATION
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- ATTAWAPISKAT RIVER (MAIN CHANNELS)
- MUKETEI RIVER (MAIN CHANNELS)
- MUKETEI RIVER SUBWATERSHED
- RIVER/STREAM/DRAINAGE
- CONTOUR
- WATER
- PROVINCIAL PARK
- AQUATIC RESOURCES LOCAL STUDY AREA

NOTES:

1. BASE MAP PROVIDED BY SNC-LAVALIN GROUP INC. (2010) AND BASEMAP : © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. INFRASTRUCTURE INFORMATION PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.
5. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY KIEWIT INFRASTRUCTURE ENGINEERS (NOVEMBER 26, 2013).
6. MAJOR WATERSHED DATA PROVIDED BY NATURAL RESOURCES CANADA.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	RAC	SWK	SRA	RAM

SAVED: I:\1102\00390\01\A\GIS\Figs\A663_rA.mxd; Dec 20, 2013 2:46 PM; spenfold

NORONT RESOURCES LTD.

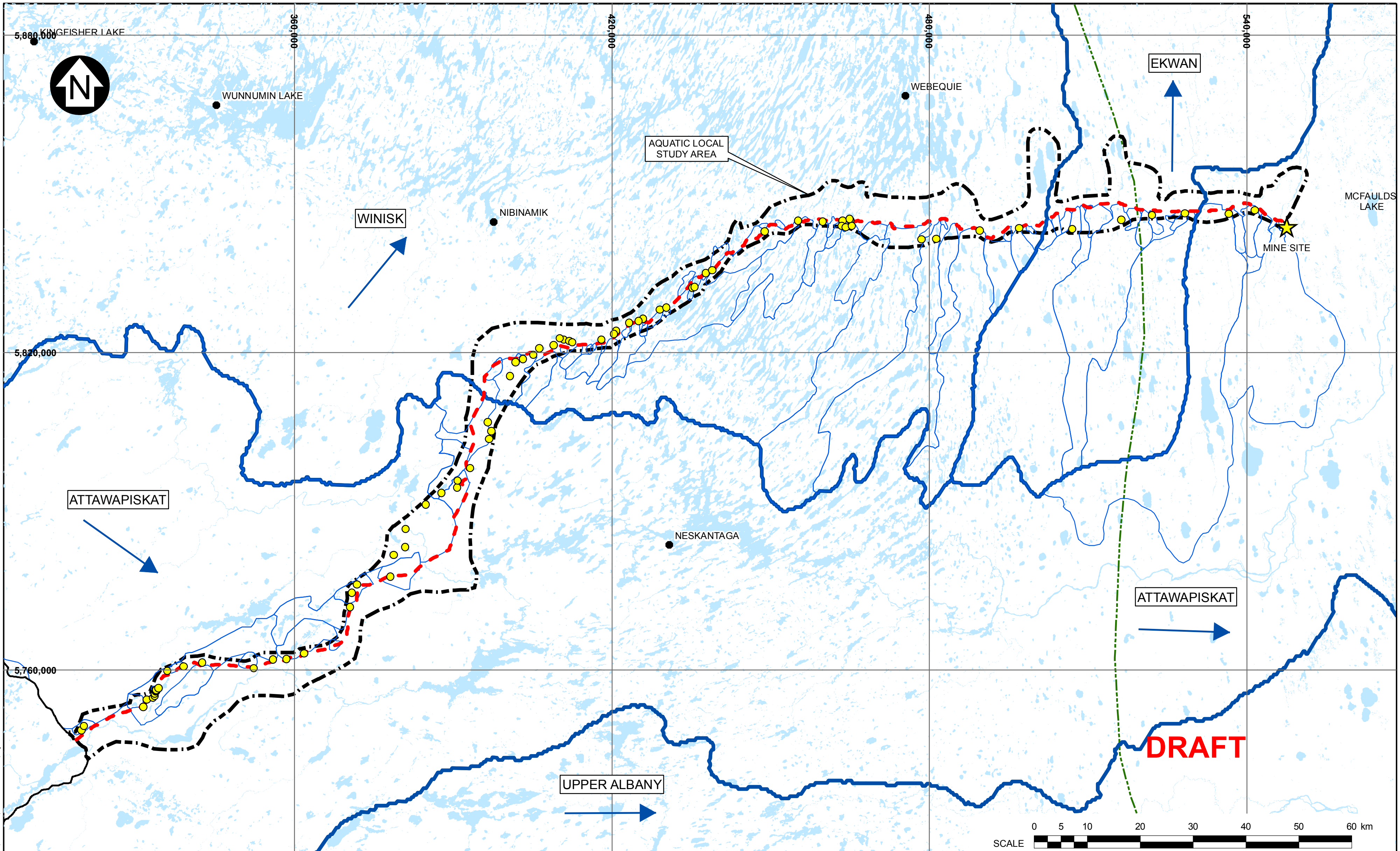
EAGLE'S NEST PROJECT

MINE SITE LOCAL STUDY AREA AND SAMPLE LOCATIONS

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.5-2 REV A



LEGEND:

- MINE SITE
- COMMUNITY
- SURFACE WATER QUALITY SAMPLING LOCATION
- WATERSHED FLOW DIRECTION
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- RIVER/STREAM/DRAINAGE
- WATER
- ROAD CROSSING CATCHMENT
- MAJOR WATERSHED COURSE
- TRANSPORTATION CORRIDOR LOCAL STUDY AREA

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA, DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: WGS 1984 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013).
4. MAJOR WATERSHED DATA PROVIDED BY NATURAL RESOURCES CANADA.

A	20DEC'13	ISSUED WITH REPORT	RAC	SWK	SRA	RAM
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

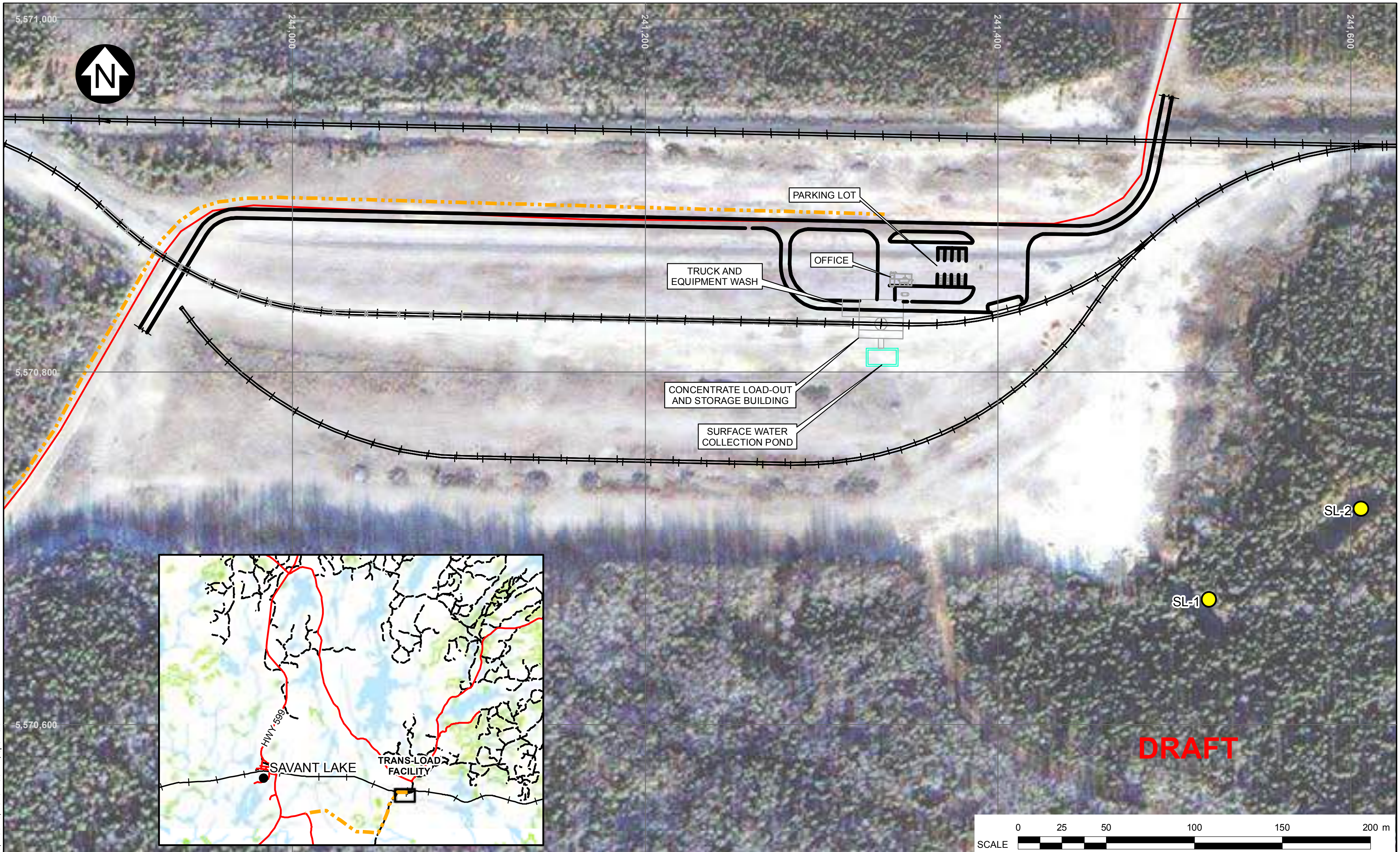
TRANSPORTATION CORRIDOR LOCAL STUDY AREA AND SAMPLE LOCATIONS

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 3.5-3 | REV A

SAVED: I:\1102\00390\01\A\GIS\Figs\A664_rA.mxd; Dec 20, 2013 2:53 PM; spenfold



LEGEND:

- COMMUNITY
- SURFACE WATER SAMPLE LOCATION
- EXISTING ALL-SEASON ROAD
- RAILWAY
- PROPOSED HYDRO CORRIDOR
- PROPOSED INFRASTRUCTURE
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- SURFACE WATER COLLECTION POND

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. INFRASTRUCTURE IS BASED ON INFORMATION PROVIDED BY TETRA TECH (APRIL 19, 2012).
4. IMAGE OBTAINED FROM ESRI ONLINE SERVICE LAYERS (MAY 2013).

A	20DEC'13	ISSUED WITH REPORT	ALR	SWK	SRA	RAM
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

TRANS-LOAD FACILITY LOCAL STUDY AREA AND SAMPLE LOCATIONS

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF NO. 34

FIGURE 3.5-4

REV A

SAVED: I:\1\02\00390\01\A\GIS\Figs\A665_rA.mxd; Dec 20, 2013 2:56 PM; spenfold

The MOE coordinates the Provincial Water Quality Monitoring Network (PWQMN), which collects stream water quality data at over 400 locations in Ontario. There are not many stations located in northern Ontario. The majority of these stations are positioned in urbanized areas such as Thunder Bay. The closest stations to the Project are located on the Albany River approximately 220 km southeast of the mine site. The next closest stations are on the Kenogami River that are approximately 290 km southeast of the mine site. These four stations were sampled once in July 2009 (PWQMN, 2009). These data provide a regional context for site-specific water quality conditions.

The Mushkegowuk Environmental Resources Centre (MERC) recently compiled a baseline water quality report for the Attawapiskat River. Samples were obtained from 60 water quality stations upstream, downstream, and adjacent to the DeBeers Canada, Victor Diamond mine. These stations were selected based on changes in the river morphology and aquatic habitat features near the mine (Litvinov, 2013). The majority of the upstream water quality monitoring stations established by MERC are located approximately 90 km downstream of the confluence of the Muketei and Attawapiskat Rivers. These data provide a general characterization of the baseline conditions in the Attawapiskat River far downstream from the mine site.

3.5.3 Methods

The baseline surface water sampling program was initiated at the mine site LSA in 2010. Water quality sampling was conducted in the transportation corridor LSA during the baseline aquatic baseline studies from June to August, 2011.

Borrow and aggregate quarry sites were not identified at the time of the aquatic environment surveys. Once identified, water quality data will be collected for the permitting and approval of these sites.

Water quality samples were also obtained during the aquatic baseline studies from several muskeg ponds in the mine site LSA. The surface water quality sampling program in the trans-load facility LSA was initiated in 2012. Water quality samples were obtained during the spring, summer, and fall of 2012.

In situ field measurements of pH, specific conductance, and temperature were recorded during each sampling event using a Hanna or YSI multiparameter probe. The probes were calibrated prior to each sampling event and re-calibrated daily or as required according to the operating manual for the instrument. Water samples were collected as sub-surface grabs at least 15 cm below the surface using containers provided by the analytical laboratory. The samples were preserved in the field as required and stored at 4 to 10°C until shipped to the ALS Environmental Laboratory (ALS) in Thunder Bay, ON. All sampling activities and site conditions were documented on field data sheets. Standard protocols for surface water sampling were used, following those outlined in the:

- Protocols Manual for Water Quality Sampling in Canada, (CCME, 2011)
- Guidance on Sampling and Analytical Methods for use at Contaminated Sites in Ontario, Version 1.1, (MOEE, 1996)

Standard surface water quality analytes were measured in all samples and are summarized in Table 3.5-1. A complete list of analytes is provided in Appendix 5.

The ALS laboratory is a CALA certified and accredited independent laboratory. Peat wetlands can contribute mercury to surface water (Mitchell et al., 2007). As such, low level mercury and methyl mercury samples were taken at the mine site. The low level mercury samples were submitted to Flett Research Ltd. (Flett), a CALA accredited laboratory for analysis. The low detection limits achieved by Flett can recognize the presence of mercury at levels not typically included in standard surface water quality monitoring programs.

Table 3.5-1 In situ and Laboratory Parameter Summary

Parameter Category	Analytes
In situ	Temperature, Conductivity, Dissolved Oxygen, pH
Physical Tests	Conductivity, Hardness, pH, TSS, TDS, Turbidity
Anions and Nutrients	Acidity, Alkalinity, Ammonia-N, Un-Ionized Ammonia, Bicarbonate, Bromide, Carbonate, Chloride, Fluoride, Hydroxide, Nitrate, Nitrite, Total Kjeldahl Nitrogen (TKN), Orthophosphate, Phosphorus, TDS (calculated), Sulphate, Anion Sum, Cation Sum, Cation Balance
Cyanides	Total Cyanide
Organic/Inorganic Carbon	DIC, DOC, Total Organic Carbon
Metals	Total Metals (full ICP-MS scan), Dissolved Metals (full ICP-MS scan)
Speciated Metals	Hexavalent Chromium, Total Methyl-mercury and ortho-phosphate
Aggregate Organics	BOD, COD
Radiological Parameters	Radium 226

NOTES:

1. ANALYTES LISTED INCLUDE ADDITIONAL PARAMETERS NOT REQUIRED BY THE EIS GUIDELINES (CEA AGENCY, 2012).
2. SITE SPECIFIC ANALYTE PARAMETERS FOR EACH LSA ARE PROVIDED IN APPENDIX 5.

The laboratory MDLs for some parameters decreased throughout the course of the study as ALS refined or modified their testing procedures. When more than one detection limit was used during the study, a range of the detection concentrations has been provided.

3.5.4 Sample Locations

3.5.4.1 Mine Site

The seasonal sampling stations near the mine site were selected based on the location of the Project infrastructure and the hydrologic setting. Stations were positioned upstream and downstream of the infrastructure to support future monitoring plans and detection of potential mine-related effects. The location of the sites is shown on Figure 3.5-2 and the rationale for the selection of each station is provided in Table 3.5-2.

Table 3.5-2 Mine Site Sample Locations and Rationale

Station ID	Location	UTM Coordinates		Location Rationale
		Easting	Northing	
Koper Lake	North end of Koper Lake	0550700	5841350	Main point of entry by Noront and other local companies. Largest lake in the vicinity of the mine site.
Koper Creek	Koper Creek, outflow of Koper Lake	0551340	5843260	To characterize surface water quality in Koper Creek. Koper Creek intercepts waters flowing east from the mine site and Koper Lake
MR-Trib	Main branch of the Muketei River prior to the confluence with east branch	0550140	5854465	Watershed reference site. To characterize the surface water quality of the west branch of the Muketei River prior to confluence with the east branch of the Muketei River.
MR-D	East branch of the Muketei River downstream of the project site	0550250	5852970	Far field site - To characterize surface water quality of the east branch of the Muketei River downstream of the potential effluent discharge site.
MR-U	East Branch of the Muketei River upstream of the project site	0544760	5839980	Reference site - To characterize surface water quality of the east branch upstream of the mine site.
MR-M	East Branch of the Muketei River adjacent to the project site	0546635	5846595	To characterize surface water quality of the east branch adjacent to the mine site in the area of mine and sewage effluent discharge.
Trib-1	Unnamed Tributary flowing into Muketei River upstream of project site	0546575	5840000	Reference site - To characterize surface water quality conditions from a local tributary upstream of the site.
Trib-3	Unnamed Tributary downstream of project site	0550110	5847315	Reference site - To characterize surface water quality in the slow moving wetland environment north of the project site.
BP-1	Beaver Pond located adjacent to and downstream of the project site	0546505	5843760	Near field site - To characterize surface water quality leaving the site to the west.
AR-1	Attawapiskat River upstream of confluence with the Muketei River	0571716	5838597	Reference site - To characterize surface water quality upstream of the confluence with Muketei River.
AR-2	Muketei River prior to the confluence with the Attawapiskat River	0612392	5891456	Far field site - To characterize surface water quality within the Muketei River prior to the confluence with the Attawapiskat River as per consultation request from Attawapiskat First Nation.

NOTES:
1. UTM - UNIVERSAL TRANSVERSE MERCATOR, COORDINATES PROVIDED IN ZONE 16U, NAD 83.

Seasonal samples were obtained at 10 sites from the fall of 2010 until the spring of 2012. An additional site on the Muketei River was added during the spring of 2012 as a result of consultation with Attawapiskat First Nation and regulatory agencies. The 11 sites were sampled during the spring, summer and fall of 2012. In some cases, samples were not obtained as the stations were completely frozen or were not able to be accessed. A summary of the sampling events is shown in Table 3.5-3.

Table 3.5-3 Mine Site Sampling Events 2010 to 2012

Station ID	2010				2011				2012			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Koper Lake	x	x	x	x	x	x	x	x	x	x	x	x
Koper Creek	x	x	x		x	x	x	x	x	x	x	x
MR-Trib	x	x	x	x	x	x	x	x	x	x	x	x
MR-D	x	x	x	x	x	x	x	x	x	x	x	x
MR-U	x	x	x	x	x	x	x	x	x	x	x	x
MR-M	x	x	x	x	x	x	x	x	x	x	x	x
Trib-1	x	x	x	x	x	x	x	x	x	x	x	x
Trib-3	x	x	x		x	x	x		x	x	x	
BP-1	x	x	x	x	x	x	x	x	x	x	x	
AR-1	x	x	x	x	x	x	x	x	x	x	x	
AR-2									x	x	x	

NOTES:

1. SHADED CELLS INDICATE THE SAMPLE WAS NOT ABLE TO BE COLLECTED DURING THAT SAMPLING EVENT (E.G., FROZEN TO BOTTOM OF SAMPLING LOCATION).
2 NEW SAMPLE LOCATIONS: AR-2 ADDED IN SPRING 2012.

Water quality sampling was also conducted during the baseline aquatic environment assessment in 10 muskeg ponds east of the mine site in August 2011. The location of these ponds is shown on Figure 3.5-2.

3.5.4.2 Transportation Corridor

Water quality samples were taken along the transportation corridor at locations used for the assessment of the baseline aquatic environment. Water quality data were collected at 76 stations along the transportation corridor. The locations of the stations are shown on Figure 3.5-3. The locations and station names are summarized in Appendix 5. In situ water quality data were collected at all 76 stations and water quality samples were submitted to ALS for analysis from 40 stations.

In the Attawapiskat watershed, physical parameters were reported at 36 stations including in situ measurements of temperature, pH, dissolved oxygen and conductivity. Samples for laboratory analyses were taken from 13 stations.

In the Winisk watershed, physical parameters were reported at 37 stations including in situ measurements of temperature, pH, dissolved oxygen and conductivity. Samples for laboratory analyses were taken from 24 stations.

In the Ekwan watershed, physical parameters were reported at 36 stations including in situ measurements of temperature, pH, dissolved oxygen and conductivity. Samples for laboratory analyses were taken from 13 stations.

3.5.4.3 Trans-Load Facility

Water quality samples were taken at two stations in the trans-load facility LSA (Figure 3.5-4).

3.5.4.4 Quality Assurance and Quality Control

Field quality assurance and quality control (QA/QC) procedures were developed based on the Standards Development Branch Guidance on Sampling and Analytical Methods for use at Contaminated Sites in Ontario (MOEE, 1996). The QA/QC procedures were implemented throughout the baseline water quality program to ensure that high quality and representative data were obtained in a scientifically defensible, repeatable, and well documented manner. Details of the QA/QC program are provided in Appendix 5.

3.5.4.5 Relevant Water Quality Guidelines

Surface water quality data were compared to the relevant provincial and federal criteria typically utilized for assessing water quality:

- Provincial Water Quality Objectives (PWQO) (MOEE, 1994)
- Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQG-PAL), (CCME 1999)
- The CWQG-PAL criteria were utilized for the parameters that do not have an established PWQO

The CWQG-PAL criteria were utilized for the parameters that do not have an established PWQO. The relevant PWQO and CWQG-PAL criteria are shown in Table 3.5-4.

Table 3.5-4 Relevant PWQO and CWQG-PAL Guidelines

Parameter	PWQO[1]	CWQG-PAL[2]	Parameter	PWQO	CWQG-PAL
Physical Tests			**Total Metals continued**		
pH	6.5-8.5	N/A	Iron	0.3	N/A
DO (mg/L/%)	4-8/47-63	N/A	Lead	Variable[9]	N/A
Anions and Nutrients			Mercury	-	0.000026
Ammonia-N (Total)	-	Variable[3]	Molybdenum	0.04	N/A
Un-Ionized Ammonia-N	0.02	N/A	Nickel	0.025	N/A
Chloride	-	120	Selenium	0.1	N/A
Fluoride	-	0.12	Silver	0.0001	N/A
Nitrate	-	13	Thallium	0.0003	N/A
Nitrite	-	0.06	Tungsten	0.03	-
Phosphorous	30[4]	-	Uranium	0.005	N/A
Cyanides			Vanadium	0.006	-
Total Cyanide	0.005	N/A	Zinc	0.02	N/A
Total Metals			Zirconium	0.004	-
Aluminum	-	Variable[5]	**Dissolved Metals**		
Antimony	0.02	-	Aluminum	Variable[10]	-
Arsenic	0.005	N/A	Mercury	0.0002	-
Beryllium	Variable[6]	-	**Speciated Metals**		
Boron	0.2	N/A	Hexavalent Chromium (ug/L)	1	1
Cadmium	Variable[7]	N/A	Total Methyl Mercury (ug/L)	-	0.004
Cobalt	0.0009	-	**Radiological Parameters**		
Copper	Variable[8]	N/A	Radium 226 (Bq/L)	1	-

NOTES:

1. PWQO REFERS TO PROVINCIAL WATER QUALITY OBJECTIVES, WATER QUALITY MANAGEMENT POLICIES, GUIDELINES, PWQO OF THE ONTARIO MINISTRY OF ENVIRONMENT AND ENERGY (1994).
2. CWQG-PAL = CANADIAN WATER QUALITY GUIDELINES FOR THE PROTECTION OF FRESHWATER AQUATIC LIFE (CCME, 2002).
3. CWQG-PAL TOTAL AMMONIA CRITERIA BASED ON IN SITU PH AND TEMPERATURE VALUES, EXPRESSED AS mg/L NH3.
4. INTERIM PWQO – ELIMINATION OF EXCESSIVE PLANT GROWTH IN STREAMS <30 µg/L.
5. CWQG-PAL ALUMINUM CONCENTRATIONS ARE BASED ON IN SITU PH VALUES. CWQG-PAL OF 0.0005 mg/L WHEN PH < 6.5, OR 0.1 mg/L WHEN PH > 6.5.
6. PWQO BERYLLIUM CONCENTRATION LIMITS ARE 0.011 mg/L WHEN HARDNESS <75 mg/L AS $CACO_3$, OR 1.1 mg/L WHEN HARDNESS > 75 mg/L AS $CACO_3$.
7. INTERIM PWQO CADMIUM CONCENTRATIONS ARE 0.0001 mg/L WHEN HARDNESS ≤ 100 mg/L AS $CACO_3$, OR 0.0005 mg/L WHEN HARDNESS > 100 mg/L AS $CACO_3$.
8. PWQO COPPER CONCENTRATIONS ARE 0.001 mg/L WHEN HARDNESS ≤ 20 mg/L AS $CACO_3$, OR 0.005 mg/L WHEN HARDNESS > 20 mg/L AS $CACO_3$.
9. PWQO LEAD CONCENTRATIONS ARE 0.001 mg/L WHEN HARDNESS < 30 AS $CACO_3$, OR 0.003 mg/L WHEN HARDNESS 30 TO 80 mg/L AS $CACO_3$, OR 0.005 mg/L WHEN HARDNESS > 80 mg/L AS $CACO_3$.
10. INTERIM PWQO ALUMINUM CONCENTRATIONS ARE PH DEPENDENT AND ARE BASED ON PH VALUE OF IN SITU MEASUREMENTS.
11. UNITS ARE IN mg/L UNLESS OTHERWISE INDICATED.Mine Site Results

3.5.4.6 Seasonal Sampling Stations

Physical Parameters

The physical parameter data are summarized in Table 3.5-5. A detailed discussion of each parameter and the in situ measurements, laboratory results and summary statistics from each site visit are presented in Appendix 5.

The temperature measurements from all samples classify the mine site stations as cool water aquatic habitat since the temperature was never measured above 25°C (DFO, 2013). In general, the stations were soft to moderately hard (0-120 mg/L as $CaCO_3$), with the lowest hardness values being measured during the spring and highest values being measured in the winter. The measurement of turbidity and solids were generally highest during the spring and fall sampling events, which is concurrent with the highest amounts of precipitation and surface runoff. The in situ pH and dissolved oxygen (DO) results varied by station and by season.

- **pH** - The Muketei and Attawapiskat River samples had neutral pH. The samples from the Trib-3 station had consistently low pH values with the majority below the PWQO of 6.5. The remaining stations also had relatively neutral pH values with some samples indicating higher acidity, but, rarely were the values below the criteria.
- **Dissolved Oxygen** - Seasonal variability of DO is a natural occurrence and is evident in the data. The lowest DO values were obtained during the winter sampling events, when measurements were taken under ice cover. These low values were obtained due to limited atmospheric gas exchange. Most stations reported at least one concentration below the PWQO of 4 mg/L, most of which occurred during the March 2011 sampling event. The Koper Creek and BP-1 Stations reported the lowest DO concentrations.

Table 3.5-5 Mine Site - Physical Parameters Summary

Station ID	In Situ				Laboratory		
	Temperature (°C)	Dissolved Oxygen	Conductivity (µS/cm)	pH	Hardness	Total Suspended Solids	Total Dissolved Solids
Koper Lake	10.8 (0.1-20.8)	10.1 (6.6-13.2)	23 (8-70)	6.7 (5.2-8.1)	10 (7-14)	3.4 (*2.0*-12.9)	35 (18-70)
Koper Creek	9.5 (0.1-22.1)	4.1 (1.4-8.4)	99 (23-430)	6.6 (5.7-7.4)	50 (10-184)	8.2 (*2.0*-28.5)	89 (38-207)
MR-Trib	11.2 (0-21.3)	9.2 (3.5-11.1)	91 (48-263)	7.5 (6.5-8.1)	48 (25-92)	5.8 (*2.0*-14.7)	79 (42-127)
MR-D	10.7 (0.1-21.5)	7.4 (3.0-10.2)	129 (12-360)	7.4 (6.9-7.8)	82 (28-158)	3.2 (*2.0*-5.9)	106 (56-175)
MR-U	11.2 (0.1-22.1)	8.0 (3.4-12.3)	132 (13-385)	7.6 (7.2-8.1)	86 (32-189)	2.7 (*2.0*-6.8)	113 (59-201)
MR-M	11.1 (0.1-20.2)	8.7 (3.5-11.5)	116 (14-306)	7.6 (7.4-7.9)	79 (26-154)	3.8 (*2.0*-8.1)	108 (60-162)
Trib-1	10.5 (0.0-21.0)	8.8 (6.2-10.9)	89 (50-210)	7.3 (6.5-7.9)	50 (20-100)	8.4 (*2.0*-51.4)	86 (40-164)
Trib-3	12.8 (5.1-22.8)	6.4 (2.4-10.4)	18 (10-29)	5.8 (4.5-7.0)	10 (4-14)	36.6 (3.1-92.1)	46 (25-68)
BP-1	11.9 (1.1-18.3)	6.0 (0.5-11.9)	87 (61-129)	7.0 (6.0-7.7)	48 (19-102)	8.8 (2.0-52.5)	80 (50-148)
AR-1	13.4 (0.1-23.0)	10.3 (8.9-13.1)	92 (64-116)	7.7 (7.1-8.2)	55 (42-68)	4.6 (*2.0*-9.0)	81 (56-109)
AR-2	14.9 (10.9-20.8)	11.0 (9.7-12.8)	90 (71-120)	7.7 (7.3-7.9)	50 (43-65)	17.0 (3.6-42.4)	72 (42-92)

NOTES:

1. ALL UNITS ARE mg/L UNLESS OTHERWISE INDICATED.
2. SUMMARY TABLE VALUES REPRESENT MEAN REPORTED CONCENTRATIONS.
3. BRACKETED VALUES REPRESENT THE RANGE OF REPORTED CONCENTRATIONS.
4. ITALICIZED VALUES REPRESENT THE LABORATORY METHOD DETECTION LIMIT.

Nutrients and Anions

In general, alkalinity was lowest in the spring and highest during the winter sampling events. The concentrations of other nutrients were mostly below the MDL, except during winter events. Total phosphorus was the only nutrient where PWQOs were exceeded:

- **Total Phosphorus** - In general, most concentrations were below the PWQO of 0.03 mg/L. In some samples, the PWQO were exceeded during the summer months. The highest concentration was recorded at the Trib-3 Station (0.0964 mg/L), which is in a stagnant wetland environment. Some exceedances were also reported in Trib-1 (0.0476 mg/L), BP-1 (0.0749 mg/L) and Koper Creek (0.308 and 0.0532 mg/L). The Muketei and Attawapiskat River reported concentrations below the criteria with the exception of two samples MR-M (0.384 mg/L) and AR-2 (0.0328 mg/L).

All anion concentrations were below their respective regulatory criteria and generally near to or below their MDLs. The nutrients and anions that were near or below their respective MDLs are shown in Table 3.5-6. A summary of selected nutrient and anion concentrations is provided in Table 3.5-7.

Table 3.5-6 Mine Site - Nutrients and Anions (≤ MDL)

Anions and Nutrients	MDL
Bromide	0.18 mg/L*
Carbonate	5.0 mg/L
Cyanide	0.0020 mg/L
Fluoride	0.04 mg/L*
Hydroxide	5.0 mg/L
Nitrite	0.020 to 0.10 mg/L
Orthophosphate	0.0030 to 0.60 mg/L
Un-Ionized Ammonia-N	0.019 to 0.020 mg/L

NOTES:
1. MDL = LABORATORY METHOD DETECTION LIMIT.
2. * INDICATES VALUES THAT REFLECT AVERAGE CONCENTRATIONS DIFFERENT FROM THE MDL.

Table 3.5-7 Mine Site - Nutrients and Anions Summary

Station ID	Total Alkalinity	Total Ammonia-N	Nitrate-N	Total Phosphorous	Sulphate
Koper Lake	7.5 (6.1-10.2)	0.027 (*0.020*-0.083)	0.036 (*0.030-0.10*)	0.0107 (*0.0050*-0.0265)	0.61 (*0.30-2.00*)
Koper Creek	46.3 (9.2-179.0)	0.174 (*0.020*-1.140)	0.036 (*0.030-0.10*)	0.0205 (*0.0050*-0.0532)	0.45 (*0.30-2.00*)
MR-Trib	39.9 (20.2-72.4)	0.028 (*0.020*-0.062)	0.048 (*0.030-0.10*)	0.0115 (*0.0050*-0.0217)	0.50 (*0.30-2.00*)
MR-D	73.2 (25.2-138.0)	0.027 (*0.020*-0.068)	0.054 (*0.030*-0.123)	0.0138 (0.0070-0.0289)	0.62 (*0.30-2.00*)
MR-U	78.1 (31.5-169.0)	0.029 (*0.020*-0.088)	0.049 (*0.030-0.*103)	0.0082 (*0.0050*-0.0146)	0.73 (*0.30-2.00*)
MR-M	72.6 (24.9-132.0)	0.031 (*0.020*-0.064)	0.058 (*0.030*-0.154)	0.0123 (*0.0050*-0.0384)	0.65 (*0.30-2.00*)
Trib-1	44.3 (18.1-86.9)	0.038 (*0.020*-0.112)	0.048 (*0.030*-0.108)	0.0162 (0.0107-0.0476)	0.45 (*0.30-2.00*)
Trib-3	5.2 (5.0-6.2)	*0.020*	0.038 (*0.030-0.10*)	0.0283 (*0.0050*-0.0964)	0.49 (*0.30-2.00*)
BP-1	43.3 (18.2-99.7)	0.037 (*0.020*-0.190)	0.036 (*0.030-0.10*)	0.0138 (*0.0050*-0.0749)	0.51 (*0.30-2.00*)
AR-1	50.7 (41.9-61.8)	*0.020*	0.046 (*0.030*-0.110)	0.0088 (*0.0050*-0.0156)	0.69 (0.35-2.*00*)
AR-2	44.9 (36.9-59.1)	*0.020*	*0.030*	0.0191 (0.0103-0.0328)	*0.30*

NOTES:
1. ALL UNITS ARE mg/L WITH THE EXCEPTION OF TOTAL ALKALINITY WHICH IS EXPRESSED AS mg/L AS $CaCO_3$.
2. SUMMARY TABLE VALUES REPRESENT MEAN REPORTED CONCENTRATIONS.
3. BRACKETED VALUES REPRESENT THE RANGE OF REPORTED CONCENTRATIONS PER STATION.
4. ITALICIZED VALUES REPRESENT THE LABORATORY METHOD DETECTION LIMIT.

Metals

Several of the metals concentrations were consistently near or below their respective MDLs and are summarized in in Table 3.5-8.

Table 3.5-8 Mine Site - Metals (≤ MDL)

Parameter	MDL	Parameter	MDL
Total Metals		**Dissolved Metals**	
Antimony	0.0050 to 0.00060	Antimony	0.0050 to 0.00060
Beryllium	0.0010	Beryllium	0.0010
Bismuth	0.0010	Bismuth	0.0010
Boron	0.050	Boron	0.050
Chromium	0.0010	Cadmium	0.00010 to 0.000017
Cobalt	0.00050	Chromium	0.0010
Lead	0.0010	Cobalt	0.00050
Lithium	0.050 to 0.10	Copper	0.0010
Mercury	0.00010 to 0.000010	Lead	0.0010
Molybdenum	0.0010	Lithium	0.10 to 0.050
Nickel	0.0020	Mercury	0.00010 to 0.000020
Selenium	0.0050 to 0.00040	Molybdenum	0.0010
Silver	0.00010	Nickel	0.0020
Tellurium	0.0010	Selenium	0.0050 to 0.0010
Thallium	0.00030	Silver	0.00010
Tin	0.0010	Tellurium	0.0010
Tungsten	0.010	Thallium	0.00030
Uranium	0.0050	Tin	0.0010
Vanadium	0.0010	Titanium	0.0020
Zirconium	0.0010 to 0.0040	Tungsten	0.010
Speciated Metals		Uranium	0.0050
Chromium VI	10 to 0.01 µg/L	Vanadium	0.0010
Radiological Parameters		Zirconium	0.0040 to 0.0010
Radium-226	0.01 Bq/L		

NOTES:
1. MDL = LABORATORY METHOD DETECTION LIMIT.
2. UNITS ARE IN mg/L UNLESS OTHERWISE INDICATED.

The concentrations of selected metals of interest (e.g. Aluminium, Arsenic, Chromium, Iron, Lead, Mercury, and Nickel) are summarized in in Table 3.5-9.

Table 3.5-9 Mine Site - Metals Summary

Station ID	Al	As	Cr	Cr VI	Fe	Pb	Hg	CH_3Hg	Ni
Koper Lake	0.056 (0.026-0.196)	*0.0010*	*0.0010*	*0.01 - 10 µg/L*	0.19 (0.044-0.269)	*0.0010*	*0.00010-0.000010*	*0.08 ng/L*	*0.0020*
Koper Creek	0.030 (0.011-0.068)	0.0018 (*0.0010*-0.0051)	*0.0010*	*0.01 - 10 µg/L*	1.983 (0.261-4.720)	*0.0010*	*0.00010-0.000010*	*0.08 ng/L*	*0.0020*
MR-Trib	0.106 (0.042-0.233)	0.0010 (*0.0010*-0.0011)	*0.0010*	*0.01 - 10 µg/L*	0.497 (0.239-0.947)	*0.0010*	*0.00010-0.000010*	*0.08 ng/L*	*0.0020*
MR-D	0.055 (0.021-0.103)	*0.0010*	*0.0010*	*0.01 - 10 µg/L*	0.628 (0.203-1.500)	*0.0010*	*0.00010-0.000010*	*0.08 ng/L*	*0.0020*
MR-U	0.035 (0.011-0.099)	*0.0010*	*0.0010*	*0.01 - 10 µg/L*	0.683 (0.190-1.620)	*0.0010*	*0.00010-0.000010*	*0.08 ng/L*	*0.0020*
MR-M	0.077 (0.033-0.288)	0.0010 (*0.0010*-0.0011)	*0.0010*	*0.01 - 10 µg/L*	0.696 (0.174-1.570)	*0.0010*	*0.00010-0.000010*	*0.08 ng/L*	*0.0020*
Trib-1	0.095 (0.041-0.144)	0.0013 (*0.0010*-0.0020)	*0.0010*	*0.01 - 10 µg/L*	0.852 (0.290-2.100)	*0.0010*	*0.00010-0.000010*	*0.08 ng/L*	*0.0020*
Trib-3	0.044 (0.014-0.177)	*0.0010*	*0.0010*	*0.01 - 10 µg/L*	0.347 (0.067-1.710)	*0.0010*-0.0024	*0.00010-0.000010*	*0.08 ng/L*	*0.0020*
BP-1	0.048 (0.010-0.134)	0.0011 (*0.0010*-0.0017)	*0.0010*	*0.01 - 10 µg/L*	0.560 (0.055-2.810)	*0.0010*	*0.00010-0.000010*	*0.08 ng/L*	*0.0020*
AR-1	0.070 (0.023-0.197)	*0.0010*	*0.0010*	*0.01 - 10 µg/L*	0.175 (0.071-0.399)	*0.0010*	*0.00010-0.000010*	*0.08 ng/L*	*0.0020*
AR-2	0.123 (0.065-0.208)	*0.0010*	*0.0010*	*0.01 - 10 µg/L*	0.618 (0.467-0.750)	*0.0010*	*0.00010-0.000010*	*0.08 ng/L*	*0.0020*-0.0048

NOTES:

1. ALL UNITS ARE mg/L UNLESS OTHERWISE INDICATED.
2. ITALICIZED VALUES REPRESENT THE LABORATORY MDL. A RANGE OF VALUES INDICATES THAT THE MDL WAS CHANGED BY THE LAB THROUGH THE COURSE OF THE STUDY.
3. BRACKETED VALUES REPRESENT THE RANGE OF CONCENTRATIONS REPORTED PER STATION.
4. CR VI IS HEXAVALENT CHROMIUM AND CH_3HG IS METHYL MERCURY.

The results for the selected metals are summarized as follows:

- **Aluminium** - Total aluminium concentrations varied both spatially and temporally. Over one-third of the samples were above the CWQG-PAL criteria, (which ranges between 0.005 mg/L and 0.100 mg/L depending on sample pH). The sample results from 2010 contain over half of these exceedances. There were no criteria exceedances in the samples from the most upstream Muketei River Station (MR-U) or from the Attawapiskat River Station (AR-1). The remaining Muketei River Stations show generally elevated concentrations during the spring and fall sampling events. The Stations MR-Trib and Trib-3 had the highest number of CWQG-PAL exceedances.
- Dissolved aluminium concentrations also varied both spatially and temporally. The Muketei River stations had elevated concentrations in the spring and fall, but did not exceed the PWQO (0.015 or 0.075 mg/L depending on sample pH). Trib-3 was the only station that reported results exceeding the PWQO, with more than half of the samples above the guideline limit.
- **Arsenic** - At most stations, total arsenic concentrations were generally near to or below the MDL of 0.0010 mg/L, which is below the PWQO of 0.005 mg/L. Station Trib-1 had the most number of samples above the MDL, however, all were below the PWQO. The Koper Creek

Station had the highest concentration of arsenic in the July 2011 sample (0.0051 mg/L), which is equal to the PWQO.

- **Chromium** - Total and dissolved chromium concentrations were reported below the MDL (0.0010 mg/L) in all sampled, except the MR-D sample obtained in February 2012, which had a concentration of 0.0014 mg/L. There are no PWQO or CWQG-PAL criteria established for total or dissolved chromium.
- **Hexavalent Chromium** - Hexavalent chromium concentration was reported below the MDLs and PWQO in all samples.
- **Iron** - Total iron concentrations were elevated at all sample stations. More than half of the concentrations reported were above the PWQO of 0.3 mg/L. The highest concentrations were reported during the winter sampling events. The Muketei River stations had concentrations above the PWQO in nearly all of the samples. The Attawapiskat River Station (AR-1) had the lowest baseline concentrations of all the riverine stations. Koper Lake was the only station consistently below the PWQO for all sampling events. Most samples from the Koper Creek Station, which is downstream of Koper Lake, were above the PWQO criteria.
- **Lead** - Total and dissolved lead concentrations were reported below the MDL (0.0010 mg/L) in all samples.
- **Mercury** - Total and dissolved mercury concentrations were reported below the MDLs in all samples. The MDL used during 2010 and the first sampling event of 2011 was 0.00010 mg/L. This limit satisfied the PWQO of 0.0002 mg/L for dissolved mercury, but not the total mercury CWQG-PAL criteria of 0.000026 mg/L. The remaining 2011 and 2012 samples were reported with an MDL of 0.000010 mg/L, which met both criteria.
- **Methyl Mercury** - Most low level methyl mercury concentrations were reported below the MDL (0.00008 µg/L) in all samples, and all were below the CWQG-PAL criteria of 0.004 µg/L.
- **Nickel** - Total and dissolved nickel concentrations were reported below the MDL of 0.0020 mg/L at all stations. This upper limit of baseline condition is also below the PWQO criteria of 0.025 mg/L.

3.5.4.7 Muskeg Ponds Near The Mine Site

Physical Parameters

The temperature measurements classify these stations as cool water aquatic habitat since the temperature was not measured above 25°C (DFO, 2013). The in situ measurements show these ponds range from acidic to neutral pH (4.3 to 7.4). In general, the ponds had soft water (0-60 mg/L as $CaCO_3$) with one hard water station (EP-06 = 146 mg/L as $CaCO_3$). These ponds had moderate DO concentrations that satisfied the PWQO of ≥ 4 mg/L. The turbidity values and the amount of solids indicate that these ponds generally have low particulate matter with high transparency and light penetration. Station EP-06 was the only station with elevated particulate matter. Low conductivity was measured throughout these ponds, with the exception of Station EP-06 that had high conductivity. The ranges of selected physical parameters are summarized in Table 3.5-10.

Table 3.5-10 Muskeg Ponds - Physical Parameters Summary

Parameter	Minimum	Mean	Median	Maximum	Standard Deviation
Temperature (°C)*	14.2	18.3	19.2	20.2	2.1
pH (pH units)*	4.3	6.4	6.8	7.4	1
Dissolved Oxygen (mg/L)*	6.0	8.9	9.4	9.7	1.3
Conductivity (μS/cm)*	11	44	21	202	59
Hardness (mg/L as $CaCO_3$)	2.4	29.1	13.5	146.0	43.3
Total Suspended Solids (mg/L)	*2.0*	5.5	2.1	22.9	7.3
Turbidity (NTU)	0.58	0.95	0.84	2.22	0.49

NOTES:
1. * INDICATES IN SITU MEASUREMENTS.
2. ITALICIZED VALUES REPRESENT THE LABORATORY METHOD DETECTION LIMIT.

Nutrients and Anions

The nutrients reported for these stations include alkalinity, total ammonia, un-ionized ammonia, nitrate, nitrite, and total phosphorus. The alkalinity results indicate limited buffering capacity exists in these ponds, which results in the predominately acidic in situ pH values. Most of the nutrients concentrations were near or below the MDL. Elevated un-ionized ammonia concentrations were detected in most of the ponds, which were all above the PWQO of 0.020 mg/L. Total ammonia concentrations were all reported below the CWQG-PAL criteria, which is variable based on sample temperature and pH. Total phosphorus concentrations suggest that these water bodies have mesotrophic nutrient levels that are commonly associated with clear water and submergent aquatic plants. All total phosphorus concentrations were below the PWQO of 0.03 mg/L.

The anions reported for these stations include bromide, chloride, cyanide, fluoride, hydroxide, and sulphate. All anion concentrations were below their respective regulatory criteria and generally near to or below their MDLs. A summary of selected nutrient and anion concentrations is provided in Table 3.5-11.

Table 3.5-11 Muskeg Ponds - Nutrients and Anions Summary

Parameter	Minimum	Mean	Median	Maximum	Standard Deviation
Alkalinity (mg/L as $CaCO_3$)	*5*	26	11	134	40
Total Ammonia (mg/L)	*0.020*	0.028	0.030	0.036	0.006
Un-ionized Ammonia (mg/L)	*0.020*	0.027	0.029	0.036	0.007
Nitrate-N (mg/L)	*0.10*	*0.10*	*0.10*	*0.10*	0
Total Phosphorus (mg/L)	*0.0050*	0.0072	0.0057	0.0155	0.0034
Sulphate (mg/L)	*2.0*	*2.0*	*2.0*	*2.0*	0

NOTES:
1. ITALICIZED VALUES REPRESENT THE LABORATORY METHOD DETECTION LIMIT.

Metals

The majority of the metals analyzed were consistently near or below their respective MDLs and nearly all samples were below their respective water quality criteria. Total aluminium concentrations showed the highest variability between stations and there were three exceedances of the CWQG-PAL criteria. The highest concentrations of total aluminum were detected at Station EP-09 (0.035 mg/L) and EP-10 (0.031 mg/L). The dissolved aluminium concentrations were also highly variable among stations. Station EP-10 reported the highest dissolved aluminum concentration (0.028 mg/L) and was the only exceedance of the PWQO. Naturally elevated total iron concentrations were detected throughout these ponds but the results did not exceed the PWQO of 0.3 mg/L. A summary of the concentrations for selected metals of interest is provided in Table 3.5-12.

Table 3.5-12 Muskeg Ponds - Metals Summary

Parameter	Minimum	Mean	Median	Maximum	Standard Deviation
Total Aluminium (mg/L)	*0.010*	0.022	0.021	0.035	0.009
Dissolved Aluminium (mg/L)	*0.010*	0.018	0.016	0.030	0.008
Arsenic (mg/L)	*0.0010*	*0.0010*	*0.0010*	*0.0010*	0
Total Chromium (mg/L)	*0.0010*	*0.0010*	*0.0010*	*0.0010*	0
Hexavalent Chromium (µg/L)	*10*	*10*	*10*	*10*	0
Iron (mg/L)	0.050	0.104	0.089	0.207	0.045
Lead (mg/L)	*0.0010*	*0.0010*	*0.0010*	*0.0010*	0
Dissolved Mercury (mg/L)	*0.00010*	*0.00010*	*0.00010*	*0.00010*	0
Nickel (mg/L)	*0.0020*	*0.0020*	*0.0020*	*0.0020*	0

NOTES:

1. ITALICIZED VALUES REPRESENT THE LABORATORY METHOD DETECTION LIMIT.

3.5.5 Transportation Corridor Results

3.5.5.1 Attawapiskat Watershed

Physical Parameters

The temperature measurements classify the 36 stations as cool water aquatic habitat, since the temperature was not measured above 25°C (DFO, 2013). The in situ measurements show the samples had neutral pH with higher acidity at some stations. In general, the stations had soft water (0-60 mg/L as $CaCO_3$) with moderately hard water at Station X015. The samples had moderate DO concentrations, with low values recorded at some stations with slow moving water. The turbidity values and amount of solids indicate that the samples had low particulate matter with high transparency and light penetration. The generally low conductivity measurements (<100 µS/cm) are an indication of low dissolved solids concentrations throughout the watershed. The ranges of selected physical parameters are summarized in Table 3.5-13.

Table 3.5-13 Attawapiskat Watershed - Physical Parameters Summary

Parameter	Minimum	Mean	Median	Maximum	Standard Deviation
Temperature (°C)*	2.6	11.7	11.9	21.8	5.4
pH (pH units)*	5.8	6.8	6.9	7.9	0.5
Dissolved Oxygen (mg/L)*	3.3	8.0	8.3	11.2	2.0
Conductivity (µS/cm)*	17	60	50	253	43
Hardness (mg/L as $CaCO_3$)	14.3	48.5	40.1	163.0	36.9
Total Suspended Solids (mg/L)	2.0	4.1	3.1	10.7	2.8
Turbidity (NTU)	0.48	1.87	1.03	7.19	2.37

NOTES:
1. * INDICATES IN SITU MEASUREMENTS.

Nutrients and Anions

The neutral in situ pH values suggest that a suitable buffering capacity exists to neutralize acidic or basic inputs. Most of the nutrients concentrations were near or below the MDL. Total phosphorus concentrations show this watershed has mesotrophic nutrient levels commonly associated with clear water and submergent aquatic plants. All total phosphorus concentrations were below the PWQO of 0.03 mg/L.

All anion concentrations were below their respective regulatory criteria and generally near to or below their MDLs. A summary of selected nutrient and anion concentrations is provided in Table 3.5-14.

Table 3.5-14 Attawapiskat Watershed - Nutrients and Anions Summary

Parameter	Minimum	Mean	Median	Maximum	Standard Deviation
Alkalinity (mg/L as $CaCO_3$)	12	43	32	152	35
Total Ammonia (mg/L)	*0.020*	0.021	*0.020*	0.027	0.002
Nitrate (mg/L)	*0.030*	0.035	*0.030*	*0.100*	0.0194
Total Phosphorus (mg/L)	0.0057	0.0141	0.0136	0.0228	0.0053
Sulphate (mg/L)	*0.30*	0.56	0.38	*2.00*	0.46

NOTES:
1. ITALICIZED VALUES REPRESENT THE LABORATORY METHOD DETECTION LIMIT.

Metals

The majority of the metals analyzed were consistently near or below their respective MDLs and nearly all samples were below their respective quality criteria. Total aluminium concentrations showed the highest variability among stations and there were two exceedances of the CWQG-PAL criteria. The highest concentrations of aluminum were detected within largest watercourses:

Totogan Creek Station (X020, 0.300 mg/L) and the Pineimuta River (Station X023, 0.332 mg/L). Naturally elevated total iron concentrations were also detected throughout the watershed, which exceeded the PWQO of 0.3 mg/L at four stations. Iron exceedances were detected in the largest watercourses sampled in this watershed (e.g., Nemeibenikan Brook, Totogan Creek, Pineimuta River and the Muketei River). A summary of the concentrations for selected metals of interest is provided in Table 3.5-15.

Table 3.5-15 Attawapiskat Watershed - Metals Summary

Parameter	Minimum	Mean	Median	Maximum	Standard Deviation
Aluminium (mg/L)	*0.010*	0.078	0.036	0.332	0.107
Arsenic (mg/L)	0.*0010*	*0.0010*	*0.0010*	0.0011	1.0
Total Chromium (mg/L)	*0.0010*	*0.0010*	*0.0010*	*0.0010*	0
Hexavalent Chromium (µg/L)	*10*	*10*	*10*	*10*	0
Iron (mg/L)	0.070	0.222	0.163	0.536	0.147
Lead (mg/L)	*0.0010*	*0.0010*	*0.0010*	*0.0010*	0
Dissolved Mercury (mg/L)	*0.00010*	*0.00010*	*0.00010*	*0.00010*	0
Nickel (mg/L)	*0.0020*	*0.0020*	*0.0020*	*0.0020*	0

NOTES:
1. ITALICIZED VALUES REPRESENT THE LABORATORY METHOD DETECTION LIMIT.

3.5.5.2 Winisk Watershed

Physical Parameters

The temperature measurements classify the 37 stations as cool water aquatic habitat, since the temperature was not measured above 25°C (DFO, 2013). The average in situ measurements show the stations had neutral to slightly alkaline pH ranging between 6.6 and 8.6. In general, the samples from the stations were moderately hard (61-120 mg/L as $CaCO_3$) with one station with hard water (WJ-2). These samples had moderate DO concentrations that generally satisfy the PWQO (≥ 4 mg/L). Concentrations of DO below this limit were measured at stations with slow moving, nearly stagnant water (e.g., Station X052, 0.20 mg/L). The turbidity values and concentration of solids show that the samples had low particulate matter with high transparency and light penetration. Low to moderate conductivity was measured throughout the samples. The ranges of selected physical parameters are summarized in Table 3.5-16.

Table 3.5-16 Winisk Watershed - Physical Parameters Summary

Parameter	Minimum	Mean	Median	Maximum	Standard Deviation
Temperature (°C)*	6.8	17.1	17.3	24.8	3.8
pH (pH units)*	6.6	7.4	7.2	8.6	0.5
Dissolved Oxygen (mg/L)*	0.2	7.2	7.7	10.9	2.6
Conductivity (µS/cm)*	53	141	130	418	61
Hardness (mg/L as $CaCO_3$)	50.0	77.6	72.9	145.0	23.0
Total Suspended Solids (mg/L)	2.0	7.6	3.2	59.8	14.3
Turbidity (NTU)	0.33	1.87	1.29	13.40	2.76

NOTES:
1. * INDICATES IN SITU MEASUREMENTS.

Nutrients and Anions

The neutral in situ pH suggests that a suitable buffering capacity exists to neutralize acidic or basic inputs, as indicated by. Most of the nutrients concentrations were near or below the MDL. Total phosphorus concentrations show this watershed has the mesotrophic nutrient levels, which are commonly associated with clear water and submergent aquatic plants. All total phosphorus concentrations were below the PWQO of 0.03 mg/L with the exception of Station WJ-1, which had a value of 0.171 mg/L.

Most anion concentrations were below their respective regulatory criteria and generally near to or below their MDLs. Fluoride concentrations were detected above the CWQG-PAL of 0.12 mg/L on the Wapitotem River at Station WJ-1 and Station X068 (0.125 mg/L was measured at both stations). A summary of selected nutrient and anion concentrations is provided in Table 3.5-17.

Table 3.5-17 Winisk Watershed - Nutrients and Anions Summary

Parameter	Minimum	Mean	Median	Maximum	Standard Deviation
Alkalinity (mg/L as $CaCO_3$)	44	72	72	120	21
Total Ammonia (mg/L)	*0.020*	0.030	0.025	0.057	0.012
Nitrate (mg/L)	0.030	0.042	0.030	0.100	0.025
Total Phosphorus (mg/L)	0.0050	0.0193	0.0116	0.1710	0.0329
Sulphate (mg/L)	*0.30*	0.61	0.31	*2.0*	0.59

NOTES:
1. ITALICIZED VALUES REPRESENT THE LABORATORY METHOD DETECTION LIMIT.

Metals

The majority of the metals analyzed were consistently near or below their respective MDLs and most samples were below their respective water quality criteria. Total aluminium concentrations showed the highest variability among stations and there was one exceedance of the CWQG-PAL criteria. The highest concentration of aluminum was detected at the Wapitotem River (WJ-1, 0.158 mg/L). Naturally elevated total iron concentrations were detected throughout the watershed, exceeding the PWQO of 0.3 mg/L at three stations. Two of these iron exceedances were detected in the samples from the Wapitotem River at Station WJ-1 and Station X068 (0.801 mg/L and 0.518 mg/L respectively). A summary of the concentrations for selected metals of interest is provided in Table 3.5-18.

Table 3.5-18 Winisk Watershed - Metals Summary

Parameter	Minimum	Mean	Median	Maximum	Standard Deviation
Aluminium (mg/L)	*0.010*	0.025	0.015	0.158	0.031
Arsenic (mg/L)	*0.0010*	*0.0010*	*0.0010*	0.0019	0
Total Chromium (mg/L)	*0.0010*	*0.0010*	*0.0010*	*0.0010*	0
Hexavalent Chromium (µg/L)	*10*	*10*	*10*	*10*	0
Iron (mg/L)	0.050	0.167	0.096	0.801	0.181
Lead (mg/L)	*0.0010*	0.0010	0.0010	0.0012	0
Dissolved Mercury (mg/L)	*0.00010*	*0.00010*	*0.00010*	*0.00010*	0
Nickel (mg/L)	*0.0020*	*0.0020*	*0.0020*	*0.0020*	0

NOTES:
1. ITALICIZED VALUES REPRESENT THE LABORATORY METHOD DETECTION LIMIT.

3.5.5.3 Ekwan Watershed

Physical Parameters

The recorded temperatures classify the stations as cool water aquatic habitat, since the temperature was not measured above 25°C (DFO, 2013). The average of the in situ measurements show that the samples had a neutral pH, which ranged from 7.3 to 7.5. All stations had soft water (0-60 mg/L as $CaCO_3$). The DO concentrations ranged from 9.7 mg/L to 11.0 mg/L and satisfy the PWQO of ≥ 4 mg/L. The turbidity values and amount of solids indicate that the samples from this watershed had low particulate matter with high transparency and light penetration. Low conductivity was measured throughout these stations. The ranges of selected physical parameters are summarized in Table 3.5-19.

Table 3.5-19 Ekwan Watershed - Physical Parameters Summary

Parameter	Minimum	Mean	Median	Maximum	Standard Deviation
Temperature (°C)*	15.6	17.4	16.7	19.9	2.2
pH (pH units)*	7.3	7.4	7.4	7.5	0.1
Dissolved Oxygen (mg/L)*	9.7	10.5	10.8	11.0	0.7

Parameter	Minimum	Mean	Median	Maximum	Standard Deviation
Conductivity (µS/cm)*	34	56	63	72	20
Hardness (mg/L as $CaCO_3$)	22.5	40.6	45.3	54.0	16.3
Total Suspended Solids (mg/L)	*2.0*	*2.0*	*2.0*	*2.0*	0
Turbidity (NTU)	0.65	1.34	1.66	1.72	0.60

NOTES:
1. * INDICATES IN SITU MEASUREMENTS.
2. ITALICIZED VALUES REPRESENT THE LABORATORY METHOD DETECTION LIMIT.

Nutrients and Anions

The neutral in situ pH values suggest that there is a suitable buffering capacity to neutralize acidic or basic inputs, as indicated by. Most of the nutrients concentrations were near or below the MDL. Total phosphorus concentrations show this watershed has the mesotrophic nutrient levels that are commonly associated with clear water and submergent aquatic plants. All total phosphorus concentrations were below the PWQO of 0.03 mg/L.

All anion concentrations were below their respective regulatory criteria and near to or below their respective MDL. A summary of selected nutrient and anion concentrations is provided in Table 3.5-20.

Table 3.5-20 Ekwan Watershed - Nutrients and Anions Summary

Parameter	Minimum	Mean	Median	Maximum	Standard Deviation
Alkalinity (mg/L as $CaCO_3$)	17	34	38	46	15
Total Ammonia (mg/L)	*0.020*	0.0217	0.020	0.025	0.003
Nitrate (mg/L)	*0.10*	*0.10*	*0.10*	*0.10*	0
Total Phosphorus (mg/L)	0.0089	0.0119	0.0103	0.0165	0.0040
Sulphate (mg/L)	*2.0*	*2.0*	*2.0*	*2.0*	0

NOTES:
1. ITALICIZED VALUES REPRESENT THE LABORATORY METHOD DETECTION LIMIT.

Metals

The majority of the metals analyzed were near or below their respective MDLs and below their respective quality criteria. Total aluminium concentrations were naturally elevated in the samples and were below the CWQG-PAL criteria of 0.100 mg/L. Naturally elevated total iron concentrations were detected in the samples and were below the PWQO of 0.3 mg/L. A summary of the concentrations for selected metals of interest is provided in Table 3.5-21.

Table 3.5-21 Ekwan Watershed - Metals Summary

Parameter	Minimum	Mean	Median	Maximum	Standard Deviation
Aluminium (mg/L)	0.019	0.024	0.025	0.027	0.004
Arsenic (mg/L)	*0.0010*	0.0011	0.0011	0.0011	0
Total Chromium (mg/L)	*0.0010*	*0.0010*	*0.0010*	*0.0010*	0
Hexavalent Chromium (µg/L)	*10*	*10*	*10*	*10*	0
Iron (mg/L)	0.156	0.211	0.203	0.273	0.059
Lead (mg/L)	*0.0010*	*0.0010*	*0.0010*	*0.0010*	0
Dissolved Mercury (mg/L)	*0.00002*	*0.00002*	*0.00002*	*0.00002*	0
Nickel (mg/L)	*0.0020*	*0.0020*	*0.0020*	*0.0020*	0

NOTES:
1. ITALICIZED VALUES REPRESENT THE LABORATORY METHOD DETECTION LIMIT.

3.5.6 Trans-Load Facility Results

3.5.6.1 Physical Parameters

The temperature measurements classify these stations as cool water aquatic habitat, since the temperature was not measured above 25°C (DFO, 2013). The in situ measurements show that the ponds samples had a neutral to moderately alkaline pH. In general, the ponds had moderately hard water (61-120 mg/L as $CaCO_3$) and moderate DO concentrations that satisfied the PWQO of ≥ 4 mg/L. The turbidity values and amount of solids sampled indicate that these ponds generally had low particulate matter with high transparency and light penetration. Moderately high conductivity was measured. The ranges of selected physical parameters are summarized in Table 3.5-22.

Table 3.5-22 Trans-Load Facility - Physical Parameters Summary

Parameter	Minimum	Mean	Median	Maximum	Standard Deviation
Temperature (°C)*	8.8	12.2	10.3	18.5	4.1
pH (pH units)*	7.0	7.6	7.4	8.6	0.7
Dissolved Oxygen (mg/L)*	4.6	6.1	6.2	7.5	1.2
Conductivity (µS/cm)*	110	155	152	208	40
Hardness (mg/L as $CaCO_3$)	36.7	91.2	108.0	115.0	32.5
Total Suspended Solids (mg/L)	*2.0*	2.3	2.2	2.7	0.3
Turbidity (NTU)	0.81	1.02	0.96	1.45	0.24

NOTES:
1. * INDICATES IN SITU MEASUREMENTS.
2. ITALICIZED VALUES REPRESENT THE LABORATORY METHOD DETECTION LIMIT.

3.5.6.2 Nutrients and Anions

The neutral in situ pH values suggest that there is adequate buffering capacity to neutralize acidic or basic inputs, as shown by. Most of the nutrients concentrations were near or below the MDL. Total phosphorus concentrations show mesotrophic nutrient levels that are commonly associated with clear water and submergent aquatic plants. All total phosphorus concentrations were below the PWQO of 0.03 mg/L.

All anion concentrations were below their respective regulatory criteria and generally near to or below their MDLs. A summary of selected nutrient and anion concentrations is provided in Table 3.5-23.

Table 3.5-23 Trans-Load Facility - Nutrients and Anions Summary

Parameter	Minimum	Mean	Median	Maximum	Standard Deviation
Alkalinity (mg/L as $CaCO_3$)	32	88	108	115	36
Total Ammonia (mg/L)	*0.020*	0.032	0.030	0.046	0.013
Un-ionized Ammonia (mg/L)	*0.019*	*0.019*	*0.019*	*0.019*	0.000
Nitrate (mg/L)	*0.030*	*0.030*	*0.030*	*0.030*	0.000
Total Phosphorus (mg/L)	0.0073	0.0098	0.0098	0.0133	0.0023
Sulphate (mg/L)	0.71	1.52	1.15	3.21	0.96

NOTES:
1. ITALICIZED VALUES REPRESENT THE LABORATORY METHOD DETECTION LIMIT.

3.5.6.3 Metals

The majority of the metals analyzed were consistently near or below their respective MDLs and all samples were below their respective quality criteria. Total and dissolved aluminium concentrations showed the highest variability among seasons and stations. The highest aluminium concentrations were detected during the spring sampling event. Total iron concentrations were also variable among seasons and stations. The highest iron concentrations were detected during the summer sampling event. A summary of the concentrations for selected metals of interest is provided in Table 3.5-24.

Table 3.5-24 Trans-Load Facility - Metals Summary

Parameter	Minimum	Mean	Median	Maximum	Standard Deviation
Total Aluminium (mg/L)	0.0059	0.0322	0.0166	0.0921	0.0349
Dissolved Aluminium (mg/L)	0.0050	0.0191	0.0050	0.0572	0.0227
Arsenic (mg/L)	*0.0010*	0.0012	0.0010	0.0017	0.0003
Total Chromium (mg/L)	*0.0010*	*0.0010*	*0.0010*	*0.0010*	0.0000
Hexavalent Chromium (µg/L)	*10*	*10*	*10*	*10*	0

Parameter	Minimum	Mean	Median	Maximum	Standard Deviation
Iron (mg/L)	0.101	0.217	0.192	0.413	0.110
Lead (mg/L)	*0.0010*	*0.0010*	*0.0010*	*0.0010*	0
Dissolved Mercury (mg/L)	*0.00001*	*0.00001*	*0.00001*	*0.00001*	0
Nickel (mg/L)	*0.0020*	*0.0020*	*0.0020*	*0.0020*	0

NOTES:
1. ITALICIZED VALUES REPRESENT THE LABORATORY METHOD DETECTION LIMIT.

3.5.7 Summary

3.5.7.1 Mine Site

Seasonal Water Quality

Most parameter concentrations had low variability between stations with some noted exceptions. The pH measured from samples from Koper Creek, Koper Lake and Trib-3 Stations were the more acidic than at the other stations. More than 85% of the pH PWQO exceedances occurred at these three stations. The remaining stations had relatively neutral pH and higher alkalinities.

In general, DO concentrations were moderately high throughout the mine site samples. The lowest DO concentrations were measured at the Koper Creek, BP-1 and Trib-3 stations, where values did not satisfy the lower limit of the PWQO. The lowest DO concentrations were measured during the winter and summer sampling events. The DO was low during winter measurements as they were taken under ice cover and during a period when flows are minimal or non-existent due to the nearly complete freezing of the water at some stations. The DO was lower during summer sampling events as it is a period of reduced precipitation, increased evapotranspiration and lower surface water flows.

Conductivity, TDS, alkalinity and hardness showed seasonal variation. Concentrations were generally highest during the winter sampling events. Nutrient levels were typically below MDLs, with the exception of total phosphorus that typically peaked during the summer months. Total phosphorus concentrations were similar at most stations except at Trib-3, which reported consistently high total phosphorus concentrations during the summer sampling events. Concentrations of total cyanide were below detection limits in 95 % of the samples.

The majority of total and dissolved metals results were reported near to or below the MDLs. The metals reported above their MDL were generally below the PWQOs and CWQG-PAL criteria. There were 33 exceedances of the CWQG-PAL criteria for total aluminum and five samples exceeded the PWQO for dissolved aluminum. Total arsenic, cadmium, copper, lead, mercury and nickel were reported below their MDLs in most samples. Arsenic levels were greatest in Koper Creek with 45% of the samples having concentrations above the MDL and one near the PWQO. Iron concentrations were elevated concentrations in 61% of the samples. The Attawapiskat River Station AR-1 had the lowest baseline iron concentrations of all the riverine stations. Koper Lake was the only station consistently below the PWQO during all sampling events. Naturally elevated concentrations of aluminum and iron are typical for surface water on the Canadian Shield (PWQMN, 2009).

Other parameters of interest measured during the surface water quality program at the mine site included hexavalent chromium, low level mercury and methyl mercury, and radium-226. These parameters were not present in high enough concentrations to be detected in the samples as their concentrations were below the lowest analytical concentration measured by the laboratory.

Muskeg Pond Water Quality

Surface water quality in the muskeg ponds ranged from moderately acidic to neutral. In situ pH was measured below the PWQO in three of the ponds. The predominately acidic in situ pH indicates that limited buffering capacity exists in these ponds.

The majority of nutrient concentrations were reported below their respective MDLs. Un-ionized ammonia exceeded the PWQO (0.02 mg/L) in 60% of the ponds sampled. Anion and cation concentrations were low with most results being below the MDL. All total phosphorus concentrations were below the quality criteria. Total cyanide was below the MDL in all of the samples.

The majority of total and dissolved metals results were reported near to or below the MDLs. Those metals reported above the MDL generally met the PWQO and CWQG-PAL criteria. Three exceedances of the CWQG-PAL were noted for total aluminum and one sample exceeded the PWQO for dissolved aluminum.

Other parameters of interest measured in the muskeg ponds included hexavalent chromium and dissolved mercury. These parameters were not typically present in high enough concentrations to be detected in the samples. Their concentrations were below the lowest analytical concentration that could be measured by the laboratory.

3.5.7.2 Transportation Corridor

Attawapiskat Watershed

The Attawapiskat watershed samples had generally neutral pH values with higher acidity at some stations. The pH values below the PWQO were measured in some small streams with low flows. The low in situ temperature of some of the streams suggests they may be fed by groundwater seepage. There was a moderate to high buffering capacity measured at these stations. Anion concentrations were generally low, with concentrations near to or below their MDLs.

Nutrient levels were low with most nutrients present at concentrations below their respective MDLs. Phosphorous concentrations were moderate to low. Total cyanide was below the MDL in all of the samples.

The majority of total and dissolved metals results were reported near to or below the MDLs. Total arsenic, cadmium, copper, lead, mercury and nickel were reported below their MDLs in most samples. There were two exceedances of the CWQG-PAL criteria reported for total aluminum concentrations. Four samples in the largest streams surveyed had total iron concentrations exceeding the PWQO (Nemeibenikan Brook, Totogan Creek, Pineimuta River and the Muketei River). These streams also had the highest conductivity and TSS concentrations in the watershed. Naturally elevated levels of aluminum and iron are typical within surface waters on the Canadian Shield. (PWQMN, 2009)

Other parameters of interest measured in the Attawapiskat watershed included hexavalent chromium and dissolved mercury. These parameters were not typically present in high enough concentrations to be detected in the samples. Their concentrations were below the lowest analytical concentration that was measured by the laboratory.

Winisk Watershed

The Winisk watershed samples had generally neutral pH with higher alkalinity at some stations. The upper PWQO limit was exceeded at one station and no samples were below the lower limit. Anion concentrations were higher in the Winisk watershed than in the Attawapiskat watershed.

Nutrients concentrations were low with most nutrients detected below their respective MDLs. Total phosphorus concentrations were generally low. Fluoride concentrations were detected near equal to the CWQG-PAL criteria on the Wapitotem River. Groundwater seepage is typically the major cause of naturally elevated fluoride in surface water (Anon., 1980). Total cyanide concentrations were below the MDL at all stations.

The majority of total and dissolved metals concentrations were reported near to or below the MDLs. Total arsenic, cadmium, copper, lead, mercury and nickel were reported below their MDLs in most samples. One exceedances of the CWQG-PAL was noted for total aluminum. There were three samples that reported concentrations of total iron exceeding the PWQO. These stations also reported elevated TSS concentrations, which typically accompany elevated total metal concentrations.

Other parameters of interest measured in the Winisk watershed included hexavalent chromium and dissolved mercury. These parameters were not typically present in high enough concentrations to be detected in the samples. Their concentrations were below the lowest analytical concentration that was measured by the laboratory instrumentation.

Ekwan Watershed

The Ekwan watershed samples had neutral pH and moderate to high DO concentrations. There were no PWQO or CWQG-PAL criteria exceedances reported. Surface water samples were slightly alkaline and had moderate buffering capacity. Anions and nutrients were generally reported below detection limits. Concentrations of phosphorous were similar to those measured in the other watersheds and were reported below the quality criteria. The majority of metals analyzed were below MDLs. Concentrations of aluminum, arsenic, calcium, iron, magnesium and sodium were present at detectable levels.

Other parameters of interest measured in the Ekwan watershed included hexavalent chromium and dissolved mercury. These parameters were not typically present in high enough concentrations to be detected in the samples. Their concentrations were below the lowest analytical concentration that could be measured by the laboratory.

3.5.7.3 Trans-Load Facility

The surface water quality of the two small ponds at the trans-load facility site was similar. Surface waters ranged from neutral to moderately alkaline with the highest alkalinity detected during the fall sampling event. One sample showed seasonal variability in levels of conductivity, hardness, alkalinity and TDS. While the other sample remained relatively constant for all of these parameters.

These stations reported low nutrient and anion concentrations. The majority of the nutrients had concentrations below the MDL. Concentrations of total phosphorus were below the PWQO. The total alkalinity concentrations suggest a moderate buffering capacity. Total cyanide was below the MDL in all of the samples.

The majority of total and dissolved metals results were reported near to or below the MDLs. The metals that were reported above the MDL generally met the PWQO and CWQG-PAL criteria. Iron was the only metal measured at concentrations above the guideline limits. Elevated iron concentrations are typical for surface water bodies on the Canadian Shield (PWQMN, 2009).

Other parameters of interest measured during the trans-load facility surface water quality program included hexavalent chromium and dissolved mercury. These parameters were not typically present in high enough concentrations to be detected in the samples. Their concentrations were below the lowest analytical concentration that could be measured by the laboratory.

3.6 GROUNDWATER QUALITY

This section provides a description of the existing groundwater quality baseline conditions for the Eagle's Nest Project. The supporting technical document that provides additional details regarding the study methods, results, and discussion is available in Appendix 4.

3.6.1 Study Areas

The spatial boundaries of the baseline hydrogeological studies were defined by areas within which potential impacts on groundwater resources may occur from the development of the Project.

Interaction with the groundwater is expected to occur primarily at the mine site due to the underground mining activities and the withdrawals of groundwater for water supply. The Project may also interact with groundwater resources at the Savant Lake trans-load facility during site development and operations. Groundwater resources could also be impacted along the transportation corridor during the construction and operation of the all-season road.

3.6.1.1 Mine Site Study Area

The mine site study area is defined as the area around the mine site. The boundary of the study area takes into consideration, the project footprint, the local topography, drainage patterns, and groundwater flow. The study area extends from the wetland surrounding the mine site to the Muketei River.

3.6.1.2 Transportation Corridor Study Area

The transportation corridor study area is defined as the proposed all-season road between the mine site and the existing infrastructure at the Northern Ontario Resource Road. There is the potential for interactions with the groundwater resources during construction of the road at borrow and aggregate sources. The final aggregate source locations for the construction of the road have not been selected and no detailed hydrological studies were undertaken as a result.

3.6.1.3 Savant Lake Trans-Load Facility Study Area

The study area for the Savant Lake trans-load facility is based on the location of the facility infrastructure and the proposed site activities.

3.6.2 Background

Bedrock groundwater flow systems in most of the Canadian Shield include a shallow freshwater system (to a depth of about 150 m) and a deep system of brine water that can extend to several hundred metres (Thorne and Gascoyne, 1993). The shallow bedrock groundwater system is typically characterized by small localized aquifers. In most parts of the Canadian Shield, these aquifers may be connected to overburden aquifers. Surficial aquifers are often bedrock controlled, however multiple layered aquifer/aquitard settings are rare (Singer and Cheng, 2002).

The sediments nearest to surface at the mine site are silty-clay of glaciolacustrine origin, and a layer of organic soil up to 2 m thick was encountered in some boreholes. The organic material is typically saturated and the water table in these areas is at, or less than one metre below the ground surface. The water in the organic layer is connected directly to surface water in many locations. Below the silt and clay layer, there is an aquifer in the sand and fine grained till material overlying the bedrock. The bedrock and overburden aquifers are likely connected in certain areas, with the groundwater surface water interactions being controlled by the permeability of the silt/clay layer.

The proposed east-west transportation corridor crosses the Attawapiskat, Ekwan and Winisk Watersheds. The road traverses predominantly wetlands in the first 100 km from the mine site. As the route moves west from the mine site, the relief increases, the soil becomes better drained, and there is more exposed bedrock. Bedrock along the transportation corridor is expected to be similar to the mine site and relatively impermeable. The permeability could be higher in zones of poorer rock mass quality and greater fracturing. The surficial geology along the transportation corridor consists of glacial till, glaciofluvial ice-contact and outwash deposits, glaciolacustrine deposits, and exposed bedrock.

The trans-load facility at Savant Lake is located on the Canadian Shield. The bedrock at the site is composed of basaltic and andesitic tuffs, and breccias with related migmatites. The surficial material is predominantly a galciofluvial ice-contact deposit consisting mainly of discontinuous layers of sand and silts with some clays and gravel.

Regional groundwater quality is typically consistent throughout the Precambrian and Paleozoic Canadian Shield rocks. The bedrock aquifers above 150 m and overburden aquifers generally contain calcium-bicarbonate type groundwater. Singer and Cheng (2002) suggest that the groundwater in the region is expected to be generally hard, with elevated iron concentrations and total dissolved solids (TDS).

The local study areas for the Project are generally in remote areas with little development. Groundwater at the mine site is currently used for ongoing exploration activities. Potable water is obtained from groundwater at the Noront Esker Camp and the Cliffs Natural Resources Esker Camp near the mine site. Groundwater is also often used during exploration drilling.

There are no communities or other groundwater users adjacent to the proposed east-west transportation corridor. The residents of Savant Lake, which is located approximately 5 km from the proposed trans-load facility, utilize groundwater for potable water supply.

3.6.3 Methods

3.6.3.1 Monitoring Well Installations

Monitoring wells were installed at the mine site and the Savant Lake trans-load facility. Monitoring well locations were selected based on the proximity to proposed Project infrastructure. All monitoring wells were installed in the overburden material or shallow bedrock.

Mine Site

Monitoring wells were installed at the mine site during two separate site investigation programs. In the fall of 2010, 11 monitoring wells were installed at seven locations (KP, 2011). Four locations had two wells, one in the overburden material and one in shallow bedrock. Three locations had a single well installed in the overburden material. In the fall of 2012, an additional six monitoring wells at three locations were installed at the mine site as a result of refinements to proposed infrastructure locations (KP, 2013a). At each location, one well was installed in the overburden and one in the shallow bedrock. Pressure transducer data loggers were installed to monitor water level on an hourly basis in each well at the mine site.

The locations of the monitoring wells installed at the mine site are shown on Figure 3.6-1. A summary of the well installation details and well logs for the monitoring wells at the mine site are provided in Appendix 5.

Savant Lake Trans-Load Facility

Monitoring wells were installed at the Savant Lake trans-load facility location in the fall of 2011. Eight monitoring wells were installed at six locations (KP, 2012b). At three locations, one well was installed in the near surface overburden material and one well was installed deeper in the overburden. At three locations, a single well was installed in the overburden. The locations of the monitoring wells installed at the Savant Lake site are shown on Figure 3.6-2. A summary of the well installation details and the well logs are provided in Appendix 5.

3.6.3.2 Groundwater Quality Sampling

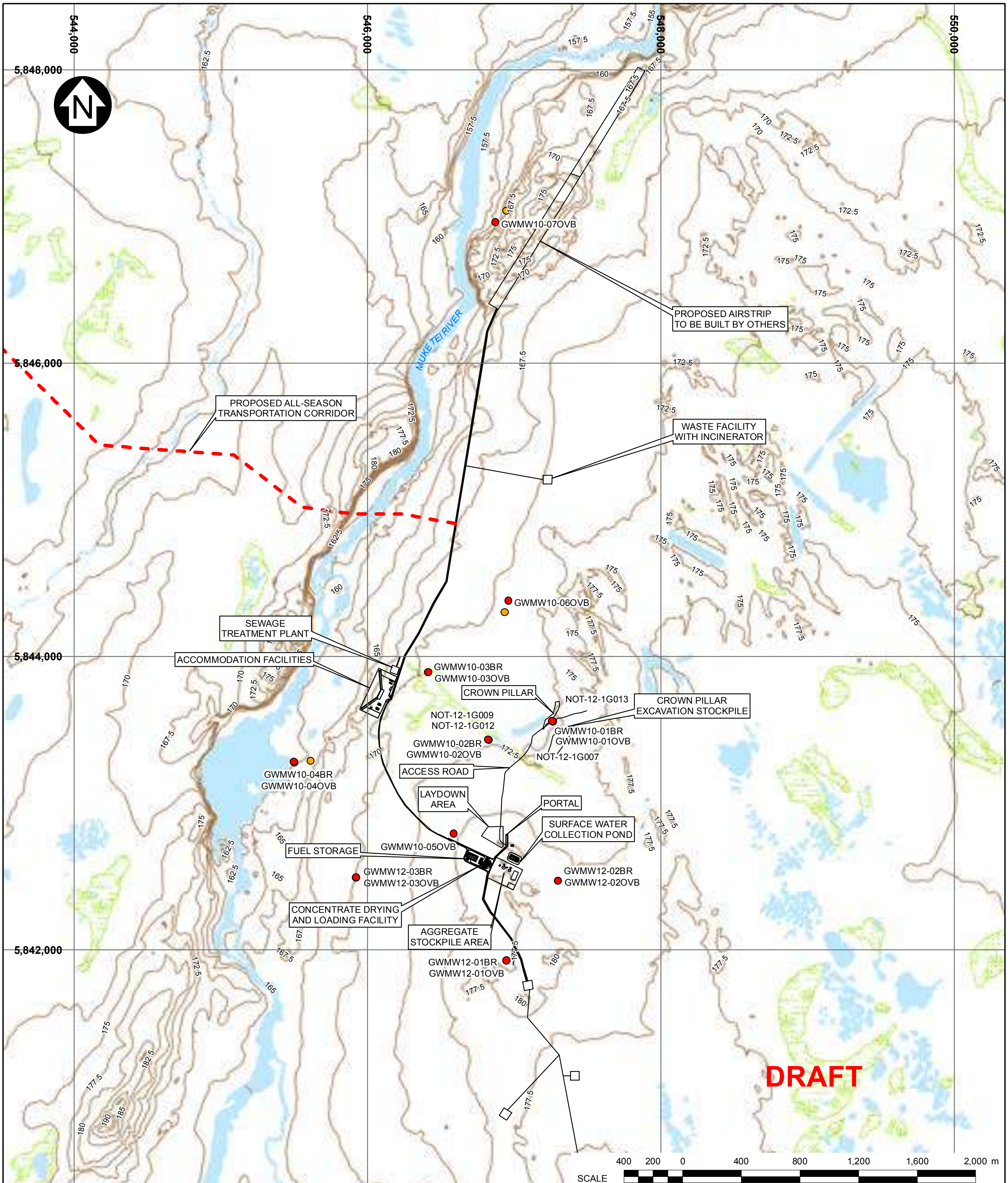
Samples for groundwater quality testing were obtained from the monitoring wells at the mine site and Savant Lake trans-load facility. The test results provide an estimate of the pre development concentrations of select chemical parameters. The groundwater sampling program is described in the following sections.

Groundwater sampling at each site was initiated following the installation and development of the monitoring wells. Sampling at the mine site was carried out at three times of the year: spring (May/June), summer (July/August), and fall (October/November) over a two year period (2010 to 2012). Sampling at the Savant Lake site was carried out in fall 2011, spring 2012, and summer 2012.

Groundwater samples at the mine site were obtained using low flow sampling techniques to minimize agitation during sampling and reduce the potential for artificially elevating total suspended solids and turbidity. A peristaltic pump was used during all site visits, except during fall 2012 when Waterra© tubing and foot valve were used for inertial sampling. Inertial pumping with Waterra© tubing and foot valve was used at the Savant Lake trans-load facility.

At least three volumes of standing water were purged from each well to obtain fresh formation water. After purging was complete, in-situ field measurements of pH, specific conductance, and temperature were recorded using a Hanna or YSI multiparameter probe. The probes were calibrated prior to each sampling event and re-calibrated daily or as required according to the operating manual for the instrument. Groundwater samples were collected directly from the pumping system into laboratory supplied bottles. Samples were filtered using a 0.45 micron inline filter and preserved in the field when required. All samples were stored at 4 to 10°C and shipped to the ALS Environmental Laboratory (ALS) in Thunder Bay, ON. The ALS laboratory is a CALA certified and accredited independent laboratory. All sampling activities and site conditions were documented on field data sheets.

A summary of the analytical water quality parameters that were assessed during the baseline characterization program are shown in Table 3.6-1.



LEGEND:

- GROUNDWATER MONITORING WELL LOCATION
- DRIVE POINT PIEZOMETER LOCATION
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- PROPOSED INFRASTRUCTURE
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND

NOTES:

1. BASE MAP PROVIDED BY SNC-LAVALIN GROUP INC. (2010).
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 2.5 METRES.
4. INFRASTRUCTURE INFORMATION AND PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

MINE SITE GROUNDWATER MONITORING WELL LOCATIONS

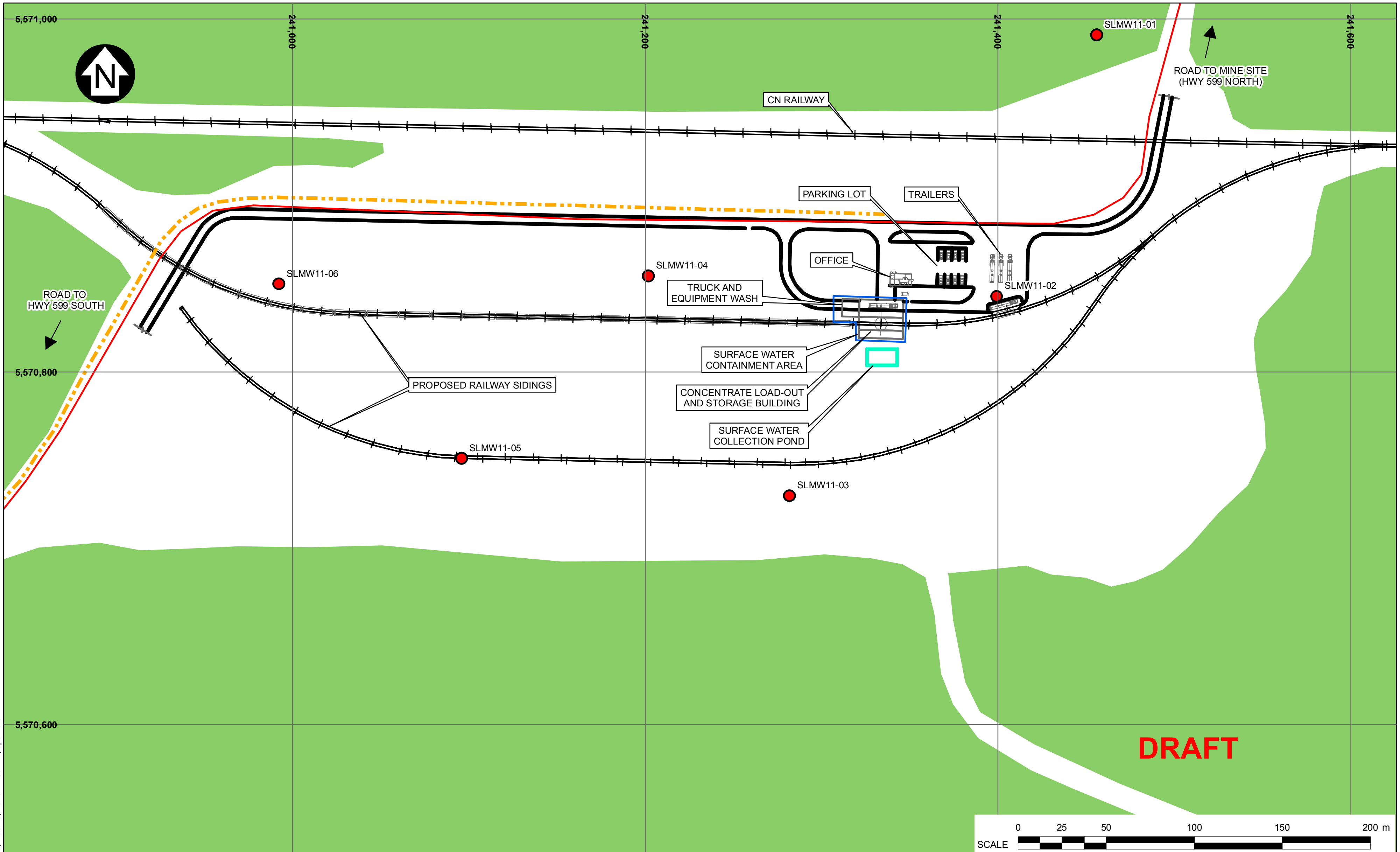
Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.6-1 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH DRAFT REPORT	DKK	SWK	SRA	RAM

SAVED: I:\1102\00390\01\A\GIS\Figs\A708_rA.mxd; Dec 20, 2013 12:52 PM; spenfold



LEGEND:

- GROUNDWATER MONITORING WELL LOCATION
- EXISTING ALL-SEASON ROAD
- RAILWAY
- PROPOSED HYDRO CORRIDOR
- PROPOSED INFRASTRUCTURE
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- SURFACE WATER COLLECTION POND
- FORESTED AREA

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. INFRASTRUCTURE IS BASED ON INFORMATION PROVIDED BY TETRA TECH (APRIL 19, 2012).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

GROUNDWATER MONITORING LOCATIONS AT THE SAVANT LAKE TRANS-LOAD FACILITY

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.6-2 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	ALR	SWK	SRA	RAM

SAVED: I:\1102\00390\01\A\GIS\Figs\A703_rA.mxd; Dec 20, 2013 12:58 PM; spenfold

Table 3.6-1 Groundwater Analytical Suite

Parameter Category	Analytes
Physical Tests	Conductivity, Hardness, pH, TSS, TDS, Turbidity
Anions and Nutrients	Acidity, Alkalinity, Ammonia-N, Un-Ionized Ammonia, Bicarbonate, Bromide, Carbonate, Chloride, Fluoride, Hydroxide, Nitrate, Nitrite, Total Kjeldahl Nitrogen (TKN), Orthophosphate, Phosphorus, TDS (calculated), Sulphate, Anion Sum, Cation Sum, Cation Balance
Cyanides	Total Cyanide
Organic/Inorganic Carbon	DIC, DOC, Total Organic Carbon
Metals	Total Metals (full ICP-MS scan), Dissolved Metals (full ICP-MS scan)
Speciated Metals	Hexavalent Chromium, Total Methyl-mercury and ortho-phosphate
Aggregate Organics	BOD, COD
Radiological Parameters	Radium 226
PAHs	LEPH & HEPH (low level PAH)
VOCs and TPH [1]	TPH (C^6 – C^{50} fractions), BTEX

NOTES:

1. GROUNDWATER SAMPLES WERE ANALYSED FOR VOCS AND TPH AT THE SAVANT LAKE SITE DURING THE INITIAL GROUNDWATER MONITORING EVENT.

The water quality results for the mine site and the Savant Lake trans-load facility site are discussed in Section 6.

3.6.3.3 Groundwater Quality Guidelines

Groundwater quality data were compared to the Ontario Drinking Water Standards (ODWS) (MOE, 2006). The groundwater quality data were also compared to the Health Canada Guidelines for Canadian Drinking Water Quality (HC-GCDWQ), which are generally consistent with the ODWS except for dissolved metals (Health Canada, 2012). The HC-GCDWQ are not included in the summary tables but are discussed in the text when relevant. The laboratory Method Detection Limits (MDLs) and ODWS guidelines are provided in Appendix 5.

3.6.3.4 Quality Assurance/Quality Control

Field quality assurance and quality control (QA/QC) procedures were developed based on the Standards Development Branch Guidance on Sampling and Analytical Methods for use at Contaminated Sites in Ontario (OMOEE, 1996) and the Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators (BCMOE, 2011).

Dedicated tubing was used to sample each well and disposable nitrile gloves were worn during sampling to prevent contamination. Field blanks were utilized during each site visit. Chain of custody forms accompanied all samples for identification, tracking and transportation purposes. The QA/QC results are discussed below.

3.6.4 Results

3.6.4.1 Mine Site

The groundwater quality results from the sampling of the mine site monitoring wells were compared to the ODWS guidelines and are summarized in Appendix 5. Descriptive statistical analyses of results were completed for all monitoring wells where more than two sets of data were available. For parameters that were reported below the MDL, a value equivalent to the MDL was used to calculated the summary statistics.

<u>In-Situ Parameters and Physical Parameters</u>

In general, groundwater at the Mine Site area was observed to be neutral to slightly basic from both in-situ and lab measurements. There were two samples that had slightly acidic pH from the in-situ observations. In both cases, the lab measured pH was neutral to slightly basic and the in-situ data are likely erroneous.

All samples had hardness values in the hard to very hard range and all were above the ODWS limits of 80 mg/L $CaCO_3$ to 100 mg/L $CaCO_3$. The Total Suspended Solids (TSS) concentrations and turbidity were elevated in several of the samples. For example, all monitoring wells had turbidity results above ODWS limits during at least one sampling event. In most cases, it is assumed that the turbidity and TSS observed in the samples is at least partly due to sediment in the bottom of the well being mobilized during sampling. This was especially evident in the elevated turbidity measurements obtained during the fall of 2012 when an inertial pumping system was used. As such, it is unlikely that the reported TSS and turbidity values are representative of groundwater conditions in the sampled formation. .

The range of pH, temperature, conductivity, TDS and turbidity are summarized in Table 3.6-1.

Table 3.6-2 Mine Site Physical Parameter Ranges

Monitoring Well	pH	Temperature (°C)	Conductivity (µs/cm)	TDS (mg/L)	Turbidity (NTU)
GWMW10-01OVB	6.9 - 7.84	4.5 - 12.1	208 - 647	334 - 420	22.4 - 22.7
GWMW10-02OVB	7.32- 8.07	3.2 - 11.47	354 - 696	380 - 422	43.1 -172
GWMW10-03OVB	7.37 - 7.98	5.2 -12.3	324 - 498	263 - 302	23.3 - 169
GWMW10-04OVB	6.40 - 7.17	2.5 - 9.34	206 - 337	198 - 236	1.04 - 58.6
GWMW10-05OVB	7.33 - 8.07	2.52 - 4.2	158 - 560	267 - 309	14.3 - 58.1
GWMW10-06OVB	7.10 -8.12	5.1 - 12.42	262 - 515	270 - 328	28.1 - 274
GWMW10-07OVB	7.82 - 8.33	4 - 13.3	115 - 398	191 - 218	0.47 - 10.4
GWMW12-01OVB [2]	7.52	2.8	423	272	129
GWMW12-02OVB [2]	7.69	2.7	574	324	1850
GWMW12-03OVB [2]	7.29	3.6	569	344	>4000
GWMW10-02BR	6.8 - 9.03	5.3 - 8.7	459 - 703	351 - 432	3.6 - 120
GWMW10-03BR	7.29 - 8.24	5.2 - 11.93	165 - 492	269 - 305	8.17 - 27.8
GWMW10-04BR	7.16 - 8.09	3.98 - 9.6	231 - 471	200 - 300	1.36 - 7.29
GWMW12-01BR [2]	8.21	2.3	472	320	17.1

Monitoring Well	pH	Temperature (°C)	Conductivity (µs/cm)	TDS (mg/L)	Turbidity (NTU)
GWMW12-02BR [2]	7.94	2.2	543	309	13.1
GWMW12-03BR [2]	7.48	3.3	539	340	167

NOTES:

1. ALL PARAMETER RESULTS ARE FROM IN-SITU SAMPLING MEASUREMENTS EXCEPT TDS AND TURBIDITY, WHICH ARE PROVIDED FROM LABORATORY ANALYSIS.
2. ONLY ONE SAMPLING EVENT WAS AVAILABLE FOR THE GWMW12 SERIES WELLS.
3. THE COMPLETION ZONES FOR GWMW10-01OVB, GWMW10-02OVB, GWMW10-03OVB, GWMW10-04OVB, GWMW10-05 AND GWMW10-06 EXTEND OVER OVERBURDEN AND BEDROCK. GWMW12-03BR IS INSTALLED IN OVERBURDEN.

Nutrients

Nutrients reported include Nitrite (N), Total Phosphorus (P), Total Ammonia (Am), Total Kjeldahl Nitrogen (TKN), and Orthophosphate (OP). Nutrient concentrations in the groundwater samples from the bedrock and overburden wells were generally consistent among and within the sampling events. None of the reported nutrient concentrations exceeded the ODWS limits. The average nutrient values in the groundwater samples from the monitoring wells are shown in Table 3.6-2.

Table 3.6-3 Average Nutrient Concentrations

Monitoring Well	N	P	Am	TKN	OP
Overburden Wells	0.05 mg/L	0.03 mg/L	0.36 mg/L	0.6 mg/L	0.12 mg/L
Bedrock Wells	0.03 mg/L	0.06 mg/L	0.17 mg/L	0.41 mg/L	0.12 mg/L

Major Ions

Major ions sampled included Total Chloride, Nitrate, Potassium, Sodium, Calcium, Magnesium, Sulphate and Bicarbonate. The groundwater quality results show that the major ion concentration within the bedrock and overburden were relatively consistent throughout the monitoring period and that no major ion concentrations were reported over the 250 mg/L ODWS limit.

A tri-linear piper plot of the major dissolved ions was produced to provide a visual interpretation of the similarities and differences in the groundwater sampled from each monitoring well. The piper plot shows that the groundwater chemistry in the overburden and groundwater wells is similar and dominated by Calcium/Bicarbonate ions (Figure 3.6-3).

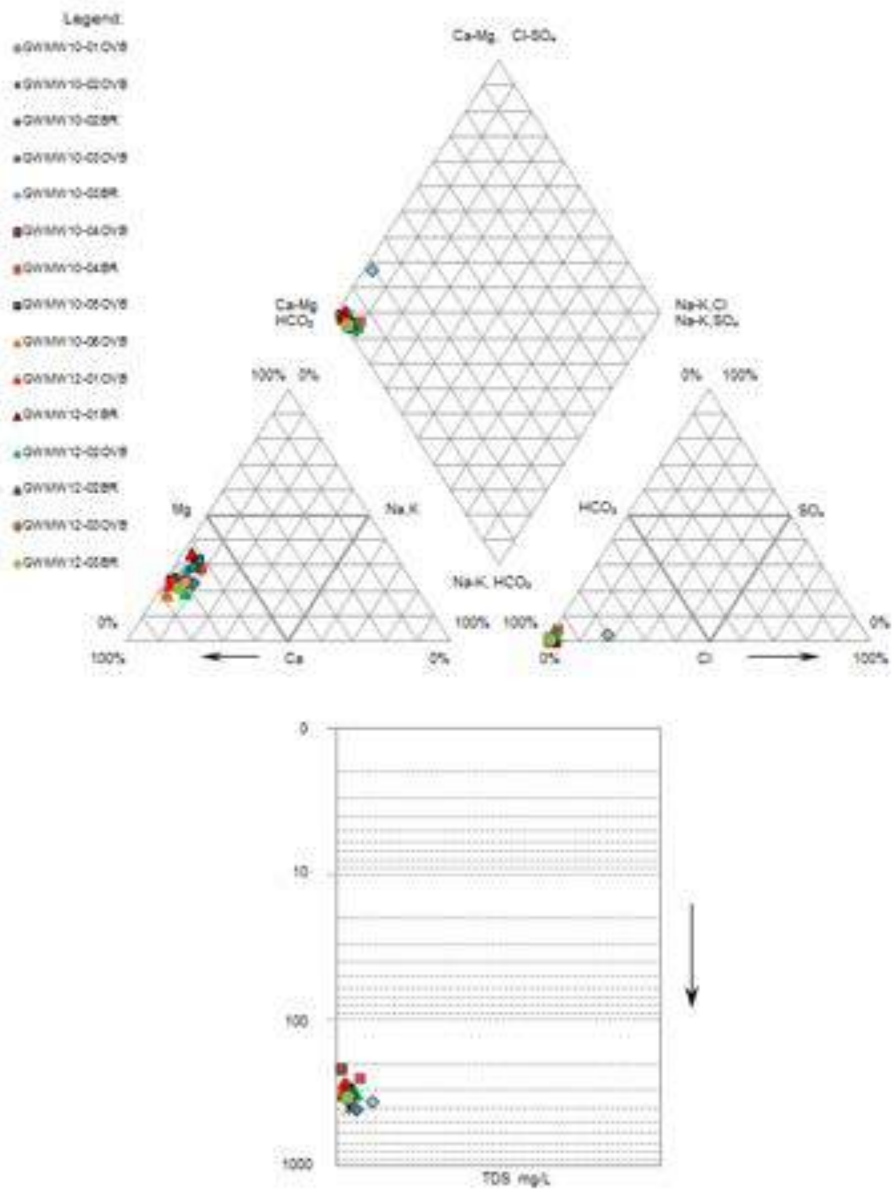


Figure 3.6-3 Mine Site Groundwater Quality Piper Plot

Concentrations of bicarbonate, the dominant anion, ranged from 171 to 468 mg/L, with an average concentration of 300 mg/L. Concentrations of calcium, the dominant cation, ranged between 8.2 and 119 mg/L, with an average concentration of 77 mg/L.

Metals

The concentrations of total and dissolved metals were reported for all groundwater samples. The total metals include the metals content dissolved in the water and present in the particulates in the water. The analysis of the metals was focussed on the dissolved metal concentrations as they are considered more mobile throughout a groundwater formation and biologically available. In addition, despite the use of low flow sampling methods, total metal concentrations can be influenced by sampling induced turbulence of the sediments that are present in most wells from installation and development.

Most of the dissolved metal concentrations were reported at or below the MDLs. Iron (Fe) and Manganese (Mn) concentrations were the only dissolved metals that were reported above the ODWS.

Dissolved Fe concentrations ranged from the MDL of 0.05 mg/L to 8.46 mg/L with an average of 2.84 mg/L and were reported above ODWS guideline (0.3 mg/L) in all wells during most sampling events except GWMW12-02BR, GWMW10-07OVB, and GWMW12-02OVB. No seasonal trends were evident in the concentration of dissolved Fe.

The dissolved Mn concentrations ranged from 0.001 (MDL) to 0.36 mg/L with an average of 0.17 mg/L and were reported above the ODWS guideline (0.05 mg/L) in all wells except GWMW12-01BR, GWMW10-01OVB, and GWMW12-05BR. No seasonal trends were evident in the concentration of dissolved Mn.

Dissolved arsenic concentrations were reported below the ODWS guideline of 0.025 mg/L in all samples, however, above the HC-GCDWQ limit of 0.01 mg/L at GMMW10-06OVB, GMMW12-03BR, and GMMW12-03OVB in one or more sample.

3.6.4.2 Savant Lake Trans-Load Facility

The groundwater quality results from the sampling of the Savant Lake monitoring wells were compared to the ODWS guidelines and are summarized in Appendix 5.

All samples had hardness values in the hard range and all above the ODWS guideline of 80 mg/L $CaCO_3$ to 100 mg/L $CaCO_3$. The groundwater pH ranged between 6.5 and 8.2, with an average pH of 8.0.

The TSS and turbidity concentrations were elevated in most samples. This result was most likely due to the mobilization of fine sediments present in the bottom of the well during sampling. As such, the reported TSS and TDS concentrations are unlikely to be representative of groundwater conditions in the sampled formation. The physical parameters are summarized in Table 3.6-4.

Table 3.6-4 Savant Site Physical Parameters

	pH	Temperature (°C)	Conductivity (μs/cm)	TDS (mg/L)	Turbidity (NTU)
Average	7.7	8.7	255	185	290
Minimum	6.5	4.6	48	50	7.4
Maximum	8.2	14.1	572	320	4000[1]

NOTES:
1. MAXIMUM REPORTABLE TURBIDITY UNDER NEPHELMOTETRIC TESTING METHOD.
2. TEMPERATURE AND CONDUCTIVITY DERIVED FROM IN SITU MEASUREMENTS. PH, TDS AND TURBIDITY DERIVED FROM LABORATORY ANALYSES.

Major ion concentrations were relatively consistent among the samples and suggest that the groundwater is dominated by calcium bicarbonate ions. Concentrations of bicarbonate ranged from 32 to 335 mg/L, with an average concentration of 152 mg/L. Concentrations of calcium ranged from 11 to 92 mg/L, with an average concentration of 42 mg/L.

There were no dissolved metal concentrations reported above the ODWS limits. Several exceedances were noted in the total metals, likely due to mobilization of the fine sediments in the bottom of the wells during sampling with aninertial pumping system.

In November 2011, groundwater samples were analyzed for volatile organic compounds (VOC), including Benzene, Ethyl Benzene, Toluene, and Xylenes, and total petroleum hydrocarbons (TPH) $C^6 – C^{50}$. One sample (SLMW11-06S) had a Toluene concentration of 1.74 µg/L, which is below the Health Canada aesthetic objective of 24 µg/L (Health Canada, 2013).

3.6.4.3 Quality Assurance/Quality Control

The QA/QC samples were used to determine the accuracy and precision of the sample data and whether cross-contamination had occurred.

The QA/QC review of groundwater quality results for the Project indicate that the data collected from all but one of the groundwater monitoring wells at the mine site are of acceptable quality to represent baseline groundwater conditions. The data from the mine site groundwater monitoring well GWMW10-01BR were omitted from the groundwater quality discussion because major ion parameters were observed to decrease steadily from the onset of sampling in 2010. This indicates that the water quality in the well did not stabilize after development and that further well development may be required. A summary of the QA/QC program and results are shown in Appendix 5.

3.7 SURFACE WATER QUANTITY

This section provides a description of the existing surface water quantity environment baseline conditions for the Eagle's Nest Project. The supporting technical document that provides additional details regarding the study methods, results, and discussion is available in Appendix 1.

3.7.1 Study Area

The spatial boundaries for the assessment of baseline surface water quantity were defined as areas within which the potential impacts on surface water resources may occur from the development, operation or closure of the Project.

3.7.1.1 Regional Study Area

A regional study area (RSA) was defined for the assessment of potential effects of the project on surface water quantity. The three regional watersheds which encompass all components of the Project were used to delineate the RSA.

The baseline hydrological studies were conducted at representative sites along the transportation corridor and sites on rivers near the mine site. There are no water courses near the trans-load facility and there will be no interaction with the two small water bodies located to the southeast of the site. As such, no hydrological investigations were undertaken at the trans-load facility.

3.7.1.2 Local Study Area

The mine site is the primary LSA for the assessment of baseline water quantity. It encompasses the relevant water bodies and streams around the mine site infrastructure.

3.7.2 Background

3.7.2.1 Regional Hydrology

The two major physiographic regions of Ontario's Far North Region are the Hudson Bay Lowlands and the Canadian Shield. The lowlands represent the second largest continuous wetland on earth (Singer and Cheng, 2002). Practically all of the Project infrastructure will be located in the Canadian Shield region, which is upstream of the Hudson Bay lowlands. The Canadian Shield in the Far North Region has much lower relief than other parts of Ontario and the bedrock is overlain by till and glaciolacustrine deposits of up to several metres thick. The RSA is gently sloping and runoff is attenuated or moderated by the large number of lakes and wetlands in the area. Deep organic soils are prevalent around the mine site, which is located at the western boundary of the lowlands.

The annual stream flow pattern in the RSA is characterized by peak flows in spring due to snowmelt, receding flows during summer and fall, and low flows during winter. Multiple smaller flood events are possible in spring and summer due to rainfall events. Low flows can occur during summer due to high evapotranspiration coincident with periods of low rainfall. Low flows also occur during winter due to cold temperatures and precipitation being stored as snow (Woo and Waylen, 1986).

3.7.2.2 Wetland Hydrology

The majority of the Project infrastructure, including the all-season road to access the mine site, will be constructed on dry ground. However, the road will cross through an array of fen, bog, and swamp wetlands over its 280 km length. The final 40 km to the mine site will be constructed through predominantly wetland terrain.

There are many types of wetland, each of which result from differences in their hydrology and location on the landscape. Few catchments on the Canadian Shield do not contain wetlands, which are typified by hydric soils, hydrophilic vegetation and near surface water tables (Schiff et al., 1998). The relationship between wetlands and the nature of their basin runoff is complex. Wetlands can either attenuate peak flows by storing precipitation and runoff (Bullock and Acreman, 2003), or they can accentuate storm flows and produce flashy runoff regimes (Verry and Kolka, 2003) because of their saturated soil condition. The ability of a wetland to influence stream flow is largely dependent on the antecedent moisture conditions and its storage capacity (Quinton and Roulet, 1998).

Wetlands are generally shallow compared to other water bodies and unlike lakes and rivers, small changes in water levels can result in significant change to the wetland ecosystem. The water balance of a wetland is an important indicator of the environment of the wetland, and water level is the major determinant of the distribution of plants and animals within a wetland. The spatial and temporal distribution of precipitation varies from year to year and, as a result, the amount of water in a wetland and the associated flow paths often change significantly from season to season and from year to year. As a consequence, the plant and animal communities are constantly adjusting to natural changes in wetland hydrology (van der Valk, 2009).

The wetlands in the RSA are either mineral or organic. The hydrological system that supports mineral wetlands is composed of streams, ponds, rivers and lakes, and is dominated by marshes, meadow marshes and swamps. The water in these wetlands is in contact with mineral substrate and with rising elevation the wetland type grades from marsh into fen and swamp (Riley, 2011). Organic wetlands consist of peat, where the upper layer is less compacted and has a higher hydraulic conductivity than the lower, denser peat, such that the surface waters are sealed from the substrate (van der Valk, 2009). The peatland hydrological system has limited surface flow, especially during spring melt periods, and very slow water percolation occurs laterally.

The main classes of wetlands in the RSA have different hydrologic conditions that are described as follows:

- **Fens** - Primarily peat-covered sloping plains or channels with very high water tables. There is typically evidence of lateral surface flow or seepage with average depth to water of less than 20 cm, even during dry periods (Riley, 2011).
- **Bogs** - Peat covered plains or peat filled depressions with a high water table and surface carpet of mosses. The water table is at or near surface during the spring and below surface during drier times of year. Surface waters and peat waters in bogs are typically isolated from mineral soil water (Riley, 2011).
- **Swamps** - Nutrient rich wetlands that are heavily wooded or with dense shrubs over 2 m tall. Swamps often have hummocky surfaces broken by interstitial hollows. There is pronounced internal water movement through swamps and the hydrologic regimes are typically complex (Riley, 2011).
- **Marsh** - Mineral wetlands or peatlands periodically or continuously inundated by standing or slowly moving water. Marshes are associated with the open waters of streams, rivers and lakes. Surface waters fluctuate seasonally during spring floods and during summer drawdown (Riley, 2011).

The flow of water in a wetland is the main determinant of vegetation type, pattern and succession. In general, the lateral flow of water is least in bogs, greater in fens, and greatest in marshes. Despite the low relief of the region, the flow of water is influenced primarily by topography (Riley, 2011). As the flow of water changes due to the natural evolution of the landscape, so do the characteristics of the wetlands. For example, fens or swamps can become isolated, lose their hydrologic connectivity and become more characteristic of bogs.

3.7.2.3 Drainage Basins

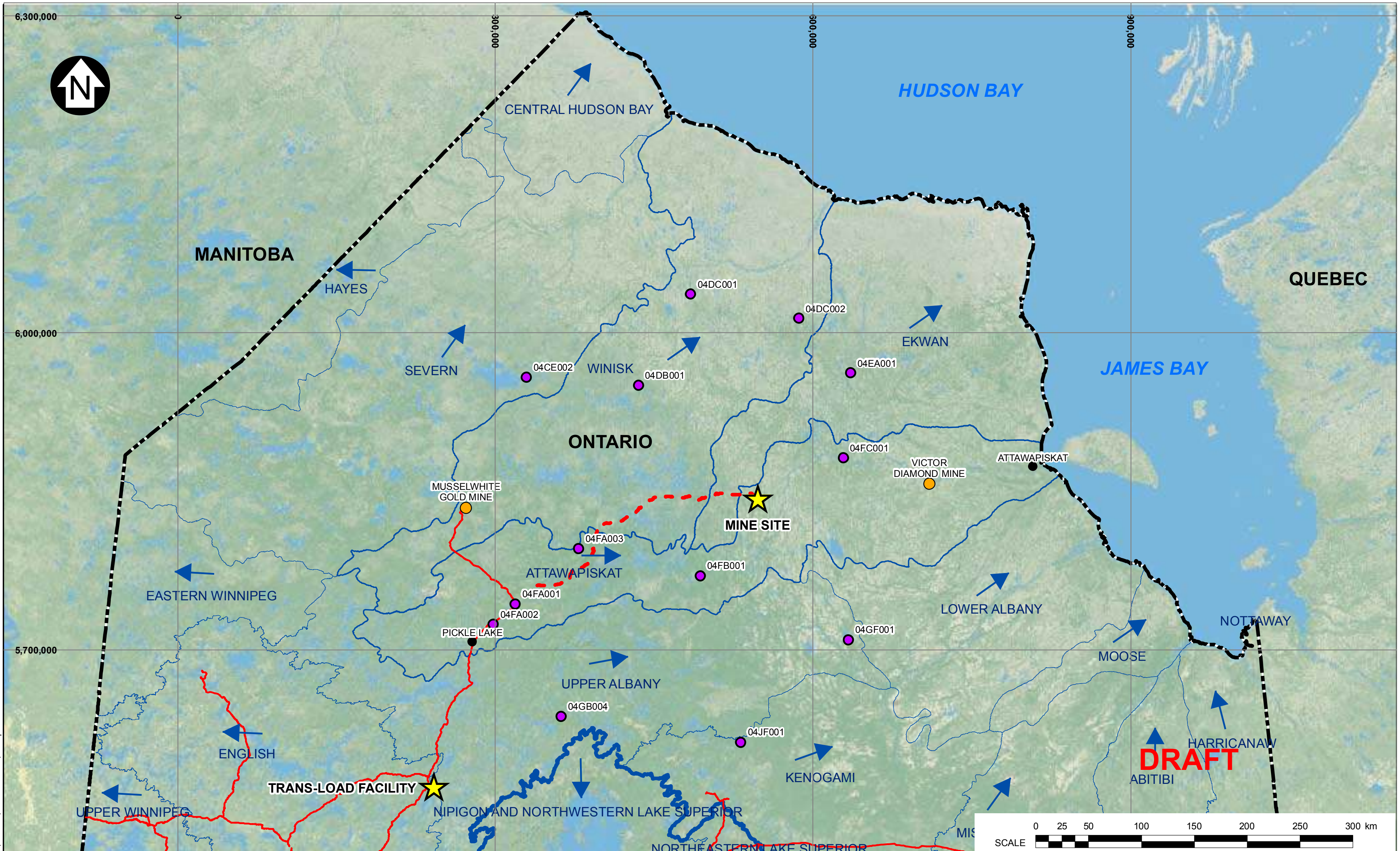
The Far North Region of northern Ontario is divided by several major watersheds (Figure 3.7-1). The mine site is located in the Muketei River catchment of the Attawapiskat River watershed that drains eastward to James Bay (Figure 3.7-2). The transportation corridor crosses through the Attawapiskat, Ekwan, Winisk, Albany, and English River watersheds (Figure 3.7-3). The water crossings along the proposed all-season road section of the transportation corridor have a range of catchment sizes, as shown on Figure 3.7-3. The trans-load facility is located in the upper Albany River Watershed near the drainage divide of the English River Watershed (Figure 3.7-4).

3.7.2.4 Regional Hydrology Data

Regional hydrology data were obtained from four active regional streamflow stations operated by the Water Survey of Canada (WSC) in the Project region, as summarized in Table 3.7-1. The stations have a 45 to 47 year period of record and are all located on large river systems.

Table 3.7-1 Summary of Regional Hydrology Stations

Station ID	Location	Catchment Area (km^2)	Latitude	Longitude	Period of Record	Mean Annual Unit Runoff ($l/s/km^2$)
04GD001	Albany River Above Nottik Island	32,400	51.64	-86.40	1966-2013	7.1
04FC001	Attawapiskat River Below Muketei River	36,000	53.09	-85.07	1968-2013	10.3
04FA003	Pineimuta River at Eyes Lake	4,900	52.31	-88.76	1966-2013	9.6
04FA001	Otoskwin River Below Badesdawa Lake	9,010	51.82	-89.60	1966-2013	9.7



LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- OTHER MINE PROJECT
- COMMUNITY
- WSC HYDROLOGY STATION
- PROVINCIAL BORDER
- EXISTING ALL-SEASON ROAD
- MAJOR WATERSHED DIVIDE
- WATERSHED FLOW DIRECTION
- ATLANTIC OCEAN - HUDSON BAY DRAINAGE DIVIDE
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013).
4. MAJOR WATERSHED DATA PROVIDED BY NATURAL RESOURCES CANADA.
5. IMAGERY: © ESRI DATA AND MAPS [ONLINE] (2010). REDLANDS, CA: ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE. ALL RIGHTS RESERVED.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	DKK	SWK	SRA	RAM

SAVED: I:\1102\00390\01\A\GIS\Figs\A666_rA.mxd; Dec 20, 2013 3:03 PM; asimpson

NORONT RESOURCES LTD.

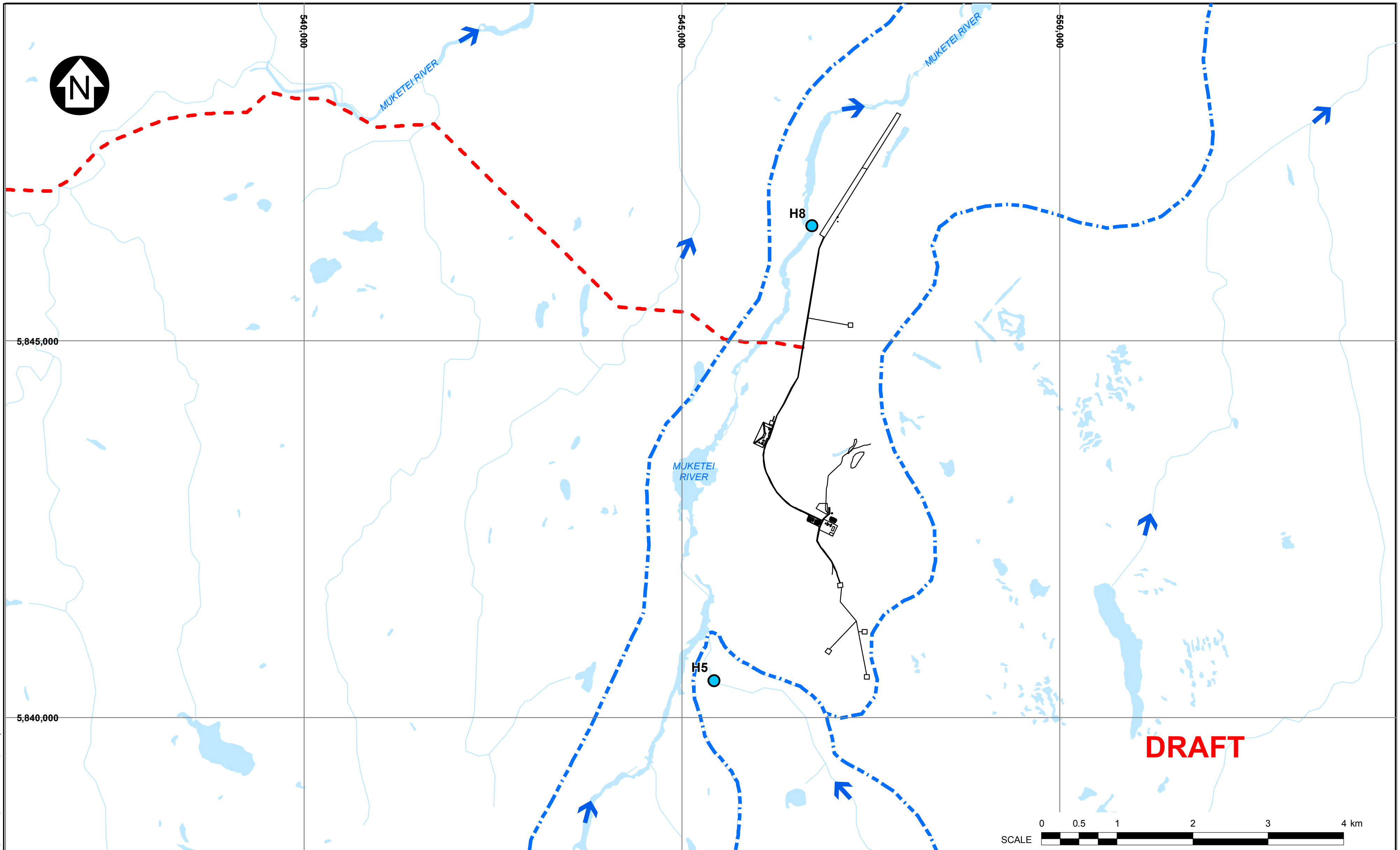
EAGLE'S NEST PROJECT

MAJOR WATERSHEDS AND PROJECT INFRASTRUCTURE

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.7-1 REV A



LEGEND:

- HYDROLOGY STATION
- FLOW DIRECTION
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- PROPOSED INFRASTRUCTURE
- RIVER/STREAM/DRAINAGE
- WATER
- CATCHMENT AREA

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA, DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES.
   COORDINATE SYSTEM: WGS 1984 UTM ZONE 16N.
3. INFRASTRUCTURE INFORMATION AND PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.
4. MAJOR WATERSHED DATA PROVIDED BY NATURAL RESOURCES CANADA.

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

WATERSHEDS IN THE MINE SITE AREA

Knight Piésold CONSULTING

P/A NO. NB102-390/1

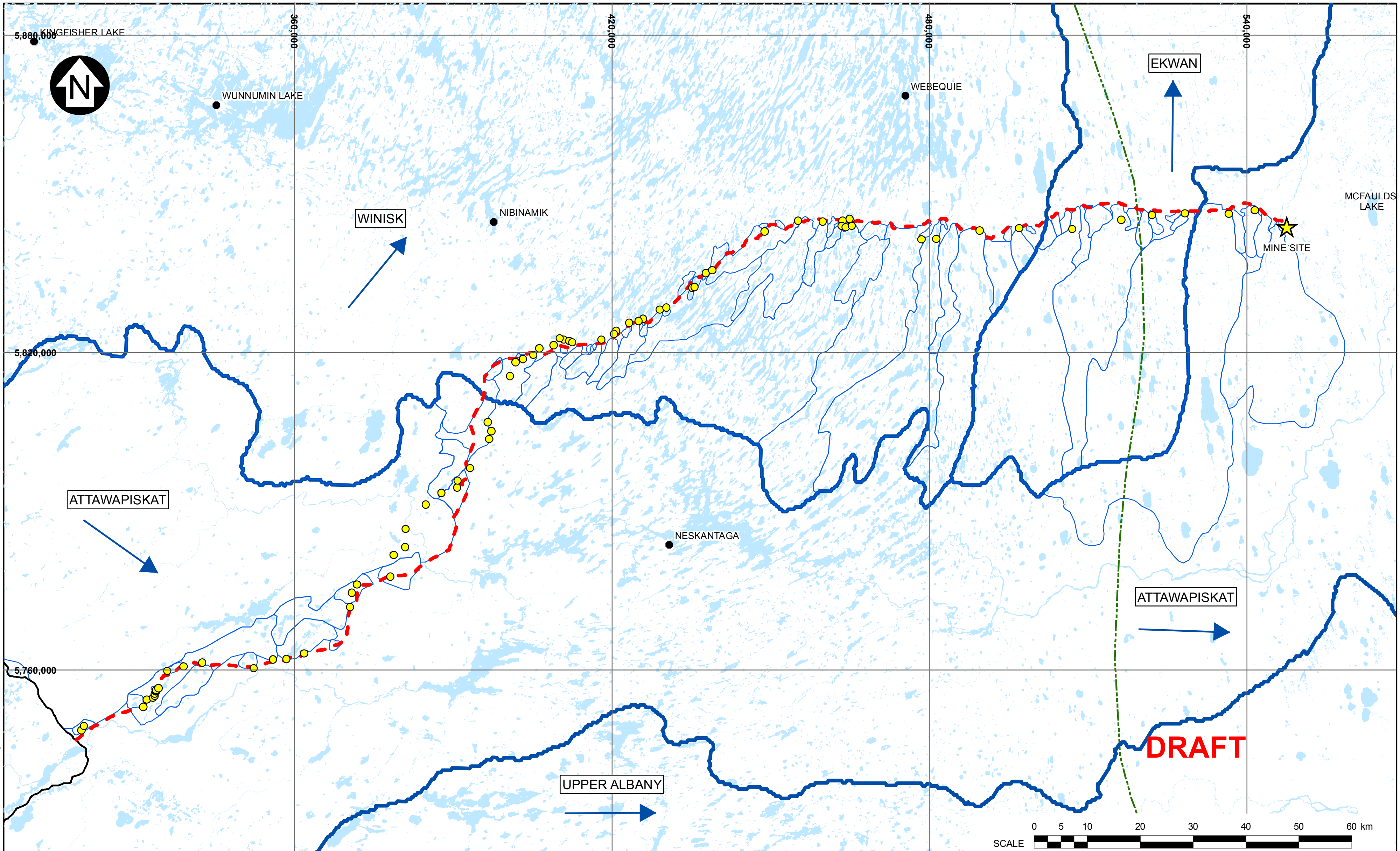
REF NO. 34

FIGURE 3.7-2

REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	ALR	SWK	SRA	RAM

SAVED: I:\102\00390\01\A\GIS\Figs\A667_rA.mxd; Dec 20, 2013 3:10 PM; asimpson



LEGEND:

- MINE SITE
- COMMUNITY
- SURFACE WATER QUALITY SAMPLING LOCATION
- WATERSHED FLOW DIRECTION
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- RIVER/STREAM/DRAINAGE
- WATER
- ROAD CROSSING CATCHMENT
- MAJOR WATERSHED COURSE

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA, DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: WGS 1984 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013).
4. MAJOR WATERSHED DATA PROVIDED BY: NATURAL RESOURCES CANADA.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	RAC	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

WATERSHEDS ALONG THE TRANSPORTATION CORRIDOR

Knight Piésold CONSULTING

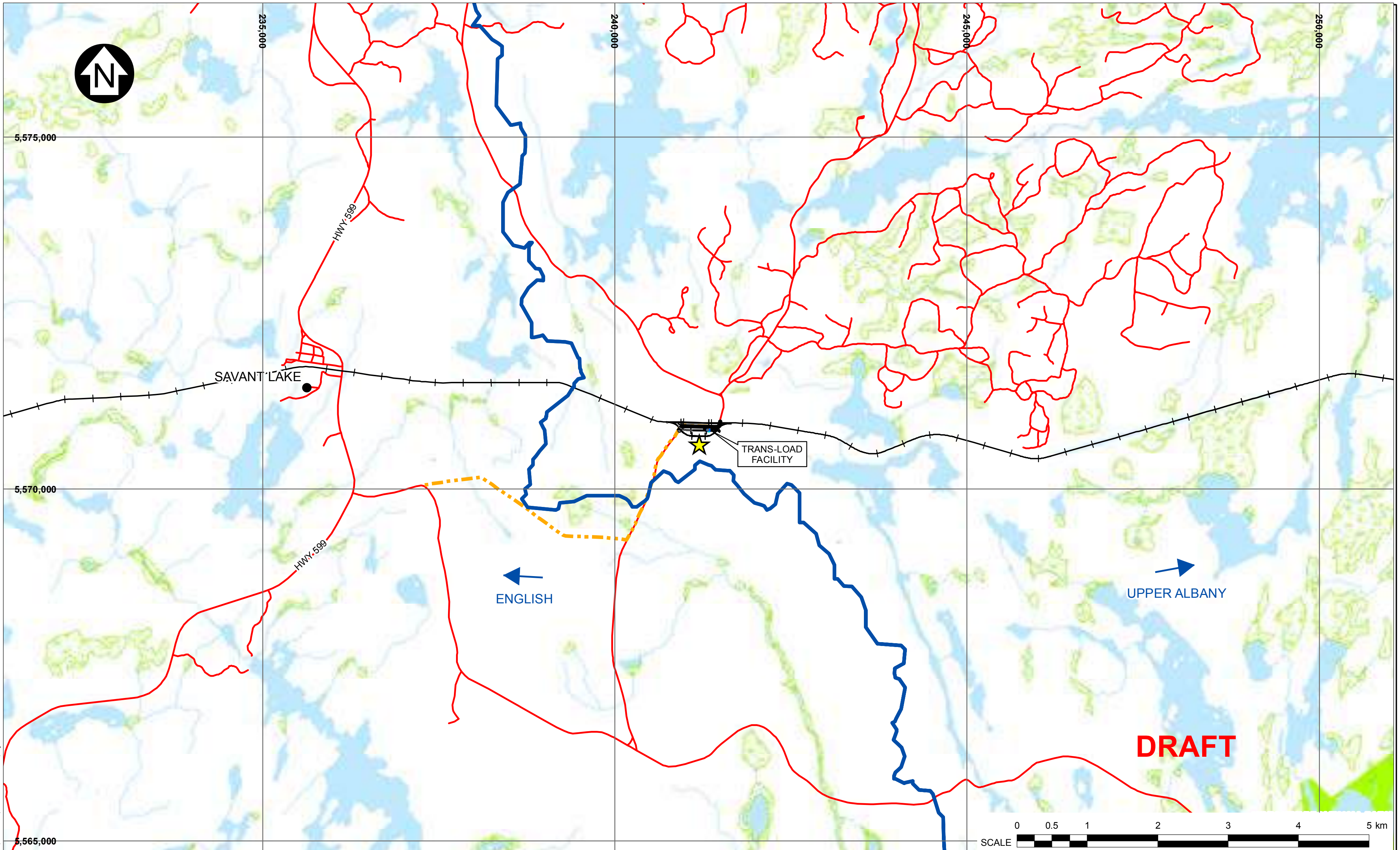
P/A NO. NB102-390/1

REF NO. 34

FIGURE 3.7-3

REV A

SAVED: I:\1102\00390\01\A\GIS\Figs\A668_rA.mxd; Dec 20, 2013 3:13 PM; spenfold



LEGEND:

- COMMUNITY
- TRANS-LOAD FACILITY
- EXISTING ALL-SEASON ROAD
- RAILWAY
- PROPOSED HYDRO CORRIDOR
- MAJOR WATERSHED DIVIDE
- WATERSHED FLOW DIRECTION
- WETLAND

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. INFRASTRUCTURE IS BASED ON INFORMATION PROVIDED BY TETRA TECH (APRIL 19, 2012).
5. MAJOR WATERSHED DATA PROVIDED BY NATURAL RESOURCES CANADA.

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

WATERSHEDS IN THE TRANS-LOAD FACILITY AREAS

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF NO. 34

FIGURE 3.7-4

REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	PAQ	SWK	SRA	RAM

SAVED: I:\1102\00390\01\A\GIS\Figs\A669_rA.mxd; Dec 20, 2013 3:24 PM; spenfold

The long-term mean annual runoff from the stations is shown on Figure 3.7-5 below. The long-term annual flow patterns at the WSC stations in the area are all very similar. The low flows generally occur during the winter months when precipitation falls predominantly as snow, and the peak flows occur during the spring due to snowmelt. Flows recede through the summer when evaporation is high and there is an increase in flow during fall as evaporation decreases.

The Albany River had the lowest unit runoff value of all the WSC stations. The highest unit runoff was at the Pineimuta River station, likely due to the station's small catchment relative to the other WSC stations. The Pineimuta, which is a tributary of the Attawapiskat, had a very similar unit runoff to the Attawapiskat River during summer and early fall. The Pineimuta River has the smallest drainage area of the regional stations and its unit flows are likely the most similar to those of the project stations.

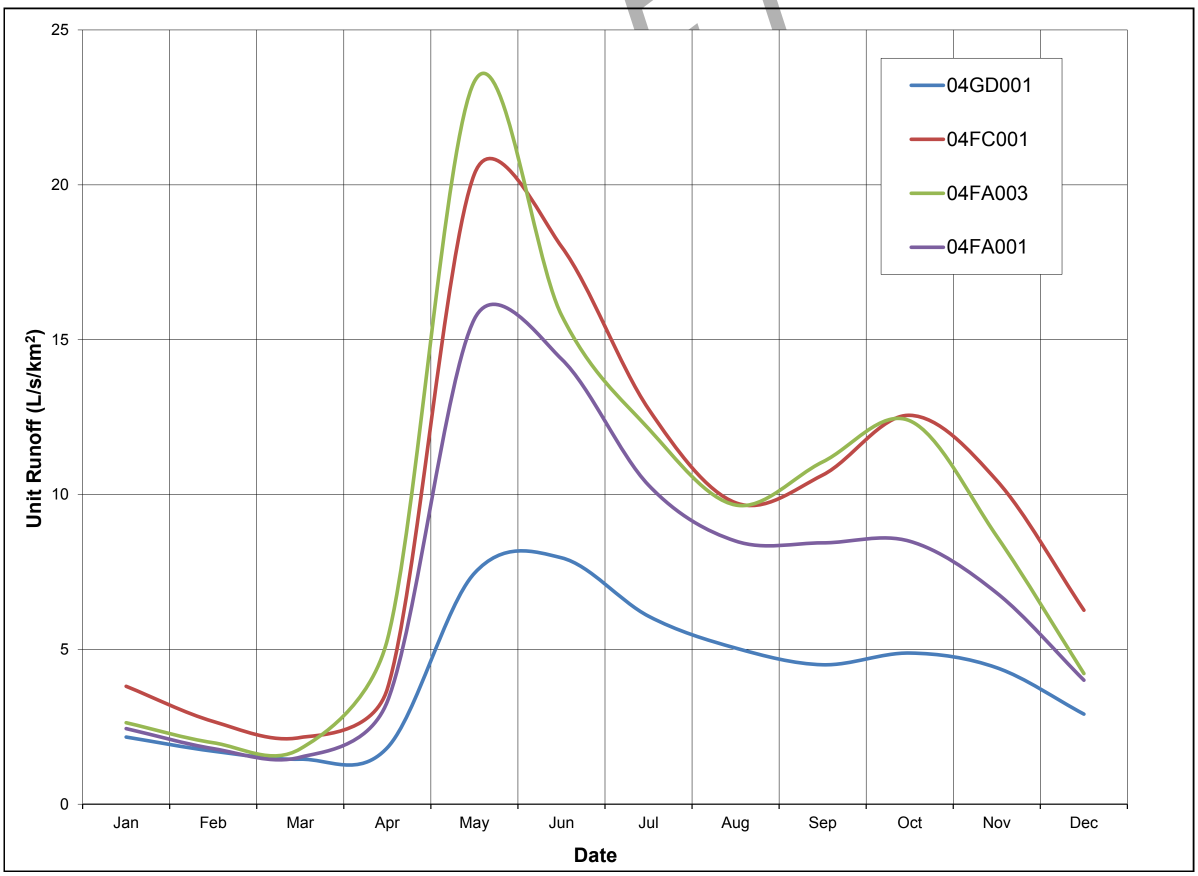


Figure 3.7-5 Unit Flow Annual Hydrographs for Regional Stations

3.7.3 Methods

3.7.3.1 Project Hydrometric Stations

Hydrometric monitoring was initiated in August of 2010 at four stations along the transportation corridor and two stations near the mine site. All six stations were re-installed in May of 2011 along with two new stations along the transportation corridor. Two of the stations along the transportation corridor were decommissioned at the end of 2011 due to the influence of beaver dams and poor downstream hydraulic control. The remaining four stations along the transportation corridor and the two stations at the mine site were re-installed in 2012. In the spring of 2013, the two stations near the mine site were re-installed. The locations and drainage areas of the active and inactive stations are shown on Figure 3.7-6 and summarized in Table 3.7-2.

Table 3.7-2 Project Hydrometric Station Details

Station ID	Location	Latitude	Longitude	Drainage Area (km^2)	Year of Record
H1	Transportation Corridor - West	52.11	-89.55	372	2010-2012[1]
H2	Transportation Corridor - West	52.23	-89.42	71	2011[2]
H3	Transportation Corridor - East	52.78	-87.01	72	2010-2012
H4	Transportation Corridor - East	52.76	-86.76	349	2010-2012
H5	Mine Site	52.71	-86.33	200	2010-2013
H8	Mine Site	52.77	-86.31	544	2010-2013
H9	Transportation Corridor - West	51.99	-89.28	113	2010-2012
H10	Transportation Corridor - West	52.08	-88.89	23	2011[2]

NOTES:
1. NO DATA AVAILABLE FROM H1 DURING 2012 DUE TO SENSOR FAILURE
2. THE STAGE DATA AT H2 AND H10 WERE AFFECTED BY BEAVER ACTIVITY AND NO ANALYSIS WAS DONE

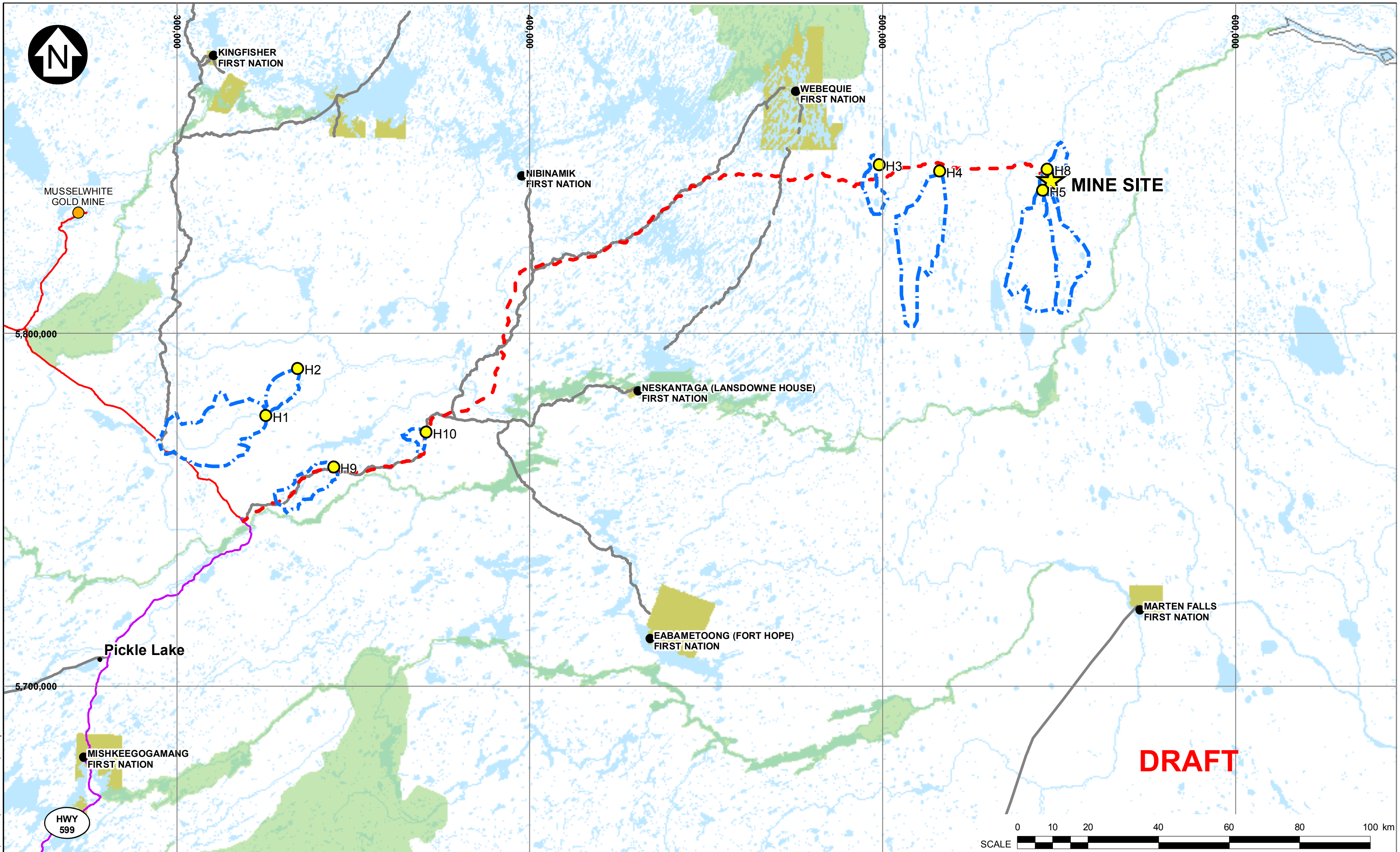
Water levels were measured at each station using pressure transducers and were recorded at 15 minute intervals using automated data loggers. The pressure transducers were installed in the spring on the smaller streams once the channels were completely ice free. The pressure transducer was installed permanently at H8 starting in fall 2011 because the Muketei River does not freeze completely to the bottom. This allowed for the measurement of water levels right up to the time of freeze-up in the fall and immediately after the time of break-up in the spring. The pressure transducer was removed in the spring and replaced with a unit that was cleaned and calibrated. Manual benchmark surveys were completed along with a measurement of stream discharge during each site visit. Discharge was measured on smaller streams using the area velocity method and a wading current meter. On the larger streams, when it was not possible to safely wade the channel, an RDI StreamPro(TM) acoustic doppler current profiler (ADCP) was used to measure discharge.

3.7.3.2 Rating Curve Development

Rating curves were developed for all stations except H2 and H10, whose records were affected by beaver activity. The curves were developed according to the following equation:

$$\boldsymbol{Q = C\,x\,(Stage - A)^n}$$

Where Q is discharge in cubic meters per second (m^3/s), C is a rating curve coefficient, Stage is the height of the water surface above an arbitrary datum, A is an offset (frequently given as the stage where flow is zero), and n is a curve exponent. The form of the rating curve equation is based on general hydraulic theory pertaining to open channel flow, and the values of the coefficient and exponent for the low flow portion of the curve are dependent on the hydraulic characteristics of the control section at the gauge, which provides a means of checking the validity of the derived equation. Typically, C is in the order of 0.5 to 2.5 times the channel width and n is between 1.6 and 3. The rating curves and gauging data for each station are shown in Appendix E.



LEGEND:

- ☆ MINE SITE
- COMMUNITY
- OPERATING MINE
- HYDROLOGY STATION
- EXISTING ALL-SEASON ROAD
- EXISTING WINTER ROAD
- CONCENTRATE HAUL ROUTE
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- STREAM/RIVER/DRAINAGE
- WATER
- PARK
- FIRST NATIONS RESERVE
- HYDROLOGY STATION CATCHMENT AREA

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013).
4. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).

SAVED: I:\1\02\00390\01\A\GIS\Figs\A670_rA.mxd; Dec 20, 2013 2:43 PM; asimpson

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	ALR	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

PROJECT HYDROMETRIC STATION LOCATIONS

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF NO. 34

FIGURE 3.7-6

REV A

3.7.4 Results

All of the stations show reasonably strong relationships between stage and discharge over the range of measured flows, although the number of stage-discharge points at each site is fairly limited. The consistency of the points from year to year suggests that the channels have been stable through time and over the range of observed flows, except at H3, where the need for two curves reflects changing channel conditions due to vegetation growth in different seasons. Scatter in the relationships at some stations is attributed to expected measurement uncertainty. The rating curves presented include extrapolation to zero discharge and to the highest stage recorded at each site. While the stage-discharge data collected fit the delineated curves well, there is considerably less certainty in the extrapolated high flow portions of the curves due to the lower number of observations. Additional high flow measurements are required to increase the confidence in the upper parts of rating curves. The fit of the stage-discharge data to the rating curves is discussed for each station:

- ***H1*** - The lower flow stage-discharge measurements are considered to be good quality and the curve is well defined over this range because flows in this range are contained in a well-defined channel with good downstream control. As flow increases at H1, the water spreads into multiple channels and an increase in discharge produces a much smaller change in stage. This change in control is reflected by the breakpoint shown at a stage of 1.248 m. The flow corresponding to the maximum recorded stage is approximately 1.1 times higher than the maximum measured discharge, which equates to very high uncertainty in the upper ends of the rating curves.
- ***H3*** - The channel at the H3 station is gently sloping and water levels are affected by vegetation that matures during the summer months. As a result, two different rating curves were developed to account for vegetated and non-vegetated conditions. All of the stage-discharge data were a good fit to the appropriate rating curve. The flow corresponding to the maximum recorded stage is approximately 6 times higher than the maximum measured discharge, which equates to very high uncertainty in the upper ends of the rating curves.
- ***H4*** - All of the stage-discharge data were a good fit to the rating curve. The flow corresponding to the maximum recorded stage is approximately 3 times higher than the maximum measured discharge, which indicates some uncertainty in the upper end of the rating curve. The channel bed and banks at the hydraulic control section consist of large boulders that appear to be very stable. Thus, it is expected that the control section should provide a long-term stable relationship between stage and discharge.
- ***H5*** - Most of the stage-discharge data were a good fit to the rating curve. The scatter in the data is likely due to expected measurement uncertainty. The fit of the multi-year data suggests that the channel has been stable through a range of flows over several years. The flow corresponding to the maximum recorded stage is close to the maximum measured discharge, which indicates that there is good confidence in the upper end of the rating curve.
- ***H8*** - The channel at H8 is bedrock with a section control immediately downstream of the gauge pool. All of the stage-discharge data were a good fit to the rating curve, including the higher flow measurements. The flow corresponding to the maximum recorded stage is approximately 2 times the maximum measured discharge, which indicates that there is reasonable confidence in the upper end of the rating curve. The channel bed and banks at the control section consist of boulders and exposed bedrock. As such, it is expected that the control section should provide a long-term stable relationship between stage and discharge.

- ***H9*** - All of the stage-discharge data at H9 were a good fit to the rating curve. A breakpoint elevation of 1.17 m was identified, where the channel widens and the relationship between stage and discharge changes. The flow corresponding to the maximum recorded stage is approximately 4 times higher than the maximum measured discharge, which indicates considerable uncertainty in the upper end of the rating curve.

3.7.4.1 Discharge Hydrographs

Hydrograph shape is a function of the complex interplay of both physiographic and meteorological conditions within a watershed. The difference in hydrograph shape is primarily a function of differences in basin shape, area, stream network, slope, land cover and in-catchment storage. Discharge hydrographs were developed for each station by applying the stage-discharge rating curves to the corresponding water level records. The Project hydrometric stations near the mine site are in close proximity to each other and the variability in meteorologic parameters (such as precipitation) is expected to be minimal. The stations at the western end of the transportation corridor (H1 and H9) are in close proximity to each other but are approximately 230 km southwest of the mine site. The stations along the transportation corridor near the mine site (H3 and H4) are in close proximity to each other and approximately 45 km west of the mine site. Hydrographs of daily discharge are presented in Appendix 1.

Table 3.7-3 provides a summary of the monthly average flows and unit flows for the period of record, and comparisons of the unit flow hydrographs are shown on Figure 3.7-7, including the values for the most relevant regional station, which is the WSC Pineimuta River station (04FA003).

The flow patterns at all the stations are generally quite similar, but there is a wide range of station to station and year to year variability. For instance, in 2010, Stations H1 and H4, which are at the most east and west ends of the transportation corridor, demonstrated very similar unit flows that were substantially greater than the unit flows at Stations H3, H5 and H8, which are near the mine site.

The 2010 flows were measured in August and September, when rainfall is the driving mechanism, and the variability reflects the spatial variability of convective storm systems. In contrast, in 2011, the flows at stations near the mine site were generally higher than those at stations along the corridor. Also in 2011, flows at all the stations were quite similar towards the end of the freshet period in July, but Station H9 went almost dry in August, September and October, while flows at the other stations responded notably to rainfall events during these months. A similar pattern is also evident in 2012.

The highest recorded flows at four of the stations occurred in late May of 2012, during the spring freshet. The stations were not installed during the freshet of 2011 or 2013 due to ice in the channels. The lowest flows were observed during July of 2011, and periods of low flow were also observed during August 2012.

Discharge hydrographs for the WSC stations were generated from the concurrent period of daily flow and are presented with the Project station hydrographs in Appendix 1.

Table 3.7-3 Summary of Measured Flows

Year	Station	Flow	May	Jun	Jul	Aug	Sep	Oct	Nov
2010	H1	Average Discharge m^3/s Unit Runoff $l/s/km^2$	-	-	-	4.8 13	6.0 16	-	-
	H3	Average Discharge m^3/s Unit Runoff $l/s/km^2$	-	-	-	0.31 4.4	0.40 5.7	-	-
	H4	Average Discharge m^3/s Unit Runoff $l/s/km^2$	-	-	-	5.0 14.3	5.5 15.7	-	-
	H5	Average Discharge m^3/s Unit Runoff $l/s/km^2$	-	-	-	0.70 3.5	0.72 3.6	-	-
	H8	Average Discharge m^3/s Unit Runoff $l/s/km^2$	-	-	-	1.7 3.1	1.9 3.5	-	-
2011	H1	Average Discharge m^3/s Unit Runoff $l/s/km^2$	-	2.1 5.7	0.47 1.3	1.7 4.4	2.5 6.6	-	-
	H3	Average Discharge m^3/s Unit Runoff $l/s/km^2$	-	0.47 6.5	0.08 1.1	0.16 2.2	0.30 4.2	-	-
	H4	Average Discharge m^3/s Unit Runoff $l/s/km^2$	-	2.5 7.0	0.35 1.0	1.7 4.9	3.2 9.5	-	-
	H5	Average Discharge m^3/s Unit Runoff $l/s/km^2$	-	1.2 5.8	0.48 2.4	0.99 5.0	2.2 11	-	-
	H8	Average Discharge m^3/s Unit Runoff $l/s/km^2$	-	3.7 6.8	1.8 3.3	3.3 6.2	6.4 11.8	5.8 10.6	4.2 7.6
	H9	Average Discharge m^3/s Unit Runoff $l/s/km^2$	-	0.52 4.6	0.001 0.01	0.004 0.04	0.02 0.14	-	-
2012	H3	Average Discharge m^3/s Unit Runoff $l/s/km^2$	-	1.05 14.6	-	-	-	-	-
	H4	Average Discharge m^3/s Unit Runoff $l/s/km^2$	-	15.3 44	2.0 5.8	1.1 3.2	0.57 1.6	-	-
	H5	Average Discharge m^3/s Unit Runoff $l/s/km^2$	-	-	0.60 2.9	0.84 4.2	0.41 2.0	-	-
	H8	Average Discharge m^3/s Unit Runoff $l/s/km^2$	10.6 19.4	11.1 20.5	2.0 3.6	2.5 4.5	1.5 2.8	5.4 9.9	4.2 7.8
	H9	Average Discharge m^3/s Unit Runoff $l/s/km^2$	-	3.3 29	0.72 0.64	0.01 0.12	0.02 0.2	-	-
2013	H5	Average Discharge m^3/s Unit Runoff $l/s/km^2$	-	4.88 24	1.3 6.7	0.92 4.6	0.80 4.0	-	-
	H8	Average Discharge m^3/s Unit Runoff $l/s/km^2$	-	7.1 13.1	1.2 2.2	1.4 2.5	1.0 1.8	-	-

NOTES:

1. AVERAGE MONTHLY FLOWS REPORTED FOR MONTHS WITH COMPLETE DATA RECORD AND COMPLETELY ICE FREE CONDITIONS.

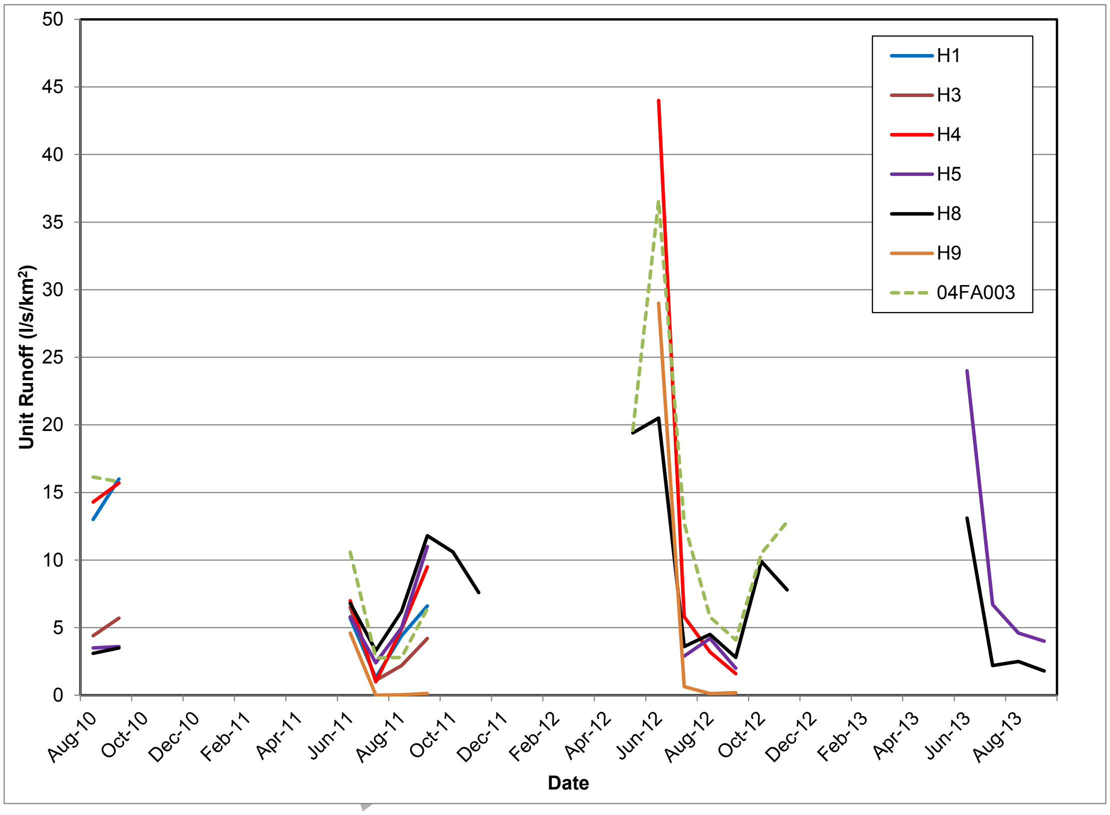


Figure 3.7-7 Measured Unit Flow Hydrographs for Site Stations

3.7.4.2 Winter Low Flow Measurements

Stage data were only collected during the open water season because of the freezing of all streams in winter. Winter site visits were made in 2011 and 2012 at the stations near the mine site to collect under ice discharge measurements suitable for assessing winter base flows (Table 3.7-4). Flows recorded in 2012 are substantially lower than those recorded in 2011, as a result of unusually low precipitation and groundwater recharge in the fall of 2011.

Table 3.7-4 Winter Low Flow Measurements

Station	March, 2011	February, 2012
H3	0.29 m^3/s	0.08 m^3/s
H4	0.59 m^3/s	0.12 m^3/s
H5	0.29 m^3/s	0.13 m^3/s
H8	1.29 m^3/s	0.65 m^3/s

3.7.4.3 Comparison of Project and Regional Streamflow

The general shapes of the discharge hydrographs at the WSC stations are similar to those at the Project stations, as demonstrated by comparing the plots of unit runoff for the Pineimuta River to the project stations, as shown on Figure 3.7-7. The highest peak flows at both the WSC and Project stations occurred during the spring freshet, and during 2011 an increase in flows in October was evident at all stations except H9. However, low amplitude, high frequency changes in flow, as well as rapid high amplitude changes in flow, which commonly occur at the Project stations in the summer months as indicated by the plots in Appendix 1, are not nearly as evident in the WSC hydrographs. This is because all of the WSC stations have much larger drainage areas than the Project stations and are therefore not as sensitive to local differences in summer precipitation. As stated previously, the Pineimuta River has the smallest catchment area of the WSC stations, and its flow patterns are most similar to those of the Project stations. However, the large difference in catchment size and the long distance between the Pineimuta station and the Project stations precludes the use of the Pineimuta River flow record to make reliable long-term flow estimates for the project stations.

To place the measured site data in the context of long-term flow patterns, the 2011 and 2012 April to November mean monthly discharge values for the Pineimuta WSC station were compared to the 1966 to 2012 mean values, as shown in Table 3.7-5.

Table 3.7-5 Pineimuta River Mean Monthly Discharge

Year	Mean Monthly Discharge (m^3/s)							
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
2011	14	56	32	13	13	22	24	24
2012	69	96	179	62	28	20	51	63
Average (1966-2012)	27	124	83	64	51	57	65	45

These values indicate that flows in 2011 were well below average in each month and especially during July and August. Furthermore, flows in 2012 were above average in April, November and especially June, near average in July, and below average in May, August, September, and October.

Therefore, the data collected at the Project stations in July and August 2011 could be expected to show well below average conditions. This appears to be the case at H1, H3 and H4, which are on the transportation corridor, but at H5 and H8, which are near the mine site, flows appear to have been near to or above average. This difference demonstrates the local variability of flows, and highlights the need to have site specific data. The flows measured in June 2012 could have been expected to show well above average conditions, and this appears to be the case at all sites.

3.7.4.4 Peak Flow

High flows are specific levels of stream flow above which floods are considered to occur. Typically, the highest discharge in a given year is used to define the annual flood conditions or peak flow. Peak instantaneous flows in the region commonly occur as a result of the spring freshet. On smaller streams, peak instantaneous flows may occur either as a result of snowmelt during the freshet or from intense or prolonged rainfall in summer or early autumn. The highest instantaneous flows recorded at the Project stations are shown in Table 3.7-6.

Table 3.7-6 Highest Observed Flows at the Project Stations

Station	Flow (m^3/s)	Date
H1	11.7	September 14, 2010
H3	7.7	May 29, 2012
H4	46.4	May 31, 2012
H5	9.0	June 4, 2013
H8	34.3	May 29, 2012
H9	6.8	May 30, 2012

The streamflow records at the Project sites are not sufficient in length to develop a statistical peak flow analysis. Return period peak flows were calculated from the annual peak flow data from the WSC stations on the Attawapiskat River (04CF001) and the Pineimuta River (04FA003). The data were fitted to a Gumbel distribution, which has been successfully used to represent flood probabilities in the region (Woo and Waylen, 1986). Return period flows for the WSC stations are shown in Table 3.7-7.

Table 3.7-7 WSC Station Return Period Peak Discharge

Attawapiskat River (04CF001)		Pineimuta River (04FA003)	
Return Period (years)	Discharge (m^3/s)	Return Period (years)	Discharge (m^3/s)
2	1,249	2	216
5	1,740	5	284
10	2,067	10	329
15	2,251	15	354
20	2,379	20	372
25	2,479	25	386
50	2,784	50	428
100	3,087	100	470
200	3,389	200	512
500	3,788	500	567
Mean	1,340	Mean	233

The very large differences in basin size between the site and regional stations precludes the use of the regional datasets to estimate return period peak flows for the project area streams. However, the peak flows in 2011 and 2012 at the regional stations do provide insight into the relative magnitudes of the peak flows measured at the site stations. The peak discharge during 2011 and 2012 at the Pineimuta and Attawapiskat Stations are shown in Table 3.7-8.

Table 3.7-8 WSC Station Peak Flows During 2011 and 2012

Attawapiskat River (04CF001)		Pineimuta River (04FA003)	
Date	Peak Flow (m^3/s)	Date	Peak Flow (m^3/s)
May 2, 2011	960	May 8, 2011	126
June 1, 2012	1,468	May 31, 2012	251

The peak flow at the WSC stations were below the average peak flows in 2011 (less than 2 year return period flow) and were above the average peak flows in 2012 (between 2 and 5 year return period flow). Thus, the peak flows observed at the Project stations were likely lower than average in 2011 and slightly above average in 2012.

3.7.4.5 Low Flow

The long-term WSC data show that low flows typically occur in late winter (February and March). The lowest observed flows at the Project stations are shown in Table 3.7-9.

Table 3.7-9 Lowest Observed Flows at Project Stations

Station	Flow (m^3/s)	Date
H1	0.27	July 19, 2011
H3	0.008	June 13, 2011
H4	0.05	July 6, 2011
H5	0.03	July 31, 2012
H8	0.65	July 6, 2011
H9	0[1]	July 22, 2011

NOTES:
1. THE WATER LEVEL DROPPED BELOW THE PRESSURE TRANSDUCER AT H9 DURING JULY 2011, WHICH RESULTED IN AN ESTIMATE OF NEAR ZERO DISCHARGE.

The lowest flows observed at the Project station all occurred during summer months and are lower than the measured winter low flows at all stations except H8, which had similar summer and winter low flows. This may be because the lowest flows do occur in the summer, or because the measured winter instantaneous flow measurements did not coincide with the lowest winter flow conditions.

The Project stations do not have an adequate data record to support the computation of statistical low flows. Where data are lacking, regional analyses are typically undertaken to provide estimates of low flow magnitudes. Stainton (2010) summarizes several approaches adopted by the Ontario Ministry of the Environment (MOE) for defining low flow, including the $7Q_{20}$, which is the minimum 7-day average flow with a recurrence interval of 20 years. The $7Q_{20}$ is commonly used as a design low flow for receiving waters and to ensure adequate quantities of water are maintained in Ontario's streams and rivers (OMOEE, 1994). The annual and summer 7-day low flow statistics were computed from the Pineimuta River streamflow record using Environment Canada's LFA Software, and are shown in Table 3.7-10.

Table 3.7-10 Pineimuta River 7-day Low Flows

Return Period	Annual Low Flow		Summer Low Flow	
(years)	(m^3/s)	($l/s/km^2$)	(m^3/s)	($l/s/km^2$)
1	12	2.45	113	23.06
2	6.3	1.29	25	5.10
5	4.8	0.98	14	2.86
10	4.1	0.84	11	2.24
20	3.6	0.73	9	1.84
50	3.2	0.65	7.9	1.61
100	3	0.61	7.6	1.55
200	2.8	0.57	7.4	1.51
500	2.7	0.55	7.2	1.47

NOTES:

1. RETURN PERIOD LOW FLOW CALCULATED FROM THE DAILY FLOW RECORD FROM 1967 to 2011.
2. THE SUMMER LOW FLOW WAS CALCULATED FROM 7-DAY AVERAGE FLOWS DURING JUNE, JULY, AND AUGUST.

As shown in Appendix 1, the lowest annual flows at the regional stations occur during the winter months. The data collected at the Project stations was for the open water season, during which the lowest flows occur during summer months (June to August). The lowest flow observed on the Pineimuta River during the summer of 2011 was 10.7 m^3/s, which corresponds to a 10 to 20 year return period 7-day low flow. The lowest flow observed during 2012 was 14.8 m^3/s, which corresponds to approximately a 5 year return period 7-day low flow. The low flows observed at the Project stations are assumed to be representative of similar return period low flows.

3.7.4.6 Trends in Streamflow

The year-to-year variability of streamflow at the Pineimuta and Attawapiskat River WSC stations were examined. Streamflows in these rivers are largely unaffected by human activity. The effects of forest disturbance on streamflow in small basins (<10 km^2) is well documented, but the effect of either natural or anthropogenic disturbance on larger rivers in the boreal forest is less clear (Buttle and Metcalfe, 2000).

The change in streamflow over time is a consequence of variability or change in climate. In several regions of Canada there is evidence that streamflow is increasing, flood events are becoming more frequent, and the magnitude of spring peak flows is changing (Cunderlik and Ouarda, 2009).

The trends in minimum discharge, mean annual discharge and peak discharge for the Pineimuta and Attawapiskat WSC stations were evaluated using the Mann-Kendall test and Sen's slope (Mann 1945, Kendall 1975). The trend analysis is shown in Appendix G and the results are summarized in Table 3.7-11.

Table 3.7-11 Summary of Trends in Stream Discharge

WSC Station	Minimum Discharge	Mean Annual Discharge	Maximum Discharge
Pineimuta River (04FA003) 1967-2011	No significant trend	No significant trend	Negative Trend (Slope: - 1.75)
Attawapiskat River (04FC001) 1968-2011	No significant trend	No significant trend	Negative Trend (Slope - 12.5)

No significant trends were evident in the minimum or mean annual discharges in the Pineimuta or Attawapiskat River flow data. Both stations had a significant negative trend in maximum discharge, which suggests that the severity of annual peak flows is decreasing.

3.8 GROUNDWATER QUANTITY

This section provides a description of the existing groundwater quality baseline conditions for the Eagle's Nest Project. The supporting technical document that provides additional details regarding the study methods, results, and discussion is available in Appendix 4.

3.8.1 Study Areas

The spatial boundaries of the baseline hydrogeological studies were defined by areas within which potential impacts on groundwater resources may occur from the development of the Project.

Interaction with the groundwater is expected to occur primarily at the mine site due to the underground mining activities and the withdrawals of groundwater for water supply. The Project may also interact with groundwater resources at the Savant Lake trans-load facility during site development and operations. Groundwater resources could also be impacted along the transportation corridor during the construction and operation of the all-season road.

3.8.1.1 Mine Site Study Area

The mine site study area is defined as the area around the mine site. The boundary of the study area takes into consideration, the project footprint, the local topography, drainage patterns, and groundwater flow. The study area extends from the wetland surrounding the mine site to the Muketei River.

3.8.1.2 Transportation Corridor Study Area

The transportation corridor study area is defined as the proposed all-season road between the mine site and the existing infrastructure at the Northern Ontario Resource Road. There is the potential for interactions with the groundwater resources during construction of the road at borrow and aggregate sources. The final aggregate source locations for the construction of the road have not been selected and no detailed hydrological studies were undertaken as a result.

3.8.1.3 Savant Lake Trans-Load Facility Study Area

The study area for the Savant Lake trans-load facility is based on the location of the facility infrastructure and the proposed site activities.

3.8.2 Background

3.8.2.1 Mine site

The mine site is located on a greenstone belt within the northwestern part of the Archean-age Superior Province. Metsaranta and Houlé (2012) suggest that there is a general northeast-southwest trend in the orientation of igneous and metamorphic rocks in the area with a series of at least five supracrustal rock groups in the area. Metasedimentary rocks were deposited during periodic inundation by inland seas in the Paleozoic and Mexozoic and have been observed to overlie mafic metavolcanic rocks. Several significant fault zones, on the scale of kilometers in width, have been identified to the west of the Mine Site near Webequie (MNDM, 2012). Displacement of the faults is both sinistral and dextral and generally in the direction of foliation (Buse and Smar, 2007). The regional bedrock geology as mapped by OGS (2006) is shown on Figure 3.8-1.

Bedrock groundwater flow systems in most of the Canadian Shield include a shallow freshwater system (to a depth of about 150 m) and a deep system of brine water that can extend to several hundred metres (Thorne and Gascoyne, 1993). The shallow bedrock groundwater system is typically characterized by small localized aquifers. In most parts of the Canadian Shield, these aquifers may be connected to overburden aquifers. Surficial aquifers are often bedrock controlled, however multiple layered aquifer/aquitard settings are rare (Singer and Cheng, 2002).

Shallow bedrock aquifers have a higher potential yield than deeper bedrock ones due to greater near surface weathering and fracturing. The flow of groundwater in the shallow bedrock is primarily a function of secondary permeability created by fractures in the rock.

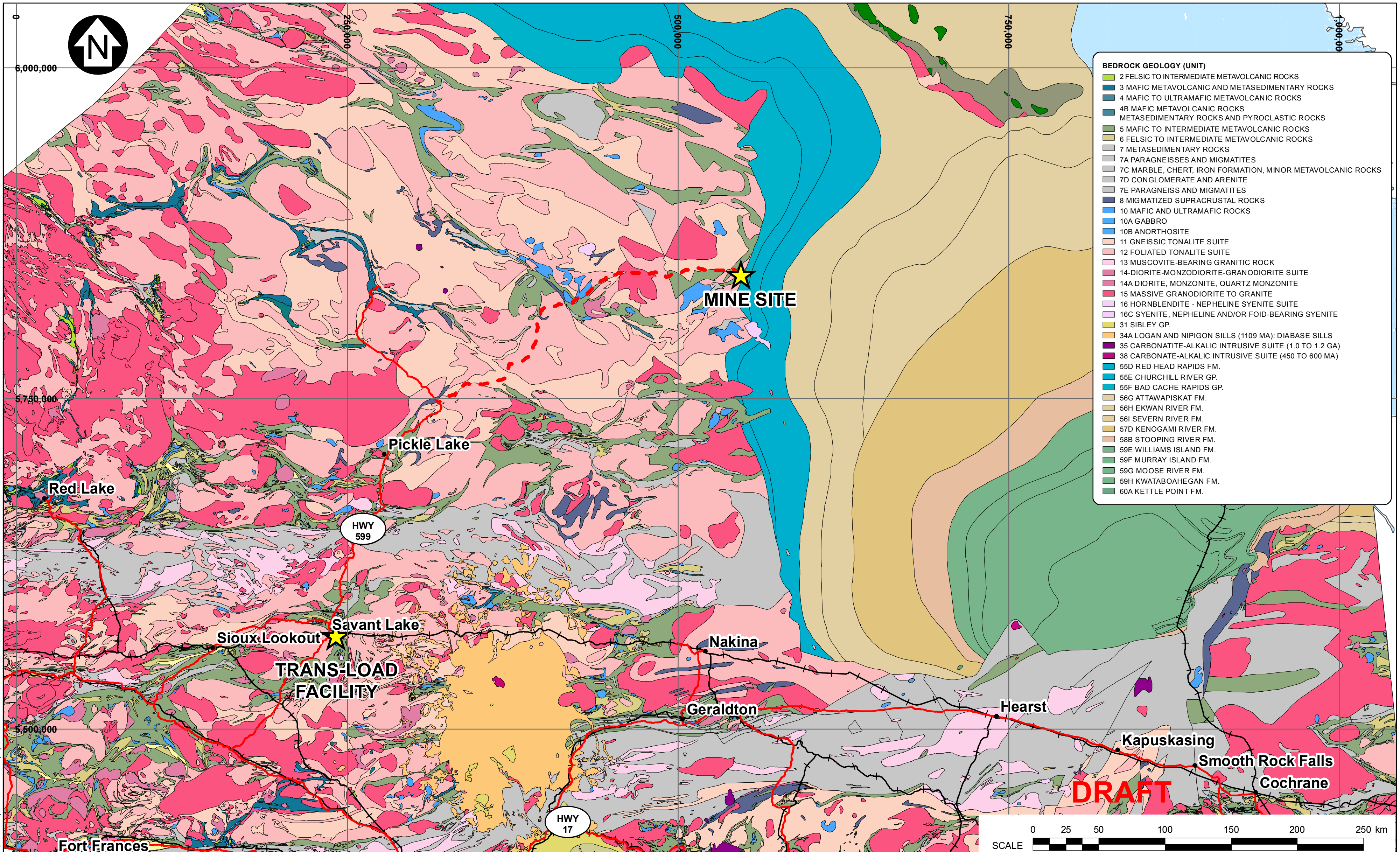
The surficial sediments at the mine site are composed of stratified and unstratified tills deposited during the Wisconsin glacial stage (85,000 to 11,000 years ago). The mine site is located on the boundary of the Hudson Bay and Canadian Shield till provinces. The Hudson Bay tills are typical of a lowland environment with lodgement tills and englacial boulder pavement (Scott, 1976). The Canadian Shield tills tend to be coarser grained, non-calcareous and between 2 and 8 m thick These tills can be thicker over bedrock valleys (Scott, 1976).

Esker deposits and possibly marine beach deposits occur throughout the region. An embankment type esker runs roughly north-south through the mine site study area and there is evidence to suggest that several of the other upland areas may be part of a complex esker system. Eskers normally consist of sands and gravel. Near the mine site they are typically composed of a greater proportion of sand. Prest (1963), suggests that the east-west limit of post-glacial marine sediment deposits is located at approximately 86^{o} 05’ W longitude (approximately 14 km east of the mine site) and that the mine site area was flooded by post-glacial lakes. The mine site surficial geology is shown on Figure 3.8-2.

The sediments nearest to surface at the mine site are silty-clay of glaciolacustrine origin, and a layer of organic soil up to 2 m thick was encountered in some boreholes. The organic material is typically saturated and the water table in these areas is at, or less than one metre below the ground surface. The water in the organic layer is connected directly to surface water in many locations. Below the silt and clay layer, there is an aquifer in the sand and fine grained till material overlying the bedrock. The bedrock and overburden aquifers are likely connected in certain areas, with the groundwater-surface water interactions being controlled by the permeability of the silt/clay layer.

Hydrologic cross sections were generated to illustrate the surficial hydrogeologic features in the mine site area. The location of the cross sections are shown on Figure 3.8-3, an east-west (1) section is shown on Figure 3.8-4 and a north-south (2) section is shown on Figure 3.8-5.

The mine site is located in the Attawapiskat River Basin, which has an average annual recharge of approximately 30 to 40 mm (Singer and Cheng, 2002). Recharge will occur at a greater rate in areas where more permeable units of sand and gravel are close to or at surface. These units are estimated to make up about 6% of the basin. The permeability of the units in the basin is expected to vary from 5 x 10^{-3} m/day to 1.5 m/day, with an average of 0.2 m/day (Singer and Cheng, 2002).



SAVED: I:\1102\00390\01\A\GIS\Figs\A704_rA.mxd: Dec 20, 2013 1:02 PM: spenfold

LEGEND:

- ☆ MINE SITE AND TRANS-LOAD FACILITY
- ● COMMUNITY
- RAILWAY
- EXISTING ALL-SEASON ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013).
4. ONTARIO GEOLOGICAL SURVEY 2006. 1:250 000 SCALE BEDROCK GEOLOGY OF ONTARIO; ONTARIO GEOLOGICAL SURVEY, MISCELLANEOUS RELEASE—DATA 126 – REVISED.

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

REGIONAL BEDROCK GEOLOGY

Knight Piésold CONSULTING

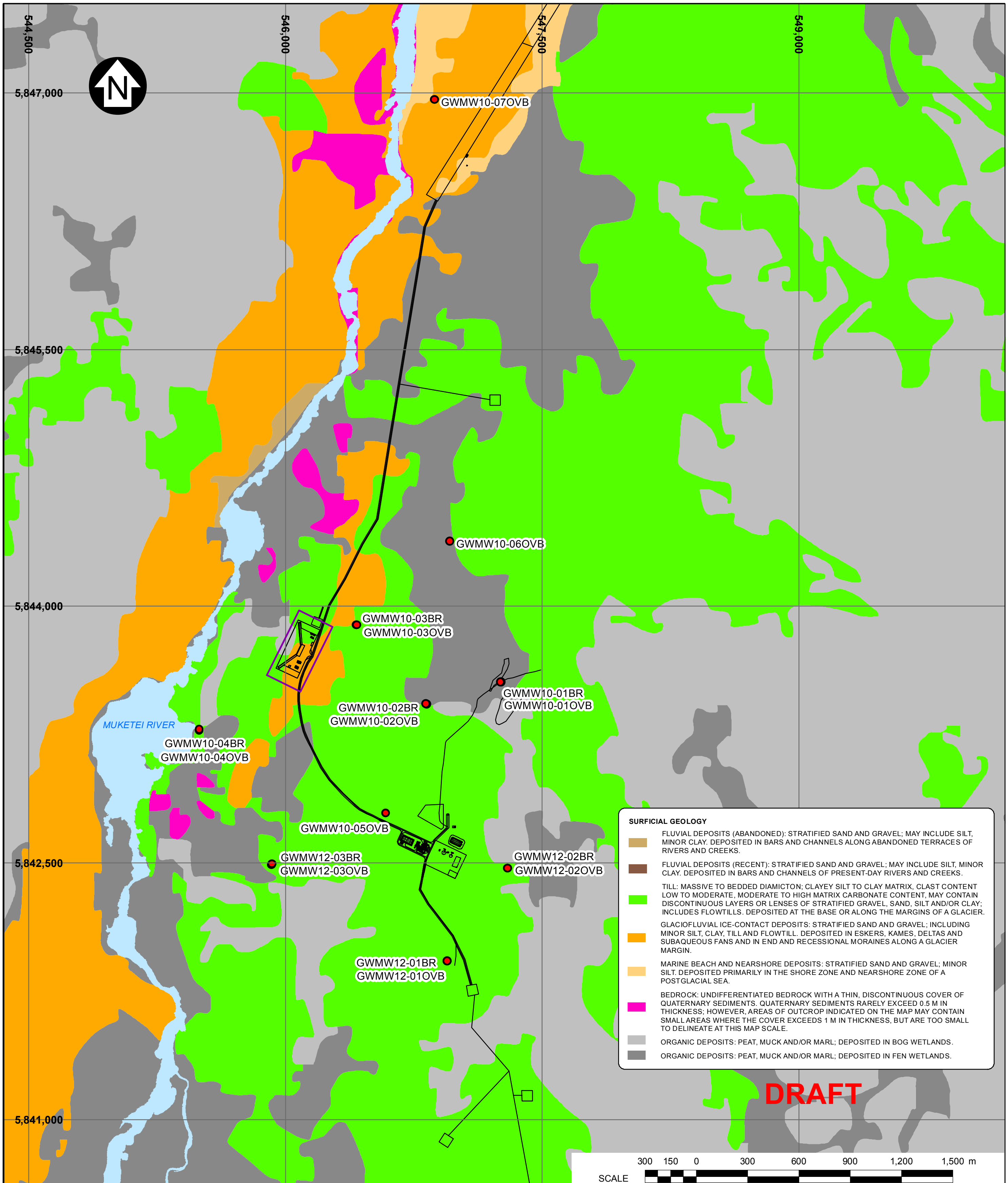
P/A NO. NB102-390/1

REF NO. 34

FIGURE 3.8-1

REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	ALR	SWK	SRA	RAM



LEGEND:

- MINE SITE
- GROUNDWATER MONITORING WELL LOCATION
- PROPOSED INFRASTRUCTURE
- RIVER/STREAM/DRAINAGE
- WATER

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. INFRASTRUCTURE INFORMATION PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.
4. ONTARIO GEOLOGICAL SURVEY, BARNETT, P.J., YEUNG, K.H. AND MCCALLUM, J.D. 2013. SURFICIAL GEOLOGY OF THE LANSDOWNE HOUSE AREA NORTHEAST, NORTHERN ONTARIO; ONTARIO GEOLOGICAL SURVEY, PRELIMINARY MAP P.3697, SCALE 1:100 000.

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

MINE SITE SURFICIAL GEOLOGY

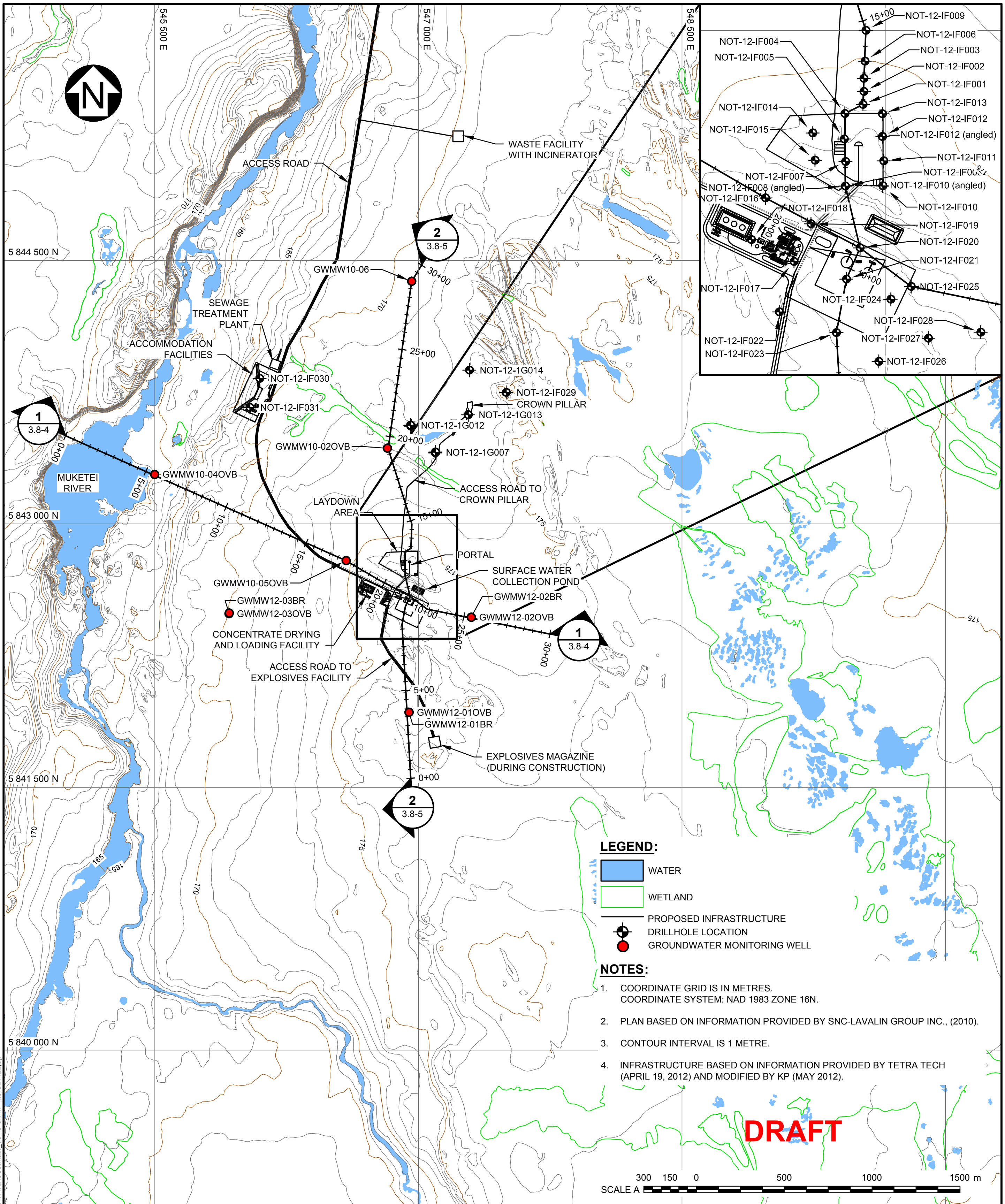
Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.8-2 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	SCP	SWK	SRA	RAM

SAVED: I:\1102\00390\01\A\GIS\Figs\A705_rA.mxd; Dec 20, 2013 1:10 PM; spenfold



NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

LOCATION OF MINE SITE
HYDROGEOLOGICAL CROSS SECTION

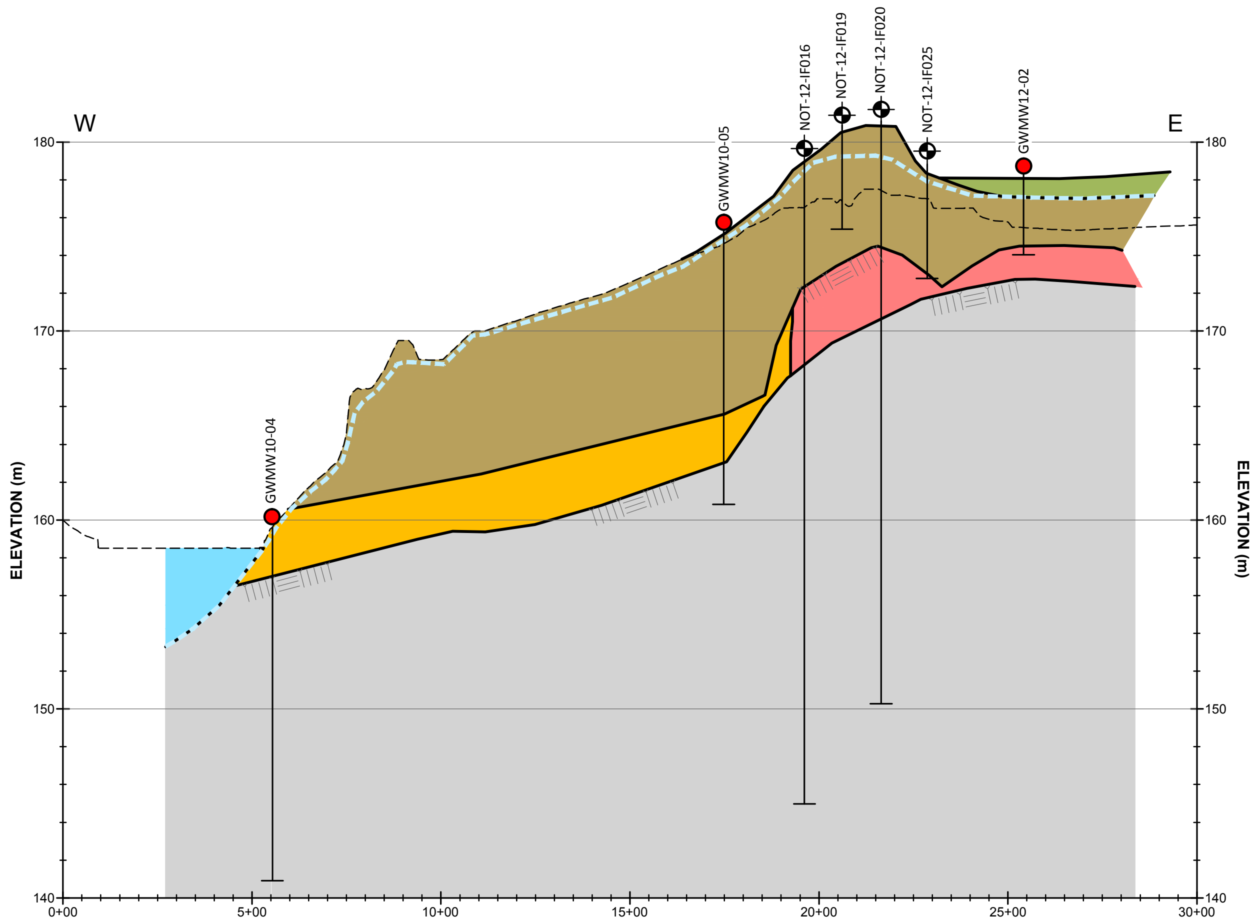
Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 3.8-3 | REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	ALR	AS	SRA	RAM

SAVED: I:\102\00390\01\A\Acad\Figs\A04_A, 12/20/2013 1:23:09 PM , ASIMPSON PRINTED: 12/20/2013 1:24:43 PM, PLAN, ASIMPSON
XREF FILE(S): ATLASGeomatic_TOPO; ESKER-CAMP-SITE-LAYOUT; ATLASGeomatic_TOPO-SWMP IMAGE FILE(S):



1 / 3.8-3 **EAST-WEST SECTION**
HORIZONTAL: SCALE A
VERTICAL: SCALE B

LEGEND:

- ORGANICS (PEAT)
- FINE GRAINED MATRIX (SILT/CLAY)
- COARSE GRAINED MATRIX (SAND, GRAVEL COBBLE)
- SEDIMENTARY BEDROCK
- IGNEOUS BEDROCK
- WATER
- BEDROCK
- ORIGINAL GROUND
- INFERRED WATER TABLE
- DRILLHOLE LOCATION
- GROUNDWATER MONITORING WELL

NOTES:

1. ELEVATIONS ARE IN METRES.

DRAFT

SCALE A: 200 100 0 200 400 600 800 1000 m
SCALE B: 4 2 0 4 8 12 16 20 m

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

EAST-WEST MINE SITE HYDROGEOLOGICAL CROSS SECTION

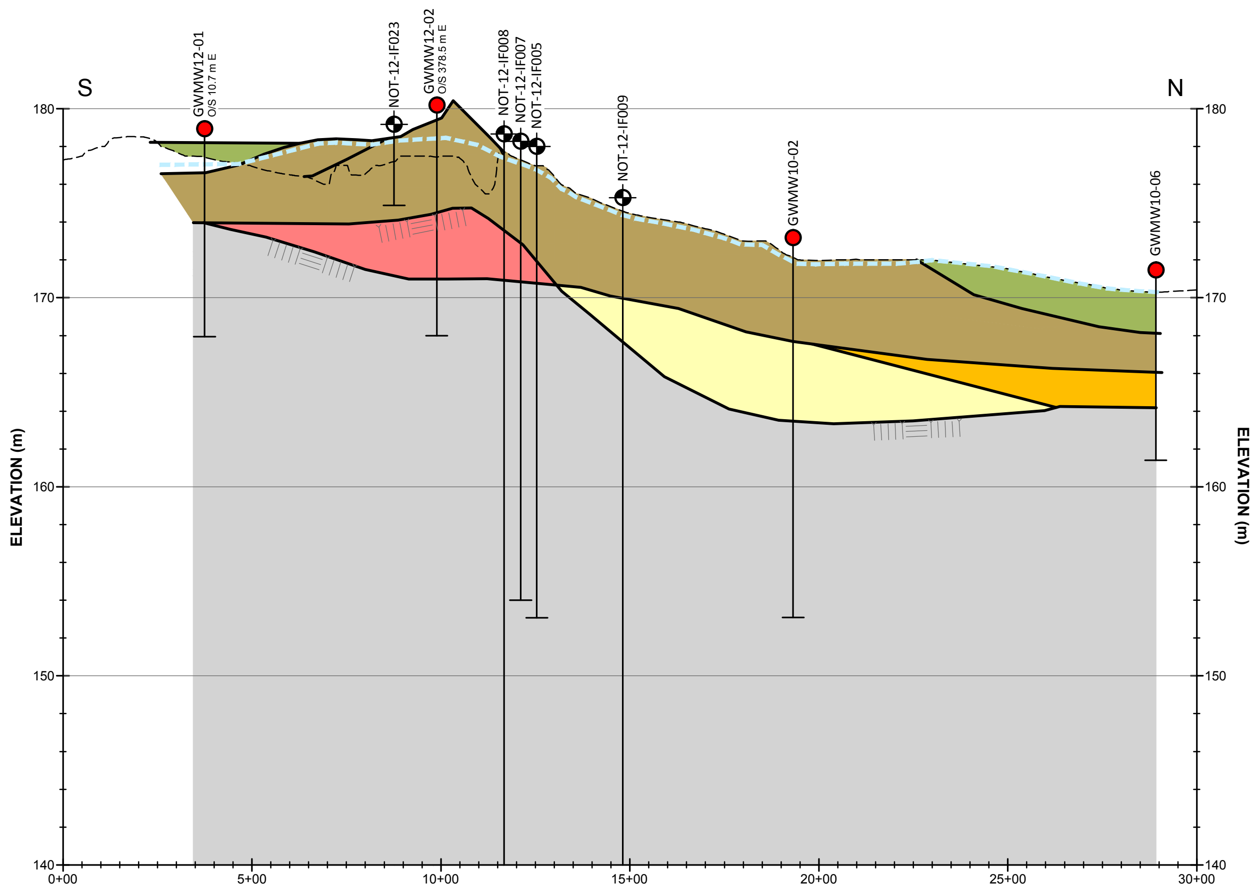
Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.8-4 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	RDW	AS	SRA	RAM

SAVED: I:\1\02\00390\01\A\Acad\Figs\A04_A, 12/20/2013 1:23:09 PM , ASIMPSON PRINTED: 12/20/2013 1:29:54 PM, SECT 1, ASIMPSON
XREF FILE(S): ATLASGeomatic_TOPO, ESKER-CAMP-SITE-LAYOUT, ATLASGeomatic_TOPO-SWMP IMAGE FILE(S):



2
3.8-3

NORTH-SOUTH SECTION

HORIZONTAL: SCALE A
VERTICAL: SCALE B

LEGEND:

- ORGANICS (PEAT)
- SAND
- FINE GRAINED MATRIX (SILT/CLAY)
- COARSE GRAINED MATRIX (SAND, GRAVEL COBBLE)
- SEDIMENTARY BEDROCK
- IGNEOUS BEDROCK
- BEDROCK
- ORIGINAL GROUND
- INFERRED WATER TABLE
- DRILLHOLE LOCATION
- GROUNDWATER MONITORING WELL

NOTES:

1. ELEVATIONS ARE IN METRES.

DRAFT

SCALE A: 200 100 0 200 400 600 800 1000 m
SCALE B: 4 2 0 4 8 12 16 20 m

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	RDW	AS	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

NORTH-SOUTH MINE SITE HYDROGEOLOGICAL CROSS SECTION

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.8-5 REV A

Regional groundwater quality is typically consistent throughout the Precambrian and Paleozoic Canadian Shield rocks. The bedrock aquifers above 150 m and overburden aquifers generally contain calcium-bicarbonate type groundwater. Singer and Cheng (2002) suggest that the groundwater in the region is expected to be generally hard, with elevated iron concentrations and total dissolved solids (TDS).

3.8.2.2 Transportation Corridor

The proposed east-west transportation corridor crosses the Attawapiskat, Ekwan and Winisk Watersheds. The road traverses predominantly wetlands in the first 100 km from the mine site. As the route moves west from the mine site, the relief increases, the soil becomes better drained, and there is more exposed bedrock. Bedrock along the transportation corridor is expected to be similar to the mine site and relatively impermeable. The permeability could be higher in zones of poorer rock mass quality and greater fracturing. The surficial geology along the transportation corridor consists of glacial till, glaciofluvial ice-contact and outwash deposits, glaciolacustrine deposits, and exposed bedrock. The land surface topography is expected to exert the strongest control on the configuration of the groundwater table and the groundwater flows.

3.8.2.3 Savant Lake Trans-load Facility

The trans-load facility at Savant Lake is located on the Canadian Shield. The bedrock at the site is composed of basaltic and andesitic tuffs, and breccias with related migmatites. The surficial material is predominantly a galciofluvial ice-contact deposit consisting mainly of discontinuous layers of sand and silts with some clays and gravel. Aquifers in these types of glaciofluvial deposits usually have high water supply potentials, even when dominated by silt and clay, due to the presence of sand lenses (Singer and Cheng, 2002). Bedrock was not encountered during the installation of the monitoring wells, which were drilled to depths of 20 m below ground.

3.8.3 Methods

Limited existing groundwater data are available for the study areas due to the remote location and lack of previous development. As such, it was necessary to carry out site-specific hydrogeological investigations. The investigations consisted of drilling, the installation of monitoring wells, the installation of vibrating wire piezometers, the measurement of static water levels, packer testing, hydraulic conductivity testing, and the collection and analysis of groundwater samples.

3.8.3.1 Site Investigation Summary

The baseline hydrogeology site investigations at the mine site were focused on near surface (overburden and shallow bedrock) and deep bedrock (up to 750 m below ground). At the Savant Lake trans-load facility the investigations were focussed on near surface overburden and shallow bedrock.

A summary of the hydrogeology site investigation work is as follows:

1. **September 2010:** Packer testing was completed in four drillholes in the mine site area (Golder, 2010).

2. **October/November 2010:** Drilling, geological logging, installation, development and hydraulic testing of groundwater monitoring wells, and the installation of drive point piezometers at the mine site (KP, 2011).
3. **November 2011:** Drilling, geological logging, installation, development, and hydraulic testing of groundwater monitoring wells at the Savant Lake trans-load facility site (KP, 2012).
4. **August to November 2012**: Drilling, geological logging, installation, development and hydraulic testing of groundwater monitoring wells at the mine site (KP, 2013a). Drilling, geomechanical logging, packer testing and the installation of vibrating wire piezometers (KP, 2013b).

3.8.3.2 Monitoring Well Installations

Monitoring wells were installed at the mine site and the Savant Lake trans-load facility. Monitoring well locations were selected based on the proximity to proposed Project infrastructure. All monitoring wells were installed in the overburden material or shallow bedrock.

Mine Site

Monitoring wells were installed at the mine site during two separate site investigation programs. In the fall of 2010, 11 monitoring wells were installed at seven locations (KP, 2011). Four locations had two wells, one in the overburden material and one in shallow bedrock. Three locations had a single well installed in the overburden material. In the fall of 2012, an additional six monitoring wells at three locations were installed at the mine site as a result of refinements to proposed infrastructure locations (KP, 2013a). At each location, one well was installed in the overburden and one in the shallow bedrock. Pressure transducer data loggers were installed to monitor water level on an hourly basis in each well at the mine site.

The locations of the monitoring wells installed at the mine site are shown on Figure 3.8-6. A summary of the well installation details and well logs for the monitoring wells at the mine site are provided in Appendix 4.

Savant Lake Trans-Load Facility

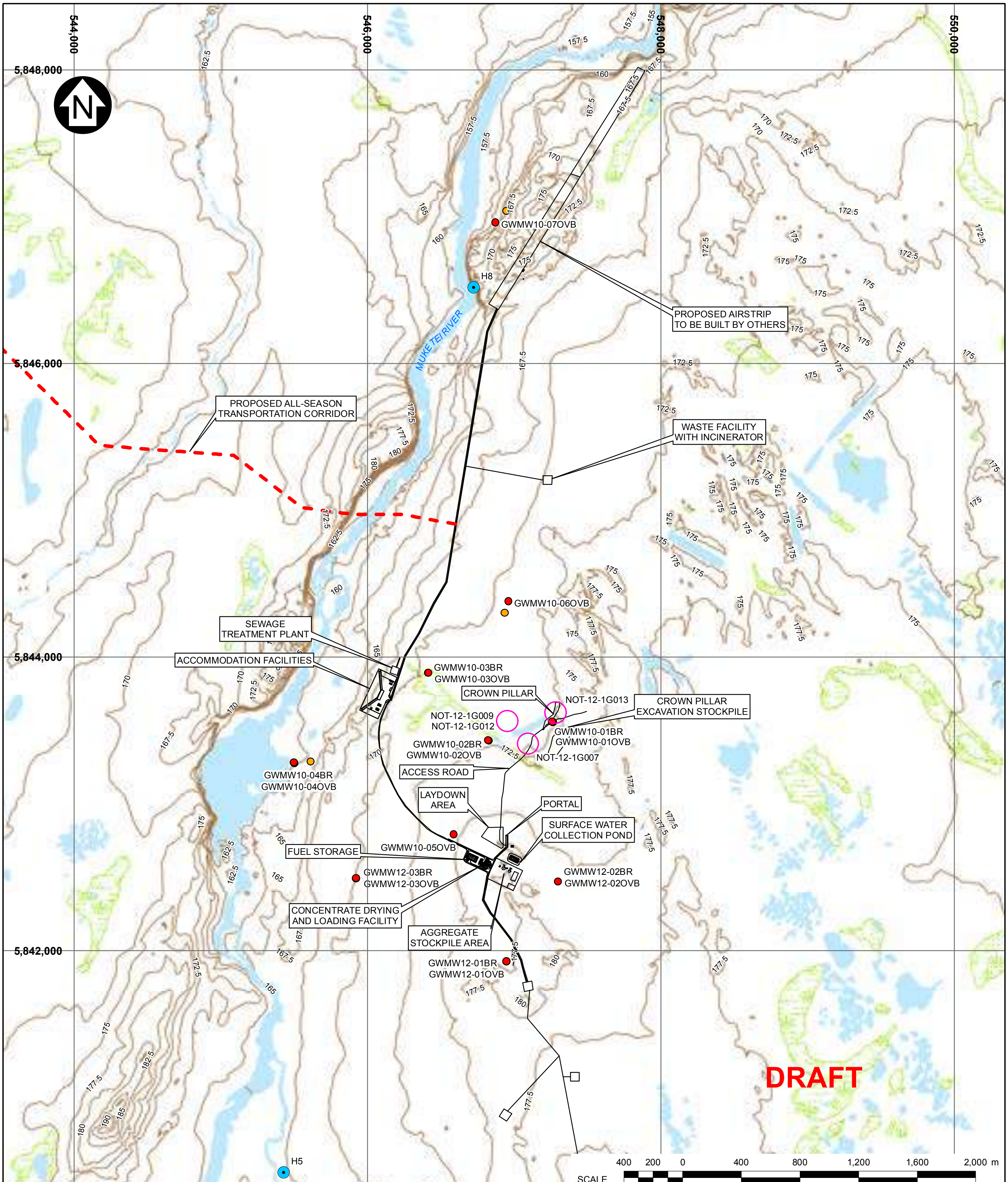
Monitoring wells were installed at the Savant Lake trans-load facility location in the fall of 2011. Eight monitoring wells were installed at six locations (KP, 2012b). At three locations, one well was installed in the near surface overburden material and one well was installed deeper in the overburden. At three locations, a single well was installed in the overburden. The locations of the monitoring wells installed at the Savant Lake site are shown on Figure 3.8-7. A summary of the well installation details and the well logs are provided in Appendix 4.

3.8.3.3 Vibrating Wire Piezometer Installation

Vibrating wire piezometers (VWP) were installed in three inclined drillholes at the mine site during the 2012 hydrogeology site investigations (KP, 2013c). The locations of VWP installations are shown on Figure 3.8-6 and a summary of the installation details are provided in Appendix 4.

3.8.3.4 Hydraulic Conductivity Testing

Hydraulic testing was completed in all monitoring wells and in several drillholes. Falling and/or rising head response tests (open-hole) up to 750 mbgs were conducted in an exploration drill hole. Packer tests were conducted in several drill holes up to 250 m below ground surface (mbgs).



LEGEND:

- GROUNDWATER MONITORING WELL LOCATION
- DRIVE POINT PIEZOMETER LOCATION
- VIBRATING WIRE PIEZOMETER INSTALLATION
- HYDROLOGY STATION LOCATION
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- PROPOSED INFRASTRUCTURE
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND

NOTES:

1. BASE MAP PROVIDED BY SNC-LAVALIN GROUP INC. (2010).
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 2.5 METRES.
4. INFRASTRUCTURE INFORMATION AND PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

MINE SITE GROUNDWATER MONITORING WELL LOCATIONS

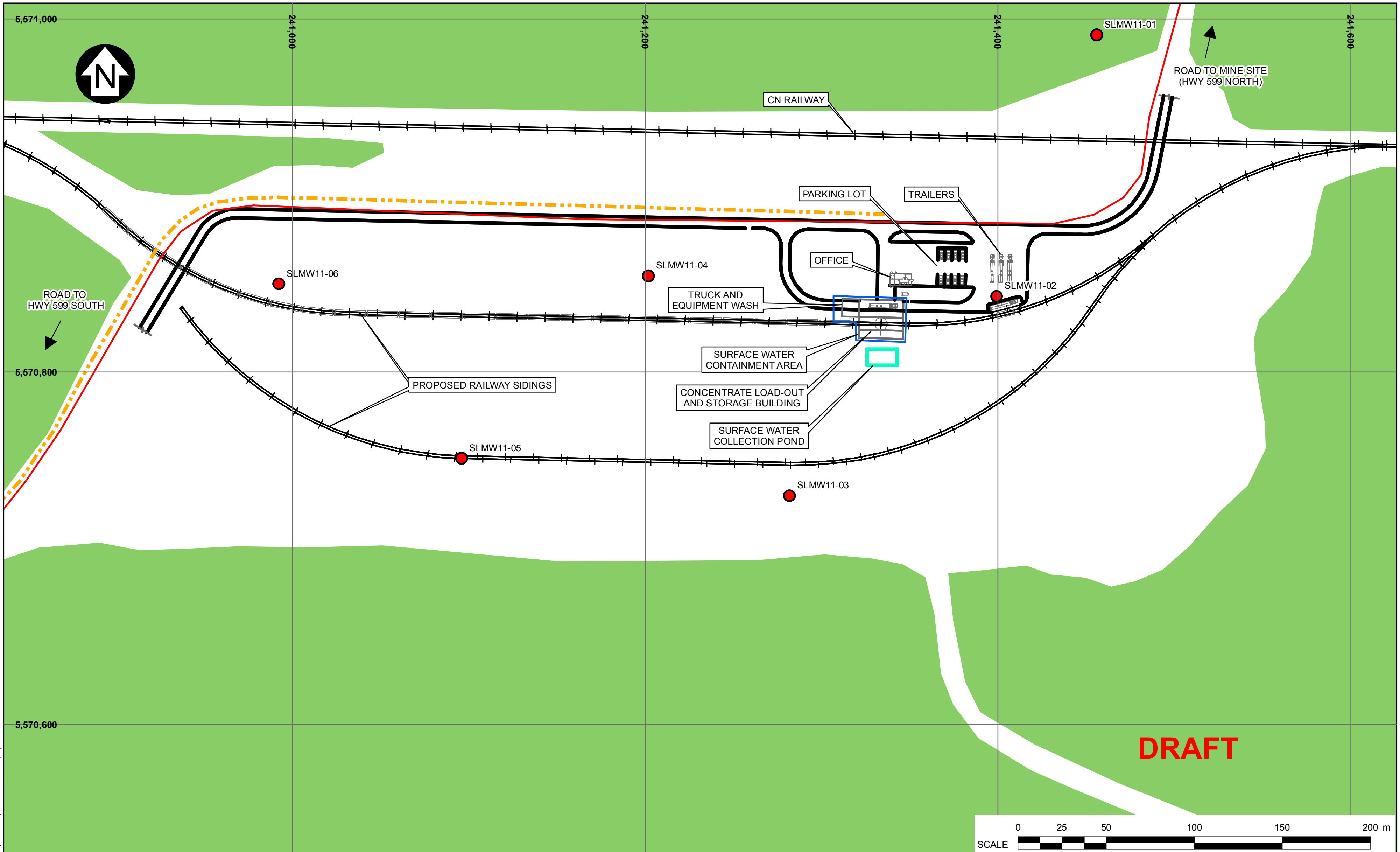
Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.8-6 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	DKK	SWK	SRA	RAM

SAVED: I:\1102\00390\01\A\GIS\Figs\A702_rA.mxd; Dec 20, 2013 1:22 PM; spenfold



LEGEND:

- GROUNDWATER MONITORING WELL LOCATION
- EXISTING ALL-SEASON ROAD
- RAILWAY
- PROPOSED HYDRO CORRIDOR
- PROPOSED INFRASTRUCTURE
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- SURFACE WATER COLLECTION POND
- FORESTED AREA

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. INFRASTRUCTURE IS BASED ON INFORMATION PROVIDED BY TETRA TECH (APRIL 19, 2012).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

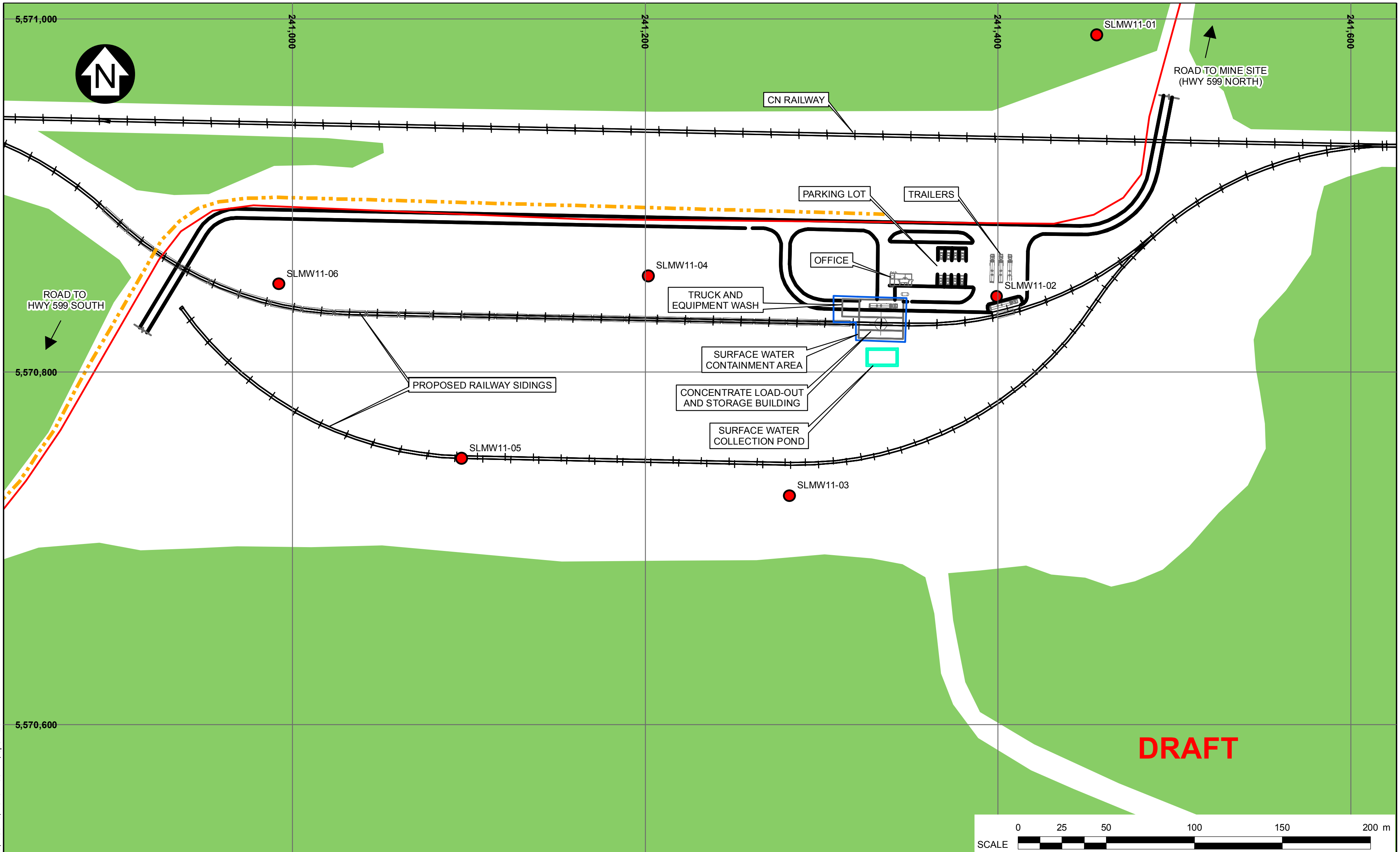
GROUNDWATER MONITORING LOCATIONS AT THE SAVANT LAKE TRANS-LOAD FACILITY

Knight Piésold CONSULTING

P/A NO.	REF NO.	
NB102-390/1	34	
FIGURE 3.8-7		REV A

A	20DEC'13	ISSUED WITH REPORT	ALR	SWK	SRA	RAM
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

SAVED: I:\1102\00390\01\A\GIS\Figs\A709_rA.mxd; Dec 20, 2013 1:38 PM; spenfold



LEGEND:

- GROUNDWATER MONITORING WELL LOCATION
- EXISTING ALL-SEASON ROAD
- RAILWAY
- PROPOSED HYDRO CORRIDOR
- PROPOSED INFRASTRUCTURE
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- SURFACE WATER COLLECTION POND
- FORESTED AREA

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. INFRASTRUCTURE IS BASED ON INFORMATION PROVIDED BY TETRA TECH (APRIL 19, 2012).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

GROUNDWATER MONITORING LOCATIONS AT THE SAVANT LAKE TRANS-LOAD FACILITY

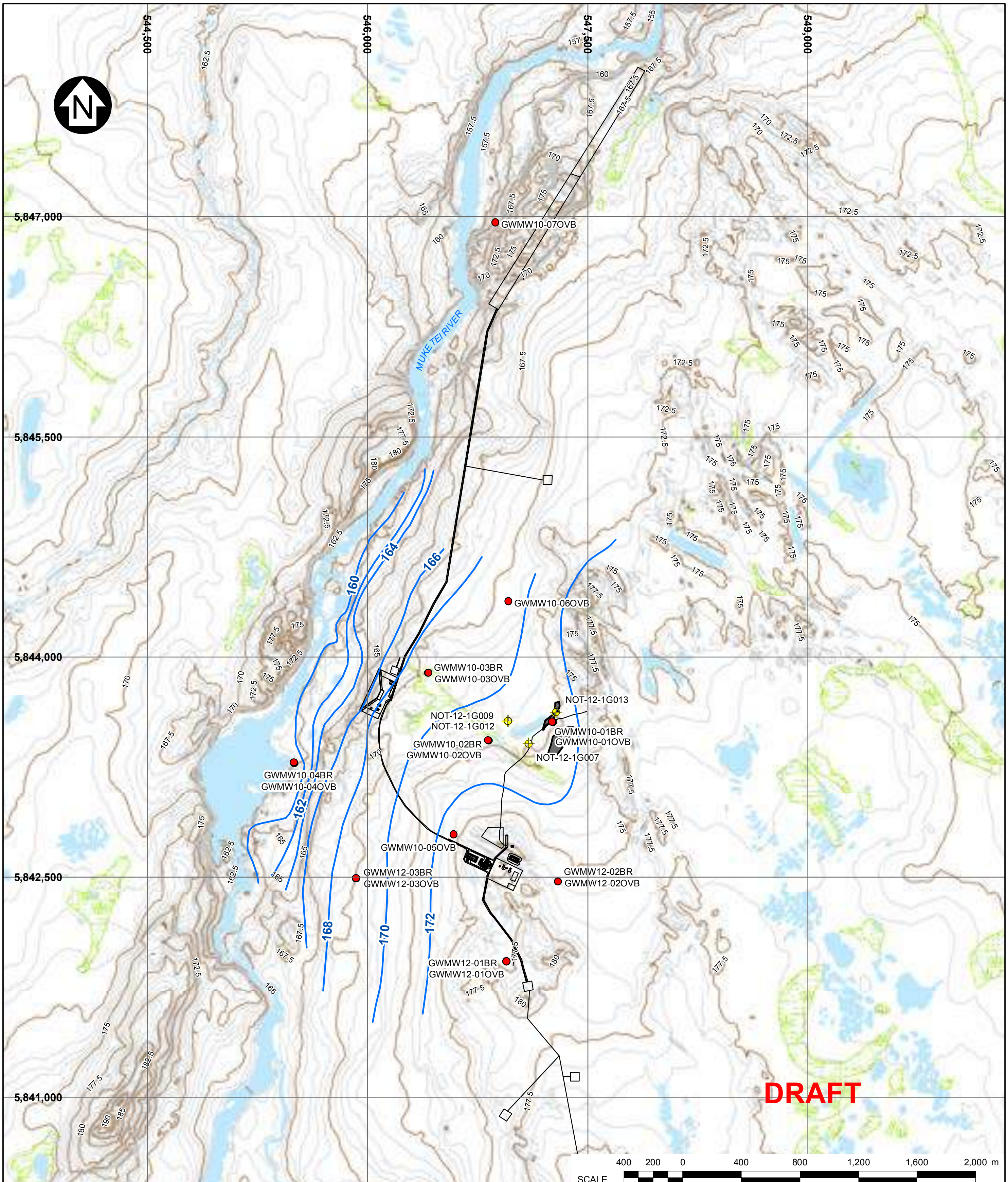
Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.8-7 REV A

A	20DEC'13	ISSUED WITH REPORT	ALR	SWK	SRA	RAM
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

SAVED: I:\1102\00390\01\A\GIS\Figs\A709_rA.mxd; Dec 20, 2013 1:38 PM; spenfold



LEGEND:

- GROUNDWATER MONITORING WELL LOCATION
- 2012 HYDROGEOLOGICAL TESTING
- PROPOSED INFRASTRUCTURE
- GROUNDWATER CONTOUR
- MINOR CONTOUR
- MAJOR CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND

NOTES:

1. BASE MAP PROVIDED BY SNC-LAVALIN GROUP INC. (2010).
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 0.5 METRES.
4. INFRASTRUCTURE INFORMATION PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

GROUNDWATER ELEVATION CONTOUR MAP

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.8-8 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	SCP	SWK	SRA	RAM

SAVED: I:\1102\00390\01\A\GIS\Figs\A706_rA.mxd; Dec 20, 2013 1:26 PM; spenfold

Hydraulic testing was completed in all of the monitoring wells using rising and falling head response tests using a slug. Hydraulic conductivity data were analyzed using the methods described in Hvorslev (1951), van der Kamp (1976) and Lugeon (1933).

3.8.3.5 Water Level Measurement

Groundwater levels in all of the monitoring wells were measured manually during seasonal water quality sampling events. At the mine site, groundwater levels were recorded hourly by the pressure transducers installed in each well. The pressure transducer dataloggers were downloaded and checked seasonally. Barometric pressure was recorded for correction of the pressure transducer data. Static groundwater levels were measured manually during each site visit using an electronic water level meter.

3.8.3.6 Drive Point Piezometers

Drive point piezometers were installed at the mine site to sample near surface groundwater at three different locations (Figure 3.8-6). The drive points were installed to a depth of approximately 1.5 mbgs. Sampling was not successful in the piezometers because very little water could be extracted and the recovery was extremely slow. In an attempt to retrieve a greater volume of water from the near surface groundwater, a PVC monitoring well pipe with a 0.25 m screened interval was capped at the bottom used as a piezometer. The pipe was installed to a depth of 1.5 m near GWM10-06 using a soil auger. Despite the saturated organic soil at this location, the well was very slow to recover in the piezometer and could not be adequately developed to clear suspended sediments. Therefore, no water samples were obtained. A falling head response test was conducted using a slug in order to estimate the hydraulic conductivity of the organic soil.

3.8.4 Mine Site Results

3.8.4.1 Groundwater Level

Overburden and Shallow Bedrock

Groundwater levels in the monitoring wells shown on Figure 3.8-6 were measured manually during seasonal sampling events and are shown in Appendix 4. The groundwater levels in the monitoring wells ranged from 0 mbgs to 4.9 mbgs. A time series of ground water level measurements from the transducers and dataloggers installed in each well is provided in Appendix 4. The data show groundwater levels are lowest in the early spring (before freshet), highest during the spring freshet, decrease through the summer, slightly increase with fall rains, and gradually decrease through the winter. Groundwater levels in the monitoring wells varied by between 0.5 and 1.5 m between the seasonal low and high. The seasonal pattern of groundwater level is similar to the seasonal change in stream flow observed at the Project hydrometric stations (KP, 2013c).

The largest range of seasonal groundwater levels was measured within the GWMW10-03OVB/BR and GWMW10-05 monitoring wells. These monitoring wells are located in areas that may act as local groundwater recharge areas. If this is the case, it would explain the more rapid and more extensive change in water level. The screened intervals of these two monitoring wells are below clay and clay/silt units, which are typically of low permeability. The responsiveness of the water level to inputs from precipitation at these monitoring wells suggests that the confining overlying clay and silt/clay units are leaky.

The smallest range of season groundwater levels was measured within the GWMW10-06 and GWMW10-07 monitoring wells. Monitoring well GWMW10-06 is installed in a wetland, which is at the base of an upland area. The well may be located in an area of local groundwater discharge, which typically see a smaller range of seasonal water level. Monitoring well GWMW10-07 is located approximately 5 m above the Muketei River and 10 m below the top of an esker deposit (Barnett et al., 2013). The screened interval of the well is installed in a sand and gravel unit that is likely recharged from the adjacent upslope esker deposit. The recharge from the esker would explain the steady water levels observed, especially through the drier winter and late summer periods.

The water levels in the nested overburden and shallow bedrock wells had similar patterns of seasonal variability in groundwater level, which is indicative of analogous flow conditions in the overburden and shallow bedrock units.

Downward vertical gradients were observed in the nested monitoring wells GWMW10-02OVB/BR and GWMW10-03OVB/BR. These monitoring wells are all located adjacent to wetland features and reflect the conditions of groundwater recharge in the area.

An upward gradient was observed in the nested monitoring wells GWMW10-01OVB/BR. These wells are located in a low lying area, adjacent to a pond and wetland, and downslope of an upland area. Similar to GWMW10-06, these wells are likely located in an area of groundwater discharge.

A variable vertical gradient was observed at the nested monitoring wells GWMW10-04OVB/BR, which suggests the site alternates between a groundwater discharge and recharge zone. These wells are located adjacent to the Muketei River, approximately 2 m above the right bank. The variability in the vertical gradient is likely controlled by the fluctuation in discharge in the river. The area around the well is predominantly in a zone of groundwater discharge, although it may be within a recharge zone during the spring freshet or during heavy rainfall events.

<u>Deep Bedrock</u>

The vibrating wire pressure transducers installed at the mine site consist of three installed within drillholes NOT-12-1G007 and NOT-12-1G013, and four within NOT-12-1G012. The groundwater elevation data for the VWPs are shown in Appendix 4.

The deep bedrock groundwater level time series measurements are summarized as follows:

- **NOT-12-1G007** - An upward vertical gradient between the middle and shallow pressure transducers. This is indicative of deeper groundwater discharge in the area of the installation.
- **NOT-12-1G012** - A downward vertical gradient exists between the shallow and one of the two middle pressure transducers.
- **NOT-12-1G013** - Groundwater elevations are close to the ground surface, with a downward gradient, reflective of groundwater recharge into deeper bedrock in this area. The fluctuations present in the data indicate that the bedrock in this area is quick to respond to changes in groundwater level.

The drillholes used for the VWP installations were inclined and any observed gradients may include components of both horizontal and vertical gradients.

3.8.4.2 Hydraulic Conductivity

Overburden and Shallow Bedrock

The estimated hydraulic conductivity ranged from 10^{-7} to 10^{-3} m/s in the overburden monitoring wells and from 10^{-8} to 10^{-5} m/s in the bedrock monitoring wells. Throughout all monitoring wells there was a general trend towards decreasing conductivity with depth. A summary of the monitoring well hydraulic conductivity test results are shown in Appendix 4.

The monitoring wells GWMW10-01OVB, GWMW10-03OVB and GWMW10-07 were installed with the screened interval within relatively coarse material (gravels and/or cobbles). The hydraulic conductivity values estimated from the response testing in these wells may have been influenced by the filter pack and slot screen size selected during installation. As a result, the hydraulic conductivity for these wells may be higher than estimated from the response testing.

The hydraulic conductivity of the organic soil was tested in a 2 m deep well installed near GWMW10-06. The screened interval was installed in the organic soil and the hydraulic conductivity was estimated to be 10^{-6} m/s. This suggests that the surface organic material has a relatively low permeability.

Deep Bedrock

Packer testing was conducted to estimate the hydraulic conductivity of the deep bedrock. The packer test results completed by Golder (in 2010) and by KP (in 2012) are summarized in Appendix 4. Faults were encountered in some of the drillholes during drilling and packer testing. An increase in permeability was observed in the NOT-12-G009 drillhole near the fault interval. This is evident in the plot of hydraulic conductivity with depth that is included within Appendix D2.

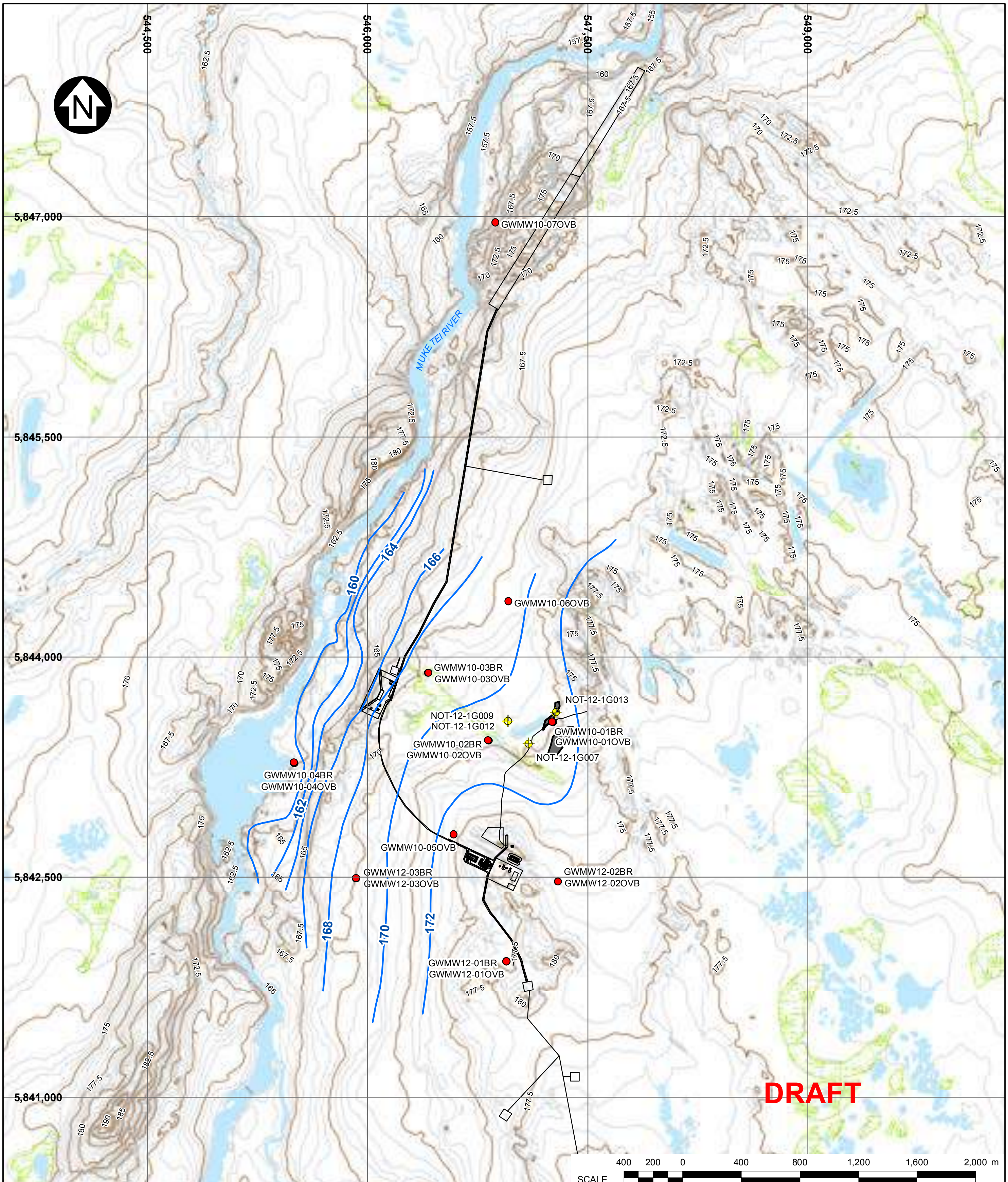
Periodic drill circulation losses were observed during the exploration program by the drilling contractor, which likely resulted from the intersection of faults during drilling. For example, drill circulation loss was recorded 293 m down the hole in the NOT-11-101. This hole passes through a fault zone in the deposit area. The evaluation of the frequency and properties of the faulting at the mine site is ongoing.

3.8.4.3 Groundwater Flow

Hydraulic Gradients

The groundwater elevations observed suggest that groundwater at the mine site flows west towards the Muketei River. A groundwater elevation map was generated from groundwater level measurements in the overburden wells obtained during the October 2012 site visit (Figure 3.8-8). Local groundwater divides were not apparent due to the predominantly flat terrain.

Based on the groundwater level time series data presented in Appendix C2, the flow direction is not expected to vary with season. The horizontal groundwater gradients within the overburden and bedrock are estimated to be 0.01.



LEGEND:

- GROUNDWATER MONITORING WELL LOCATION
- 2012 HYDROGEOLOGICAL TESTING
- PROPOSED INFRASTRUCTURE
- GROUNDWATER CONTOUR
- MINOR CONTOUR
- MAJOR CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND

NOTES:

1. BASE MAP PROVIDED BY SNC-LAVALIN GROUP INC. (2010).
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 0.5 METRES.
4. INFRASTRUCTURE INFORMATION PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

GROUNDWATER ELEVATION CONTOUR MAP

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.8-8 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	SCP	SWK	SRA	RAM

SAVED: I:\1102\00390\01\A\GIS\Figs\A706_rA.mxd; Dec 20, 2013 1:26 PM; spenfold

Vertical hydraulic gradients have been estimated at the four sites that have nested monitoring wells. The manual groundwater level measurements suggest that there is a downward vertical gradient (recharge) at the GWMW10-02 and GWMW10-03 locations and a generally upward vertical gradient (discharge) at the GWMW10-01 and GWMW10-04 locations. Horizontal gradients at the mine site are low.

Groundwater Flow Velocity

Groundwater flow was estimated based on the horizontal gradient of 0.01, the hydraulic conductivities presented in Section 4.2, and effective porosities presented in Freeze and Cherry, 1979 (Table 3.8-1).

Table 3.8-1 Groundwater Flow Velocities

Hydrogeologic Unit	Horizontal Gradient	Hydraulic Conductivity	Effective Porosity	Groundwater Flow Velocity
Clay/Silt	0.01	10^{-8} m/s	0.15	0.06 m/day
Coarser Cobbles/Gravel	0.01	10^{-4} m/s	0.3	2 m/day
Shallow Bedrock	0.01	10^{-7} m/s	0.002	0.04 m/day

The flow velocity in deeper bedrock is expected to be lower due to the decreasing hydraulic conductivities with depth as shown in Appendix 4.

3.1.1 Savant Lake Trans-Load Facility Results

The groundwater levels in the monitoring wells ranged from 3.5 to 7.4 mbgs during the fall 2011 site visit, from 3.8 to 7.7 mbgs during the summer 2012 site visit, and 3.1 to 7.0 mbgs during the fall 2012 site visit. The hydraulic conductivity estimated in the monitoring wells ranged from 10^{-4} to 10^{-7} m/s, which is typical for silty sand (Appendix 4).

3.8.5 Summary

3.8.5.1 Mine Site

Groundwater at the mine site is present in several formations. The groundwater is present in the saturated organic material and in unstratified and stratified glacial till (composed of sand, silt and clay). There is also groundwater present in the near surface and deep bedrock. Hydraulic conductivities were on the order of 10^{-4} m/s in the coarser overburden soils and as low as 10^{-7} m/s in the finer soils and bedrock. The hydraulic conductivity of bedrock generally decreases with depth. The presence of faults and fractures influences the hydraulic conductivity in the bedrock.

The groundwater level in the mine site monitoring wells ranged from 0 to 4.9 mbgs, with seasonal fluctuations between 0.5 and 1.5 m. The data show that groundwater generally flows west towards the Muketei River with a gradient of approximately 0.01. Groundwater velocity ranges from a high of approximately 2 m/d in the coarser overburden to a low of approximately 0.04 m/d in the bedrock.

3.8.5.2 Savant Lake Trans-Load Facility

Groundwater in the overburden was investigated at the Savant Lake site. The groundwater level ranged between 3.5 and 7.7 mbgs. Hydraulic conductivities were on the order of 10^{-4} m/s in the coarser overburden soils and up to 10^{-7} m/s in the finer soils.

3.9 TERRAIN AND SOILS

The section has been prepared to fulfill the terrain and soil information requirements outlined in the Project's Terms of Reference (ToR) that has been approved by the Ontario Minister of the Environment (MOE). This report also addresses the terrain and soil assessment requirements outlined in the EIS Guidelines prepared for the Project by the CEAA.

3.9.1 Study Areas

The spatial boundaries for the assessment of terrain and soil were defined as areas within which the potential impacts may occur from the development, operation or closure of the Project.

The terrain and soil will be affected during the construction phase at the mine site, along the transportation corridor, and at the trans-load facility. As such, terrain and soil will be described in the Project development areas (PDAs):

2. **Mine Site PDA** - Encompasses the footprint of the mine site infrastructure (portal, laydown and stockpile areas, surface processing facilities, diesel generators, fuel storage area, accommodation facility, site roads, waste management facility etc.). The total land area occupied by the mine site PDA is approximately 33 ha.
3. **Transportation Corridor PDA** - Encompasses the footprint of the road corridor right-of-way (30 m width), borrow sources, quarries and associated spur roads. The total land area occupied by the transportation corridor PDA is approximately 7,300 ha.
4. **Trans-load Facility PDA** - Includes the footprint of the trans-load facility infrastructure. The total land area occupied by the trans-load facility PDA is approximately 1.0 ha.

3.9.2 Background

3.9.2.1 Regional Geomorphology

The mine site and the all-season road that will be constructed for the Project are located in Ontario's Far North Region and the trans-load facility is located approximately 80 km south of the Far North Boundary. The two major physiographic regions within the Far North Region are the Hudson Bay Lowlands and the Canadian Shield.

The landscape of the Hudson Bay lowlands emerged after the recession of the postglacial Tyrell Sea over the past 6,000 years (Prest, 1970). The resulting lowlands are a vast swampy area underlain by marine sediments lying on top of flat-lying Paleozoic and Mesozoic sedimentary rocks. The poor drainage within the lowland and the cold climate, which results in a slow rate of plant decay, have led to the development of peat throughout much of the region (Singer and Cheng, 2002). Most of the lowland is mineral wetland or organic peatland with a sparse tree cover.

The Canadian Shield is gently rolling or undulating and has a general uniformity in the landscape. The Shield of the Far North Region is dominated boreal forest interspersed with lakes, swamps and ponds. The regional topographic relief is generally low (less than 20 metres).

Glacial processes are responsible for shaping the landscape of the Far North Region, the most recent occurring during the Wisconsin glacial stage (85,000 to 11,000 years ago). During the Glaciation, four large ice masses existed. Of these ice masses, the Laurentide Ice Sheet covered most of Canada and was centred over northern Ontario. Several sectors are used describe ice sheet morphology and glacial retreat, which strongly correlate to regional landforms in Ontario. The Labradorean sector covered Ontario completely when the glaciers began to retreat northward approximately 20,000 years ago. The Hudson ice was located to the north of the Labradorean, separated by the Hudson ice divide (part of the "Trans-Laurentide ice divide"). The Keewatin sector and Labrador-New Quebec ice were located to the west and east of the Labradorean sector, respectively (Fullerton and Bush, 2004).

Around 13,000 years before present, the Laurentide ice sheet had dammed and prevented melt water from draining to the sea. As a result, glacial Lake Agassiz, the largest glacial lake in North America, began to form at the southwest terminus of the ice sheet, straddling the Manitoba-Ontario border. At its maximum extent, Lake Agassiz covered an 950,000 km2 area over North Dakota, Minnesota, Saskatchewan, Manitoba, and Ontario, including the mine site, the transportation corridor and the trans-load facility (REF).

By 8,000 years before present, the Laurentide Ice Sheet had largely melted and Lake Agassiz receded. Two smaller ice sheets remained and were separated by the Tyrrell Sea. The western limit of the Tyrell sea is located at approximately 86o 05' W longitude, which is approximately 14 km east of the mine site (Prest, 1963).

3.9.2.2 Regional Landforms

The surficial material in the Far North Region is generally composed of stratified and unstratified tills, gaciofluvial deposits, and lacustrine and marine sediments. Till is defined as well-graded glacial material ranging from boulders to clay (typically rock fragments/clasts within a finer-grained matrix) formed by several different glacial processes (REF). Due to the sequencing of glaciation, tills in Canada have distinct features and have been grouped and described as till provinces. The sequencing of retreat and period re-advances of glaciers during the Wisconsinan Glaciation caused tills with similar characteristics to be deposited in what are referred to as till "provinces". Till provinces for the Project include the Hudson Bay till province, which includes the area of northern Ontario previously occupied by the Tyrrell Sea, and the Canadian Shield till province which includes the Project PDAs (Trenhaile, 2010). These till provinces are characterized by the following features:

- **Hudson Bay Till** - The Hudson Bay province is typically comprised of a thin layer of lodgement till with a fine-grained matrix that tends to be equal parts sand, silt and clay. Lodgement till is a till that is deposited when the force of a moving glacier on a material is overcome by the frictional resistance of the material.
- **Canadian Shield Till** - The Canadian Shield province to the southeast of the Project is comprised of mainly coarse-grained sublimation till that ranges in thickness from 2 to 8 m. Sublimation till is a till that is formed when glacial material is deposited as ice and transitions directly to vapour.

The movement of the ice sheets produced several types of landforms composed of till, which are typically grouped into the following categories:

- **Moraines** – Ridges or mounds of glacial material deposited by glacial ice. Moraines generally form at the margins of glaciers (e.g., sides and terminus).
- **Drumlins** – Mounds/hills, half-ellipsoid in shape consisting mainly of till with minor stratified glaciofluvial material. The orientation of the drumlin is based on the direction of ice movement.

Most of the volume of the Laurentide ice sheet was released as meltwater over a period of around 10,000 years. Meltwater rivers, ice-dammed lakes, and glacially induced marine invasions have played a large part in shaping the regional landscape (Eyles, 2006 - in trenhaile). Glaciofluvial sediments are typically composed of rounded sands and gravels and much better sorted than glacially deposited till. They are typically devoid of fine materials as the flow velocities are high enough to transport finer silts and clays in suspension. Glaciofluvial ice-contact features are those that show the effects of ice melting and are typically collapsed, twisted or contorted (Trenhaile, 2010). The two main glaciofluvial ice contact features in the region are:

- Kames – Represents a wide range of ice-contact landforms, typically mounds or ridges of stratified ice-contact sediment. Consist of sand and gravel deposited by water in, on, or against stagnant or almost stagnant ice.
- Eskers – Ridges of glaciofluvial sand, gravel and cobbles deposited by melt water. Like kames, eskers are another example of an ice-contact feature. Northern Ontario is host to numerous eskers.

Non ice-contact glaciofluvial features (e.g., outwash fans) are formed by pro-glacial streams flowing away from the ice terminus. The coarsest outwash material is typically deposited closest to the ice where flow velocities were the greatest, with finer materials being deposited further away. Outwash fans are a common depositional feature that trace back to a supraglacial, englacial or subglacial stream. Most outwash consists of a number of fans that are linked to terminal moraines, ground moraines and kame features.

Over much of the Shield region of Ontario, the ice retreat was downslope towards Hudson's Bay and as such, the ice margins were typically flooded by glacial lakes. Therefore, most of the glaciofluvial features in the region are typically ice-contact as opposed to pro-glacial in origin (Trenhaile, 2010). Over a large part of the region, glaciolacustrine material was deposited in areas flooded by glacial lakes and marine sediments were deposited in areas flooded by inland seas.

The distribution of surficial material in northern Ontario defines the post-glacial landscape at a regional scale (Figure 3.9-1).

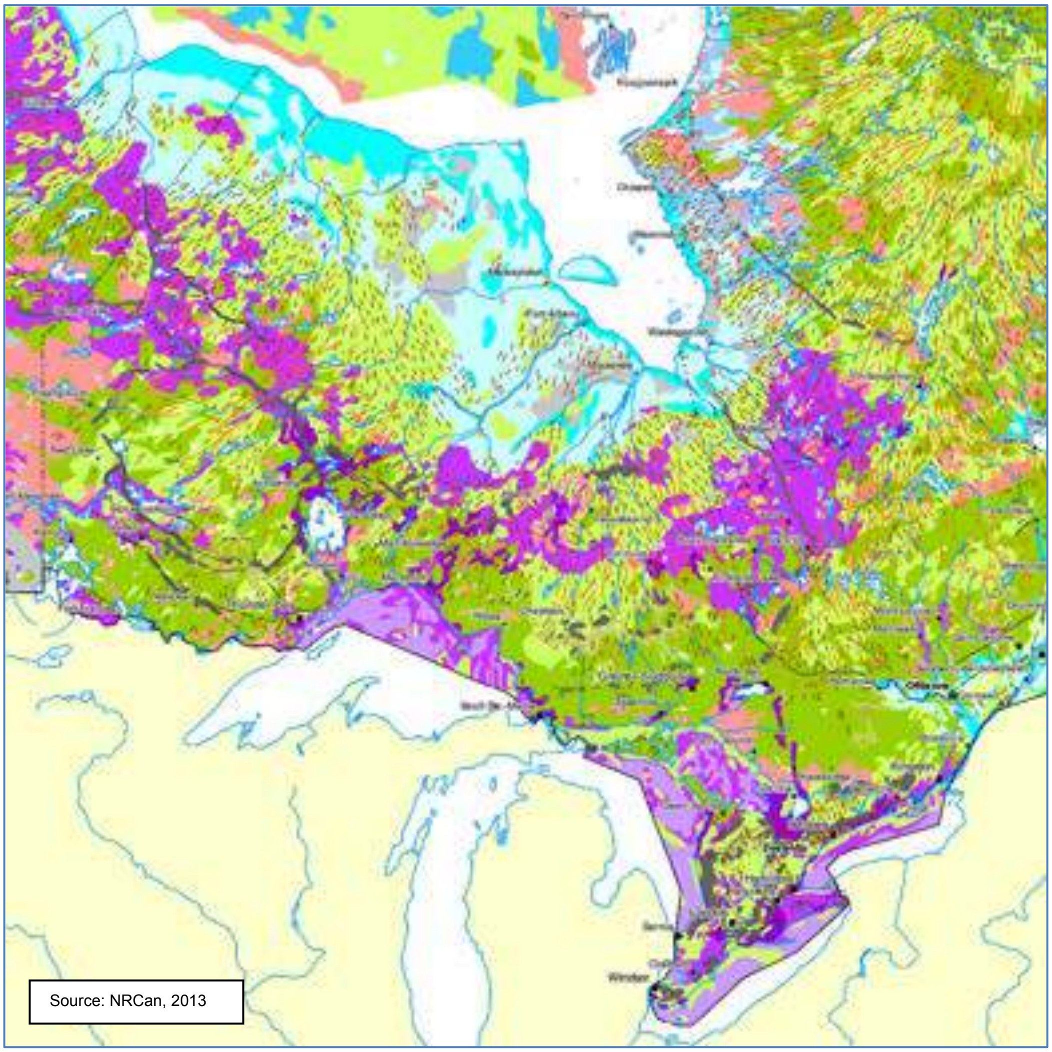
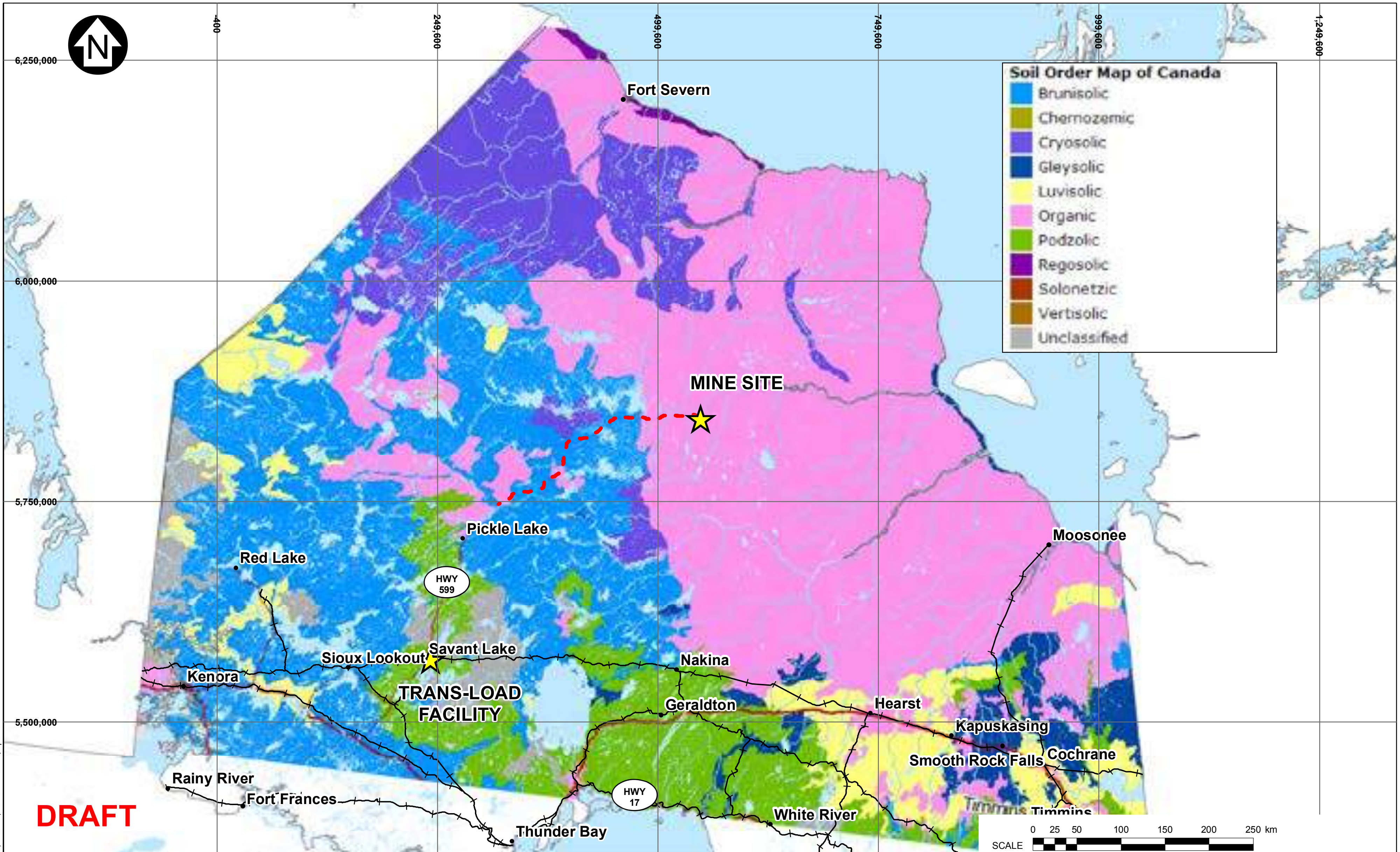


Figure 3.9-1 Distribution of Surficial Materials in Canada

3.9.2.3 Regional Soil Cover

Regional soil cover of the Canadian Shield typically includes bare outcrops of rock and, thin soils, and organic soils. The soils of the region are generally acidic and unproductive; they can maintain the boreal forests typical of the Shield, but are not suitable for cultivation (Singer and Cheng, 2002). The soil orders at the trans-load facility, along the transportation corridor, and at the mine site are shown in Figure 3.9-2 and the soil great groups in Figure 3.9-3. The soil order at the mine site is Organic and the soil orders along the transportation corridor are Organic and Brunisolic. The soil order at the trans-load facility is Podzolic.



LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- COMMUNITY
- RAILWAY
- EXISTING ALL-SEASON ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013).
4. © AGRICULTURE AND AGRI-FOOD CANADA (2010). SOIL LANDSCAPES OF CANADA. WWW.AGR.GC.CA

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	ALR	SWK	SRA	RAM

SAVED: I:\1\02\00390\01\A\GIS\Figs\A720_rA.mxd; Dec 21, 2013 12:13 AM; spenfold

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

SOIL ORDERS OF NORTHWESTERN ONTARIO

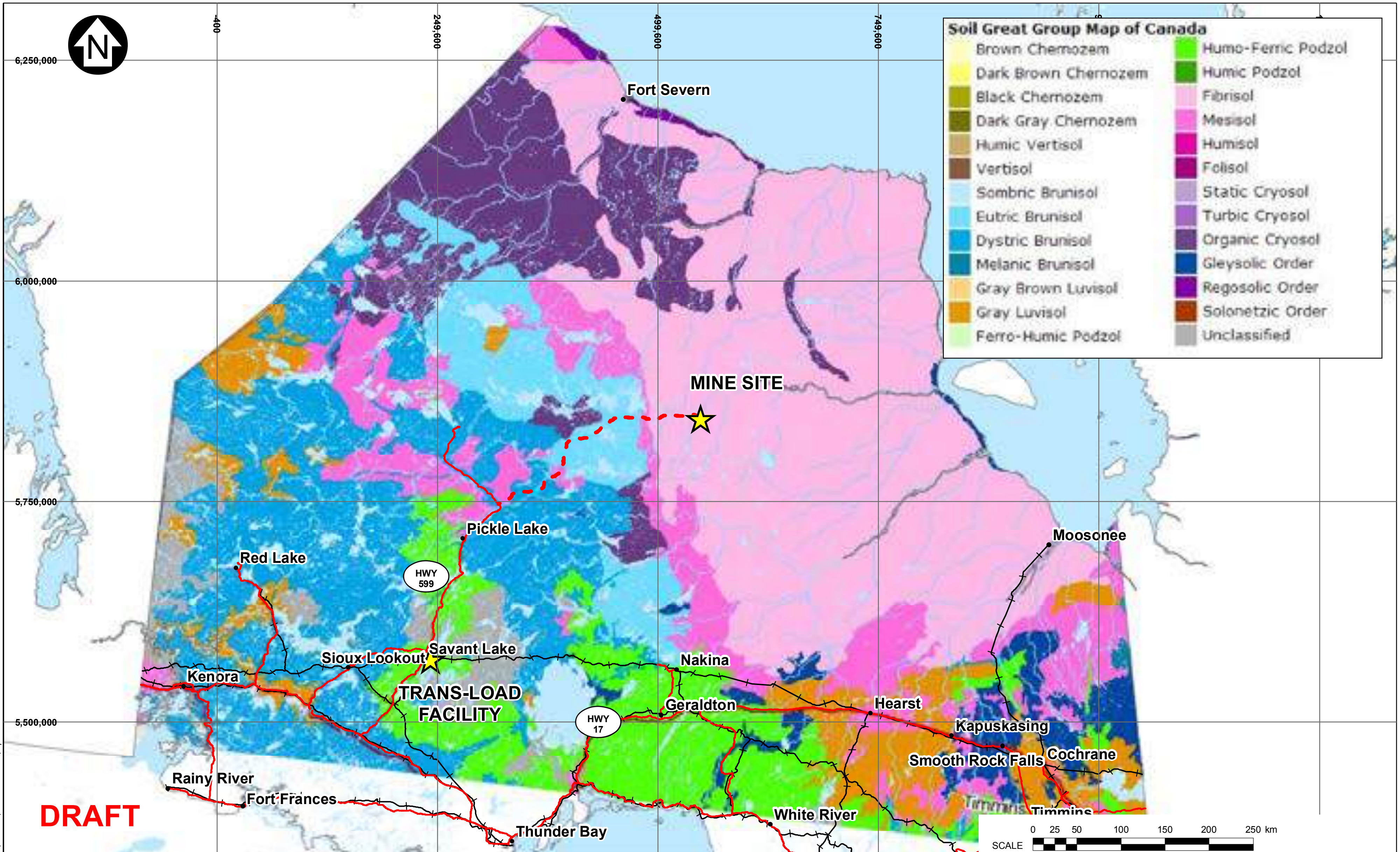
Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF NO. 34

FIGURE 3.9-2

REV A



LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- COMMUNITY
- RAILWAY
- EXISTING ALL-SEASON ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES.
   COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013).
4. © AGRICULTURE AND AGRI-FOOD CANADA (2010). SOIL LANDSCAPES OF CANADA. WWW.AGR.GC.CA

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	ALR	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

SOIL GREAT GROUPS OF NORTHWESTERN ONTARIO

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 3.9-3 | REV A

SAVED: I:\1\02\00390\01\A\GIS\Figs\A721_rA.mxd; Dec 21, 2013 12:18 AM; spenfold

3.9.3 Methods

3.9.3.1 Surficial Geology

Surficial geology at the mine site was assessed as part of the exploration and geotechnical drill programs.

3.9.3.2 Soil Surveys

This section provides specific methods as related to evaluation of terrain and soils. The terrain mapping used data collected from terrestrial ecology and geochemistry field programs in the LSA and regional terrain mapping as identified in Sections 4.3.2 and 4.3.3. The approach to classifying and describing terrain and soils units involved a review of existing information, soil sampling and analysis, and development of terrain and soils maps in a Geographical Information System (GIS) platform.

For soil mapping, the Ecological Land Classification (ELC) vegetation units are used as part of the mapping process to derive correlations between soil types and the ELC vegetation types. Due to the resolution of the ELC data, the soil map units are presented as complexes to capture the range of soil types on the landscape and minor components of a soil series (i.e., less than 20% representation within a map unit) are not mapped.

The soil map unit delineations are inferred from the interpretation of landscape features (i.e., elevation contours and landform) and ELC units, without field groundtruthing. Thus, the soil map should be viewed as a general predictive model of soil distribution. The information provided is suitable for inclusion in an environmental assessment; however it should not be used to predict discretised site-specific characteristics for purposes such as engineering design without collecting additional field information. The wind erosion risk ratings are adapted from the publication Wind Erosion Risk (Coote and Pettapiece 1989), while the water erosion risk ratings are adapted from the publication Water Erosion Risk (Tejak and Coote 1993).

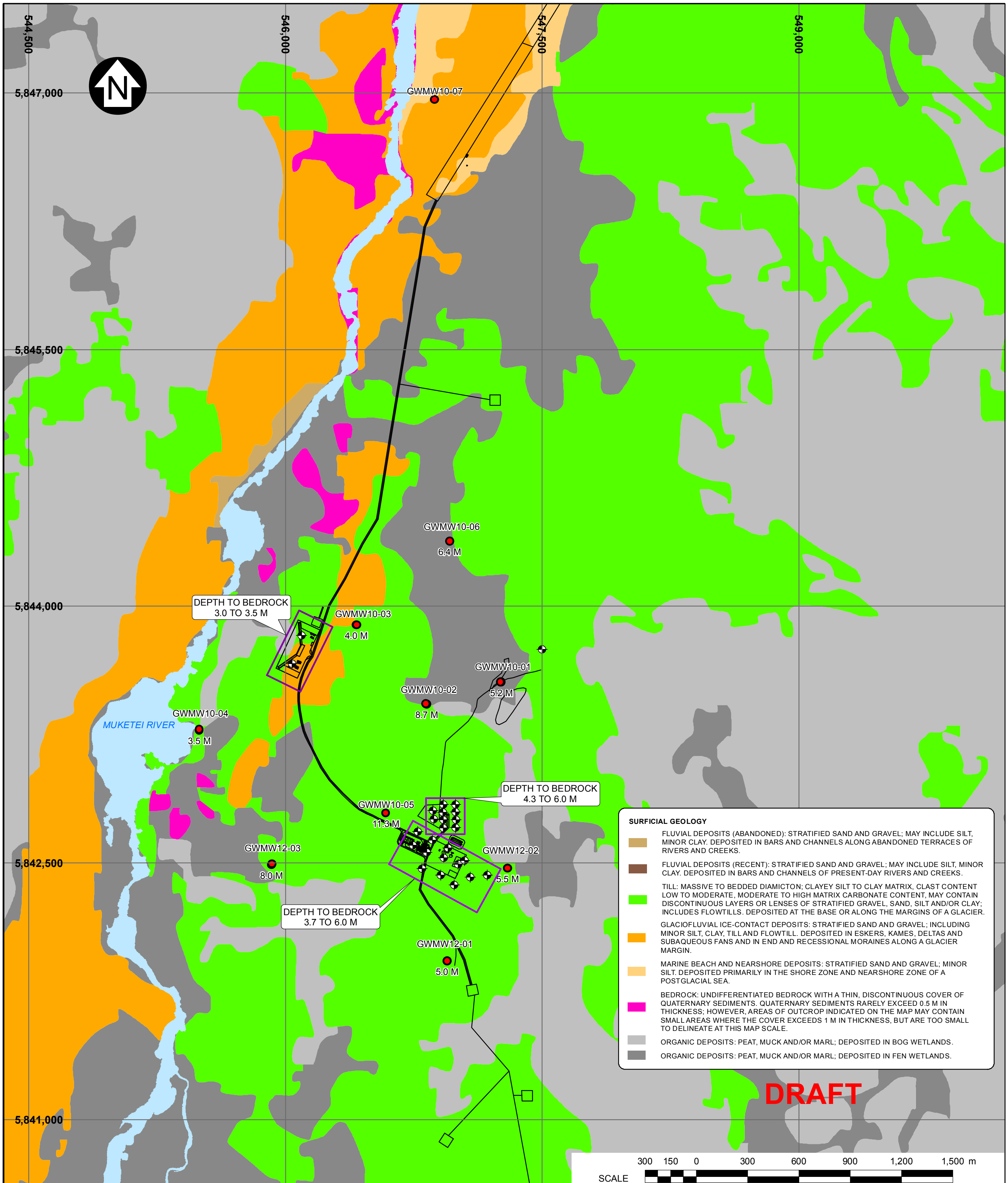
3.9.4 Results

3.9.4.1 Surficial Geology

Mine Site

The surficial sediments around the mine site are composed primarily of stratified and unstratified tills and organic deposits (Figure 3.9-4). The majority of the mine site PDA is underlain by massive to bedded diamicton till. The composition of the till is clayey silt to clay matrix with a low to moderate clast content (OGS, 2013). The proposed accommodation facility and site roads are underlain in places by glaciofluvial ice-contact deposits of stratified sand and gravel and by organic deposits. An embankment type esker runs roughly north-south through the mine site study area and there is evidence to suggest that several of the other upland areas may be part of a complex esker system. Eskers normally consist of sands and gravel. Near the mine site they are typically composed of a greater proportion of sand and silt.

The surficial sediments in the mine site PDA from the OGS, 2013 data are summarized in Table 3.9-1.



LEGEND:

- MINE SITE
- GROUNDWATER MONITORING WELL LOCATION
- DRILLHOLE LOCATION
- PROPOSED INFRASTRUCTURE
- RIVER/STREAM/DRAINAGE
- WATER

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. INFRASTRUCTURE INFORMATION PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.
4. ONTARIO GEOLOGICAL SURVEY, BARNETT, P.J., YEUNG, K.H. AND MCCALLUM, J.D. 2013. SURFICIAL GEOLOGY OF THE LANSDOWNE HOUSE AREA NORTHEAST, NORTHERN ONTARIO; ONTARIO GEOLOGICAL SURVEY, PRELIMINARY MAP P.3697, SCALE 1:100 000.
5. BEDROCK NOT ACHEIVED AT GWMW12-03 AND GWMW10-07.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	SCP	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

MINE SITE
SURFICIAL GEOLOGY

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.9-4 REV A

SAVED: I:\1102\00390\01\A\GIS\Figs\A672_rA.mxd; Dec 20, 2013 7:36 PM; spenfold

Table 3.9-1 Surficial Sediments in the mine site PDA

Surficial Unit (OGS, 2013)	Area (ha)	Percent of PDA
Till: Massive to Bedded Diamicton	21.92	66.25
Glaciofluvial ice-contact	4.27	12.90
Organic deposits: Bog Wetlands	2.28	6.88
Organic deposits: Fen Wetlands	4.62	13.97

During hydrogeological site investigations, the surficial sediments were characterized at several locations (Figure 3.9-4). A summary of the surficial material sampled during the installation of the monitoring wells is shown in Table 3.9-2.

During geotechnical site investigations, surficial materials were characterized near the proposed portal and decline (KP, 2013a) and around the proposed surface infrastructure locations (KP, 2013b). In general, surficial sediments were interpreted as silt and clay with some sand and trace gravel. The grain size distribution shows that most samples have a grain size of over 70 percent finer than sand. The overburden thickness ranges from 3.0 to 11.5 m.

Table 3.9-2 Summary of Surficial Sediments from Site Investigation

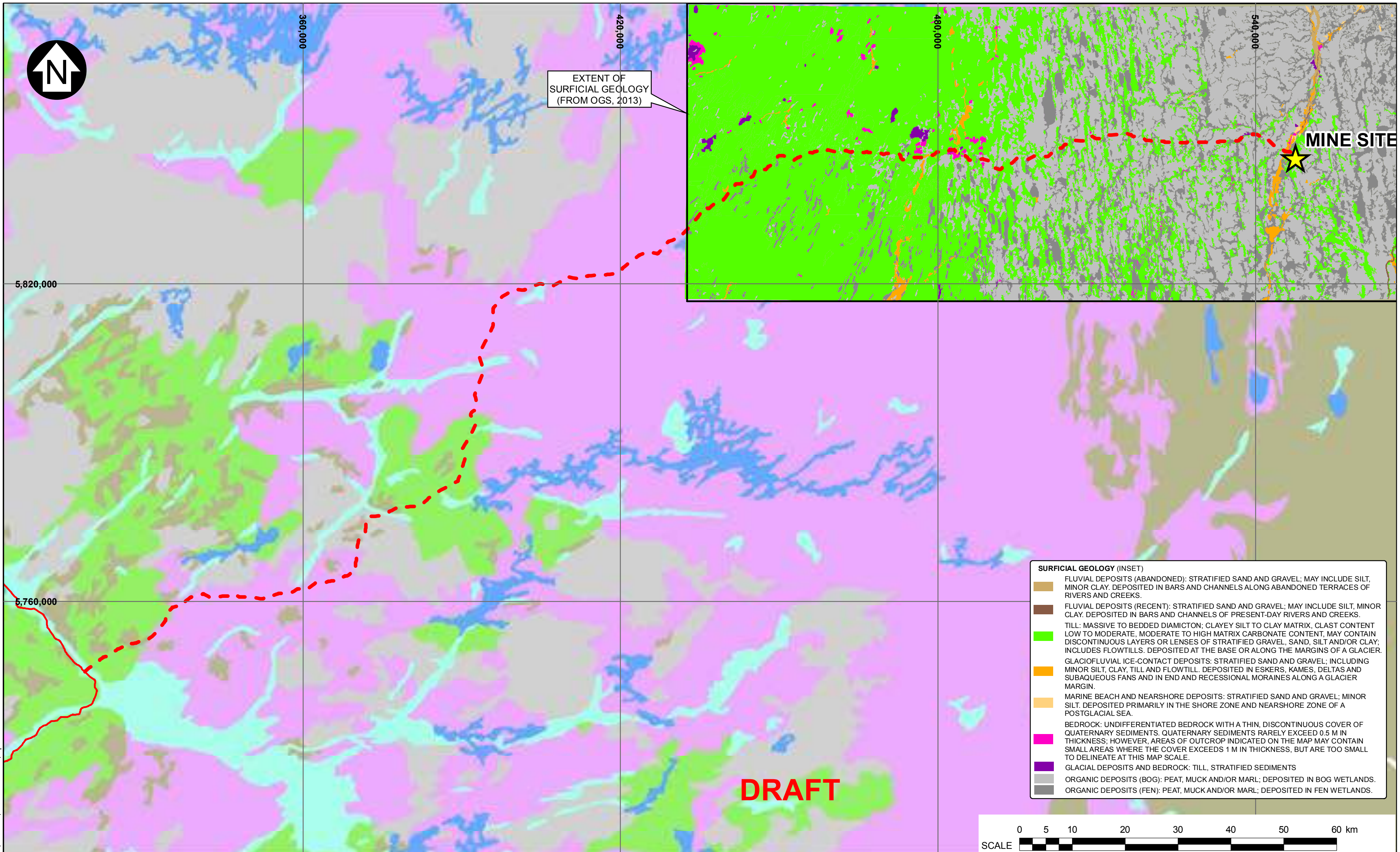
Drillhole	Surficial Unit (OGS, 2013)	Description	Depth to Bedrock
GMWM10-01	Organic deposits: Fen Wetlands	Clay and trace silt	5.2
GMWM10-02	Organic deposits: Fen Wetlands	Clay and silt	8.65
GMWM10-03	Till: Massive to Bedded Diamicton	Clay and gravel	3.95
GMWM10-04	Till: Massive to Bedded Diamicton	Sand and gravel	3.45
GMWM10-05	Till: Massive to Bedded Diamicton	Silt and clay	11.25
GMWM10-06	Organic deposits: Fen Wetlands	Organics and clay	6.8
GMWM10-07	Glaciofluvial ice-contact	Gravel and sand	-
GWMW12-01	Till: Massive to Bedded Diamicton	Silt and clay	5.03
GWMW12-02	Till: Massive to Bedded Diamicton	Silt and clay	3.92
GWMW12-03	Till: Massive to Bedded Diamicton	Silt, sand and boulder	8

NOTES:

1. BEDROCK NOT ENCOUNTERED AT GMWM10-07. DRILLHOLE EXTENDED TO A DEPTH OF 9.4 m

Transportation Corridor

The surficial geology along the proposed all-season road alignment consists of glacial till, glaciofluvial ice-contact deposits, glaciolacustrine deposits, exposed bedrock, and organic deposits (Figure 3.9-5).



LEGEND:

- ☆ MINE SITE
- EXISTING ALL-SEASON ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR

SURFICIAL GEOLOGY

- BEDROCK
- GLACIOFLUVIAL ICE-CONTACT DEPOSITS
- GLACIOFLUVIAL OUTWASH DEPOSITS
- GLACIOLACUSTRINE DEPOSITS
- GLACIOMARINE AND MARINE DEPOSITS
- LAKE
- ORGANIC DEPOSITS
- TILL

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013).
4. ONTARIO GEOLOGICAL SURVEY, BARNETT, P.J., YEUNG, K.H. AND MCCALLUM, J.D. 2013. SURFICIAL GEOLOGY OF THE LANSDOWNE HOUSE AREA NORTHEAST, NORTHERN ONTARIO; ONTARIO GEOLOGICAL SURVEY, PRELIMINARY MAP P.3697, SCALE 1:100 000.
5. ONTARIO GEOLOGICAL SURVEY 2006. 1:250,000 SCALE BEDROCK GEOLOGY OF ONTARIO: ONTARIO GEOLOGICAL SURVEY, MISCELLANEOUS RELEASE - DATA 126 - REVISED.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	ALR	AS	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

TRANSPORTATION CORRIDOR SURFICIAL GEOLOGY

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF NO. 34

FIGURE 3.9-5

REV A

SAVED: I:\1102\00390\01\A\GIS\Figs\A673_rA.mxd; Dec 20, 2013 7:38 PM; spenfold

The surficial geology for the first 100 km of the proposed all-season road alignment from the Pickle Lake North Road towards the mine site consists primarily of glaciolacustrine deposits, glacial till and bedrock. The middle 120 km of the road consists primarily of glacial till with some localized glaciofluvial ice-contact deposits. The final 60 km of the road consists primarily of organic deposits in bog wetlands with some areas of glacial till and organic deposits in fen wetlands.

A site investigation program was conducted at a previously planned infrastructure location along the transportation corridor (Figure 3.9-5). While infrastructure is no longer proposed at this location, the site investigation showed that the surficial material was typical of till: poorly to well-graded and predominantly cobbles with silty sand and trace clay (KP, 2012a). Several drillholes were advanced and bedrock was only encountered in one drillhole at a depth of 17.5 m.

<u>Trans-Load Facility</u>

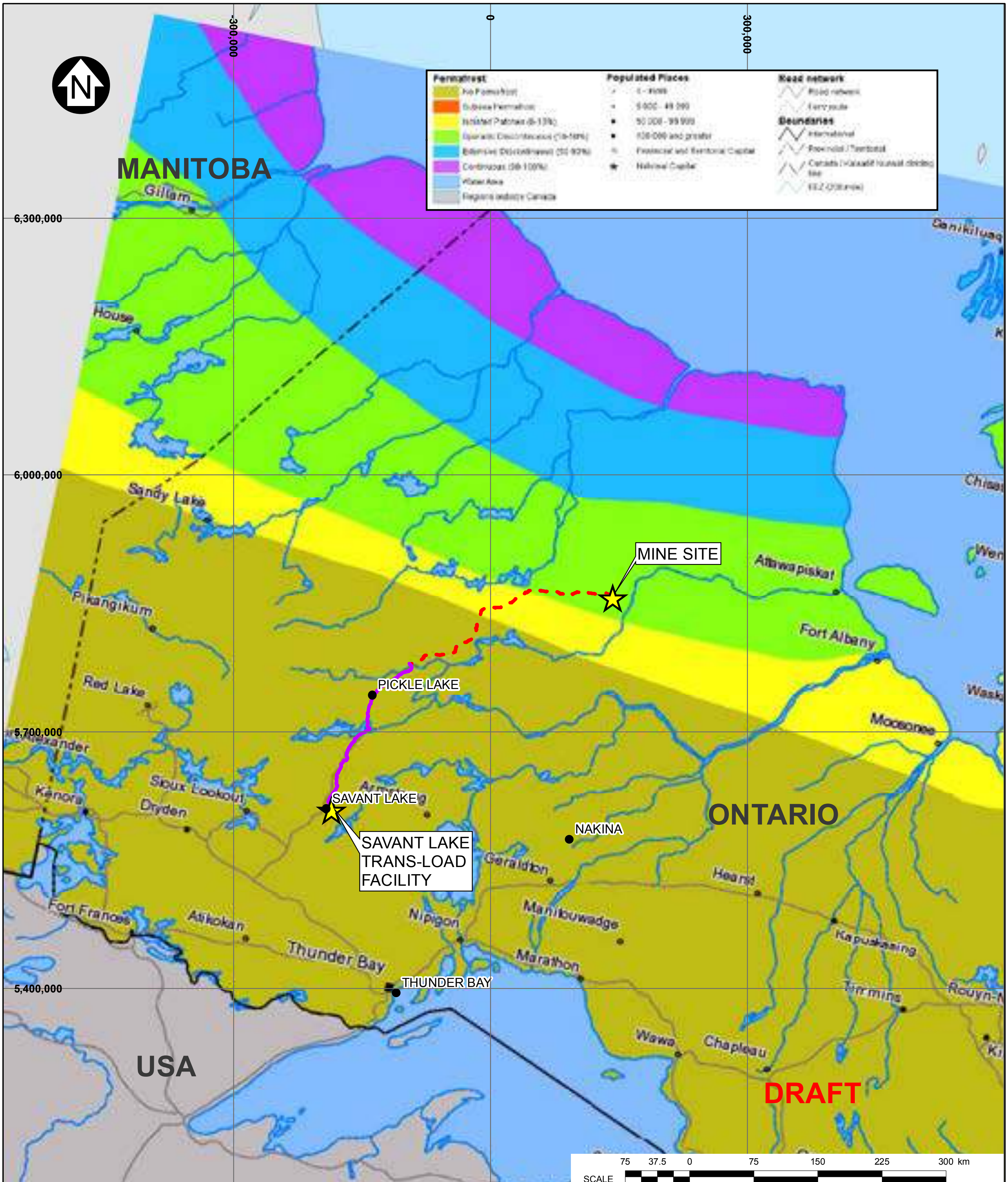
The surficial geology at the trans-load facility is bedrock with a glaciofluvial ice-contact deposit to the west of the site according to OGS, 1997. A site investigation program was undertaken at the trans-load facility as part of the hydrogeology baseline studies (KP, 2012b). The surficial materials at all of the drillhole locations were predominantly poorly graded fine sand and silt with trace clay and trace gravel. Bedrock was not encountered in any of the locations, which were drilled to depths of 20 m below ground.

3.9.4.2 Permafrost

Cold regions are typically subdivided on the basis of whether the ground is only seasonally frozen, whether permafrost occurs everywhere (continuous), or whether permafrost occurs only in some areas (discontinuous) beneath the exposed land surface. This subdivision within the project area is illustrated in Figure 3.9-6. In the discontinuous zone, permafrost occurs in scattered islands ranging in size from a few square metres at the southern limit to several hectares at the boundary with continuous permafrost. Its thickness will vary from a few centimetres at the southern limit to as much as 100 m at the boundary with continuous permafrost. Given the location of the road and mine site within the southern limit of the zone identified as possibly having sporadic discontinuous permafrost, if discontinuous permafrost is encountered during construction it is likely to be very limited in spatial extent.

Evidence to date suggests there is no permafrost at the mine site or along the transportation corridor, and discussions with local First Nations at Open Houses have confirmed that discontinuous permafrost is known only south-east of the mine and south of the access corridor. No permafrost has been encountered during any exploration, geotechnical or hydrogeological drilling programs performed at the mine site. No permafrost was encountered during a geotechnical and hydrogeological drilling program located south of Webequie along the transportation corridor.

Evidence to date suggests there is no permafrost at the mine site or along the transportation corridor. No permafrost has been encountered during any exploration, geotechnical or hydrogeological drilling programs performed at the mine site. No permafrost was encountered during a geotechnical and hydrogeological drilling program located south of Webequie along the transportation corridor.



LEGEND:

- ☆ MINE SITE AND TRANS-LOAD FACILITY
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- WATER

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N.
3. ACTIVE CLAIM BOUNDARIES BY OTHERS WERE PROVIDED BY THE MINISTRY OF NORTHERN DEVELOPMENT AND MINES (AUGUST 2012).
4. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013).
5. PERMAFROST MAP OBTAINED FROM THE ATLAS OF CANADA, 2013.

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

PERMAFROST DISTRIBUTION

Knight Piésold CONSULTING

P/A NO.	REF NO.	REV
NB102-390/1	34	A
FIGURE 3.9-6		

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	ALR	SCP	SRA	RAM

SAVED: I:\1102\00390\01\A\GIS\Figs\A674_rA.mxd; Dec 20, 2013 7:38 PM; spenfold

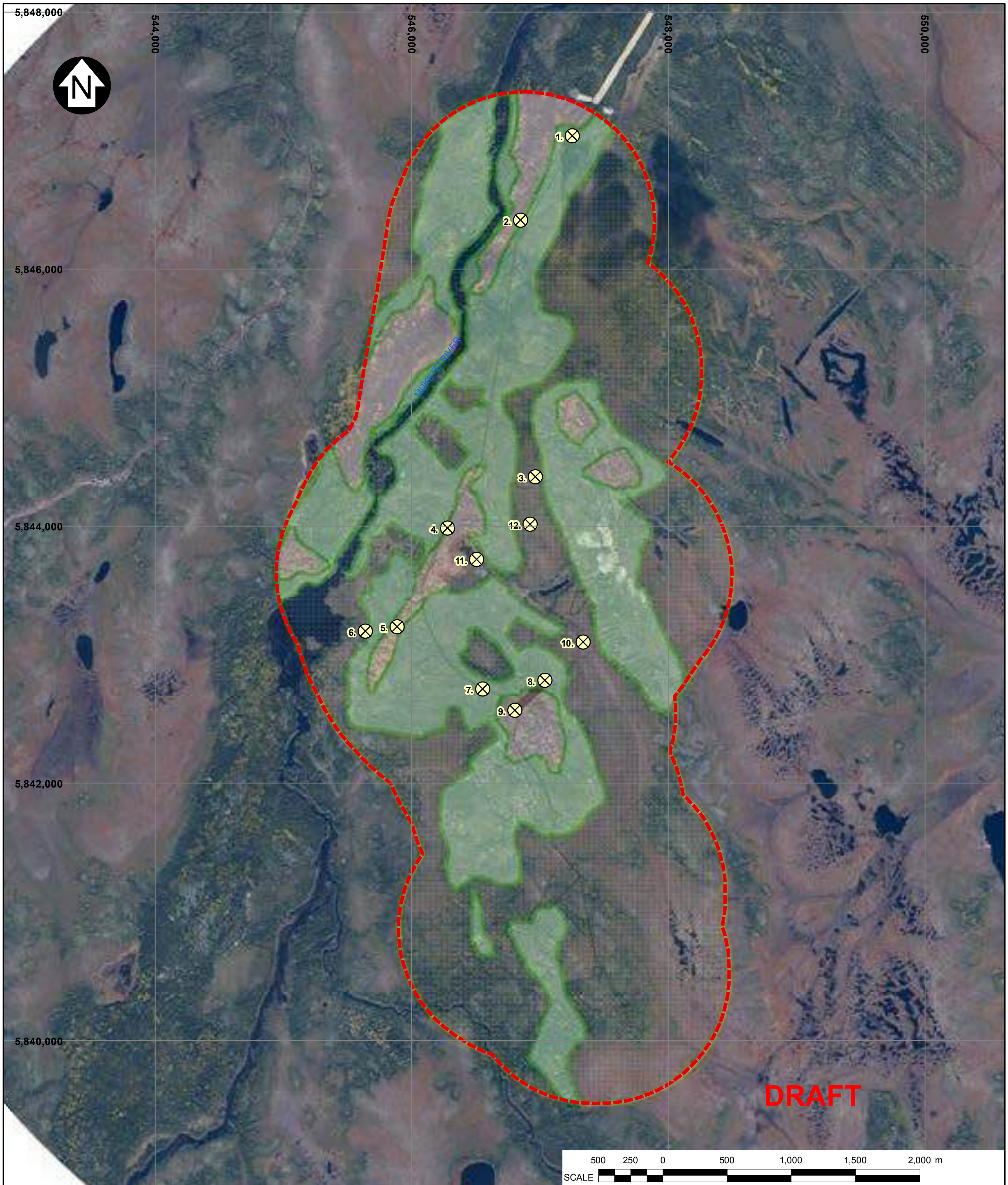
If encountered, disturbing permafrost may or may not cause any adverse effects. This would be the case in areas of fill. More obvious effects could occur if road cuts or borrow areas are excavated in permafrost soils. This is unlikely given the relatively flat terrain for the portion of the transportation corridor located in the area identified as having sporadic discontinuous permafrost. Differential settlement could occur, as well as ponding. This can be dealt with using drainage or infilling measures as part of road maintenance.

3.9.4.3 Mine Site Soil Cover

The soil cover properties at the mine site were surveyed to support soil salvage and reclamation efforts that will occur during closure. Soil types were inferred and delineated from the interpretation of landscape features including vegetation, topography, and landforms. The two main landcover and associated soil types in the mine site PDA are uplands and wetlands. Most of the infrastructure in the PDA is in upland areas.

Soil surveys were conducted within the upland and wetland landcover types. Site locations were selected based on a stratified random sampling approach. The stratification was based on the predominant soil units in the mine site PDA and a greater number of sites were selected in the upland areas. At each survey site, soil pits were excavated and the soil cover properties described based on the CSSC (1998). The soil survey locations are shown on Figure 3.9-7. Three general soil types were observed:

- Organic soils in wetland landcover (saturated and unsaturated)
- Brunisolic soils in well drained upland landcover
- Regosolic soils in poorly-drained upland landcover



LEGEND:

- SOIL SURVEY SITE
- PROPOSED INFRASTRUCTURE
- BRUNOSOLIC
- REGOSOLIC
- ORGANIC SOIL
- MINE SITE LOCAL STUDY AREA

NOTES:

1. IMAGE PROVIDED BY SNC-LAVALIN GROUP INC. (2010).
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. INFRASTRUCTURE INFORMATION AND PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	ALR	AS	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

DISTRIBUTION OF GENERAL SOIL TYPES IN THE MINE SITE LSA

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF NO. 34

FIGURE 3.9-7

REV A

SAVED: I:\1102\00390\01\A\GIS\Figs\A723_rA.mxd; Dec 21, 2013 12:57 AM; asimpson

A map of the general distribution of soil types was developed from landcover and landscape information and the soil survey data (Figure 3.9-7).

At all sites in wetland areas, organic soils were present. All of the organic soils sampled were characteristic of Hydric Fribrisols, which are composed largely of relatively undecomposed fibric organic material and are dominated by sphagnum mosses. Organic soil characteristics were assessed at sites where the soil was saturated and at sites where the soil was better drained. At the saturated sites, soil texture and colour was assessed, however, soil pits were not excavated (Figure 3.9-8).

Figure 3.9-8 Typical Organic Soil at a Saturated Site

In unsaturated organic soils, the top layer of soil was above the water table. At most sites the water table ranged from 40 to 60 cm below surface. The vegetation cover was predominantly sphagnum moss and spruce trees (Figure 3.9-9). The thickness of the organic soil was greater in low lying areas and the parent material was silty/clay in texture. Organic soils where the water table was not at surface were more characteristic of Typic Fibrisols.

Figure 3.9-9 Ground Cover and Upper Layer of Organic Soil at Well-drained Sites

In upland areas, differences in soil characteristics were observed. In areas with better drained parent material, the vegetation cover was predominantly mixed deciduous and coniferous forests and the soil was more developed (Figure 3.9-10). In upland areas with a more poorly drained silty-clay parent material, the vegetation cover was predominantly coniferous and the soil was not as well developed (Figure 3.9-11).

Figure 3.9-10   Better Drained Upland Soil Types

Figure 3.9-11   Poorly Drained Upland Soil Types

The soils in better drained areas were characteristic of Brunisolic order. The soils in more poorly drained areas had less prominent diagnostic horizons and were more characteristic of more poorly developed Regosolic soils.

The soil surveys confirm that the soil types outlined in Figure 3.9-7 are generally accurate. The exceptions were upland areas where localized depressions have organic soils up to 1 m thick on top of silty/clay parent material (12-SOIL-04). A summary of the soil pit data are shown in Table 3.9-3.

Table 3.9-3 Summary of Soil Survey Data

Site ID	Profile Depth (m)	Horizon Description and Texture	Horizon Colour	Rooting Depth (m)	Soil Type
12-SOIL-01	0 - 0.04 0.04 - 0.06 0.06 - 0.09 0.09 - 0.20 0.20 - 1.04	Of (moss/roots/leaves) Om Ae (fine sand) Bm (fine sand) C (fine sand)	brown brown light grey red/org/brn grey/brown	0.35	Eluviated Dystric Brunisol
12-SOIL-02	0 - 0.05 0.05 - 0.06 0.06 - 0.07 0.07 - 0.23 0.23 - 0.87	Of (moss/roots/leaves) Bm (fine sand) Ae (discontinuous) (fine sand) Bm (fine sand) C (fine sand)	red/brown red/brown grey red/brown brown/grey	0.40	Orthic Dystric Brunisol
12-SOIL-03	0 - 0.03 0.03 0.03 - 0.5	Of (moss/roots/leaves) W Of (fibric material)	brown dark brown	0.40	Hydric Fibrisol
12-SOIL-04	0 - 0.06 0.06 - 0.10 0.10 - 0.19 0.19 - 0.25 0.25 - 0.70	L F F Ah (silty/clay) C (silty/clay)	brown black/brown black grey/brown grey/brown	0.20	Orthic Regosol
12-SOIL-05	0 - 0.04 0.04 - 0.07 0.07 - 0.24 0.24 - 0.67	L F Bm (silty/clay), C (silty/clay)	green/brown brown brown/red grey	0.40	Orthic Dystric Brunisol
12-SOIL-06	0 - 0.40 0.40 0.40 - 1.0+	Of (fibric material) W Om	brown brown/black	0.30	Mesic Fibrisol
12-SOIL-07	0 - 0.25 0.25 - 0.50 0.5 0.5 - 1.0+	Of (fibric material) Om W Om	brown brown/black brown/black	0.25	Mesic Fibrisol
12-SOIL-08	0 - 0.11 0.11 - 0.22 0.22 - 0.85	F Ah (silty/clay) C (silty/clay)	brown grey/brown grey	0.30	Orthic Regosol
12-SOIL-09	0 - 0.04 0.04 - 0.9 0.09 - 0.15 0.15 - 0.75	L F Bm (sand) C (sand)	green/brown brown brown/red grey/brown	0.35	Orthic Dystric Brunisol
12-SOIL-12	0 - 0.30 0.04 0.30 - 0.80	Of W Om	Brown dark brown	0.30	Hydric Fibrisol

NOTES:

1. NO GROWTH IMPEDIMENTS WERE OBSERVED AT ANY OF THE SITES.

3.9.4.4 Mine Site Soil Chemistry

Soil samples were obtained in the mine site PDA for analysis of soil chemistry. A random sampling approach was employed to select the soil samples from the soil survey sites. Samples were obtained from horizons below the organic soil horizon. Soil sampling protocols and field quality assurance and quality control steps outlined in OMEE (1996) were followed. A duplicate sample was submitted from one site. All soil samples were sent to ALS Laboratory in Thunder Bay for analysis.

Metals concentrations above the Canadian Council of Ministers of the Environment (CCME) agricultural soil quality guidelines for the protection of environmental and human health were identified (CCME, 2013). The majority of metal concentrations were below criteria with the exception of Chromium (Cr), which exceeded CCME limits in two samples and Selenium (Se), which exceeded CCME limits in one sample. The Boron (B) method detection limit for soil analysis of 5.0 µg/g was above the CCME limit of 2 µg/g. However most samples reported B concentrations above 5 µg/g with the exception of station 12-SOIL-07-1, which was < 5 µg/g.

3.10 VEGETATION

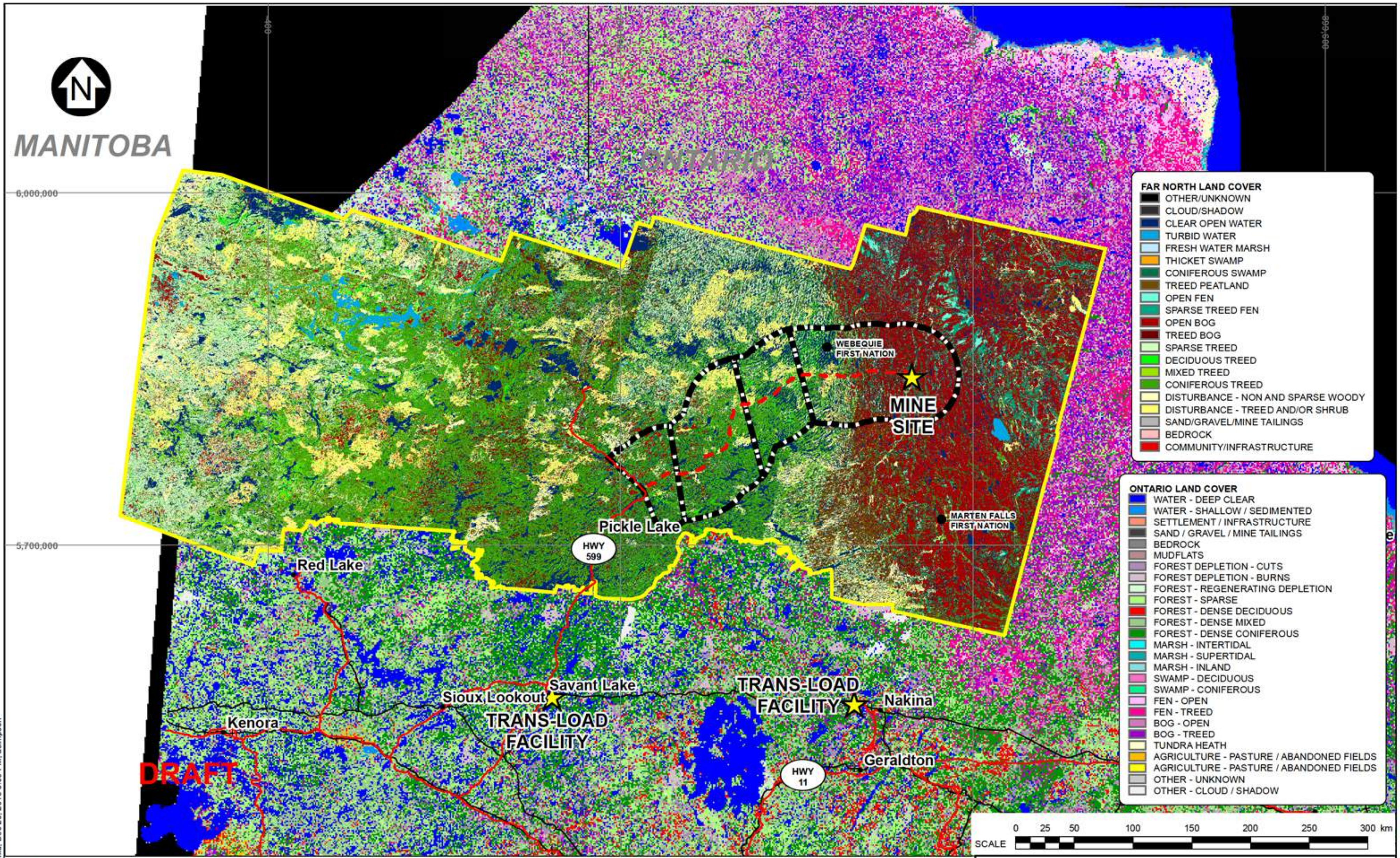
This section provides a description of the existing vegetation baseline conditions for the Eagle's Nest Project. The supporting technical document that provides additional details regarding the study methods, results, and discussion is available in Appendix 9.

3.10.1 Study Areas

The spatial boundaries for the characterization of baseline vegetation communities were delineated based on the location and extent of the Project during the construction, operation, and closure phases as well as ecological criteria including representation, size, and integrity.

3.10.1.1 Regional Study Area

The Project will have the greatest potential impact on vegetation during the development of the transportation corridor and the construction of the mine site infrastructure. The regional study area (RSA) (Figure 3.10-1) for the vegetation studies is ~1,650,000 ha (16,500 km^2) and the boundaries were chosen based on three primary criteria as follows.



LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- COMMUNITY
- RAILWAY
- EXISTING ALL-SEASON ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- FAR NORTH LAND COVER BOUNDARY
- TRANSPORTATION CORRIDOR REGIONAL STUDY AREA

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013).
4. FAR NORTH LAND COVER (2005 TO 2009) © HER MAJESTY THE QUEEN IN RIGHT OF ONTARIO AS REPRESENTED BY THE MINISTRY OF NATURAL RESOURCES (SEPTEMBER, 2010). ALL RIGHTS RESERVED.
5. ONTARIO LAND COVER DATA PROVIDED BY OMNR. SPECTRANALYSIS INC. (2004).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

PROJECT LOCATION WITHIN THE FAR NORTH LAND COVER EXTENT

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 3.10-1 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	PAQ	SWK	SRA	RAM

SAVED: I:\1102\00390\01\A\GIS\Figs\A675_rA.mxd; Dec 20, 2013 8:09 PM; asimpson

- Ecological Representation - The RSA area was determined to be representative of the variety of regional forest and wetland types as well as natural disturbances (mainly fire) that occur in the Project region. Representation was evaluated by comparing the land cover composition of the RSA with the land cover composition of Ecodistricts 2W-2 (Appendix A; from Henson et al., in press) and 2W 3 (Appendix B; from Henson et al., in press) (see Table 3.10-1), which together include more than 95% of the RSA. Table 3.10-1 shows that all land cover types in these two ecodistricts are well represented within the RSA except for the categories: “other natural”, “burn”, and “regenerating depletion”, which are classes that were not used for the Far North Land Cover (FNLC) mapping. The category of “other natural” may have been used to include the FNLC map classes of deciduous forest, conifer swamp, treed peatland, thicket swamp, and open fen. The categories of “burn” and “regenerating depletion” may have been used to include the FNLC map classes of disturbance-forest and/or shrub and disturbance-non and sparse woody.
- Size - According to Vásárhelyi et al. (2002) the RSA is more than twice as large as the minimum area required (7,200 km^2) to sustain viable populations of the two wide-ranging predators found in the RSA: wolves and black bears. By maintaining habitat for these focal species, the probability of maintaining habitat for other wildlife in the RSA is also high.
- Ecological Integrity - The RSA has an extremely high level of ecological integrity with more than 95% undisturbed by human activity. In addition, more than 95% of the 20 km buffer area adjacent to the RSA has also not been significantly disturbed by human activity. The higher the integrity of the buffer area, the lower the probability is for species extinction within the RSA (Parks and Harcourt, 2002).

3.10.1.2 Local Study Area

The LSA is the zone where there is reasonable potential for immediate interaction between Project components and the VECs. The LSA is generally the Project footprint including the mine and associated infrastructure with a buffer of varying distances depending on the VECs.

The following impacts to vegetation are anticipated:

- Physical removal of vegetation within the project footprint
- Dust deposition affecting vegetation health up to 1 km (in extreme cases)
- Alteration of the moisture regime up to 1 km from the infrastructure

Based on these anticipated impacts, we chose a 1 km distance from the Project infrastructure as the outer boundary of the LSA.

3.10.2 Background

Three land cover mapping datasets are applicable to the RSA including EOSD, PLC-2000 and PLC-2010. Field-based studies within the RSA that have used the EOSD dataset were not found during the literature search, however, two studies that used the PLC-2000 and PLC-2010 datasets for field research in the RSA were found (Phoenix et al., 2010; Stratton, 2012). Of these two PLC datasets, Stratton (2012) found PLC-2010 to be superior to PLC-2000.

In addition to these two field studies, two other projects have obtained field data from within the RSA.

Knight Piésold CONSULTING

TABLE 3.10-1

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

FAR NORTH COVER CLASSES ALONG THE TRANSPORTATION CORRIDOR

Print Dec/21/13 1:36:24

Habitat Type	PLNR[1]		Ozhiski Lake				Dearden Lake					Esker Camp			Mean
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Forest	45.9	42.2	40.6	42.9	53.4	56.1	59.1	57.0	47.5	46.3	40.7	17.3	3.9	4.4	**39.8**
Coniferous Forest	37.7	34.7	35.8	35.5	42.5	35.5	33.9	32.9	21.6	17.7	16.6	8.0	0.3	0.2	25.2
Sparse Forest	1.6	1.9	2.0	2.2	3.4	10.7	8.8	10.1	9.8	12.2	19.2	7.9	3.4	3.6	6.9
Mixed Forest	3.7	2.5	1.7	3.0	5.2	7.8	11.5	8.1	6.9	7.5	4.6	1.3	0.2	0.4	4.6
Deciduous Forest	3.0	3.1	1.0	2.3	2.4	2.2	4.9	5.8	9.2	8.9	0.3	0.0	0.0	0.0	3.1
Wetlands	41.9	42.0	44.1	44.6	29.2	19.8	13.3	9.7	8.9	15.7	35.7	72.1	89.7	89.9	**39.8**
Non-Woody Wetland	11.9	9.7	10.6	9.6	3.9	1.6	0.6	0.5	0.7	2.4	6.6	20.1	33.1	36.9	**10.6**
Open Bog	10.8	8.9	10.4	9.4	3.8	1.4	0.3	0.2	0.3	1.4	5.3	18.1	31.2	35.9	9.8
Open Fen	1.0	0.8	0.2	0.1	0.1	0.3	0.2	0.3	0.4	1.0	1.3	2.0	1.9	1.0	0.8
Woody Wetland	30.0	32.3	33.5	35.1	25.3	18.2	12.8	9.2	8.2	13.3	29.2	52.1	56.6	53.0	**29.2**
Coniferous Swamp	16.3	17.1	18.6	19.4	16.1	9.6	7.7	6.0	4.1	3.9	2.4	2.2	0.6	0.6	8.9
Treed Bog	6.7	6.6	7.7	6.2	2.7	1.7	0.1	0.1	0.2	1.8	8.2	21.4	28.6	23.5	8.2
Treed Peatland	1.4	1.6	2.1	3.0	2.3	4.6	2.9	2.0	2.3	5.2	13.8	16.7	14.7	14.9	6.3
Sparse Treed Fen	5.1	6.3	4.8	5.8	3.0	0.7	0.5	0.5	0.4	1.3	4.7	11.2	11.8	13.0	4.9
Thicket Swamp	0.5	0.7	0.4	0.6	1.3	1.6	1.6	0.7	1.1	1.1	0.0	0.6	0.9	1.0	0.9
Disturbed Areas	3.1	9.2	6.3	5.3	3.4	12.2	12.4	8.6	17.7	12.5	5.9	0.5	0.0	0.7	**7.0**
Disturbance - Forest &/or Shrub	2.6	7.0	3.7	3.8	2.6	10.2	12.4	8.6	17.7	11.2	5.7	0.3	0.0	0.4	6.2
Disturbance - Non- & Sparse-Woody	0.5	2.2	2.6	1.4	0.8	2.0	0.0	0.0	0.0	1.2	0.2	0.2	0.0	0.3	0.8
Open Water	8.6	6.1	8.7	6.7	13.6	11.8	15.1	24.7	25.9	25.5	17.6	10.0	6.4	5.1	**13.3**

I:\1\02\00390\01\A\Report\Report 34, EA Volume 2 - EA Report\REV A\8 - Section 3 - Existing Environment\1 - Draft\Tables\[Table 3.10-1.xlsx]TABLE 3.1

NOTES:

1. "PLNR" REFERS TO PICKLE LAKE NORTH ROAD.

A	20DEC'13	ISSUED WITH REPORT NB102-390/1-34	PQ	KC	SRA
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

The number of field plots obtained for these four projects are summarized as follows:

- Far
- North Terrestrial Biodiversity Project - 19 plots; east end of the RSA
- Ring of Fire Ecosystem Calibration Project - 9 plots; east end of the RSA
- Provincial Ecological Land Classification - 5 plots; west end of the RSA
- National Forest Inventory - 1 plot; west end of the RSA

It was estimated that data from at least 200 field plots and potentially up to 250 plots would be required to characterize vegetation in the RSA for this baseline study. The data available from the 34 existing field plots within the RSA was far below this requirement.

The descriptions for the two ecodistricts that occur within the RSA (Henson et al., in press) provide a comprehensive, high-level description of the broad vegetation patterns and regional ecology in the RSA, which should be understood prior to developing a field sampling program. Of particular value at the operational level are the following two field guides produced by the MNR:

- Forest Ecosystem Classification for Northwestern Ontario (Sims et al., 1997)
- Ecosites of Ontario: Boreal Range (Banton et al., 2009)

These field manuals can be used to classify field plots into known vegetation types, forest ecosystem types, and ecosites including many wetland types. In addition, plots sampled within unidentified ecosystem types can be flagged quickly and integrated into the classification using the existing typology guidelines.

As the foundation of the food chain in terrestrial ecosystems, vegetation plays a critical role as a component in the hydrological cycle, in maintaining the stability of soils, in facilitating nutrient cycling, and in providing wildlife habitat. Through the Canadian Boreal Forest Agreement, many groups including industry, government, First Nations and NGOs have recognized the importance of protecting the ecological function of Ontario's boreal forest landscapes. For example, Canada's boreal ecosystems provide services to humans worth more than $700 billion annually.

Further to protecting the values of the Far North region, the Ontario government created the Far North Science Advisory Panel, which was charged with providing scientific and policy advice to the Minister of Natural Resources for application to resolving a variety of issues. The Panel stressed the need to strive for development that does not impair the values of Far North ecosystems to both wildlife and humans. Perhaps most important are the effects of roads, which are incremental and cascading. Once one road is built to serve a single purpose or development project, it opens up the potential for further development, and creates pressure to build more road networks and power transmission lines. The Panel also emphasized that climate change could bring important socio-economic opportunities to Far North communities, but also change to the region's ecosystems.

Finally, climate change has become a concern of all sectors of society. In response, the MNR has convened workshops and produced studies addressing historical changes in climate, potential future changes to climate and resulting changes to species and ecosystems, and strategies for adapting to climate change. Observed major trends in the climate of northwestern Ontario include the following (from Racey, 2004):

- Temperature in northwestern Ontario has increased more than in any other region of Ontario
- Relative to the early 20th Century, minimum temperatures are much higher

- Spring and winter seasons are much warmer
- The amount of snowfall, the number of snowfall events, and the duration of snow cover has decreased since 1940
- There has been a large increase in the amount of rainfall during the winter season

As a result of these changes in the climate of northwestern Ontario, the MNR expects that:

- The fire season will increase by 10 to 50 days, the area burned will increase as will carbon emissions, and wood supply will decrease
- Boreal plant species will experience range retractions due to their inability to compete with more aggressive southern species
- Environmentally stressed trees will be subject to more aggressive disease and insect infestations due to better incubation conditions, reduced tree vigour and reduced availability of natural enemies that prey on pests
- Increasing temperature, moisture, and wind variability will lead to increased frequency of environmental damage to trees such as late-season drought, winter desiccation and frost damage
- Animal species will face rapidly changing habitat conditions and associated changes in predation, competition and disease factors
- Loss of suitable habitat will likely threaten animal species with limited range, adaptability or ecological requirements
- Increased parasite transmission and heat stress will negatively affect moose and caribou populations
- Protected area location and size based on current distribution and abundance of plant and wildlife species may not be adequate to provide and protect the ecological services intended

3.10.3 Methodology

3.10.3.1 Introduction

A variety of methods were used to carry out the vegetation baseline studies. These methods are described below and relate to:

- Determining sampling targets
- Field data collection
- Laboratory analyses
- Data analyses

3.10.3.2 Determining Sampling Targets

The MNR's Far North Land Cover Mapping was used to classify the habitats present in the RSA and to determine the distribution of vegetation sample plots required to adequately reflect the distribution and abundance of upland and wetland vegetation across the landscape of the RSA. Figure 3.10-2 shows vegetation composition of the 14 rectangles (20 x 60 km) that were placed along the proposed transportation corridor including the mine site.

The area encompassed by each land cover class for each of the 14 rectangles shown on Figure 3.10-2 is provided in Table 3.10-1. In addition, this table shows which rectangles are associated with the four different sections of the proposed corridor as follows:

- Rectangles 1 and 2 were associated with the PLNR sampling area
- Rectangles 3 - 6 were associated with the Ozhiski Lake sampling area
- Rectangles 7 - 11 were associated with the Dearden Lake sampling area
- Rectangles 12 - 14 were associated with the mine site location

In order to simplify and focus the field sampling, 13 terrestrial land cover classes provided by the FNLC mapping were reduced to six classes by combining some together as shown in Table 3.10-2. The two disturbance classes were combined into one class, open bog and open fen were combined into non-woody wetland, the remaining five wetland categories were combined into a woody wetland class, and mixed treed was combined with sparse treed. The relative abundance of these six new land cover classes were then determined for each of the four sample locations and were used as targets for field sampling in those locations (Table 3.10-3).

The change in land cover composition from west to east along the transportation corridor is shown on Figure 3.10-3 (Table 3.10-3) for the six land cover classes. Key observations are summarized below:

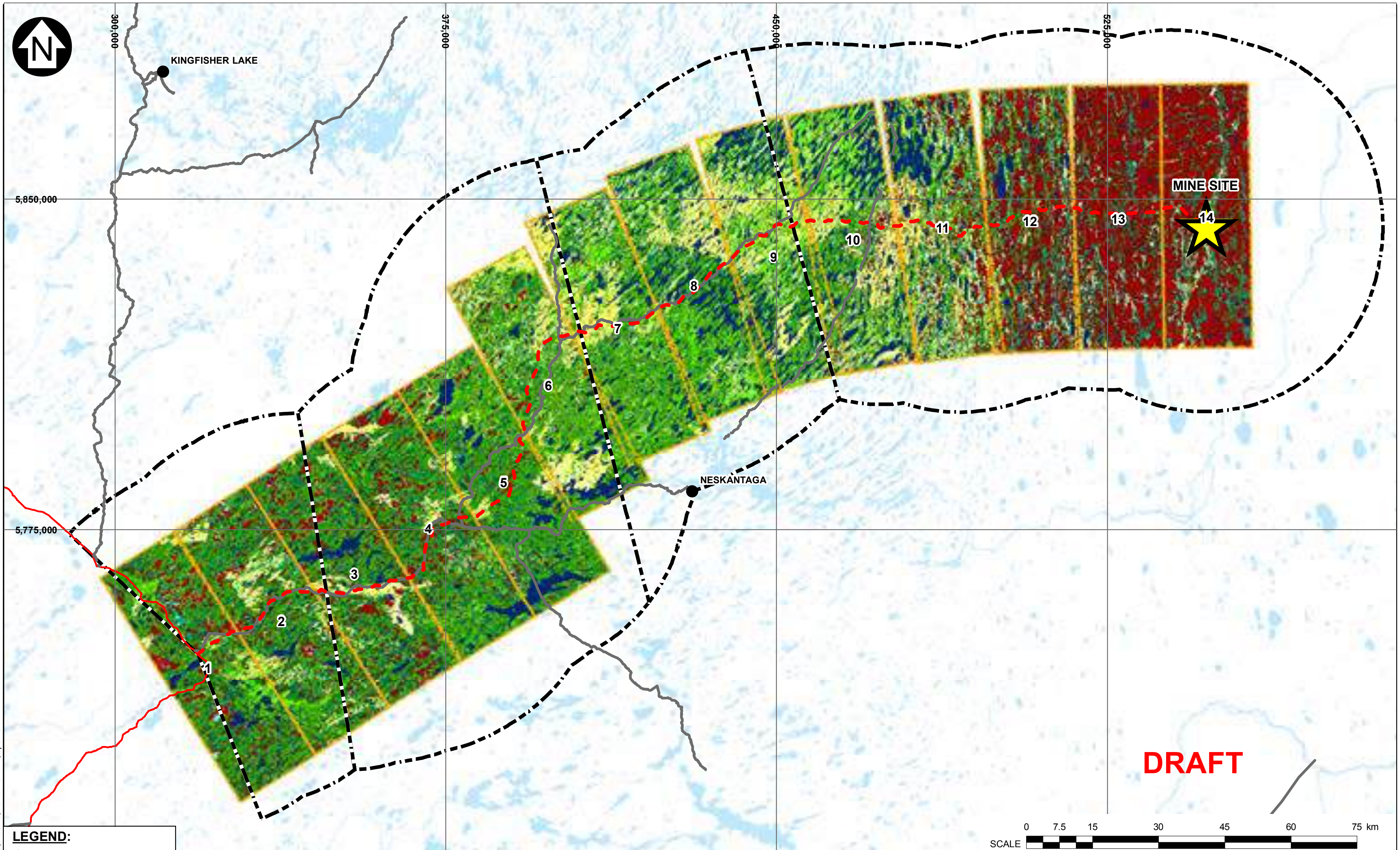
- Coniferous forest is most abundant in the west and generally decreases towards the east
- Woody wetland is more abundant than non-woody wetland, and both are most abundant in the east, least abundant in the central area, and of medium abundance in the west
- Mixed forest, deciduous forest, and disturbed areas are most abundant in the central area

3.10.3.3 Field Data Collection

In 2010, vegetation data were collected from August 26 to September 3 and from September 12 to 27. In 2011, data were collected from the beginning of June through mid-July. Sampling was completed at four locations within the RSA that were chosen based on two main criteria:

- Represent the vegetation composition along the transportation corridor, including the mine site
- Accessibility under challenging logistical conditions

The four sampling areas along the transportation corridor included the PLNR area, the Ozhiski Lake area, the Dearden Lake area, and the mine site area. Field data were also collected in the northern portion of the Cavell Trans-load site area. The land cover mapping that was used to focus vegetation samples along the transportation corridor was not used to guide sampling in the Cavell area. These plots were assessed during 2010, prior to focussing sampling along the east-west transportation corridor.



LEGEND:

- MINE SITE
- COMMUNITY
- EXISTING ALL-SEASON ROAD
- EXISTING WINTER ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- RIVER/STREAM/DRAINAGE
- WATER
- TRANSPORTATION CORRIDOR REGIONAL STUDY AREA
- FAR NORTH LAND COVER COMPOSITION RECTANGLE

FAR NORTH LAND COVER CLASSES

- -9 - CLOUD/SHADOW/UNKNOWN
- 1 - CLEAR OPEN WATER
- 2 - TURBID WATER
- 6 - FRESH WATER MARSH
- 8 - THICKET SWAMP
- 9 - CONIFEROUS SWAMP
- 10 - TREED PEATLAND
- 11 - OPEN FEN
- 12 - SPARSE TREED FEN
- 13 - OPEN BOG
- 14 - TREED BOG
- 15 - SPARSE TREED
- 16 - DECIDUOUS TREED
- 17 - MIXED TREED
- 18 - CONIFEROUS TREED
- 19 - DISTURBANCE - NON AND SPARSE WOODY
- 20 - DISTURBANCE - TREED AND/OR SHRUB
- 21 - SAND/GRAVEL/MINE TAILINGS
- 22 - BEDROCK
- 23 - COMMUNITY/INFRASTRUCTURE

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. FAR NORTH LAND COVER (2005 TO 2009) © HER MAJESTY THE QUEEN IN RIGHT OF ONTARIO AS REPRESENTED BY THE MINISTRY OF NATURAL RESOURCES (SEPTEMBER, 2010). ALL RIGHTS RESERVED.
4. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).
5. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	PAQ	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

LANDSCAPE COMPOSITION FOR MAMMAL STUDIES INCLUDING THE RSA BOUNDARIES

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 3.10-2 | REV A

SAVED: I:\1102\00390\01\A\GIS\Figs\A687_rA.mxd; Dec 20, 2013 4:02 PM; spenfold

Knight Piésold CONSULTING

TABLE 3.10-2

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

RECLASSIFICATION OF THE FAR NORTH LAND COVER CLASSES

Print Dec/21/13 1:38:43

Far North Cover Type	New Habitat Type
Coniferous Treed	Coniferous Forest
Mixed Treed	Mixed Forest
Sparse Treed	
Deciduous Treed	Deciduous Forest
Disturbance - Non and Sparse Woody	Disturbed Areas
Disturbance - Treed and/or Shrub	
Coniferous Swamp	Woody Wetland
Sparse Treed Fen	
Thicket Swamp	
Treed Bog	
Treed Peatland	
Open Bog	Non-Woody Wetland
Open Fen	

I:\1\02\00390\01\A\Report\Report 34, EA Volume 2 - EA Report\REV A\8 - Section 3 - Existing Environment\1 - Draft\Tables\[Table 3.10-2.xlsx]TABLE 3.2

A	20DEC'13	ISSUED WITH REPORT NB102-390/1-34	PQ	KC	SRA
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

TABLE 3.10-3

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

FAR NORTH LAND COVER CLASSES ABUNDANCE DISTRIBUTION AT THE FOUR SAMPLE SITES ALONG THE TRANSPORTATION CORRIDOR

Print Dec/21/13 1:39:56

Cover Type	PLNR[1] (%)	Ozhiski Lake (%)	Dearden Lake (%)	Mine Site (%)
Coniferous Forest	36.2	37.3	24.6	2.8
Mixed Forest	4.8	9.0	9.8	5.6
Deciduous Forest	3.1	2.0	5.8	0.0
Disturbed Areas	6.2	6.8	11.4	0.4
Woody Wetland	31.2	28.0	14.5	53.9
Non-woody Wetland	10.8	6.4	2.1	30.0
Total	92.1	89.5	68.3	92.8
Other	7.9	10.5	31.7	7.2

I:\1\02\00390\01\A\Report\Report 34, EA Volume 2 - EA Report\REV A\8 - Section 3 - Existing Environment\1 - Draft\Tables\[Table 3.10-3.xlsx]TABLE 3.3

NOTES:

1. "PLNR" REFERS TO PICKLE LAKE NORTH ROAD.

A	20DEC'13	ISSUED WITH REPORT NB102-390/1-34	PQ	KC	SRA
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

TABLE 3.10-3

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

FAR NORTH LAND COVER CLASSES ABUNDANCE DISTRIBUTION AT THE FOUR SAMPLE SITES ALONG THE TRANSPORTATION CORRIDOR

Print Dec/21/13 1:39:56

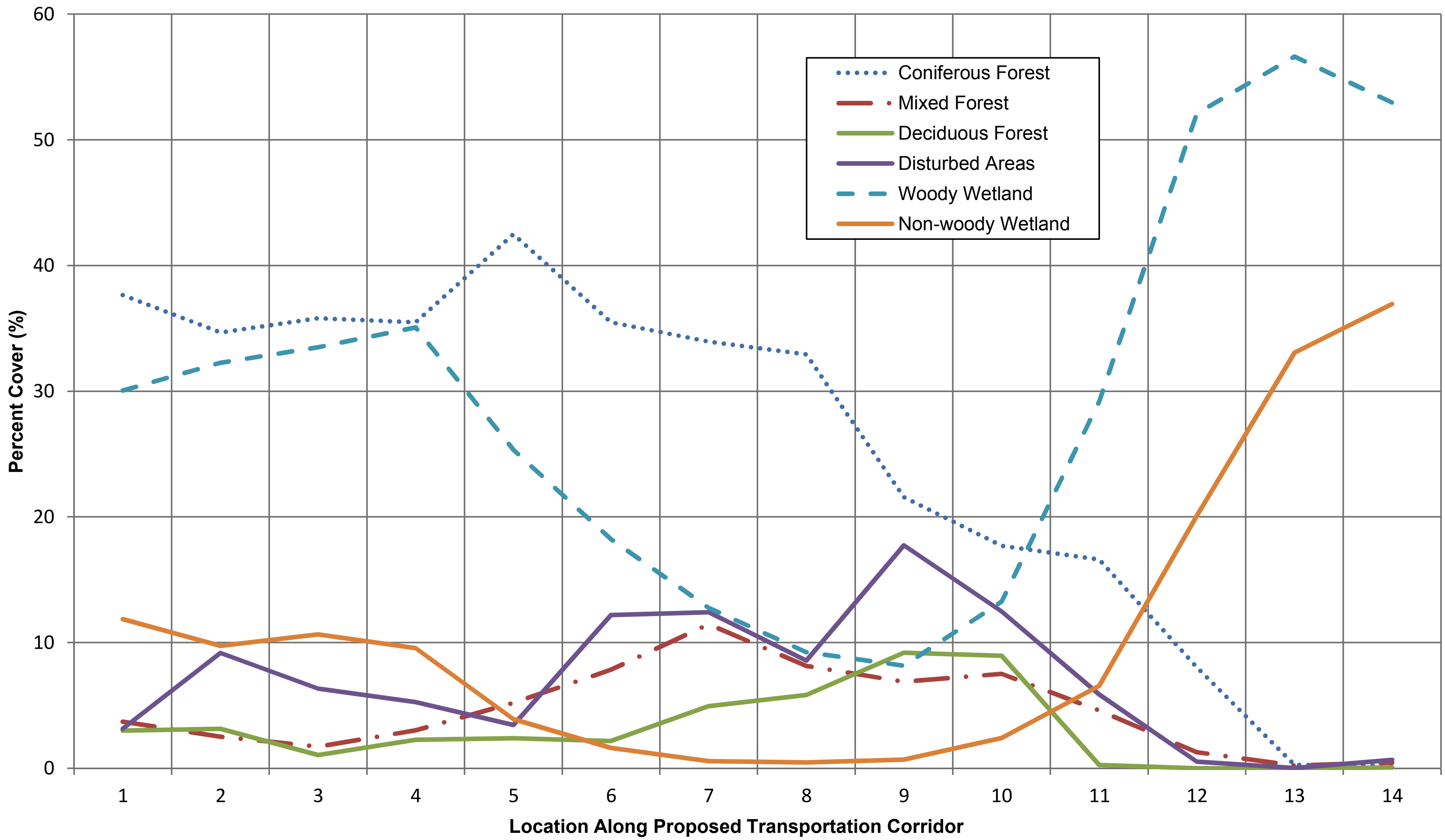
Cover Type	PLNR[1] (%)	Ozhiski Lake (%)	Dearden Lake (%)	Mine Site (%)
Coniferous Forest	36.2	37.3	24.6	2.8
Mixed Forest	4.8	9.0	9.8	5.6
Deciduous Forest	3.1	2.0	5.8	0.0
Disturbed Areas	6.2	6.8	11.4	0.4
Woody Wetland	31.2	28.0	14.5	53.9
Non-woody Wetland	10.8	6.4	2.1	30.0
Total	92.1	89.5	68.3	92.8
Other	7.9	10.5	31.7	7.2

I:\1\02\00390\01\A\Report\Report 34, EA Volume 2 - EA Report\REV A\8 - Section 3 - Existing Environment\1 - Draft\Tables\[Table 3.10-3.xlsx]TABLE 3.3

NOTES:

1. "PLNR" REFERS TO PICKLE LAKE NORTH ROAD.

A	20DEC'13	ISSUED WITH REPORT NB102-390/1-34	PQ	KC	SRA
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D



NOTES:
1. LOCATION NUMBERS REFER TO FNLC MAP SECTIONS ALONG THE TRANSPORTATION CORRIDOR ROUTE (1 = WEST END, 14 = EST END).

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	MAS	PAQ	SRA

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

CHANGE IN LAND COVER COMPOSITION ALONG THE TRANSPORTATION CORRIDOR

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF. NO. 34

FIGURE 3.10-3

REV A

Vegetation and habitat were assessed within circular plots with a 10 m radius (314 m^2), which were spaced at least 200 m apart. Standardized data sheets were used to record all vascular plant species within the plot and to record the habitat characteristics for each plot. Plant species with 10% cover or more within each of the three vertical vegetation layers were identified and recorded separately for each layer. These layers included the understory (<.5 m), the mid story (.5 m to 3 m), and the overstory (>3 m). In addition, arboreal lichens, foliose and fruiticose lichens, mosses and sedges were estimated for percent cover within each plot. All vascular plant species with less than 10% cover within the plot were identified and recorded. Snags (density and size) and logs (density and size) were also assessed within each plot.

Habitat characteristics were evaluated and described within each plot. Soils were assessed for moisture, depth, texture, exposed rock, exposed soil and open water. Percent slope, slope aspect and evidence of natural disturbance (e.g., fire, wind, insects/disease) within or near the plot were also assessed. A series of four photographs were taken from the centre of each plot in each cardinal direction. Miscellaneous other photos were also taken to document other significant components of the plots (e.g., unknown plant species). Finally, the vegetation type for each upland plot was determined using the Field Guide to the Forest Ecosystem Classification for Northwestern Ontario (Sims et al., 1997).

Ecological land classification following Banton et al. (2009) was applied at each upland sample plot in 2011. This included obtaining soil samples using soil augers to determine depths to mottles, gleying, water and bedrock. The soil samples were also used to evaluate soil texture including humus form. Tree species adjacent to the plot that were different from those in the plot were also noted and photos of soil samples were taken.

In addition to assessing the features listed on the upland data sheets, key wetland features as described in the Ontario Wetland Evaluation System-Northern Manual were assessed and recorded for the wetland plots on standardized data sheets. These included the following:

- Wetland type (swamp, marsh, fen, bog)
- Moose habitat (presence of Marestail, Water Lilies, Water Millfoil, Bullrush, Pondweeds, Horsetail, Duckweed)
- Ericaceous shrubs (six potential species)
- Ecotonal area (five potential types)
- Other features (Beaver ponds, slow moving water)

3.10.3.4 Laboratory Analyses

Plant tissue samples were collected from three land cover types in the mine site area in July of 2011 in order to assess for baseline metal content. This included foliage from a woody plant and an herbaceous plant from each of the following cover types: conifer treed, woody wetland, and non woody wetland. Samples were air-dried and sent to ALS Labs for analyses.

3.10.3.5 Data Analyses

Field data were transferred from field data sheets to Excel spreadsheets and summarized for each plot. The summarized data were then used to verify the classification of upland plots using Simms et al. (1997) and lowland plots using Banton et al. (2009). All plants were checked for current scientific and common nomenclature using VASCAN-University of Montreal (2013) as directed by MNR's Natural Heritage Information Centre (NHIC). The NHIC also provided a list of potential rare plants for the area within the RSA and up to 50 km from the RSA boundary.

In order to compare and contrast the habitat conditions of the 25 upland vegetation types, an index of productivity and moisture was used. Understory, mid-story, and overstory canopy cover estimates were added to create a productivity index for each type. A moisture index was calculated for each type by converting the field assessments of site moisture and site texture to a scale of 1 to 100 and calculating the mean of the two measurements. Each upland vegetation type was then plotted relative to X (moisture index) and Y (productivity index) coordinates.

3.10.4 Results

3.10.4.1 Introduction

A total of 236 vegetation plots were sampled. Of these, 177 were upland plots and 59 were wetland plots. Figure 3.10-4 shows the location of each plot. The plots were distributed among the infrastructure components as follows:

- PLNR (west end of transportation corridor) - 73 plots (70 upland, 3 wetland; see Figure 3.10-5)
- Ozhiski Lake (west central transportation corridor) - 42 plots (32 upland, 10 wetland; see Figure 3.10-6)
- Dearden Lake (east central transportation corridor) - 37 plots (34 upland, 3 wetland; see Figure 3.10-7)
- mine site (east end of transportation corridor) - 64 plots (27 upland, 37 wetland; see Figure 3.10-8)
- Cavell Trans-load Facility - 20 plots (14 upland, 6 wetland; see Figure 3.10-9)

A total of 177 plant species were found, which are shown in Table 3.10-4. This table also shows the infrastructure location where each species was found. In addition, 25 different upland and 17 different wetland types were found (Table 3.10-5 and Table 3.10-6). The following sections address the accuracy of the cover type mapping used and provide descriptive summaries of the upland and wetland vegetation types.

Knight Piésold CONSULTING

TABLE 3.10-4

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

PLANT SPECIES IN THE RSA AND THEIR OCCURRENCE AT FIVE PROJECT LOCATIONS

Print Dec/21/13 1:40:18

Common Name	Scientific Name	PLNR[1] (101 species)	Ozhiski (75 species)	Dearden (67 species)	Mine Site (98 species)	Cavell (107 species)
Alder-leaved Buckthorn	*Rhamnus alnifolia*				x	x
American Mountain Ash	*Sorbus americana*	x	x	x		x
Aquatic Pipewort	*Eriocaulon aquaticum*				x	
Aster spp.	*Aster spp.*	x	x			
Balsam Fir	*Abies balsamea*	x	x	x	x	x
Balsam Poplar	*Populus balsamifera*	x	x	x		
Baneberry	*Actaea spp.*	x		x	x	
Beaked Sedge	*Carex rostrata*				x	
Beaked Spike Rush	*Eleocharis rostellata*				x	
Bearberry	*Arctostaphylos uva-ursi*	x		x	x	
Bedstraw	*Galium spp.*		x		x	
Bellwort	*Uvularia spp.*					x
Black Ash	*Fraxinus nigra*					x
Black Spruce	*Picea mariana*	x	x	x	x	x
Bladderwart spp.	*Utricularia spp.*				x	x
Blue Bead Lily	*Clintonia borealis*	x	x			x
Blue Flag	*Iris versicolor*		x		x	x
Bog Aster	*Oclemena nemoralis*					x
Bog Bilberry	*Vaccinium uliginosum*				x	
Bog Laurel	*Kalmia polifolia*	x		x	x	
Bog Rosemary	*Andromeda polifolia*	x			x	x
Bracted Honeysuckle	*Lonicera Invulucre*			x		
Bristly Wild Gooseberry	*Ribes oxyacanthoides*			x		
Buckbean	*Menyanthes trifoliata*				x	x
Bunchberry	*Cornus canadensis*	x	x	x	x	x
Bush Honeysuckle	*Diervilla lonicera*	x	x			x
Canada Anemone	*Anemone canadensis*	x				
Canada Blue Joint	*Calamagrostis canadensis*				x	x
Canada Mayflower	*Maianthemum canadense*	x	x	x	x	x
Canada Soapberry	*Shepherdia canadensis*	x				
Ciliolate Aster	*Symphyotrichum ciliolatum*					x
Cloudberry	*Rubus chamaemorus*	x	x	x	x	x
Clubmoss spp.	*Lycopodium spp.*	x	x	x		
Common Arrowhead	*Sagittaria latifolia*				x	
Common Juniper	*Juniperus communis*		x		x	
Common Marestail	*Hippuris vulgaris*				x	
Cotton Grass	*Eriophorum vaginatum*				x	
Cow Wheat	*Melampyrum lineare*	x				
Creeping Snowberry	*Gaultheria hispidula*	x	x	x	x	x
Crowberry	*Empetrum nigrum*	x		x	x	
Dragon's Mouth	*Arethusia bulbosa*				x	
Dwarf Birch	*Betula pumila*	x	x		x	x
Dwarf Raspberry	*Rubus pubescens*	x	x	x	x	x
Dwarf Rattlesnake Plantain	*Goodyera spp.*	x	x	x		
Dwarf Scouring Rush	*Equisetum scirpoides*		x	x		
Eastern White Cedar	*Thuja occidentalis*	x	x			x
Feathermoss	*Ptilium crista-castrensis*	x	x		x	x
Fern Pondweed	*Potamogeton robbinsii*				x	x
Fire Cherry	*Prunus pensylvanica*	x				x
Fireweed	*Chamerion angustifolium*	x	x	x	x	x
Floating-leaved Pondweed	*Potamogeton natans*				x	
Fly Honeysuckle	*Lonicera canadensis*		x			
Fragrant Bedstraw	*Galium triflorum*	x	x	x	x	x
Glaucous Honeysuckle	*Lonicera dioica*	x				
Goldthread	*Coptis trifolia*	x	x	x	x	x
Grasses	*Graminea Family*	x	x		x	x
Green Alder	*Alnus viridis ssp. Crispa*	x	x	x		x
Greenish-flowered Pyrola	*Pyrola chlorantha*	x		x		
Ground Cedar	*Dyphasiastrum dgitatum*	x		x		x
Ground Pine	*Lycopodium dendroideum*	x		x		x
Hairy Honeysuckle	*Lonicera hirsuta*					x
High Bush Cranberry	*Viburnum opulus*	x	x			x
Honeysuckle spp.	*Lonicera spp.*		x	x		x
Horsetail	*Equisetum spp.*	x	x	x	x	x
Hudson Bay Currant	*Ribes hudsonianum*	x				
Indian Pipe	*Monotropa uniflora*	x				
Interupted Clubmoss	*Lycopodium annotinum*	x	x	x		
Inverted Bladderwort	*Utricularia resupinata*					x
Jack Pine	*Pimus banksiana*	x	x		x	x

TABLE 3.10-4

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

PLANT SPECIES IN THE RSA AND THEIR OCCURRENCE AT FIVE PROJECT LOCATIONS

Print Dec/21/13 1:40:18

Common Name	Scientific Name	PLNR[1] (101 species)	Ozhiski (75 species)	Dearden (67 species)	Mine Site (98 species)	Cavell (107 species)
Joe-Pye Weed	*Eupatorium maculatum*	x				
Kidney-leaved Violet	*Viola renifolia*	x	x	x	x	x
Labrador Tea	*Ledum groenlandicum*	x		x	x	x
Large Round-leaved Orchid	*Platanthera Orbiculata*	x	x	x		
Large Yellow Pond Lily	*Nuphar advena*					x
Large-leaved Aster	*Eurybia macrophylla*					x
Least Burreed	*Sparganium hyperboreum*					x
Leatherleaf	*Chamaedaphne calyculata*	x	x	x	x	x
Lichen	*Cladina spp.*				x	x
Lily spp.	*Liliaceae Family*				x	x
Loosetrife spp.	*Lysimachia spp.*				x	
Low Sweet blueberry	*Vaccinium angustifolium*	x	x	x	x	x
Marsh Bedstraw	*Galium palustre*	x				
Marsh Bellflower	*Campanula aparinoides*				x	
Marsh Cinquefoil	*Potentilla palustre*				x	x
Marsh Marigold	*Caltha palustris*				x	x
Marsh Skullcap	*Scutellaria galericulata*	x	x			
Marsh St. Johnswort	*Hypericum virginicum*		x			x
Monkey Flower	*Mimulus spp.*					x
Mooseberry	*Viburnum edule*	x	x	x	x	x
Mountain Cranberry	*Vaccinium vitis-idaea*	x	x	x	x	x
Mountain Fly honeysuckle	*Lonicera villosa*			x	x	x
Mountain Maple	*Acer spicatum*	x				x
Naked Mitrewort	*Mitella nuda*	x	x	x	x	x
Narrow-leaved Cattail	*Typha angustifolia*					x
Narrow-leaved Meadowsweet	*Spiraea alba*			x	x	x
Narrow-leaved Sedge	*Carex amphibola*					x
Northern Bluebells	*Mertensia paniculata*	x	x	x		
Northern Bugle-weed	*Lycopus uniflorus*	x			x	x
Northern Commandra	*Geocaulon lividum*	x	x	x	x	
Northern Dwarf Raspberry	*Rubus acaulis*			x	x	
Northern Meadow Rue	*Thalictrum confine*					x
Northern White Violet	*Viola macloskeyi*	x	x		x	
Northern Willow-herb	*Epilobium ciliatum*				x	
Nutgrass	*Cyperus esculentus*				x	
Oak Fern	*Gymnocarpium dryopteris*	x	x			
One-flowered Wintergreen	*Moneses uniflora*					x
One-sided Wintergreen	*Orthilia secunda*	x	x			x
Pear Sedge	*Cyperacaea Family*					x
Pink Lady's Slipper	*Cypripedium acaule*	x				x
Pink Pyrola	*Pyrola asarifolia*	x	x	x	x	
Pitcher Plant	*Sarracenia purpurea*				x	x
Poplar spp.	*Populus spp.*	x	x	x	x	
Prickly Wild Rose	*Rosa acicularis*	x	x	x	x	x
Princes Pine	*Chimaphila umbellata*	x				
Pyrola spp.	*Pyrola spp.*	x		x	x	
Rattlesnake Fern	*Botrychium virginianum*					x
Red Osier Dogwood	*Cornus stolonifera*	x	x	x	x	x
Reindeer Lichen	*Cladina rangiferina*	x			x	
Ribbonleaf Pondweed	*Potamogeton epihydrus*				x	
Richardsons Pond Weed	*Potamogeton richardsonii*				x	
Rose Twisted-stalk	*Streptopus lanceolatus*					x
Rough Bedstraw	*Galium asprellum*					x
Round-leaved Pyrola	*Pyrola americana*			x		x
Round-leaved Violet	*Viola rotundifolia*	x	x			
Running Club Moss	*Lycopodium clavatum*	x		x		x
Sage-leaved Willow	*Salix candida*				x	x
Sedges	*Carex spp.*		x		x	x
Serviceberry	*Amelanchier spp.*	x	x	x	x	x
Sheep Laurel	*Kalmia angustifolia*	x		x	x	x
Shining Club Moss	*Lycopodium lucidulum*	x	x	x		x
Shinleaf	*Pyrola elliptica*					x
Shrubby Cinquefoil	*Dasiphora floribunda*	x			x	
Skunk Currant	*Ribes glandulosum*	x	x	x		
Small Bedstraw	*Galium trifidium*				x	x
Small Cranberry	*Vaccinium oxycoccos*	x	x		x	x
Small Round-leaved Orchis	*Amerorhis rotundifolia*				x	
Softstem Bulrush	*Schoenoplectus tabernaemontani*				x	
Soldier Lichen	*Cladonia spp.*				x	

Knight Piésold CONSULTING

TABLE 3.10-4

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

PLANT SPECIES IN THE RSA AND THEIR OCCURRENCE AT FIVE PROJECT LOCATIONS

Print Dec/21/13 1:40:18

Common Name	Scientific Name	PLNR[1] (101 species)	Ozhiski (75 species)	Dearden (67 species)	Mine Site (98 species)	Cavell (107 species)
Speckled Alder	*Alnus incana*	x	x	x	x	x
Sphagnum Moss	*Sphagnum spp.*	x			x	x
Spinulous Wood Fern	*Dryopteris carthusiana*	x				
Spotted Jewelweed	*Impatiens capensis*	x				
Spreading Dogbane	*Apocynum androsaemifolium*	x				
Spurred Gentian	*Halenia deflexa*					x
Star-flower	*Trientalis borealis*	x	x		x	x
Swamp Fly Honeysuckle	*Lonicera Oblongifolia*		x	x		
Swamp Loosestrife	*Decodon verticillatus*		x			
Sweet Coltsfoot	*Petasites frigidus*	x	x	x	x	x
Sweet Gale	*Myrica gale*		x		x	x
Tall Meadow Rue	*Thalictrum pubescens*	x				x
Tamarack	*Larix laricina*	x	x	x	x	x
Tape-grass	*Vallisneria americana*				x	x
Three Way Sedge	*Carex spp.*					x
Three-leaved Smilacina	*Maianthemum trifolium*	x	x	x	x	x
Trailing Arbutus	*Epigaea repens*	x				
Trembling Aspen	*Populus tremuloides*	x	x	x		x
Tufted Loosestrife	*Lysimachia thyrsiflora*					x
Twinflower	*Linnaea borealis*	x	x	x	x	x
Vaccinium spp.	*Vaccinium spp.*	x	x	x	x	
Velvet Leaf Blueberry	*Vaccinium myrtilloides*	x	x	x		x
Viburnum spp.	*Viburnum spp.*				x	
Violet spp.	*Viola spp.*			x		x
Water Dock	*Rumex orbiculatus*				x	x
Water Milfoil	*Myriophyllum spp.*				x	x
Water Parsnip	*Sium suave*				x	
Water Smartweed	*Polygonum punctatum*				x	x
Watercress	*Rorippa spp.*	x			x	
White Birch	*Betula papyrifera*	x	x	x		x
White Spruce	*Picea glauca*	x				
Wild Calla	*Calla palustris*				x	
Wild Gooseberry	*Ribes hirtellum*	x	x	x		x
Wild Red Currant	*Ribes triste*		x		x	x
Wild Red Raspberry	*Rubus idaeus*	x	x		x	x
Wild Sarsaparilla	*Aralia nudicaulis*	x	x	x		x
Willow spp.	*Salix spp.*	x	x		x	x
Wintergreen	*Gaultheria procumbens*	x		x		
Woodland Strawberry	*Fragaria vesca*	x	x	x	x	x

I:\1\02\00390\01\A\Report\Report 34, EA Volume 2 - EA Report\REV A\8 - Section 3 - Existing Environment\1 - Draft\Tables\[Table 3.10-4.xlsx]TABLE 4.1

NOTES:
1. "PLNR" REFERS TO PICKLE LAKE NORTH ROAD.

A	20DEC'13	ISSUED WITH REPORT NB102-390/1-34	PQ	KC	SRA
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

TABLE 3.10-5

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

UPLAND VEGETATION TYPES

Print Dec/23/13 12:47:28

Vegetation Type	FEC Code	No. of Samples	PLNR[1]	Ozhiski Lake	Dearden Lake	Mine Site	Cavell
Conifer Forest							
Black Spruce / Bunchberry / Sphagnum (Feathermoss)	V36	2			x		
Black Spruce / Ericaceous Shrub / Sphagnum	V37	5		x	x	x	
Black Spruce / Leatherleaf / Sphagnum	V38	3	x				
Black Spruce / Speckled Alder / Sphagnum	V35	10	x			x	
Black Spruce / Feathermoss (Sphagnum) / Labrador Tea Black Spruce / Labrador Tea / Feathermoss (Sphagnum)	V33-34; V34	33	x	x	x	x	x
Black Spruce / Feathermoss	V33	27	x	x	x	x	
Black Spruce - Jack Pine / Tall Shrub / Feathermoss Black Spruce - Jack Pine/ Ericaceous Shrub / Tall Shrub / Feathermoss	V31; V31-32	3	x			x	x
Tamarack (Black Spruce) / Speckled Alder / Labrador Tea	V23	5	x			x	x
Jack Pine - Black Spruce / Ericaceous Shrub / Feathermoss	V32	3	x	x			
Jack Pine / Ericaceous Shrub / Feathermoss	V29	5	x				
Jack Pine / Low Shrub	V28	7	x				
Jack Pine - Black Spruce / Blueberry / Ericaceous Shrub / Feathermoss Jack Pine - Black Spruce / Blueberry / Lichen	V29-30; V30	11	x				x
Cedar (incl. Mixedwood) / Speckled Alder / Sphagnum	V22	1					x
Mixed Forest							
Black Spruce Mixedwood / Herb Rich	V19	7	x	x	x		x
Black Spruce Mixedwood / Feathermoss	V20	13	x	x	x		x
Jack Pine Mixedwood / Shrub Rich	V17	8	x	x			
Jack Pine Mixedwood / Feathermoss	V18	5	x	x			
Trembling Aspen - Black Spruce - Jack Pine / Low Shrub	V10	8	x	x			x
Trembling Aspen - Conifer / Blueberry / Feathermoss	V11	5	x	x	x		
Trembling Aspen (White Birch) - Balsam Fir / Mountain Maple Trembling Aspen - Balsam Fir / Balsam Fir Shrub	V6; V7	5	x	x			x
Balsam Fir Mixedwood	V14	2					x
Hardwood Forest							
White Birch Hardwood & Mixedwood	V4	3	x		x		x
Aspen Hardwood Trembling Aspen (White Birch) / Mountain Maple Trembling Aspen Mixedwood	V5; V8; V9	6	x	x	x		

I:\1\02\00390\01\A\Report\Report 34, EA Volume 2 - EA Report\REV A\8 - Section 3 - Existing Environment\1 - Draft\Tables\[Table 3.10-5 - Upland Vegetation Types.xlsx]TABLE

NOTES:

1. "PLNR" REFERS TO PICKLE LAKE NORTH ROAD.
2. "FEC" REFERS TO FOREST ECOSYSTEM CLASSIFICATION.

A	20DEC'13	ISSUED WITH REPORT NB102-390/1-34	PQ	KC	SRA
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

TABLE 3.10-6

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

WETLAND TYPES

Print Dec/21/13 1:42:21

ELC Type	Boreal ELC Code	No. of Samples	PLNR[1]	Ozhiski	Dearden	Mine Site	Cavell
Woody Wetlands (8 types)							
Swamp, Poor Conifer	B127	1		x			
Swamp, Intermediate Conifer	B128	4		x		x	
Swamp, Mineral Thicket	B134	5		x		x	
Swamp, Organic Thicket	B135	3		x	x	x	
Bog, Treed	B126	1		x			
Bog, Sparse Treed	B137	4		x	x	x	
Fen, Sparse Treed	B136	7	x			x	
Fen, Shrub Shore	B147	3		x	x		
Non-woody Wetlands (9 types)							
Bog, Open	B138	6				x	
Fen, Poor	B139	3				x	
Fen, Open Moderately Rich	B140	5				x	x
Fen, Open Extremely Rich	B141	6				x	x
Fen, Open Shore	B146	5				x	
Marsh, Mineral Meadow	B142	1		x			
Marsh, Organic Meadow	B144	3				x	
Marsh, Floating	B145	1					x
Marsh, Organic Shallow	B149	1					x

I:\1\02\00390\01\A\Report\Report 34, EA Volume 2 - EA Report\REV A\8 - Section 3 - Existing Environment\1 - Draft\Tables\[Table 3.10-6 - Wetland Types

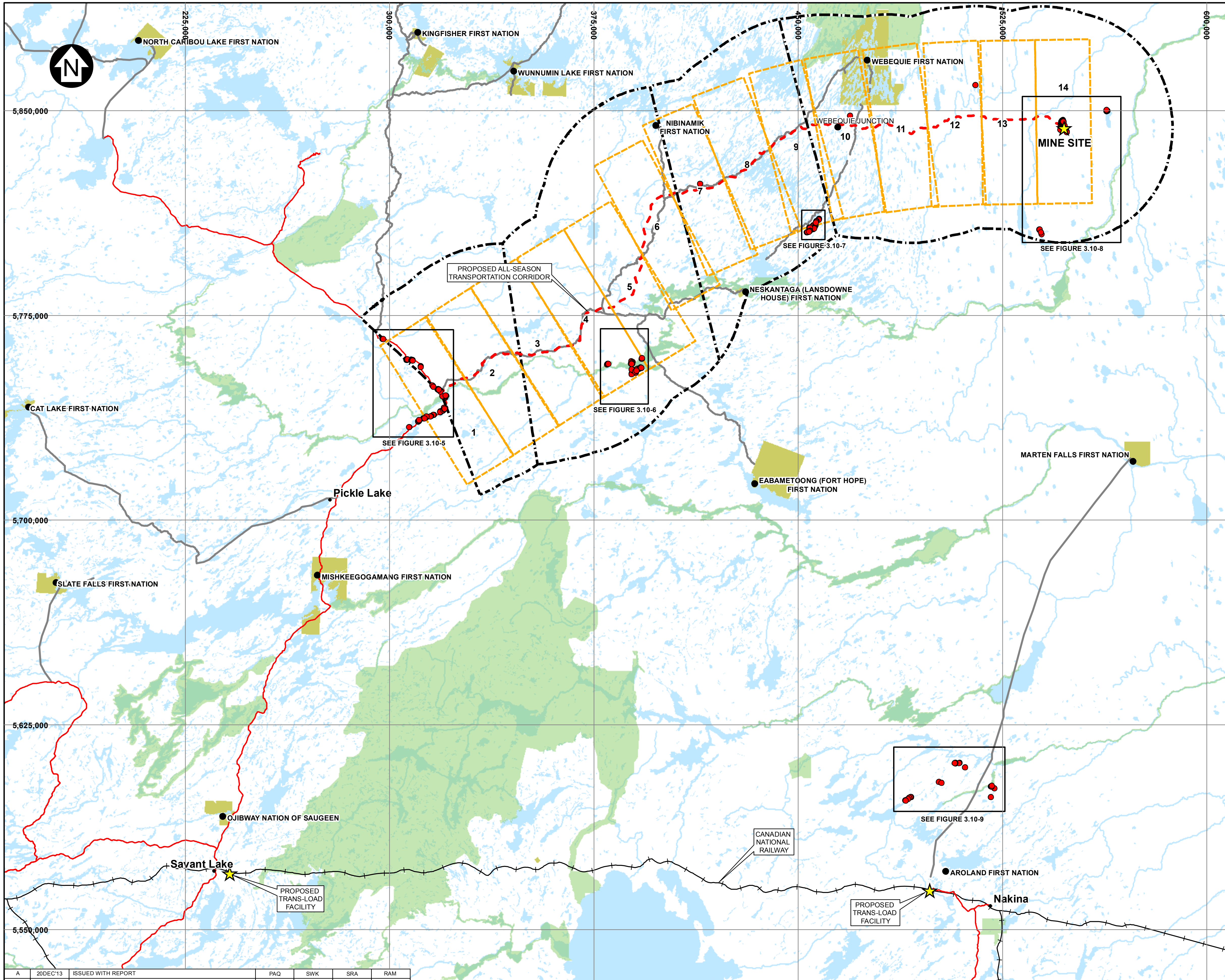
NOTES:

1. "PLNR" REFERS TO PICKLE LAKE NORTH ROAD.

A	20DEC'13	ISSUED WITH REPORT NB102-390/1-34	PQ	KC	SRA
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

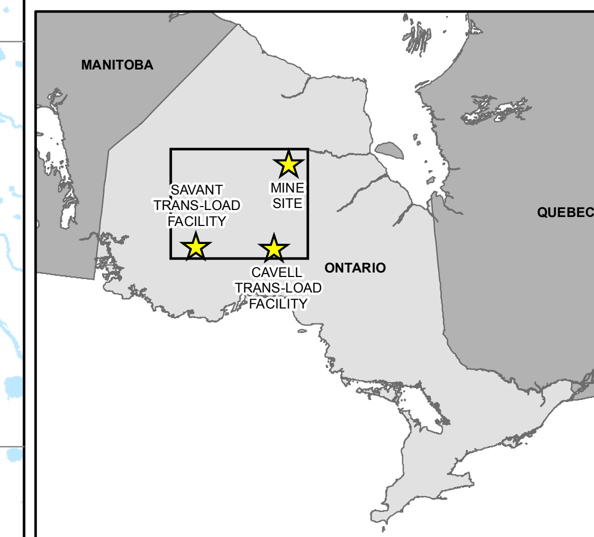
3.10.4.2 Accuracy of the Far North and Ontario Land Cover Mapping

The accuracy of the Far North Land Cover Mapping and the Ontario Land Cover Mapping (Cavell only) was evaluated by comparing the field plot assessments with the mapped cover types for each field plot location. For the upland vegetation (forest) plots, 94% of the plots were mapped as forest and 6% were mapped as cover types other than forests (e.g., bedrock, wetlands, etc.; see Appendix 9). In addition, 90% of the plots were correctly mapped to level of forest cover type including coniferous treed, deciduous treed, mixed treed, and disturbed, which is a fairly high level of mapping accuracy.



LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- COMMUNITY
- VEGETATION SAMPLE PLOT
- EXISTING ALL-SEASON ROAD
- EXISTING WINTER ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- RAILWAY
- WATER
- PARK
- FIRST NATIONS RESERVE
- TRANSPORTATION CORRIDOR REGIONAL STUDY AREA
- FAR NORTH LAND COVER COMPOSITION RECTANGLE



NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. VEGETATION SAMPLE PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011).
4. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).
5. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013).

DRAFT

SCALE 15 7.5 0 15 30 45 60 75 km

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

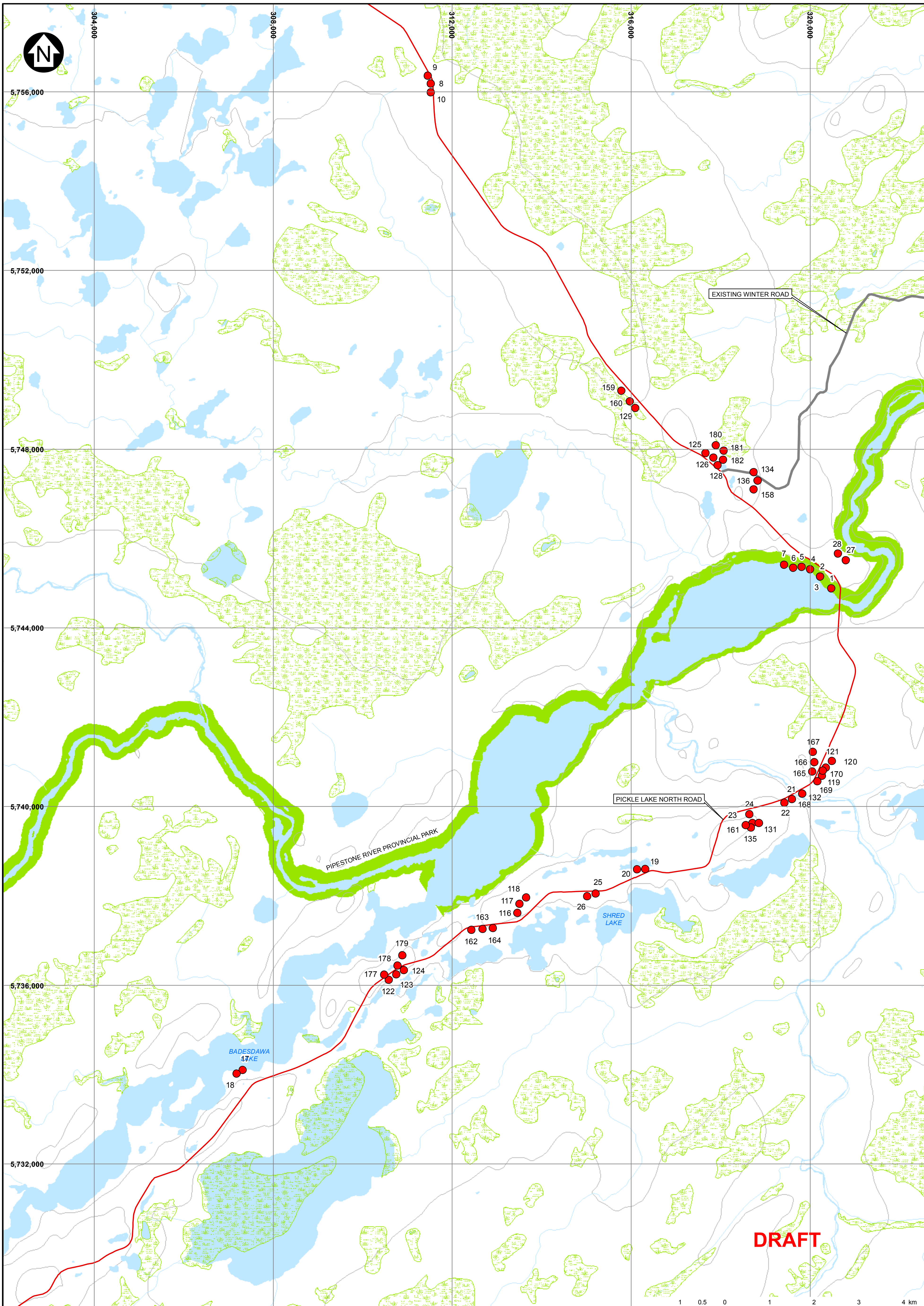
VEGETATION SAMPLE PLOT LOCATIONS

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34
FIGURE 3.10-4	REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	PAQ	SWK	SRA	RAM

SAVED: I:\102\00390\01\A\GIS\Figs\A676_rA.mxd; Dec 20, 2013 7:40 PM; asimpson



SAVED: I:\102\00390\01\A\GIS\Figs\A677_rA.mxd; Dec 20, 2013 7:43 PM; asimpson

LEGEND:

- VEGETATION PLOT LOCATION
- EXISTING ALL-SEASON ROAD
- EXISTING WINTER ROAD
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- PROVINCIAL PARK

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. VEGETATION PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011).
5. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	KC	SWK	SRA	RAM

NORONT RESOURCES LTD.

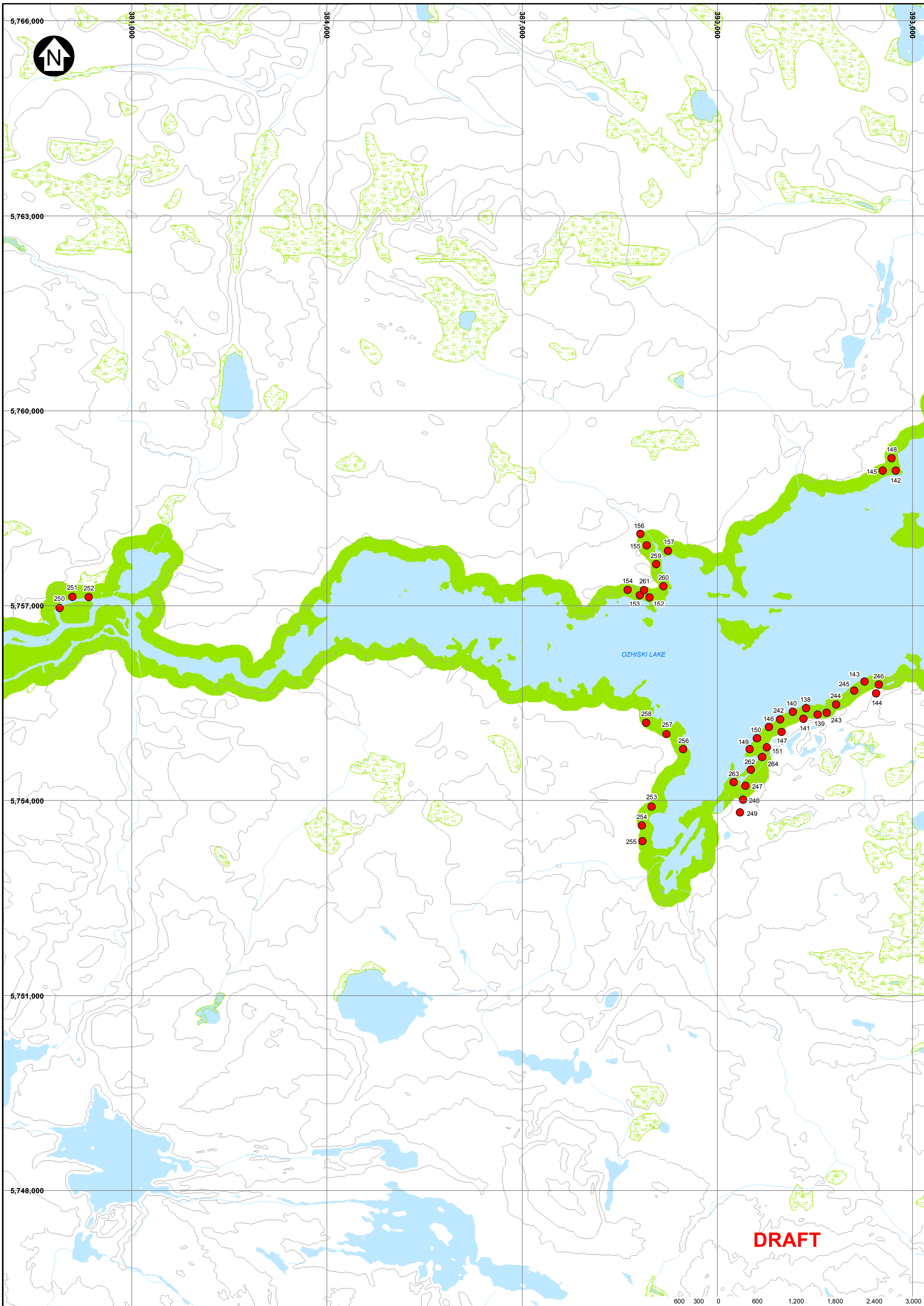
EAGLE'S NEST PROJECT

VEGETATION PLOT LOCATIONS NEAR THE PICKLE LAKE NORTH ROAD

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.10-5 REV A



LEGEND:

- VEGETATION SAMPLE PLOT
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- PROVINCIAL PARK

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. VEGETATION SAMPLE PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

VEGETATION PLOT LOCATIONS IN THE OZHISKI LAKE AREA

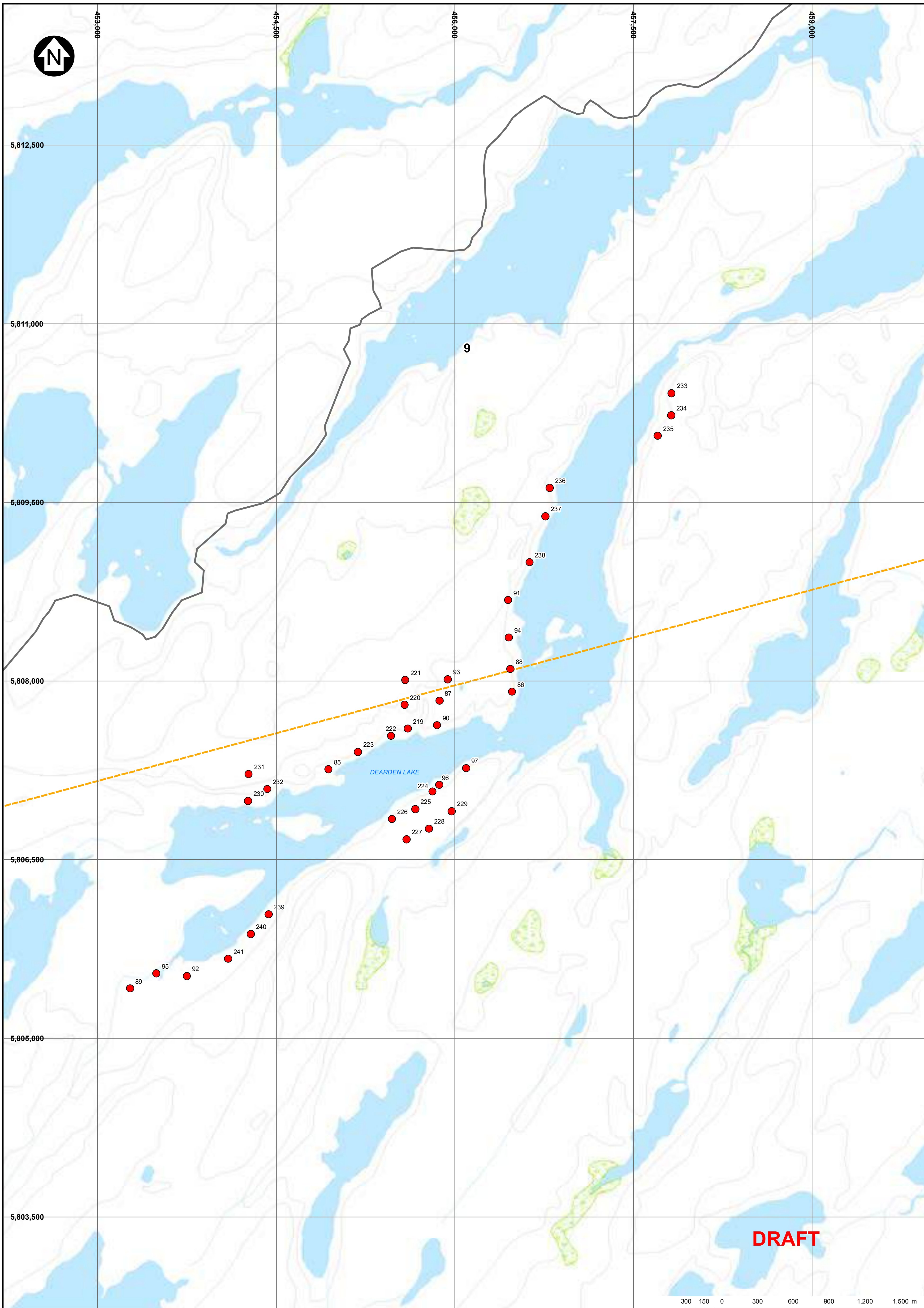
Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.10-6 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	PAQ	SWK	SRA	RAM

SAVED: I:\102\00390\01\A\GIS\Figs\A679_rA.mxd; Dec 20, 2013 7:47 PM; asimpson



LEGEND:

- VEGETATION SAMPLE PLOT
- CONTOUR
- EXISTING WINTER ROAD
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- FAR NORTH LAND COVER COMPOSITION RECTANGLE

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. VEGETATION SAMPLE PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011).
5. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	PAQ	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

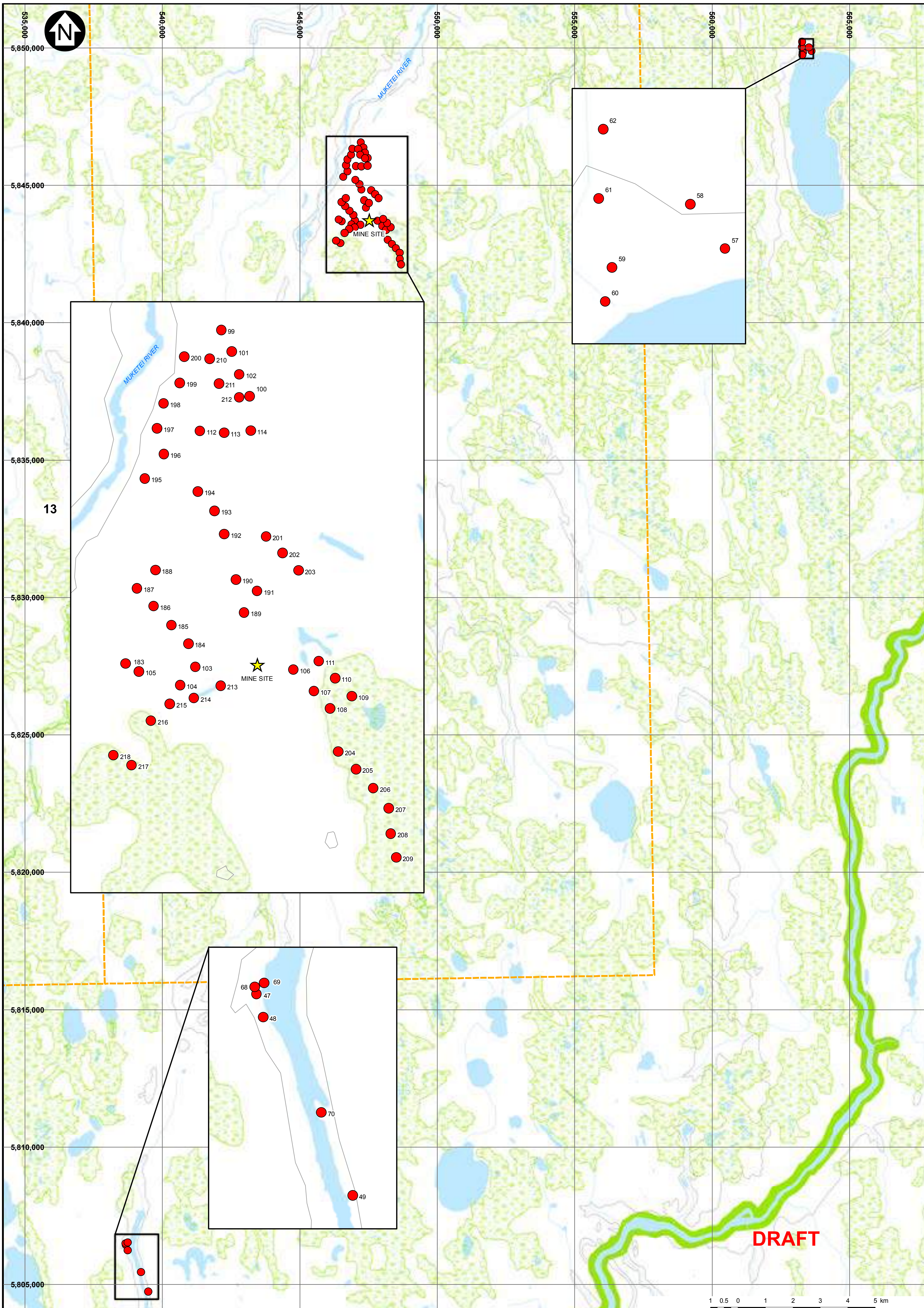
VEGETATION PLOT LOCATIONS IN THE DEARDEN LAKE AREA

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.10-7 REV A

SAVED: I:\102\00390\01\A\GIS\Figs\A680_rA.mxd; Dec 20, 2013 7:45 PM; skozmick



LEGEND:

- MINE SITE
- VEGETATION SAMPLE PLOT
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- PROVINCIAL PARK
- FAR NORTH LAND COVER COMPOSITION RECTANGLE

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. VEGETATION SAMPLE PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011).
5. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC.(MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).

A	20DEC'13	ISSUED WITH REPORT	PAQ	SWK	SRA	RAM
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

NORONT RESOURCES LTD.

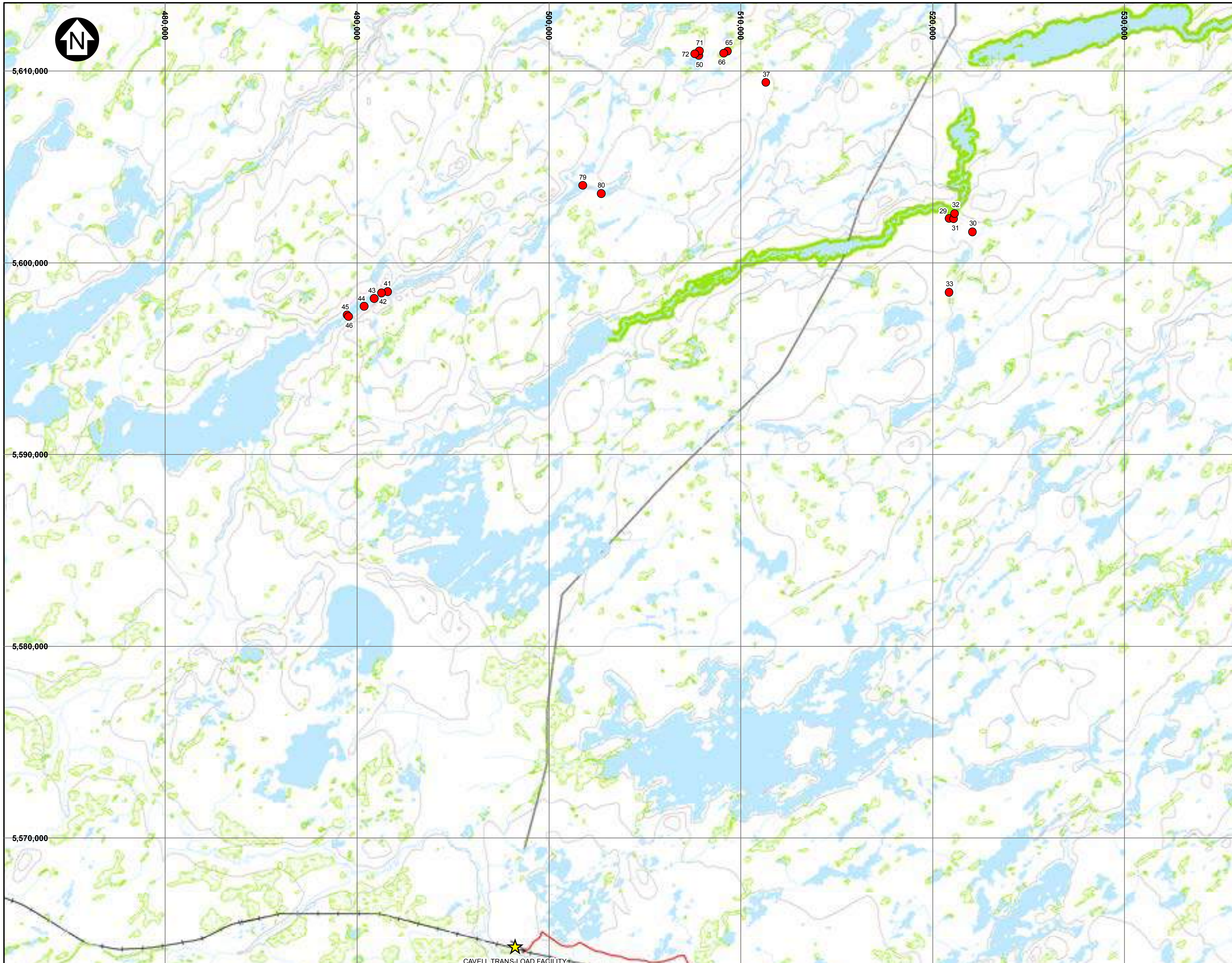
EAGLE'S NEST PROJECT

VEGETATION PLOT LOCATIONS IN THE MINE SITE AREA

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.10-8 REV A



LEGEND:

- CAVELL TRANS-LOAD FACILITY
- VEGETATION SAMPLE PLOT
- EXISTING ALL-SEASON ROAD
- EXISTING WINTER ROAD
- RAILWAY
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- PROVINCIAL PARK

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. VEGETATION SAMPLE PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011).
5. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).

DRAFT

SCALE 2 1 0 2 4 6 8 10 km

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

VEGETATION PLOT LOCATIONS IN THE CAVELL TRANS-LOAD AREA

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34
FIGURE 3.10-9	REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	PAQ	SWK	SRA	RAM

SAVED: I:\1\02\00390\01\A\GIS\Figs\A681_rA.mxd; Dec 20, 2013 7:57 PM; skozmick

Compared to the accuracy of forest cover type mapping, the mapping of wetland cover types was much less accurate. For the wetland plots, 85% of the plots were mapped as wetland and 15% were mapped as cover types other than wetlands such as coniferous treed, mixed treed, or cloud/shadow (see Appendix 9). In addition, only 39% of the plots were correctly mapped to level of woody wetland versus non-woody wetland, which is a very low level of mapping accuracy. Therefore, use of the Far North and Ontario Land Cover mapping for wetland applications should be done cautiously and with field verification if possible.

3.10.4.3 Upland Vegetation Types

A total of 25 upland vegetation types were identified and described in this study based on field data. Of these, 13 were conifer forest types, nine were mixed forest types, and three were hardwood forest types (Table 3.10-5). The scatterplot on Figure 3.10-10 provides a comparison of upland vegetation types in terms of productivity (biomass estimate) and moisture.

The least productive upland vegetation type was the Cedar (mixedwood)/Speckled Alder/Sphagnum type (Figure 3.10-10). However, four of the Jack Pine-dominated types also had very low productivity levels. The highest productivity upland vegetation types included the “Trembling Aspen (White Birch) - Balsam Fir/Mountain Maple”, “Trembling Aspen - Balsam Fir/Balsam Fir Shrub”, and “Black Spruce/Ericaceous Shrub/Sphagnum” types. The types with the highest moisture levels included “Tamarack (Black Spruce)/Speckled Alder/Labrador Tea” and “Black Spruce/Leatherleaf/Sphagnum”. Those with the lowest moisture levels were the Jack Pine-dominated types.

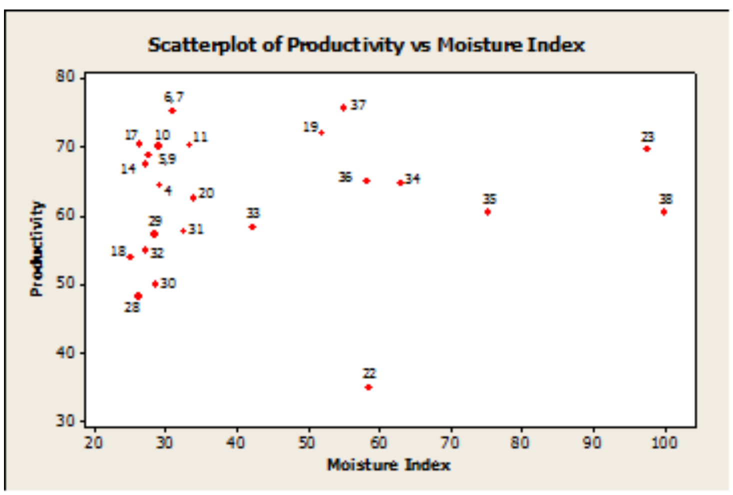


Figure 3.10-10 Productivity vs. Moisture for Upland Vegetation Types

The following provides a brief summary of the main features of each of the 25 upland vegetation types. Each of the main features for each type was described as low, medium, or high. The cut-off values used to determine these three categories are provided in Appendix 9.

3.10.4.4 Wetland Vegetation Types

A total of 17 wetland vegetation types were identified and described in this study based on field data. Of these, eight were woody wetland types and nine were non-woody wetland types (Table 3.10-6).

The following provides a brief summary of the main features of each of the 17 wetland types. Each of the main features for each type was described as low, medium, or high. The cut-off values used to determine these categories are provided in Appendix F. The codes following the name of each wetland type refers to the MNR Ecosite: Boreal Range Manual.

3.10.4.5 Riparian Ecosystems

Values of Riparian Ecosystems

Riparian ecosystems are found along the shorelines of most bodies of freshwater where the slope is low enough to facilitate the development and persistence of unique plant community composition relative to adjacent uplands. They provide many values to natural communities and humans (Racey, 1997):

- They provide shade and assist in regulating the water temperature of streams, rivers, and lakes
- They contribute to the deposition of litter, insects, pollen, and other organic material, which become part of the aquatic food chain
- They regulate water flow, act as barriers to erosion and sedimentation, and modify the flow of nutrients into aquatic systems
- They provide habitat for many species particularly for feeding and breeding
- They protect aesthetic values, especially those associated with tourism

In Northwestern Ontario, many shorelines exhibit a relatively discrete interface between open water and dry land occupied by forest. Other shorelines have a non-forested wetland fringe that may vary from a narrow band of alder to a large bog shore fen or meadow marsh complex (Racey, 1997).

Since 13% of the RSA is open water (lakes, ponds, rivers, and streams) and 40% is wetland, riparian ecosystems are very common in the RSA. And, although not based on field data, it is likely that riparian ecosystems within the RSA include many of the upland and wetland vegetation types that have been described in this report as well as many other types that were not identified here.

Ontario's Riparian Guidelines

Ontario has been implementing Timber Management Guidelines for the Protection of Fish Habitat since 1988 (OMNR, 1988). The purpose of these guidelines is to protect fish habitat and water quality from impacts such as erosion, sedimentation, excess debris, nutrient input and increased temperature. They are applied during the forest management planning process by the identification of an Area of Concern (AOC) along designated water bodies and riparian areas. AOC widths depend on slope and vary from 30 to 90 metres, as measured from the normal high water mark. Prescriptions within these AOCs may vary from no-harvest to modified or full harvest depending on the degree of risk to the values present.

The OMNR (1991) has also developed a Code of Practice for Timber Management Operations in Riparian Areas, which is summarized below:

- Trees must not be felled into water bodies at any time of year; no debris of any description is to be deposited in water bodies
- No logging debris is to be left on the banks of streams, rivers or lakes
- Trap line trails and portage routes used for recreational purposes should be rehabilitated and cleared of logging debris following timber operations

- Equipment operating adjacent to water bodies shall not cause destruction or slumping of banks
- Equipment is not to travel within streams or rivers during harvest or renewal operations to avoid causing damage to banks or beds. Stream crossings are to be kept to an absolute minimum
- Establishment of tertiary roads within riparian areas is only permitted in exceptional cases, where no reasonable alternative exists
- A narrow filter strip of approximately three metres of undisturbed forest floor or vegetation (not necessarily tree species) is to be left on the banks of water bodies except where necessary to cross a stream
- Equipment is not to be refueled or lubricated in riparian areas. Gasoline and oil for such equipment are not to be stored in riparian areas

<u>Riparian Ecosystems Affected by the Project</u>

The alignment of the transportation corridor will impact a number of riparian ecosystems. This will primarily occur at water body crossings. The corridor alignment (minus the mine site) is not yet finalized, thus field data for some of the potentially affected riparian areas have not been collected.

At the mine site, there are four locations where riparian ecosystems will be affected as follows (Figure 3.10-11, see Appendix 9 for photos):

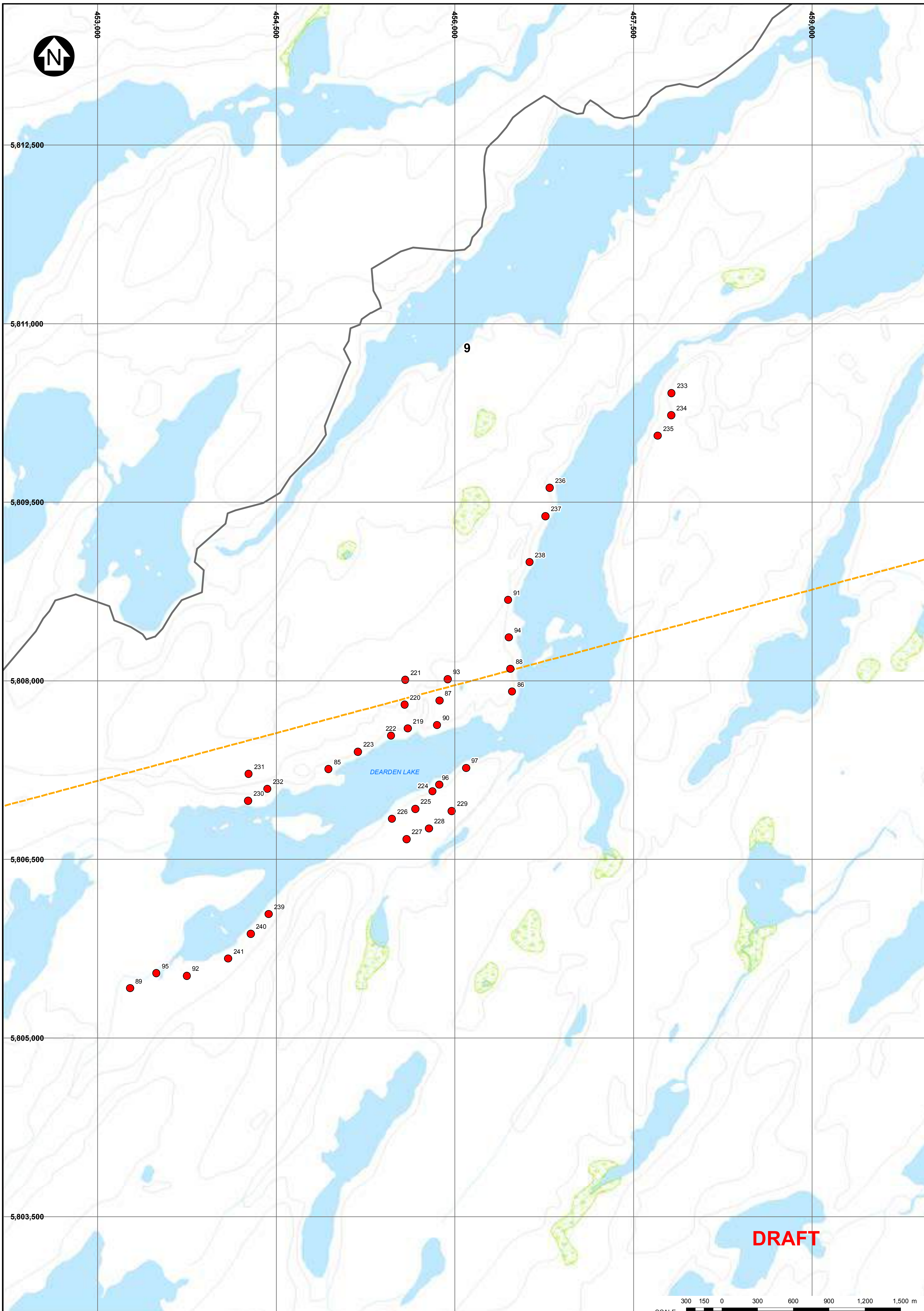
- The road crossing at the Muketei River - the riparian zone at this site is dominated by shrubs, grasses, and sedges, on a boulder-dominated channel with a flat to 3% slope
- The pond near the crown pillar - the riparian zone at this site is dominated by grasses and sedges on a flat peat substrate with minor floating portions at the water's edge
- The stream crossing along the road between the crown pillar and the portal - the riparian zone at this site is dominated by grasses, sedges and shrubs on a flat peat substrate
- The stream crossing along the road just North of the sewage treatment plant - the riparian zone at this site is dominated by grasses, sedges and shrubs (mainly alder and willow) on a flat, fine grained till substrate

3.10.4.6 Rare Plant Species and Communities

The MNR's Natural Heritage Information Centre (NHIC) was contacted to obtain a list of rare plant species and rare plant communities in the Project RSA. A list of rare plant communities is not currently available, however a list of rare plant species including coordinates of known locations was provided. Figure 3.10-12 shows the locations of these rare plant species for the Kenora District and a 90 km buffer from the Project infrastructure that was used to identify the set of rare plant species applicable to this study (see Table 3.10-7). None of these plant species were observed during the field studies conducted for this Project.

3.10.4.7 Plant Tissue Chemistry

Results of the plant tissue metals analyses for the six plant samples that were collected during the field program are presented in Table 3.10-8. Values for 30 different metals are presented and represent baseline conditions for conifer forest, woody wetland, and non-woody wetland in the mine site area are included as are the location coordinates for each plant sample. Currently there are no provincial or federal standards for plant tissue chemistry, thus the values presented in this table are not compared and/or discussed further. However, these data may be useful in the future to help evaluate potential changes in plant tissue chemistry due to Project activities.



LEGEND:

- VEGETATION SAMPLE PLOT
- CONTOUR
- EXISTING WINTER ROAD
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- FAR NORTH LAND COVER COMPOSITION RECTANGLE

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. VEGETATION SAMPLE PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011).
5. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).

A	20DEC'13	ISSUED WITH REPORT	PAQ	SWK	SRA	RAM
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

NORONT RESOURCES LTD.

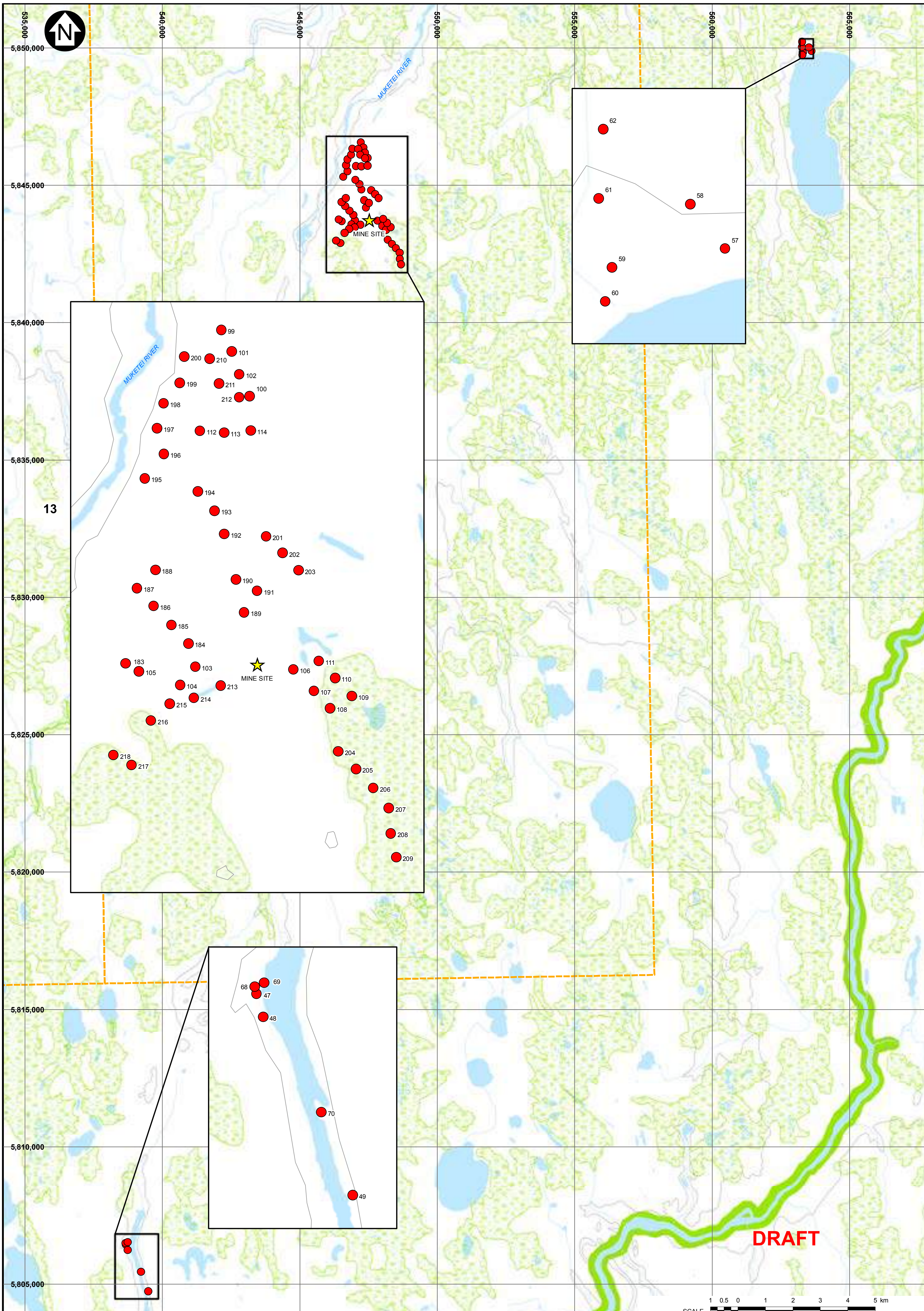
EAGLE'S NEST PROJECT

VEGETATION PLOT LOCATIONS IN THE DEARDEN LAKE AREA

Knight Piésold CONSULTING

P/A NO.	REF NO.	
NB102-390/1	34	
FIGURE 3.10-7		REV A

SAVED: I:\1102\00390\01\A\GIS\Figs\A680_rA.mxd; Dec 20, 2013 7:45 PM; skozmick



LEGEND:

- MINE SITE
- VEGETATION SAMPLE PLOT
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- PROVINCIAL PARK
- FAR NORTH LAND COVER COMPOSITION RECTANGLE

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	PAQ	SWK	SRA	RAM

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. VEGETATION SAMPLE PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011).
5. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC.(MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

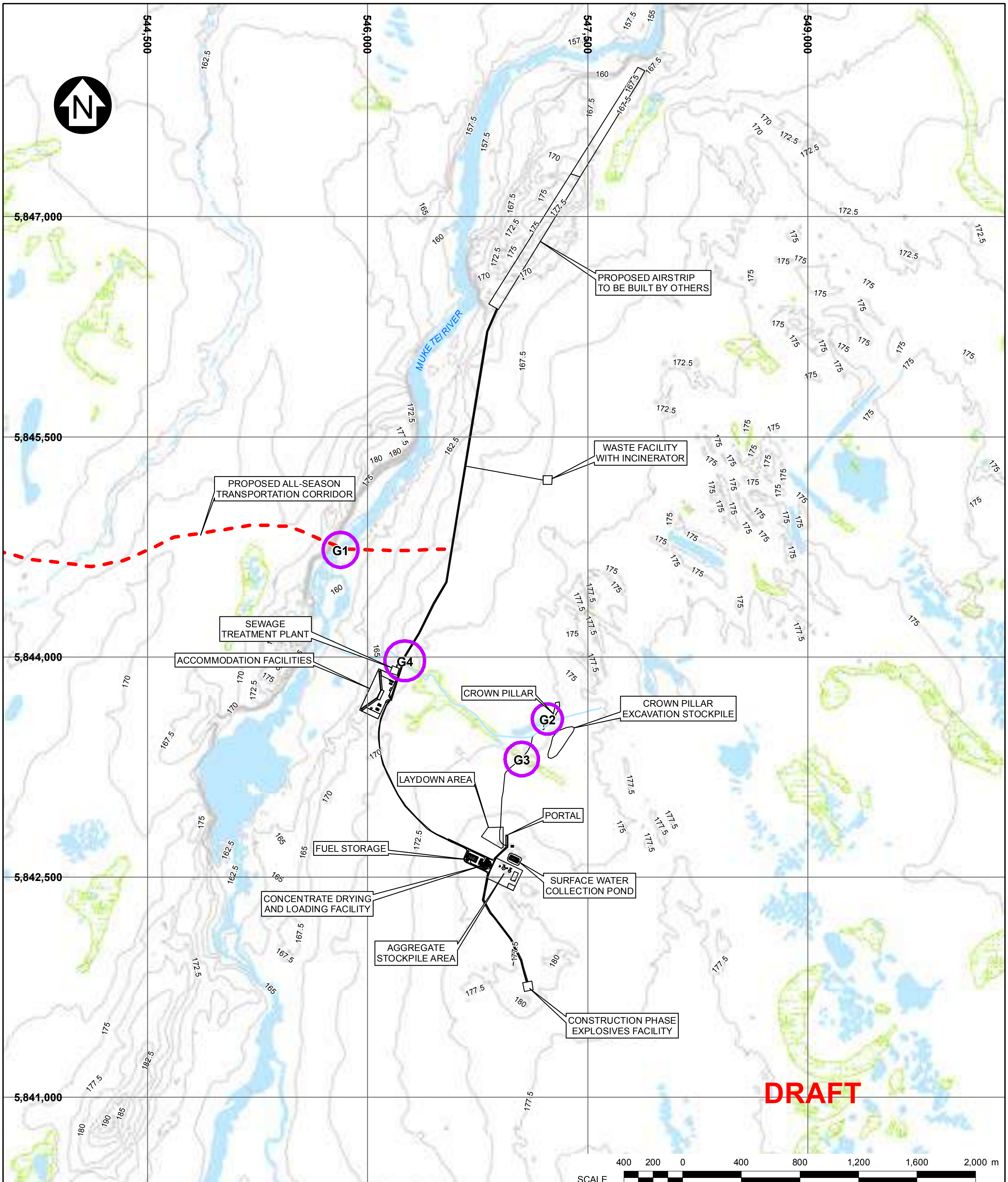
VEGETATION PLOT LOCATIONS IN THE MINE SITE AREA

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.10-8 REV A

SAVED: I:\102\00390\01\A\GIS\Figs\A678_rA.mxd; Dec 20, 2013 7:48 PM; skozmick



LEGEND:

- RIPARIAN ZONE
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- PROPOSED INFRASTRUCTURE
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND

NOTES:

1. BASE MAP PROVIDED BY SNC-LAVALIN GROUP INC. (2010).
2. COORDINATE GRID IS IN METRES.
   COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 2.5 METRES.
4. INFRASTRUCTURE INFORMATION AND PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

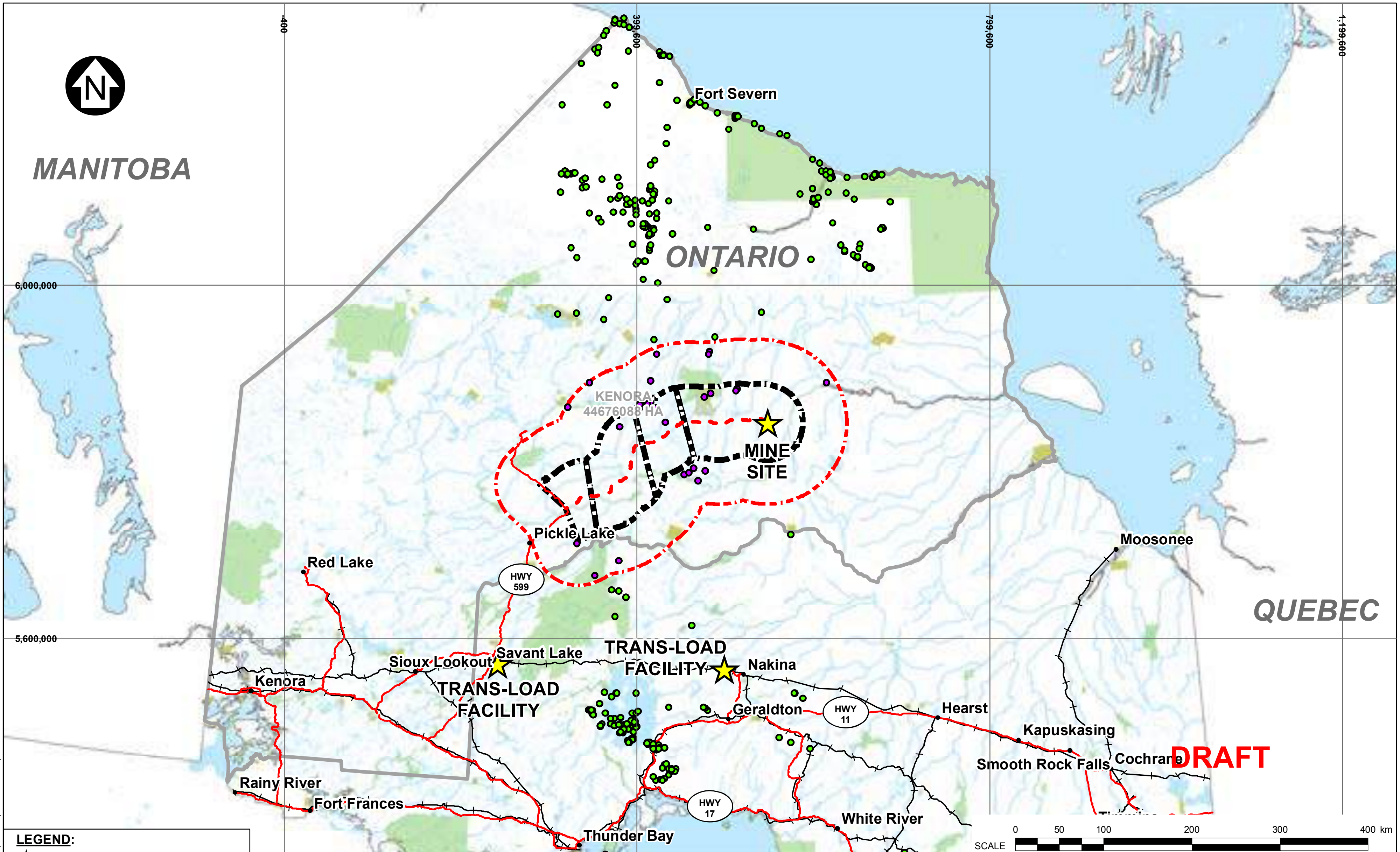
RIPARIAN ZONES AT THE MINE SITE

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.10-11 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	DKK	SWK	SRA	RAM



LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- COMMUNITY
- RARE PLANT SPECIES OCCURRENCE WITHIN KENORA DISTRICT
- RARE PLANT SPECIES OCCURRENCE WITHIN 50 KM RSA BUFFER
- RAILWAY
- EXISTING ALL-SEASON ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- WATER
- COUNTY OF KENORA
- TRANSPORTATION CORRIDOR REGIONAL STUDY AREA
- 50 KM BUFFER OF THE REGIONAL STUDY AREA

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013).
4. KENORA COUNTY BOUNDARY PROVIDED BY OLDHAM, M.J., AND S.R. BRINKER. 2009. RARE VASCULAR PLANTS OF ONTARIO, FOURTH EDITION. NATURAL HERITAGE INFORMATION CENTRE, ONTARIO MINISTRY OF NATURAL RESOURCES, PETERBOROUGH, ONTARIO. 188 PP.
5. RARE PLANT SPECIES OCCURENCE DATA PROVIDED BY THE NATURAL HERITAGE INFORMATION CENTRE, ONTARIO MINISTRY OF NATURAL RESOURCES (AUGUST 9, 2013). www.nhic.mnr.gov.on.ca

A	20DEC'13	ISSUED WITH REPORT	PAQ	SWK	SRA	RAM
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

RARE PLANT SPECIES OCCURRENCE WITHIN THE KENORA DISTRICT

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.10-12 REV A

SAVED: I:\1\02\00390\01\A\GIS\Figs\A683_rA.mxd; Dec 20, 2013 8:11 PM; skozmick

3.10.4.8 Project Location Summaries

Mine Site

The FNLC mapping shows that approximately 84% of the mine site area is made up of wetlands including woody wetlands (54%) and non-woody wetlands (30%) (Figure 3.10-3; Table 3.10-3). Other land cover classes in the area include mixed forest (6%), coniferous forest (3%) and disturbed areas (0.4%). The coniferous forests and wetlands were sampled with 64 vegetation plots (27 upland, 37 wetland) placed throughout the mine site area (Figure 3.10-8).

Field sampling resulted in the identification of six upland vegetation types including five Black Spruce types and one Tamarack type (Table 3.10-5). A total of 11 wetland ecosystem types were identified through field sampling including five woody wetland types (swamps, bogs and fens) and six non-woody wetland types (bogs, fens, and marshes) (Table 3.10-6). The mine site area had a far higher diversity of wetland types than any other portion of the project infrastructure and far lower upland vegetation type diversity than the other portions of the project infrastructure.

A total of 98 plant species were found within the 64 vegetation plots, which was more than the number of plant species found in the Ozhiski and Dearden areas but less than what was found in the PLNR and Cavell areas (Table 3.10-4). None of the rare plant species identified by the NHIC (up to 90 km from the Project infrastructure) were found in the mine site area. In order to establish baseline conditions, tissue chemistry was determined for one herbaceous plant and one woody plant from each of a conifer forest, a non-woody wetland and a woody wetland (Table 3.10-8).

Dearden Lake

The FNLC mapping shows that approximately 51% of the Dearden Lake area is made up of forests including conifer forest (25%), mixed forest (20%), and deciduous forest (6%) (Figure 3.10-3; Table 3.10-3). The other land cover classes in the area include wetlands (17%) and disturbed areas (11%). Coniferous forests, mixed forests, hardwood forests, and wetlands were sampled with 37 vegetation plots (34 upland, 3 wetland) placed throughout the Dearden Lake area (Figure 3.10-7).

PLNR

The FNLC mapping shows that approximately 44% of the PLNR area is made up of forests including conifer forest (36%), mixed forest (5%), and deciduous forest (3%) (Figure 3.10-1; Table 3.10-3). Other land cover classes in the area include woody wetland (31%), non-woody wetland (11%), and disturbed area (6%). The forests and wetlands were sampled with 73 vegetation plots (70 upland, 3 wetland) placed throughout the PLNR area (Figure 3.10-5).

Field sampling resulted in the identification of 19 upland vegetation types including five Black Spruce types, one Tamarack type, two Jack Pine-Black Spruce types, two Jack Pine types, two Jack Pine-mixedwood types, three Trembling Aspen types, and two hardwood forest types (Table 3.10-5). Only one wetland ecosystem type was sampled (sparse treed fen) (Table 3.10-6). The PLNR area had higher diversity of upland vegetation types and lower diversity of wetland types than any other portion of the Project infrastructure. However, the FNLC mapping shows that 42% of the area is dominated by wetlands, indicating that wetland diversity is far higher than determined from the minimal amount of field sampling for wetlands in this area.

A total of 101 plant species were found within the 73 vegetation plots (Table 3.10-4). None of the rare plant species identified by the NHIC (up to 50 km from the RSA boundary) were found in the PLNR area.

Figure 3.10.13 shows OLC in the Cavell Trans-Load Area. This mapping shows that approximately 50% the land area is made up of forests.

Savant Lake Trans-load Facility

Since the Savant Lake Trans-load Facility is a brownfield site and will not require modification of adjacent terrestrial habitats, no vegetation field plots were assessed in this location. However, the OLC mapping was used to characterize the cover types within a 1 km and a 5 km radius (see Figures 3.10-14 and 3.10-15). Table 3.10-9 shows that the majority of the adjacent area at both scales is covered by forest (88 to 90%), primarily conifer. Roughly 10% of the area is disturbed, including the proposed trans-load facility, and there is very little wetland (up to 2%).

Knight Piésold CONSULTING

TABLE 3.10-9

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

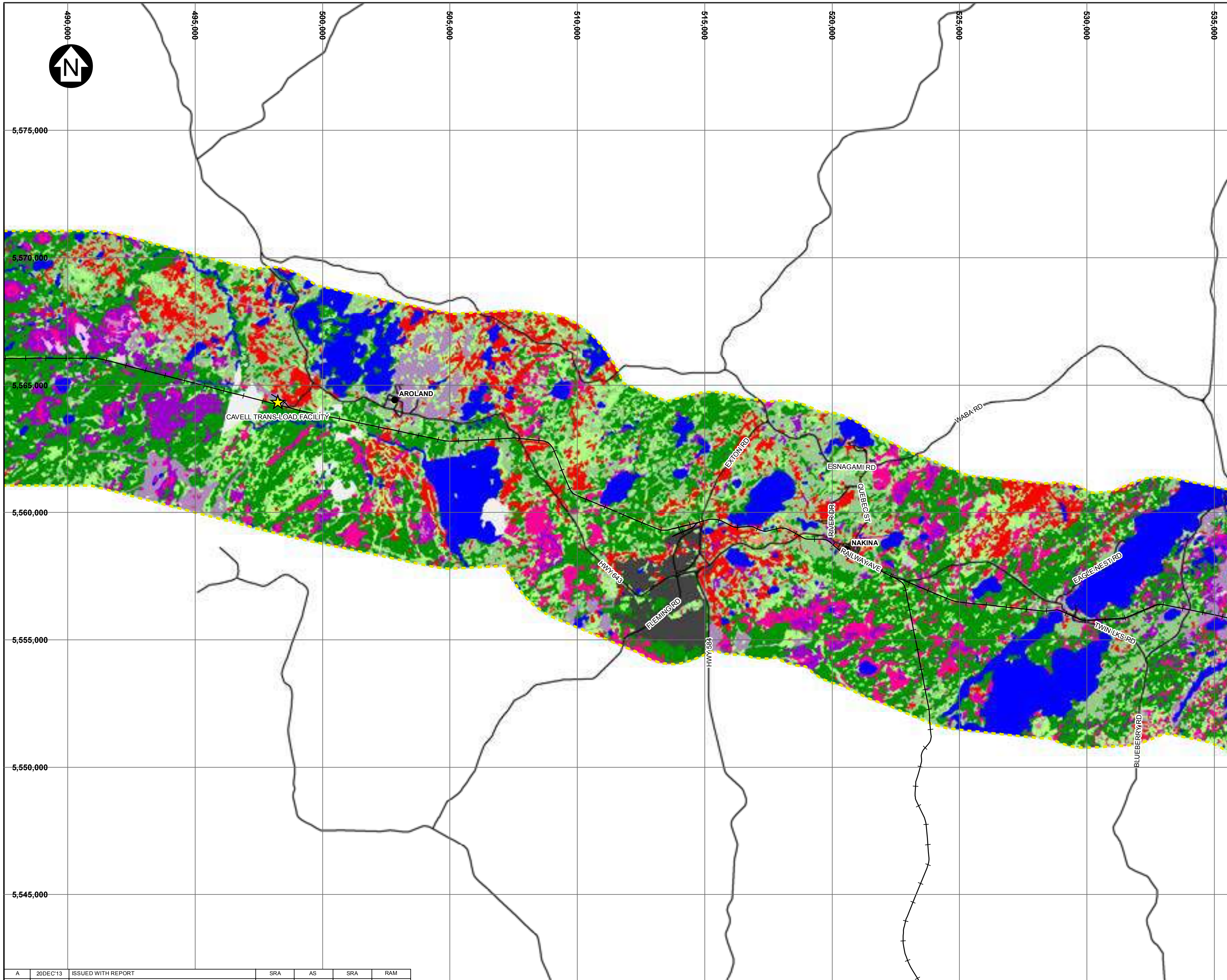
ONTARIO LAND COVER MAPPING IN THE SAVANT LAKE TRANS-LOAD FACILITY AREA

Print Dec/21/13 1:44:35

Ontario Land Cover Type	Far North Cover Type	1 km Radius		5 km Radius	
		Area (ha)	%	Area (ha)	%
Forest - Dense Coniferous	Coniferous Treed	239.5	45.1	4363.4	54.5
Forest - Dense Mixed Forest - Sparse	Mixed Treed	216.8	40.8	2651.3	33.2
Forest - Dense Deciduous	Deciduous Treed	11.1	2.1	152.5	2.1
Forest Depletion - Cuts	Disturbed	52.6	9.9	784.2	10.0
Bog - Treed Fen - Treed	Woody Wetland	10.3	1.9	68.4	0.1
Bog - Open Fen - Open	Non-Woody Wetland	0.8	0.2	9.2	0.1
Total		531.1		8029.0	

I:\1\02\00390\01\A\Report\Report 34, EA Volume 2 - EA Report\REV A\8 - Section 3 - Existing Environment\1 - Draft\Tables\[Table 3.10-9 - OLC in the Savant Lake Trans-Load Facility Area.

A	20DEC'13	ISSUED WITH REPORT NB102-390/1-34	PQ	KC	SRA
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D



LEGEND:

- CAVELL TRANS-LOAD FACILITY
- COMMUNITY
- CONTOUR
- ROAD
- RAILWAY

ONTARIO LAND COVER

- 0
- 1. WATER - DEEP CLEAR
- 3. SETTLEMENT / INFRASTRUCTURE
- 4. SAND / GRAVEL / MINE TAILINGS
- 7. FOREST DEPLETION - CUTS
- 10. FOREST - SPARSE
- 11. FOREST - DENSE DECIDUOUS
- 12. FOREST - DENSE MIXED
- 13. FOREST - DENSE CONIFEROUS
- 20. FEN - OPEN
- 21. FEN - TREED
- 22. BOG - OPEN
- 23. BOG - TREED
- 28. OTHER - UNKNOWN
- 29. OTHER - CLOUD / SHADOW

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. "SPECTRANALYSIS INC. 2004. INTRODUCTION TO THE ONTARIO LAND COVER DATABASE. SECOND EDITION (2000): OUTLINE OF PRODUCTION METHODOLOGY AND DESCRIPTION OF 27 LAND COVER CLASSES. REPORT TO ONTARIO MINISTRY OF NATURAL RESOURCE, UNPUBLISHED."

DRAFT

SCALE 1 0.5 0 1 2 3 4 5 km

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

ONTARIO LAND COVER IN THE CAVELL TRANS-LOAD AREA

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.10-13 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	SRA	AS	SRA	RAM

SAVED: I:\1102\00390\01\A\GIS\Figs\A684_rA.mxd; Dec 20, 2013 8:05 PM; skozmick

LEGEND:

- EXISTING ALL-SEASON ROAD
- RAILWAY
- PROPOSED HYDRO CORRIDOR
- PROPOSED INFRASTRUCTURE
- WETLAND
- SURFACE WATER COLLECTION POND
- TRANS-LOAD FACILITY 1 KM BUFFER

ONTARIO LAND COVER

- WATER - DEEP CLEAR
- FOREST DEPLETION - CUTS
- FOREST - SPARSE
- FOREST - DENSE MIXED
- FOREST - DENSE DECIDUOUS
- FOREST - DENSE CONIFEROUS
- FEN - TREED
- BOG - OPEN
- BOG - TREED

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. DATUM: NAD83 PROJECTION: UTM ZONE 16N
3. INFRASTRUCTURE IS BASED ON INFORMATION PROVIDED BY TETRA TECH (APRIL 19 2012).
4. ONTARIO LAND COVER DATA PROVIDED BY OMNR. SPECTRANALYSIS INC. (2004).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	PAQ	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

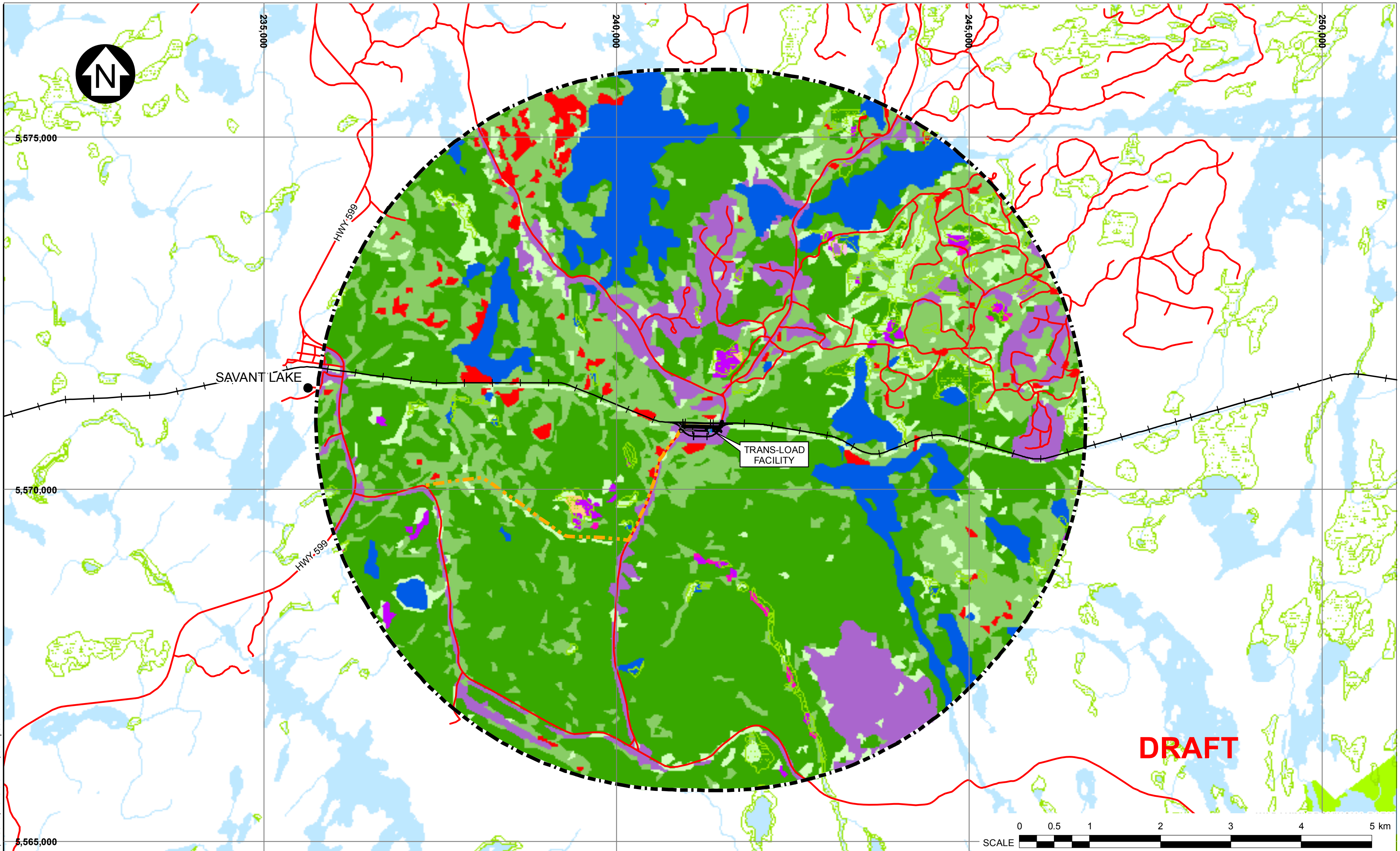
ONTARIO LAND COVER WITHIN 1 KM OF THE SAVANT LAKE TRANS-LOAD FACILITY

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 3.10-14 | REV A

SAVED: I:\1102\00390\01\A\GIS\Figs\A685_rA.mxd; Dec 20, 2013 8:13 PM; asimpson



LEGEND:

- COMMUNITY
- EXISTING ALL-SEASON ROAD
- RAILWAY
- PROPOSED HYDRO CORRIDOR
- PROPOSED INFRASTRUCTURE
- WETLAND
- SURFACE WATER COLLECTION POND
- TRANS-LOAD FACILITY 5 KM BUFFER

ONTARIO LAND COVER

- WATER - DEEP CLEAR
- FOREST DEPLETION - CUTS
- FOREST - SPARSE
- FOREST - DENSE MIXED
- FOREST - DENSE DECIDUOUS
- FOREST - DENSE CONIFEROUS
- FEN - TREED
- BOG - OPEN
- BOG - TREED

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. INFRASTRUCTURE IS BASED ON INFORMATION PROVIDED BY TETRA TECH (APRIL 19, 2012).
5. ONTARIO LAND COVER DATA PROVIDED BY OMNR. SPECTRANALYSIS INC. (2004).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	PAQ	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

ONTARIO LAND COVER WITHIN 5 KMS OF THE SAVANT LAKE TRANS-LOAD FACILITY

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 3.10-15 | REV A

SAVED: I:\1102\00390\01\A\GIS\Figs\A686_rA.mxd; Dec 20, 2013 8:07 PM; asimpson

3.10.5 Summary

The results of the literature review that are most applicable to conducting field studies in the RSA include the following:

- the Provincial Land Cover-2010 database is the best land cover mapping to use for landscape-level studies in the RSA
- based on available information, 34 field plots have been assessed by the provincial and federal governments within the RSA

The results of the baseline vegetation field studies are summarized below:

- Vegetation studies were conducted at six Project infrastructure locations including the mine site (east end of the transportation corridor), Dearden Lake (east central portion of the transportation corridor), Ozhiski Lake (west central portion of the transportation corridor), PLNR (west end of the transportation corridor), the Savant Lake Trans-load Facility and the Cavell Trans-load Facility
- 236 vegetation plots were assessed - 177 upland plots and 59 wetland plots
- 178 plant species were found
- 25 different upland vegetation types were identified and described:
  - The least productive upland vegetation type was the “Cedar (mixedwood)/Speckled Alder/Sphagnum” type; however, four of the “Jack Pine-dominated” types also had very low productivity levels
  - The highest productivity upland vegetation types included the “Trembling Aspen (White Birch) - Balsam Fir/Mountain Maple”, “Trembling Aspen - Balsam Fir/Balsam Fir Shrub”, and “Black Spruce/Ericaceous Shrub/Sphagnum” types
  - The types with the highest moisture levels included “Tamarack (Black Spruce)/Speckled Alder/Labrador Tea” and “Black Spruce/Leatherleaf/Sphagnum”; those with the lowest moisture levels were the “Jack Pine-dominated” types
  - 94% of the upland vegetation (forest) plots were mapped as forest and 6% were mapped as cover types other than forests
  - 90% of the upland vegetation plots were correctly mapped to the level of forest cover type including coniferous treed, deciduous treed, mixed treed and disturbed
- 17 wetland types were identified and described:
  - There were eight woody wetland types and nine non-woody wetland types
  - The mapping of wetland cover types was much less accurate than the mapping of the forest cover types
  - 85% of the wetland plots were mapped as wetland and 15% were mapped as cover types other than wetlands
  - Only 39% of the wetland plots were correctly mapped to level of woody wetland versus non-woody wetland
- 13% of the RSA is open water (lakes, ponds, rivers, and streams) and 40% is wetland, thus, riparian ecosystems are very common in the RSA; and there are four locations at the mine site where riparian ecosystems will be affected by the Project.
- A list of rare plant communities is not currently available for Ontario’s Far North region, but a list of rare plant species was available. None of the plant species on the list were observed in the RSA.

- Baseline data for 30 different metals was obtained from plant tissue samples. The samples were taken at the mine site in conifer forest, woody wetland and non-woody wetland were obtained at the mine site. However, currently there are no provincial or federal standards for plant tissue chemistry, but the results may be used in the future to assess the impacts of the Project on the nearby vegetation.

3.11 MAMMALS

This section provides a description of the existing mammal baseline conditions for the Eagle's Nest Project. The supporting technical document that provides additional details regarding the study methods, results, and discussion is available in Appendix 8.

3.11.1 Study Area

The spatial boundaries for the characterization of baseline vegetation communities were delineated based on the location and extent of the Project during the construction, operation, and closure phases as well as ecological criteria including representation, size, and integrity.

3.11.1.1 Regional Study Area

The Project will have the greatest potential impact to vegetation during the development of the transportation corridor and the construction of the mine site infrastructure. The regional study area (RSA) (Figure 3.11-1) for the mammal studies is ~2,532,746 ha (25,327 km^2) and was chosen based on three primary criteria as follows.

- ***Ecological Representation*** - The RSA area was determined to be representative of the variety of regional forest and wetland types as well as natural disturbances (mainly fire) that occur in the Project region. Representation was evaluated by comparing the land cover composition of the RSA with the land cover composition of Ecodistricts 2W-2 (Appendix A; from Henson et *al*., in press) and 2W 3 (Appendix B; from Henson et *al*., in press) (see Table 3.11-1), which together include more than 95% of the RSA. Table 3.11-1 shows that all land cover types in these two ecodistricts are well represented within the RSA except for the categories: "other natural", "burn", and "regenerating depletion", which are classes that were not used for the Far North Land Cover (FNLC) mapping. The category of "other natural" may have been used to include the FNLC map classes of deciduous forest, conifer swamp, treed peatland, thicket swamp, and open fen. And the categories of "burn" and "regenerating depletion" may have been used to include the FNLC map classes of disturbance-forest and/or shrub and disturbance-non and sparse woody.
- ***Size*** - According to Vásárhelyi et al. (2002) the RSA is more than three times as large as the minimum area required (7,200 km^2) to sustain viable populations of the two wide-ranging predators found in the RSA: wolves and black bears. By maintaining habitat for these focal species, the probability of maintaining habitat for other wildlife in the RSA is also high.
- ***Ecological Integrity*** - The RSA has an extremely high level of ecological integrity with more than 95% undisturbed by human activity. In addition, more than 95% of the 20 km buffer area adjacent to the RSA has also not been significantly disturbed by human activity. The higher the integrity of the buffer area, the lower the probability is for species extinction within the RSA (Parks and Harcourt, 2002).

Knight Piésold
CONSULTING

TABLE 3.11-1

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

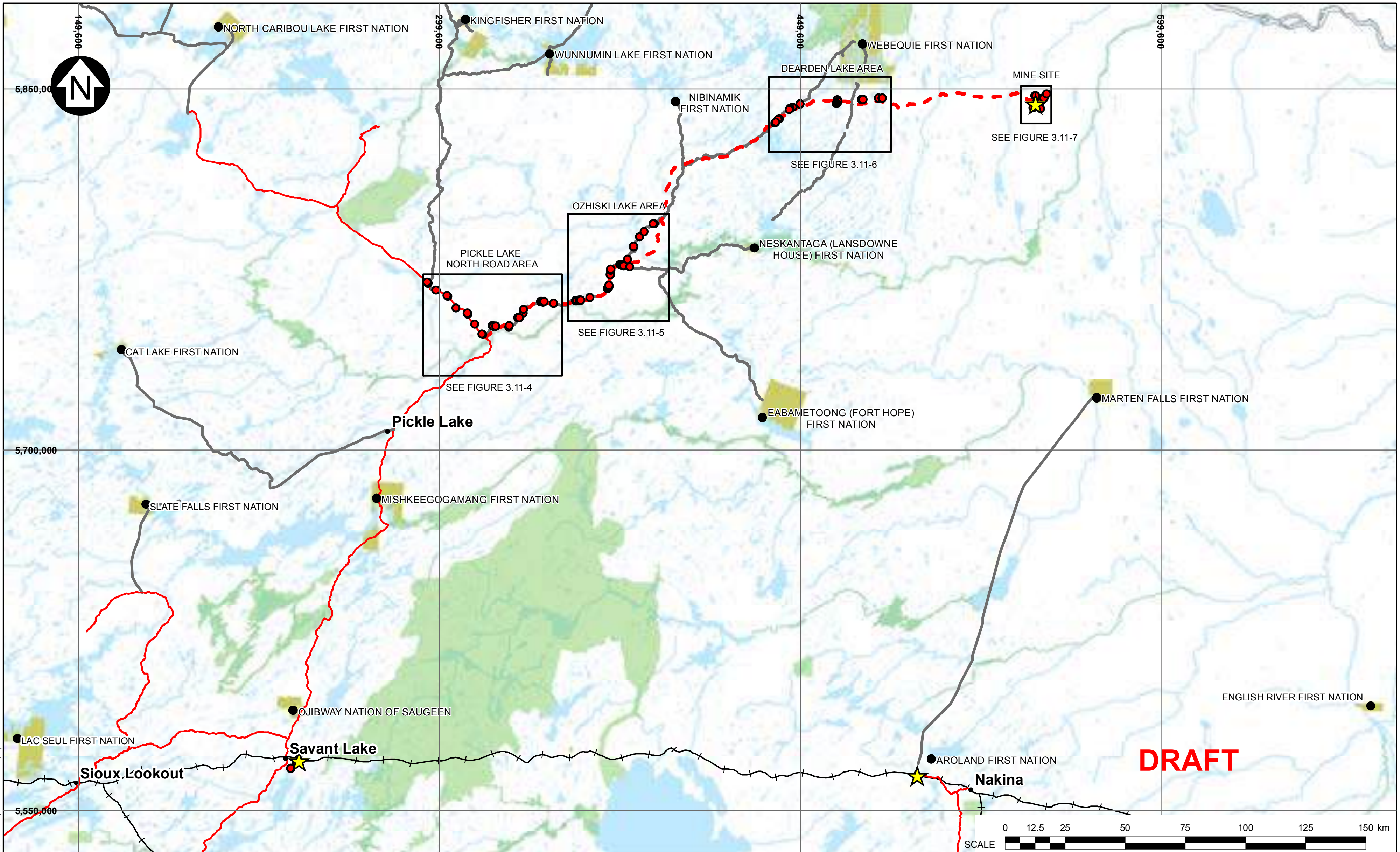
LAND COVER TYPE REPRESENTATION IN THE RSA

Print Dec/21/13 1:45:31

Land Cover Type	RSA		Ecodistrict 2W-3	Ecodistrict 2W-2
	ha	%	%	%
Forest				
Coniferous Forest	415854	25	25	19
Mixed Forest	76030	5	12	0
Deciduous Forest	50907	3	NA	NA
Sparse Forest	114035	7	26	20
Wetland				
Coniferous Swamp	146940	9	NA	NA
Treed Peatland	103282	6	NA	NA
Sparse Treed Fen	81366	5	5	8
Thicket Swamp	14095	1	NA	NA
Open Bog	161970	10	0	19
Treed Bog	136022	8	8	21
Open Fen	12543	1	NA	NA
Other Natural		NA	6	8
Disturbance				
Disturbance - Forest and/or Shrub	101580	6	NA	NA
Disturbance - Non and Sparse Woody	13644	1	NA	NA
Burn		NA	11	5
Regenerating Depletion		NA	7	0

I:\1\02\00390\01\A\Report\Report 34, EA Volume 2 - EA Report\REV A\8 - Section 3 - Existing Environment\1 - Draft\Tables\[Table 3.11-1.xlsx]

A	20DEC'13	ISSUED WITH REPORT NB102-390/1-34	DD	PQ	RAM
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D



LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- COMMUNITY
- MAMMAL TRANSECT LOCATION
- EXISTING ALL-SEASON ROAD
- EXISTING WINTER ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- RAILWAY
- WATER
- PARK
- FIRST NATIONS RESERVE

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. SAMPLE PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011).
4. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

WINTER MAMMAL SURVEY LOCATIONS OVERVIEW

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 3.11-1 | REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	PQ	AS	SRA	RAM

SAVED: I:\1102\00390\01\A\GIS\Figs\A713_rA.mxd; Dec 20, 2013 5:10 PM; spenfold

3.11.1.2 Local Study Area

The LSA is the zone where there is reasonable potential for immediate interaction between Project components and the Valued Ecosystem Components (VECs) and it is generally the Project footprint, which includes the mine and associated infrastructure, with a buffer of varying distances, depending on the VECs.

The following impacts to mammals are anticipated:

- Physical loss of mammal habitat within the Project footprint
- Dust deposition, anthropogenic light, and Project-related noise may result in the degradation of mammal habitat up to 1 km from Project infrastructure
- Mammal mortality from collisions with vehicles

Based on these anticipated impacts, we chose a 1 km distance from the Project infrastructure as the outer boundary of the LSA.

3.11.2 Methodology

3.11.2.1 Introduction

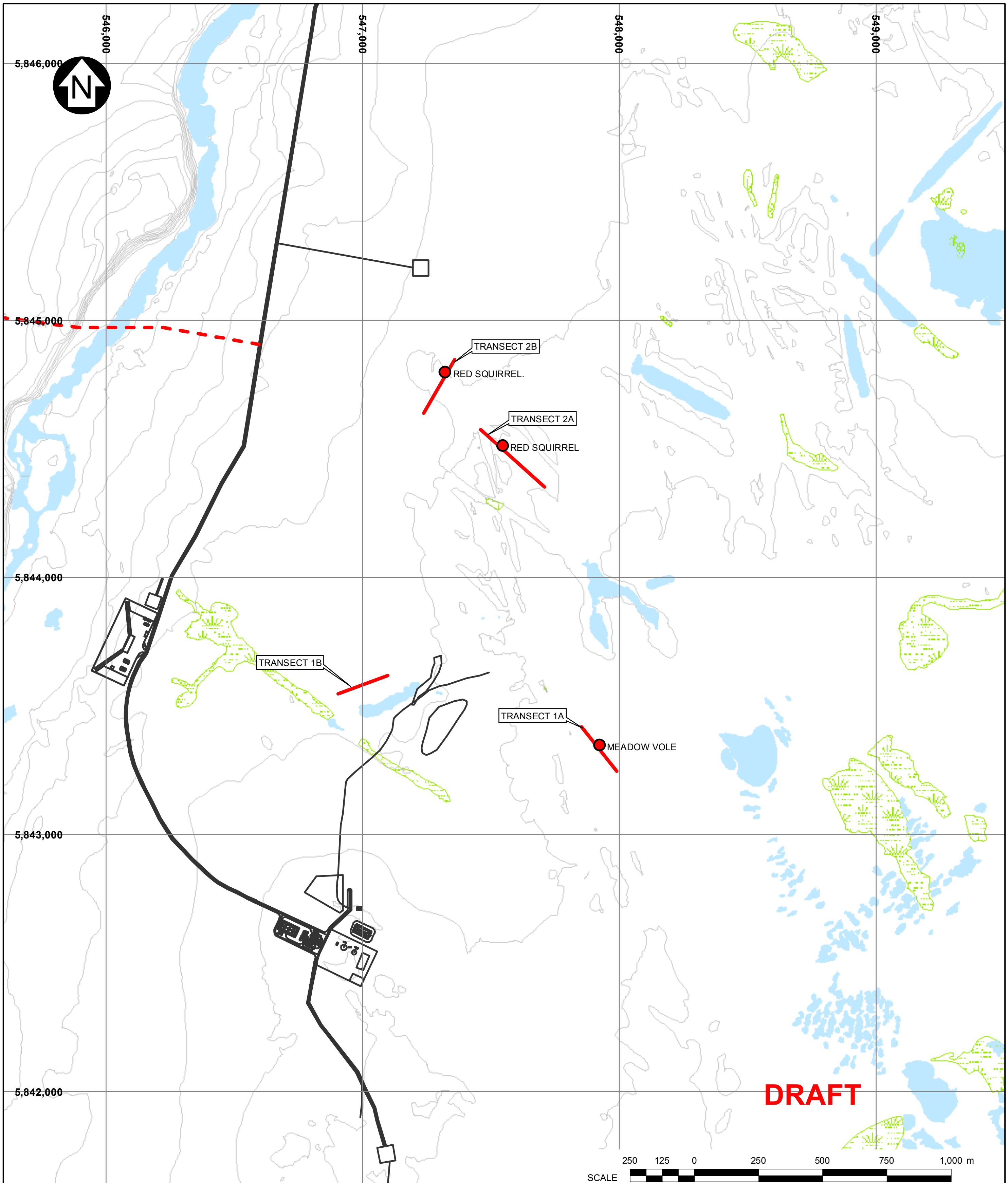
Survey methods for mammals can be expensive (e.g., helicopter surveys), may only cover a small area (e.g., remote cameras), or may be ineffective for some applications (e.g., track plates; N. Dawson, MNR, pers. comm., 2010). The most cost effective methods for conducting mammal surveys in the RSA were determined to be assessing transects in the winter for animal tracks and small mammal trapping in the summer. Winter tracking surveys are accepted methods for detecting mammal species (Bayne et al., 2005; Pellikka et al., 2005; Nielsen et al., 2007) and for estimating relative abundance for comparison across species and habitat types (Pulliainen, 1981; Thompson et al. 1989; Beauvais and Buskirk, 1999). In addition, trapping during the growing season is a common and effective technique for determining the presence and abundance of small mammals (Konze & McLaren, 1997; Rogers et *al*., 2008)

Transects were selected using representative proportional sampling of five major habitat types based on the FNLC mapping along the transportation corridor and at the mine site. Relative abundance for the five major land cover classes were calculated for each survey location, and were used as targets for field sampling. The surveyed habitat categories were conifer forest, mixed forest, disturbed areas, woody wetland, and non-woody wetland. Deciduous forests were excluded from these studies as their locations in the RSA were too far from the winter road to access on snowshoes. Figure 3.11-1 shows the location of the study area and the locations of the winter transects, and Figure 3.11-2 shows the location of the summer small mammal trap lines.

3.11.2.2 Winter Tracking

Winter surveys were conducted from March 8 to 15 and March 22 to 28 in 2011 and from February 8 to 14 in 2012. Two types of 500 m transects were used for these surveys. The first type ran perpendicular to a road with surveyors snowshoeing in opposite directions from the same point on the road. The second type ran parallel to a road and consisted of consecutively run 500 m transects for a distance of one or two km.

Along the all-season portion of the PLNR route, both types of transects were used and were established every five km. Along the winter road, both types of transects were also used and were established every seven km where the road was wide enough to safely park a vehicle. In the mine site area, ten transects were assessed using a snowmobile to access the sample locations. The portion of the transportation corridor without an existing winter road was accessed by helicopter where four transects were assessed.



LEGEND:

- MAMMAL CAPTURE
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- PROPOSED INFRASTRUCTURE
- MAMMAL SUMMER TRANSECT
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND

NOTES:

1. BASE MAP PROVIDED BY SNC-LAVALIN GROUP INC., (2010).
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 2.5 METRES.
4. MAMMAL PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011).
5. INFRASTRUCETURE INFORMATION AND PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

LOCATION OF SUMMER TRANSECTS MINE SITE

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.11-2 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	KC	AS	SRA	RAM

SAVED: I:\102\00390\01\A\GIS\Figs\A688_rA.mxd; Dec 20, 2013 7:17 PM; asimpson

Standardized mammal tracking protocols used by Bayne et al. (2005) were adapted for these surveys, which were conducted at least 12 hours after a snowfall. All tracks that crossed a surveyor's path were identified to species or species group and recorded unless the surveyor could visually confirm that it was the same animal doubling back. Snow depth, temperature, and work effort (start and end time) were also recorded. Survey sites and GPS tracks were logged with a hand-held GPS unit.

Moose and Caribou were lumped into the ungulate category unless evidence could be found indicating which animal it was (e.g., pellet groups, feeding preferences). Where identification to species was not certain, genus was used (e.g., Weasel spp., Vole spp.). Presence and/or evidence of mammals observed while not conducting tracking surveys were recorded as incidental observations. Relative occurrence of species was quantified using two methods including 1) presence of a species within a transect, and 2) number of track crossings per 24 hour period.

3.11.2.3 Summer Trapping

Mammal trapping was conducted at the mine site in 2012 with 15 traps per transect along four transects for a total of 330 trap nights. Small mammal Sherman traps (LFG folding traps, 3" x 3.5" x 9") were set 20 m apart along transects within the following habitats (Figure 3.11-2):

- Non-woody wetland composed of stunted Black Spruce, Labrador Tea, Leatherleaf, and Sphagnum Mosses (N52.73859 W86.29307 to N52.73696 W86.28923); June 14 through 19, 2012 (six days)
- Non-woody wetland composed of stunted Tamarack/Black Spruce, Leatherleaf, and Sphagnum Mosses (N52.73976 W86.30527 to N52.74039 W86.30238); June 14 through 19, 2012 (six days)
- Dry upland Jack Pine stand (N52.74896 W86.29688 to N52.74692 W86.29323); June 26-30, 2012 (five days)
- Upland Poplar/Black Spruce stand (N52.74955 W86.30011 to N52.75142 W86.29834); June 26-30, 2012 (five days)

Prior to deployment, traps were locked open and "weathered" for four days in an open area where they were subject to several heavy rainfalls and hot sun. Along each transect, traps were set in shaded areas out of direct sun, and cotton batting for bedding was placed inside each trap. In addition, traps were baited with oats, sunflower seeds, mixed seeds and a piece of potato to provide water. Non-allergenic gloves were worn when handling traps to limit scent transference from the surveyors. Traps were checked for captured animals early each morning.

3.11.2.4 Incidental observations

Incidental observations of mammals included the following:

- Individuals and signs other than tracks (e.g., browse, scat) seen along the winter transects
- Individuals and signs including tracks (e.g., browse, scat) seen while not surveying along the winter transects during both winter and summer
- Mammal trails seen from helicopter flights
- Sightings by people living and working in the RSA

3.11.3 Results

3.11.3.1 Introduction

The Atlas of the Mammals of Ontario (Dobbyn, 1994) lists 38 species within or near the RSA (Table 3.11-2). Bat species were not listed in the Atlas due to the difficulty of detection, identification and accessibility. The MNR's FNTB study detected 15 species of mammals within the Ring of Fire in the summer of 2010 (Phoenix, 2010) all of which were also listed in the Atlas.

For this baseline study, 16 mammals were identified from their tracks along transects. Four additional species were detected only as incidental observations during the winter surveys including Porcupine, Northern Flying Squirrel, Short-tailed Shrew, and an undetermined Shrew species. Another four species including Black Bear, Meadow Vole, Southern Red-back Vole, and Least Chipmunk were observed during summer baseline field studies resulting in a total of 22 mammal species detected within the RSA (Table 3.11-3).

Knight Piésold CONSULTING

TABLE 3.11-2

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

MAMMAL SPECIES EXPECTED IN THE RSA

Print Dec/21/13 1:46:20

Common Name	**Scientific Name[1]**
American Black Bear	*Ursus americanus*
American Marten	*Martes americana*
American Mink	*Mustela vison*
Arctic Fox	*Alopex lagopus*
Arctic Shrew	*Sorex arcticus*
Beaver	*Castor canadensis*
Canada Lynx	*Lynx canadensis*
Deer Mouse	*Peromyscus maniculatus*
Eastern Chipmunk	*Tamias striatus*
Ermine	*Mustela erminea*
Fisher	*Martes pennanti*
Heather Vole	*Phenacomys ungava*
Least Chipmunk	*Neotamias minimus*
Masked Shrew	*Sorex cinereus*
Meadow Jumping Mouse	*Zapus hudsonius*
Meadow Vole	*Microtus pennsylvanicus*
Moose	*Alces americanus*
Muskrat	*Ondatra zibethicus*
North American River Otter	*Lontra canadensis*
Northern Bog Lemming	*Synaptomys borealis*
Northern Flying Squirrel	*Glaucomys sabrinus*
Northern Gray Wolf	*Canis lupus occidentalis*
Northern Raccoon	*Procyon lotor*
Porcupine	*Erethizon dorsatum*
Pygmy Shrew	*Sorex hoyi*
Red Fox	*Vulpes vulpes*
Red Squirrel	*Tamiasciurus hudsonicus*
Snowshoe Hare	*Lepus americanus*
Southern Bog Lemming	*Synaptomys cooperi*
Southern Red-back Vole	*Clethrionomys gapperi*
Star-nosed Mole	*Condylura cristata*
Water Shrew	*Sorex palustris*
White-tailed Deer	*Odocoileus virginianus*
Wolverine	*Gulo gulo*
Woodchuck	*Marmota monax*
Woodland Caribou	*Rangifer tarandus caribou*

I:\1\02\00390\01\A\Report\Report 34, EA Volume 2 - EA Report\REV A\8 - Section 3 - Existing Environment\1 - Draft\Tables\[Table 3.11-2.xlsx]Table 3.11-2

NOTES:
1. SOURCE: DOBBYN, J.S. 1994. ATLAS OF THE MAMMALS OF ONTARIO. FEDERATION OF ONTARIO NATURALISTS, TORONTO. 120 PP.

A	20DEC'13	ISSUED WITH REPORT NB102-390/1-34	DD	PQ	RAM
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

TABLE 3.11-3

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

MAMMAL SPECIES FOUND WITHIN THE RSA

Print Dec/21/13 1:46:43

Species[1]	Present in Transects[2]	Incidental Observations[3]
American Black Bear		X
American Marten	X	X
American Mink	X	
Beaver		X
Canada Lynx	X	X
Fisher	X	X
Least Chipmunk		X
Meadow Vole		X
Moose	X	X
Mouse spp.	X	
North American River Otter	X	X
Northern Flying Squirrel		X
Northern Gray Wolf	X	X
Porcupine		X
Red Fox	X	
Red Squirrel	X	
Short-tailed Shrew		X
Shrew spp.		X
Snowshoe Hare	X	
Southern Red-backed Vole		X
Squirrel spp.	X	
Ungulates (Caribou/Moose)	X	
Vole spp.	X	
Weasel spp.	X	
Wolverine	X	X
Woodland Caribou		X

I:\1\02\00390\01\A\Report\Report 30, EA - Mammals Baseline Report\Tables\[Tables in KP Template (Nov 29, 2013).xlsx]Table 4.1

NOTES:

1. SEE TABLE 2.1 FOR SCIENTIFIC NAMES EXCEPT FOR: MOUSE SPP. = CRICETIDAE SPP.; SHORT-TAILED SHREW = BLARINA BREVICAUDA; SHREW SPP. = SORICIDAE SPP.; SQUIRREL SPP. = SCIURIDAE SPP.; VOLE SPP. = CRICETIDAE SPP.; WEASEL SPP. = MUSTELA SPP.

2. KNIGHT PIESOLD LTD. 2011 AND 2012 FIELD INVESTIGATIONS.

3. REFER TO APPENDIX C FOR INCIDENTAL OBSERVATION DETAILS.

A	20DEC'13	ISSUED WITH REPORT NB102-390/1-34	DD	PQ	RAM
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

3.11.3.2 Winter Tracking

Presence Within Transects

A total of 77 transects were completed. Nineteen of them were located within conifer forest, eight in mixed forest, nine in disturbed areas, 13 in woody wetlands and 28 in non-woody wetlands (Table 3.11-3). Along the transportation corridor, surveys were carried out in the following four areas (Figure 3.11-1):

- Pickle Lake North Road (PLNR, formerly Highway 808), north-east of Pickle Lake and the southern portion of the winter road to km 60; number of transects = 27
- Km 61 to km 110 on the winter road; number of transects = 25
- Km 111 to Webequie; number of transects = 11
- Mine site; number of transects = 14

The PLNR and mine site area were sampled to represent the west and east end of the RSA, respectively; and the two other locations along the winter road were chosen to represent the central portions of the proposed transportation corridor.

The mammals detected most often in the transects were American Marten (detected in 49% of all transects) and Snowshoe Hare (36%) (Table 3.11-3). Marten was detected most often in woody wetland (85%) and non-woody wetland (43%), while Snowshoe Hare was the most often detected in conifer forest (63%), mixed forest (50%) and disturbed areas (44%). Fisher was the second most detected mammal (after Marten) in Non-woody Wetland transects (36%).

Moose and Red Fox were detected in 13% of the transects, and both were found in 11% and 25% of the conifer and mixed forest transects respectively. Moose, however, occurred most often in the disturbed habitats (44%). Fox were also found in nearly a quarter of the woody wetland transects.

Mouse tracks were detected in 10% of the transects although they were likely undetected in many transects because they stayed beneath the snow cover. They were not detected in mixed woods or disturbed transects, but were found in woody wetlands and non-woody wetlands. It is possible that the wetter habitat forced them onto the snow surface more often, while the shrub growth in the dry mixed forests and in the disturbed habitats created more usable snow chambers and tunnels for travelling beneath the surface.

Gray wolf was found in nearly 10% of the transects, and most often in conifer forests (21%). Habitat associations are likely to change with other surveys though because of the wandering nature of wolf packs and the location of a kill. For example, transects located near a kill site will have numerous Wolf tracks yet the following year there may be no tracks.

3.11.3.3 Tracks Over 24 hours

Overall relative abundance of mammals detected using number of tracks/24 hr period is similar to the relative abundance based on number of transects surveyed (Table 3.11-4). Snowshoe Hare was abundant with a total of 97 tracks/24 hr, followed by American Marten (55 tracks/24 hr), and Fisher (21 tracks/24 hr). Red Fox was the next most abundant (11 tracks/24 hr). This does not mean these mammals are necessarily the most abundant in the RSA, although in the case of the Snowshoe Hare this may be true. Relative abundance measures based upon tracks/24 hr are subject to a bias from the way an animal moves in its environment. The Mustelids tend to zig-zag while hunting or exploring and the same animal may be detected numerous times on one transect. Also, they may be detected in nearby transects due to their larger home ranges. Hares do not have as large a home range, but a single hare may produce many tracks as it retraces its path several times a day.

Gray Wolf and Moose were nearly the same (7.3 and 6.7 tracks/24 hr). In terms of number of tracks at different locations, Wolf tracks were not found in the southern half of the transportation corridor (PLNR, Ozhiski Lake), but were most abundant in the northern half (Dearden Lake). Moose tracks were also most abundant in the Dearden Lake portion of the transportation corridor (3 tracks/24 hr).

Knight Piésold CONSULTING

TABLE 3.11-4

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

RELATIVE ABUNDANCE OF MAMMALS WITHIN THE MAJOR HABITAT TYPES IN THE RSA BASED ON TRACK SURVEYS

Print Dec/21/13 1:47:31

Common Name	Scientific Name	Conifer Forest (Total Transects = 19)		Mixed Forest (Total Transects = 8)		Disturbed Areas (Total Transects = 9)		Woody Wetland (Total Transects = 13)		Non-woody Wetland (Total Transects = 28)		Total Transects (Total Transects = 77)	
		No. of Transects[1]	% of Transects	No. of Transects[1]	% of Transects	No. of Transects[1]	% of Transects	No. of Transects[1]	% of Transects	No. of Transects[1]	% of Transects	No. of Transects[1]	% of Transects
American Marten	*Martes americana*	9	47	3	38	3	33	9	69	12	43	36	47
Snowshoe Hare	*Lepus americanus*	12	63	4	50	4	44	4	31	4	14	28	36
Fisher	*Martes pennanti*	5	26	1	13	1	11	3	23	10	36	20	26
Moose	*Alces alces*	2	11	2	25	4	44	2	15	0	0	10	13
Northern Gray Wolf	*Canis lupus*	5	26	1	13	0	0	3	23	1	4	10	13
Red Fox	*Vulpes vulpes*	2	11	2	25	1	11	3	23	2	7	10	13
Mouse spp.	*Peromyscus spp.*	4	21	0	0	0	0	2	15	2	7	8	10
Canada Lynx	*Lynx canadensis*	2	11	1	13	0	0	0	0	4	14	7	9
Ungulate	*Alces/Rangifer*	2	11	0	0	0	0	3	23	2	7	7	9
Weasel spp.	*Mustela spp.*	1	5	3	38	0	0	1	8	1	4	6	8
North American River Otter	*Lantra canadensis*	3	16	0	0	1	11	1	8	0	0	5	6
Red Squirrel	*Tamiasciurus hudsonicus*	1	5	1	13	1	11	0	0	2	7	5	6
Squirrel spp.	*Tamiasciurus/Glaucomys*	2	11	2	25	0	0	0	0	0	0	4	5
Vole spp.	*Microtus/Myodes*	1	5	1	13	0	0	1	8	0	0	3	4
American Mink	*Neovison vison*	1	5	0	0	0	0	0	0	1	4	2	3
Wolverine	*Gulo gulo*	1	5	0	0	0	0	0	0	0	0	1	1

I:\1\02\00390\01\A\Report\Report 34, EA Volume 2 - EA Report\REV A\8 - Section 3 - Existing Environment\1 - Draft\Tables\[Table 3.11-4.xlsx]Table 3.11-4

NOTES:

1. "NO. OF TRANSECTS" REFERS TO THE NUMBER OF TRANSECTS WHERE THE SPECIES WAS OBSERVED.

A	20DEC'13	ISSUED WITH REPORT NB102-390/1-34	DD	PQ	RAM
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

3.11.3.4 Summer Trapping

Trapping was conducted at the Mine Site. In the first session (June 14-19), 15 traps were placed in a non-woody wetland composed of stunted Black Spruce, Labrador Tea, Leatherleaf, and Sphagnum Mosses (N52.73859 W86.29307 to N52.73696 W86.28923), and 15 traps were placed in non-woody wetland composed of stunted Tamarack/Black Spruce, Leatherleaf, and Sphagnum Mosses (N52.73976 W86.30527 to N52.74039 W86.30238). In the second session (June 26-30), 15 traps were placed in a dry upland conifer stand (Jack Pine) (N52.74896 W86.29688 to N52.74692 W86.29323), and 15 traps in an upland Poplar/Black Spruce stand (N52.74955 W86.30011 to N52.75142 W86.29834) (Figure 3.11-2). These are mapped in Figure 3.11-2.

Out of 330 trap nights, two Red Squirrels and one Meadow Vole were captured. The Vole was captured in the non-woody wetland during the first session, and one Squirrel was captured in the upland conifer cover type during the second session. The other Squirrel was captured in the poplar stand during the second session. The small number of small mammal captures in the summer was also reflected in the number of tracks in the winter where only one vole track was found.

3.11.3.5 Incidental Observations

Black bears were probably the most detected incidental sightings. With the exception of Fish Rock Lake bears were seen, either directly or by signs, at all vegetation/breeding bird and migratory sites.

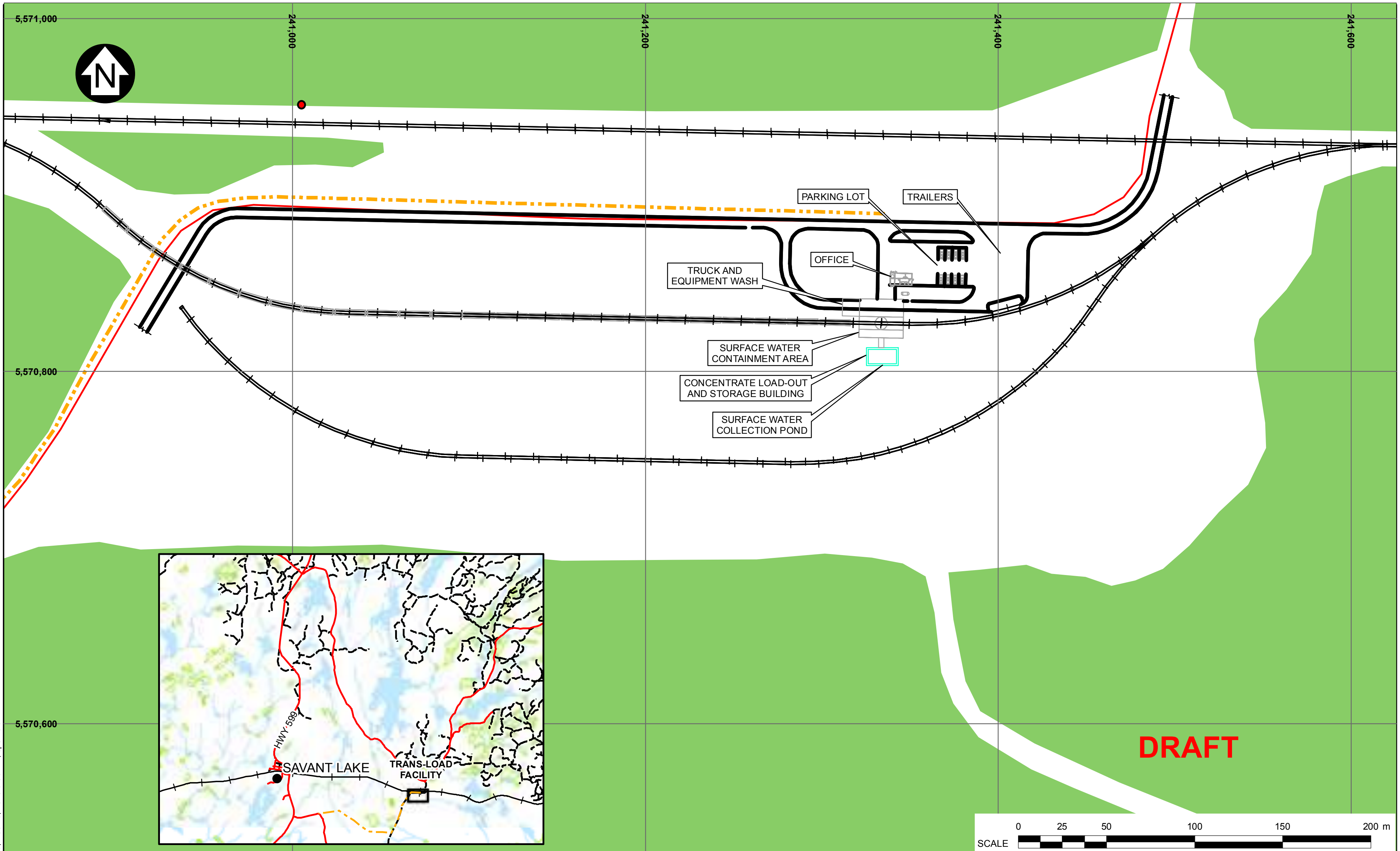
River Otter tracks were also spotted more often as incidentals (four records including one from helicopter) than they were during transects. Otter tracks were seen along waterways, which transects avoided due to safety issues of walking on the ice. Therefore, relative abundance estimates of River Otters based on transects may be underestimates.

Wolves were also seen or reported a number of times. Scott Jacobs (Manager Community Relations with Noront) reports that on Sunday March 13, 2011 they observed a wolf pack of around 10 wolves about 70-75 km southwest of Webequie toward the Summer Beaver Junction. Bernie Cox, owner of NorthStar Air, reported that residents had been hearing Wolves howling around Pickle Lake although none were detected on winter transects.

David Smith, trapper at Savant Lake, reports he took 14 wolves from his trapline by Savant Siding in 2010. He thinks he may have trapped the entire pack as in 2012 he saw eight moose on the ridge by his trapline, but no wolf tracks. The location of this incidental observation can be seen in Figure 3.11-3.

Wolverine were also not abundant on transects, but were more likely to be detected as incidental sightings, tracks, or as reports from residents. David Smith reported a Wolverine was recently killed by a truck, and that he thinks he had possible Wolverine young feeding on a Wolf carcass from his trapline.

Marten and Marten tracks were seen numerous times both on transects and as incidental sightings. KP surveyors photographed one feeding on a Moose carcass about 50 km south of Webequie. The snow around the Moose was packed solid by a Wolf pack that had been feeding on the Moose. David Smith reports that in 2007 a fire went through his trap area at Savant Siding, and consequently produced lots of Marten as he took 80 Marten from his trapline in 2010.



LEGEND:

- COMMUNITY
- MAMMAL SURVEY LOCATION
- EXISTING ALL-SEASON ROAD
- RAILWAY
- PROPOSED HYDRO CORRIDOR
- PROPOSED INFRASTRUCTURE
- RIVER/STREAM/DRAINAGE
- WATER
- SURFACE WATER COLLECTION POND
- FORESTED AREA
- WETLAND

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. INFRASTRUCTURE IS BASED ON INFORMATION PROVIDED BY TETRA TECH (APRIL 19, 2012).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

SAVANT SIDING MAMMAL LOCATIONS

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.11-3 REV A

A	20DEC'13	ISSUED WITH REPORT	ALR	SWK	SRA	RAM
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

3.11.3.6 Survey Locations

Introduction

The number of transects in which a species was detected provided similar estimates of relative abundance to tracks/24 hr period. Caribou were not detected on the transects although in a few cases the tracks observed could have been either Caribou or Moose so were recorded as "Ungulate". Caribou trails were detected during the helicopter flight from Webequie to the Mine Site (photos in Appendix).

PLNR Area

Marten were detected in 59% of the transects making them the most relative abundant mammal, while Fisher were second (33% of the transects). While Marten was still the most abundant mammal based on tracks (36 tracks/24 hr) Fisher was fourth (5 tracks/24 hr). This indicates that while the Fisher may be very widespread in the PLNR area, it may be less plentiful than the Marten. Alternately, it may indicate its travel path is less wandering than a Marten so it intersects the transect fewer times. Mice showed a similar pattern where they appeared in 30% of the transects but tracks were only just over 1 track/24 hr. The PLNR mammal transect locations can be seen in Figure 3.11-4.

Snowshoe Hare was most abundant at 36 tracks/24 hr, but slightly fewer transects that Fisher at 30%. Red Fox and Red Squirrel were fifth and sixth most abundant using both measures of relative abundance. There were no Wolves or Wolverines found in the PLNR portion of the transportation corridor.

Ozhiski Lake Area

Marten, Fisher and Hare were first, second, and third in relative abundance using both measures. While Fisher and Hare were both in 36% of the transects Hare were less abundant using track counts, and by the same measure, Fisher were more abundant in this section of the transportation corridor than anywhere else.

Lynx were fourth most abundant (percent of transects), but much less abundant (11th) using counts of tracks. Lynx tend not to deviate widely from their line of travel and are unlikely to cross a 500 m transect more than once. As well, they travel long distances and one Lynx could potentially cross more than one transect making it appear more abundant in terms of number of transects in which its tracks appeared. The Ozhiski Lake Area mammal transect locations can be seen in Figure 3.11-5.

As in the PLNR section, there were no Wolves or Wolverines found in this section on transects. However, Wolverine and Wolf were detected as incidentals.

Dearden Lake Area

Snowshoe Hare was found in 82% of the transects and with 49 tracks/24 hr making it the most abundant mammal detected. The second most abundant animal was either Moose (45% of transects, but 3 tracks/24 hrs) or Wolf (only 36% of the transects, but 6 tracks/24 hr). Both Moose and Wolf were more abundant here using both measures than at any other section.

Marten were least abundant here than at any other section. A few Marten traps (one with a Marten still in the trap) were seen along this section of the winter road so this may be partly responsible for Marten being found in fewer transects. However, being found in 36% of the transects still indicates a widespread mammal. The Ozhiski Lake Area mammal transect locations can be seen in Figure 3.11-6.

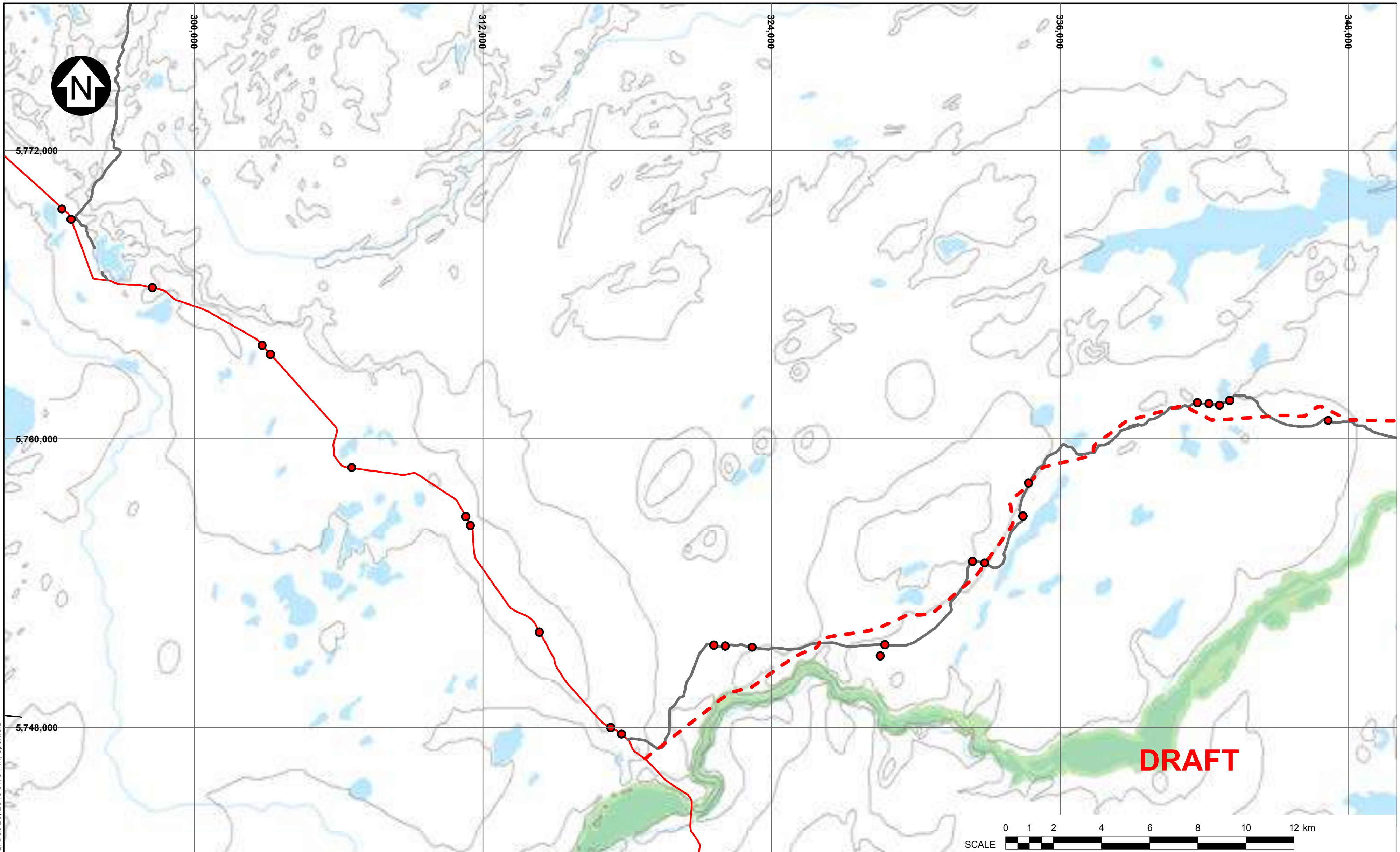
Lynx were also more abundant (18% of transects) than elsewhere in terms of both types of estimates of abundance. As well, this was the only section in which Wolverine were found in transects (9%) although as noted previously two incidental track sightings were from the more southern section, Ozhiski Lake.

Mine Site Area

Transects conducted at the other sites along the winter road could be spaced out over 80 to 100 km, but transects at the Mine Site were in closer proximity due to the nature of the trail network. This may result in some wide-ranging mammals being detected in more transects here than other sites. As well, it is possible that some species were missed completely because they avoided the human activity at the site (e.g. Wolverine and Lynx were not detected), which was greater than along the winter road.

Marten, Fisher, Hare, Wolf, Moose and Red Fox were detected in 21-57% of the transects, with Marten and Fisher being the most common (56 and 43% respectively). However, number of tracks/24 hr for those species were low compared to other sites. For example, in the PLNR when Marten were detected in 59% of the transects, the track count was also high at 36 tracks/24 hr. By comparison, at the Mine Site, Marten were detected in 57% of the transects, but only had about 3 tracks/24 hr. Moose, which were detected in 21% of the transects, seemed to be the same pair (cow and calf) each time. Figure 3.11-7, below, shows the mine site sample numbers.

Wolves were on site and while their tracks were detected in 29% of the transects, their tracks were also seen numerous times as incidental sightings as they were using the snowmobile and equipment trails to move around the area.



LEGEND:

- PROJECT LOCATION
- MAMMAL TRANSECT LOCATION
- EXISTING ALL-SEASON ROAD
- EXISTING WINTER ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- CONTOUR
- WATER
- PARK

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. SAMPLE PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011).
5. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).
6. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	KC	AS	SRA	RAM

SAVED: I:\1102\00390\01\A\GIS\Figs\A716_rA.mxd; Dec 20, 2013 6:13 PM; spenfold

NORONT RESOURCES LTD.

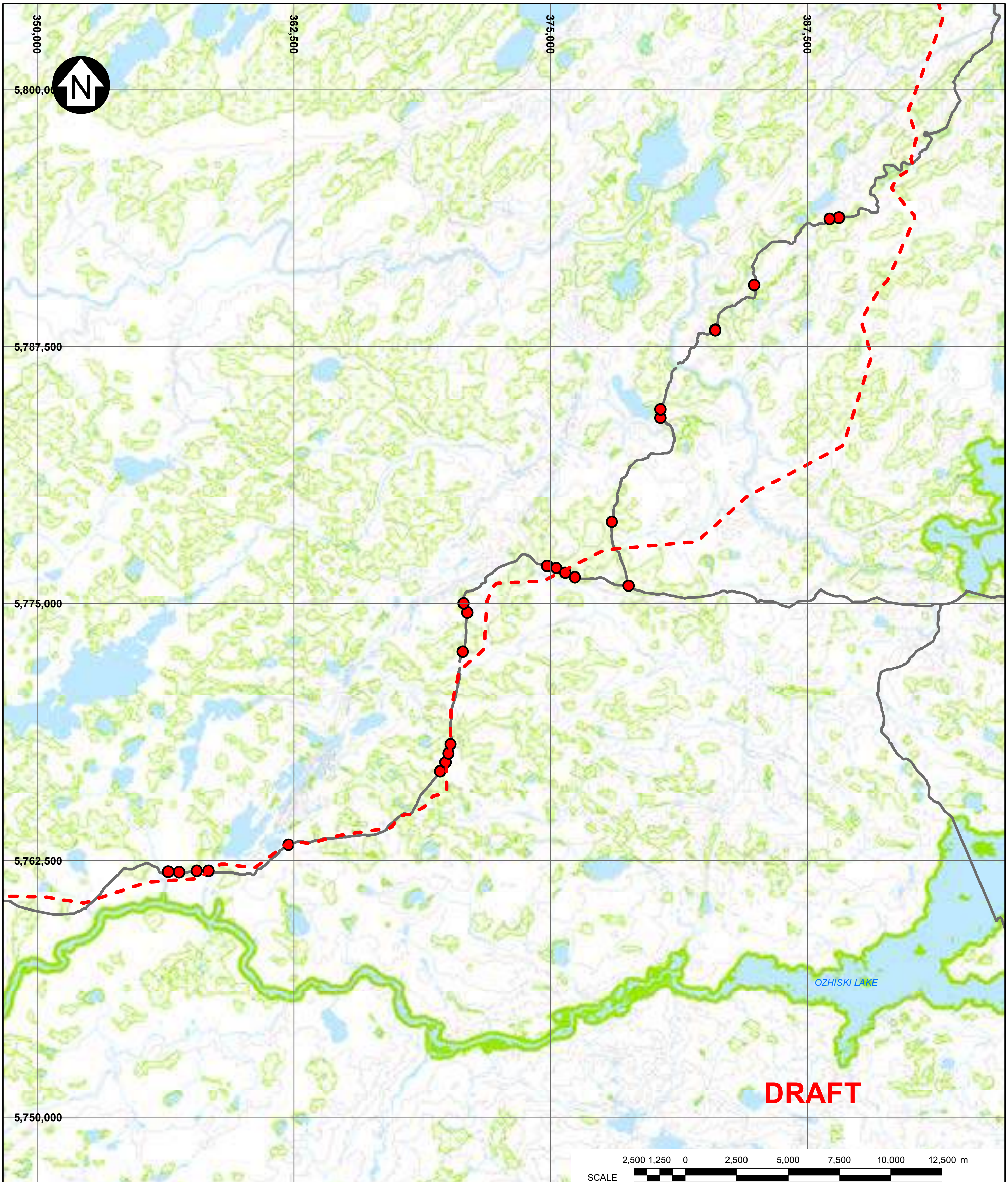
EAGLE'S NEST PROJECT

MAMMAL SAMPLE LOCATIONS
PICKLE LAKE NORTH ROAD AREA

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 3.11-4 | REV A



LEGEND:

- MAMMAL TRANSECT LOCATION
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- EXISTING WINTER ROAD
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- PROVINCIAL PARK

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. MAMMAL PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011).
5. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

MAMMAL SAMPLE LOCATIONS NEAR OZHISKI LAKE AREA

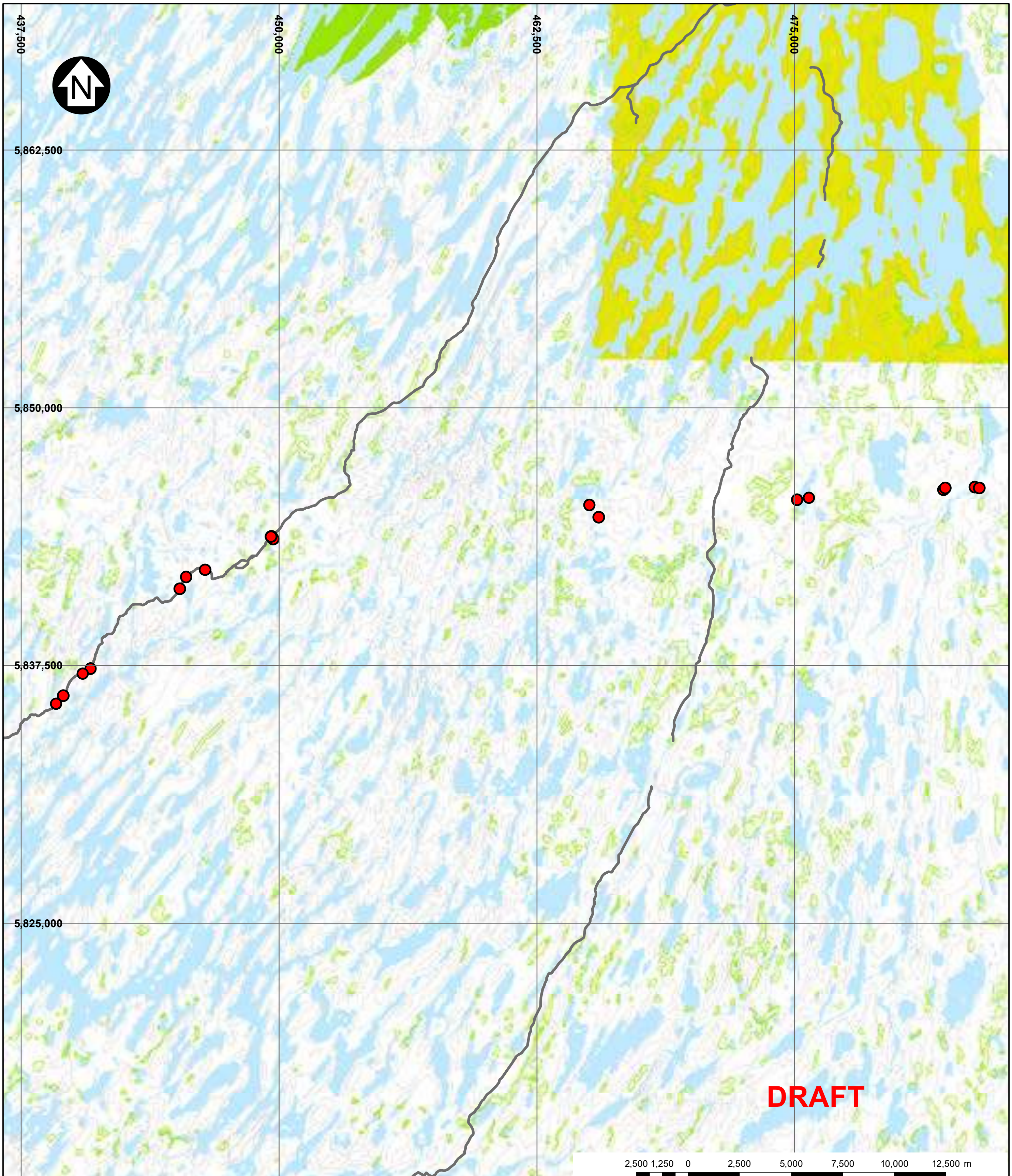
Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.11-5 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	KC	AS	SRA	RAM

SAVED: I:\102\00390\01\A\GIS\Figs\A717_rA.mxd; Dec 20, 2013 6:15 PM; spenfold



LEGEND:

- MAMMAL TRANSECT LOCATION
- EXISTING WINTER ROAD
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- PROVINCIAL PARK
- FIRST NATION RESERVE

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 10 METRES.
4. MAMMAL PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011).
5. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

MAMMAL SAMPLE LOCATIONS
DEARDEN LAKE AREA

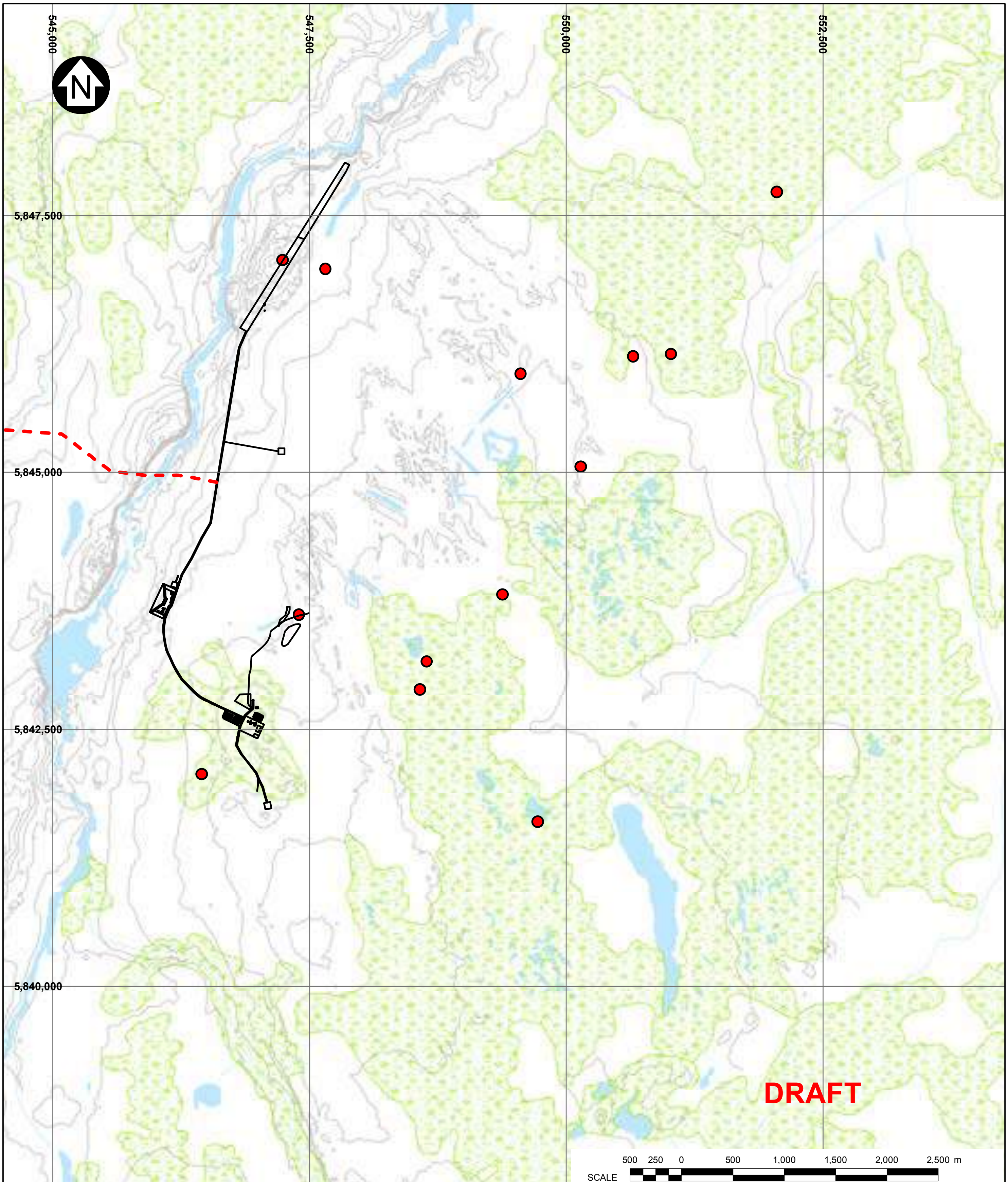
Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.11-6 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	KC	AS	SRA	RAM

SAVED: I:\1102\00390\01\A\GIS\Figs\A719_rA.mxd; Dec 20, 2013 6:18 PM; spenfold



LEGEND:

- MAMMAL TRANSECT LOCATION
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- PROPOSED INFRASTRUCTURE
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- PROVINCIAL PARK

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. MAMMAL PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011).
5. INFRASTRUCTURE INFORMATION AND PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

MAMMAL SAMPLE LOCATIONS
MINE SITE

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.11-7 REV A

A	20DEC'13	ISSUED WITH REPORT	KC	AS	SRA	RAM
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

SAVED: I:\1102\00390\01\A\GIS\Figs\A718_rA.mxd; Dec 20, 2013 6:16 PM; spenfold

3.12 BIRDS

This section provides a description of the existing birds baseline conditions for the Eagle's Nest Project. The supporting technical document that provides additional details regarding the study methods, results, and discussion is available in Appendix 7.

3.12.1 Study Area

The spatial boundaries for the characterization of baseline bird communities were delineated based on the location and extent of the Project during the construction, operation and closure phases as well as ecological criteria including representation, size and integrity.

3.12.1.1 Regional Study Area

The Project will have the greatest potential impact on birds during the development of the transportation corridor and the construction of the mine site infrastructure. The regional study area (RSA) (Figure 3.12-1) for the bird studies is ~2,532,746 ha (25,327 km^2) and was chosen based on three primary criteria as follows:

- ***Ecological Representation*** - The RSA area was determined to be representative of the variety of regional forest and wetland types, as well as natural disturbances (mainly fire) that occur in the Project region. Representation was evaluated by comparing the land cover composition of the RSA with the land cover composition of Ecodistricts 2W-2 (Appendix A; from Henson et al., in press) and 2W 3 (Appendix B; from Henson et al., in press). The two ecodistricts make up more than 95% of the RSA. Table 3.12-1 shows that all land cover types in these two ecodistricts are well represented within the RSA except for the categories: "other natural", "burn" and "regenerating depletion", which are classes that were not used for the Far North Land Cover (FNLC) mapping. The category of "other natural" may have been used to include the FNLC map classes of deciduous forest, conifer swamp, treed peatland, thicket swamp and open fen. The categories of "burn" and "regenerating depletion" may have been used to include the FNLC map classes of disturbance-forest and/or shrub and disturbance-non and sparse woody.
- ***Size*** - According to Vásárhelyi et al. (2002) the RSA (25,327 km^2) is more than three times as large as the minimum area required (7,200 km^2) to sustain viable populations of the two wide-ranging predators found in the RSA: wolves and black bears. By maintaining habitat for these focal species, the probability of maintaining habitat for other wildlife in the RSA is also high.
- ***Ecological Integrity*** - The RSA has an extremely high level of ecological integrity with more than 95% undisturbed by human activity. In addition, greater than 95% of the 20 km buffer area adjacent to the RSA has not been significantly disturbed by human activity. The higher the integrity of the buffer area, the lower the probability is for species extinction within the RSA (Parks and Harcourt, 2002).

3.12.1.2 Local Study Area

The LSA is the zone where there is reasonable potential for immediate interaction between Project components and the Valued Ecosystem Components (VECs) and it is generally defined by the Project footprint, which includes the mine and associated infrastructure, with a buffer of varying distances depending on the bird VECs.

Knight Piésold CONSULTING

TABLE 3.12-1

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

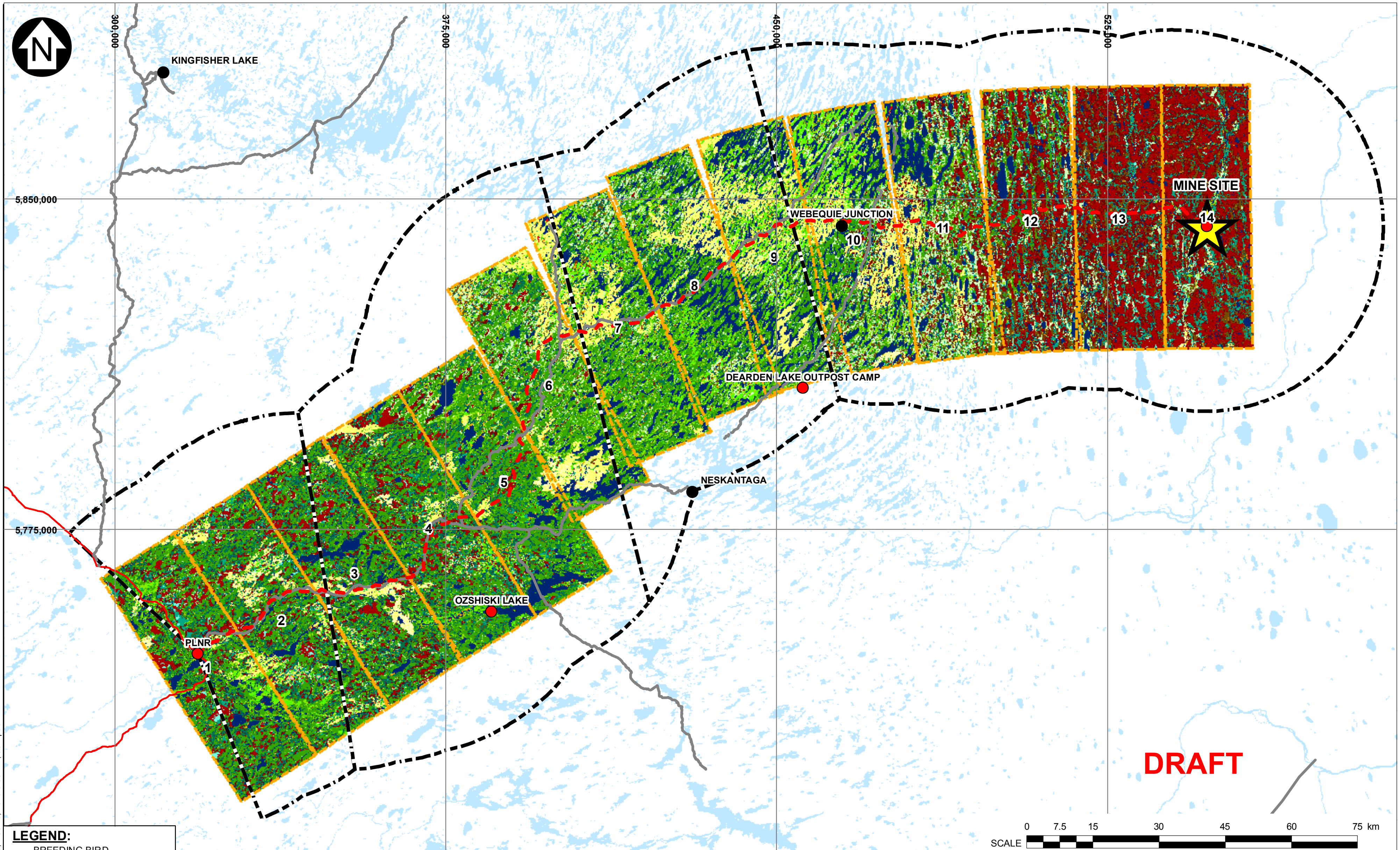
LAND COVER TYPE REPRESENTATION IN THE RSA

Print Dec/21/13 1:48:06

Land Cover Type	RSA		Ecoregion 2W-3	Ecoregion 2W-2
	ha	%	%	%
Forest				
Coniferous Forest	415854	25	25	19
Mixed Forest	76030	5	12	0
Deciduous Forest	50907	3	NA	NA
Sparse Forest	114035	7	26	20
Wetland				
Coniferous Swamp	146940	9	NA	NA
Treed Peatland	103282	6	NA	NA
Sparse Treed Fen	81366	5	5	8
Thicket Swamp	14095	1	NA	NA
Open Bog	161970	10	0	19
Treed Bog	136022	8	8	21
Open Fen	12543	1	NA	NA
Other Natural	-	NA	6	8
Disturbance				
Disturbance - Forest and/or Shrub	101580	6	NA	NA
Disturbance - Non and Sparse Woody	13644	1	NA	NA
Burn	-	NA	11	5
Regenerating Depletion	-	NA	7	0

I:\1\02\00390\01\A\Report\Report 34, EA Volume 2 - EA Report\REV A\8 - Section 3 - Existing Environment\1 - Draft\Tables\[Table 3.12-1.xlsx]

A	20DEC'13	ISSUED WITH REPORT NB102-390/1-34	PQ	KC	RAM
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D



LEGEND:

- BREEDING BIRD SURVEY LOCATION
- MINE SITE
- COMMUNITY
- EXISTING ALL-SEASON ROAD
- EXISTING WINTER ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- RIVER/STREAM/DRAINAGE
- WATER
- TRANSPORTATION CORRIDOR REGIONAL STUDY AREA
- FAR NORTH LAND COVER COMPOSITION RECTANGLE

FAR NORTH LAND COVER CLASSES

- -9 - CLOUD/SHADOW/UNKNOWN
- 1 - CLEAR OPEN WATER
- 2 - TURBID WATER
- 6 - FRESH WATER MARSH
- 8 - THICKET SWAMP
- 9 - CONIFEROUS SWAMP
- 10 - TREED PEATLAND
- 11 - OPEN FEN
- 12 - SPARSE TREED FEN
- 13 - OPEN BOG
- 14 - TREED BOG
- 15 - SPARSE TREED
- 16 - DECIDUOUS TREED
- 17 - MIXED TREED
- 18 - CONIFEROUS TREED
- 19 - DISTURBANCE - NON AND SPARSE WOODY
- 20 - DISTURBANCE - TREED AND/OR SHRUB
- 21 - SAND/GRAVEL/MINE TAILINGS
- 22 - BEDROCK
- 23 - COMMUNITY/INFRASTRUCTURE

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. FAR NORTH LAND COVER (2005 TO 2009) © HER MAJESTY THE QUEEN IN RIGHT OF ONTARIO AS REPRESENTED BY THE MINISTRY OF NATURAL RESOURCES (SEPTEMBER, 2010). ALL RIGHTS RESERVED.
4. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).
5. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	PAQ	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

LANDSCAPE COMPOSITION FOR BIRD STUDIES INCLUDING THE RSA BOUNDARIES

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 3.12-1 | REV A

The following impacts to birds are anticipated:

- Physical loss of bird habitat within the Project footprint
- Dust deposition, anthropogenic light, and Project-related noise may result in the degradation of bird habitat up to 1 km from Project infrastructure
- Bird mortality from collisions with vehicles

Based on these anticipated impacts, a 1 km distance from the Project infrastructure was chosen as the outer boundary of the LSA.

3.12.2 Background

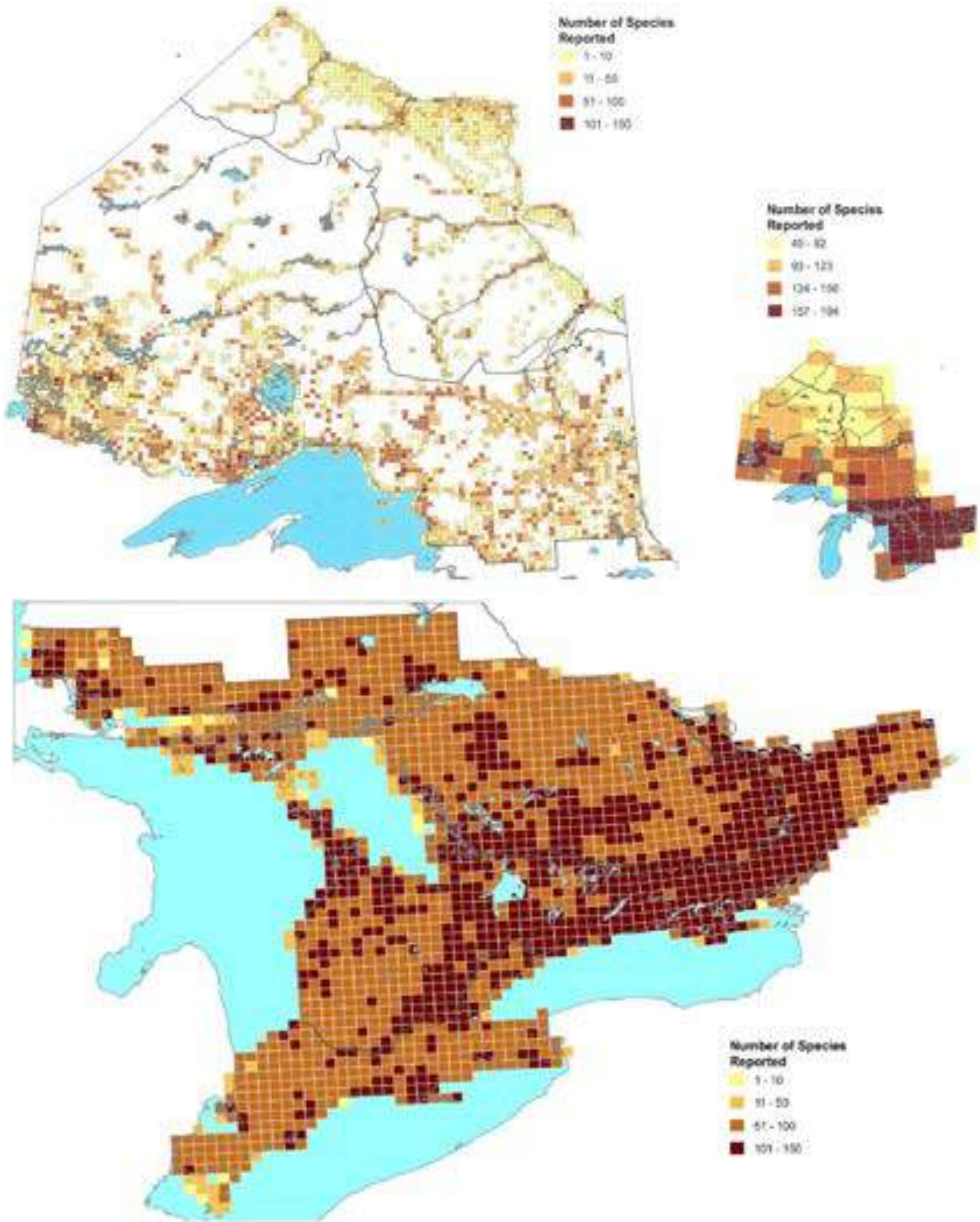
About half of the 650 bird species that occur regularly in North America are found within the Boreal region, and over 300 of them regularly breed there. More than half of the breeding population for nearly 100 species are found in the Boreal Forest region (Wells and Blancher, 2011). Since their numbers fluctuate depending on food, nesting habitat and over-wintering habitat, birds are effective indicators of the health of many ecosystems. For example, since they are affected by habitat and food quality at stopover locations along their migration routes to Boreal breeding grounds, neo-tropical migrants such as warblers, flycatchers, vireos and sparrows are good indicators of landscape change at the continental scale (Crewe et al., 2008).

Most of the ornithological field work conducted in Ontario's Far North has been along the coastlines of Hudson and James Bays. Very little information is available for birds and their habitat in the RSA and adjacent region (Allan, 2012; Phoenix, 2013). However, two publications that have focused on much larger regions that have included the Project RSA are the Atlas of the Breeding Birds of Ontario, 2001-2005 (Cadman et al., 2007) and Population Trend Status of Ontario's Forest Birds (Blancher et al., 2009).

The ABBO (Cadman et al., 2007) was spearheaded by Bird Studies Canada (BSC) in conjunction with Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources, Ontario Nature and thousands of volunteers. Data were collected over five years (2001-2005) to update the previous atlas (1981-1985). This new atlas was the first North American breeding bird atlas to develop maps that depicted relative abundance across broad geographic areas (Couturier, 2011).

As part of the ABBO sampling design, Ontario was divided into 100 x 100 km blocks, which were further subdivided into 10 x 10 km squares. A target of 25 squares surveyed per 100 km2 block was used for southern Ontario, but for road-accessible parts of northern Ontario, the target was reduced to five squares per block. In northern regions that required plane or helicopter access, which included the RSA, survey targets were further reduced to two squares per 100 km2 block.

Given the difficulties and high cost of accessing field sampling locations in Ontario's Far North, sampling squares were selected with the goal of representing each habitat type in proportion to its occurrence in a 100 km2 block. Using LANDSAT imagery, the proportion of each habitat in each 100 km2 block was determined and an index of similarity for each square within every block was computed. Then the more easily accessible squares (along water bodies) were identified and from those, the two squares with the greatest similarity were chosen for sampling. A map generated by BSC showing bird species richness in Ontario is shown on Figure 3.12-2.



NOTES:

1. SOURCE: CADMAN ET AL. (2007).

A	20DEC'13	ISSUED WITH REPORT	KC	PQ	RAM
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

NUMBER OF SPECIES REPORTED IN EACH 10 KM SQUARE AND 100 KM BLOCKS

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF. NO. 34

FIGURE 3.12-2

REV A

Data from the most recent ABBO, as well as data from 14 other large-scale bird surveys were used in an analysis by Blancher et al. (2009) to compare forest bird population trends in northern Ontario to those in southern Ontario. For the area including the RSA, 121 bird species population trends were evaluated. They found that more bird species populations increased than declined over a 30-year period with more than 50% categorized as moderate or large increases (Blancher et al., 2009). However, trend reliability was poor for the majority of species (60%) due to methodological limitations such as a low degree of coverage (less than 25% of the species range surveyed) (Blancher et al., 2009).

Special concern species at risk (SAR) within the RSA that showed population increases included Bald Eagle and Peregrine Falcon. Those that showed population decreases included Common Nighthawk, Olive-sided Flycatcher, Tree Swallow and Rusty Blackbird. The only special concern SAR with a stable population was the Canada Warbler.

In 2010, the Northeast Science and Information Section of the OMNR conducted studies in and near the RSA as part of their Far North Terrestrial Biodiversity (FNTB) study from early June to mid-July (Phoenix, 2013). It encompassed the area within a 100 km radius from the centre of the Ring of Fire and focused on the communities of Webequie and Marten Falls. The purpose of the study was to provide information on the biodiversity of Ontario's Far North for use in community-based land use planning, and to develop a baseline for assessing future changes.

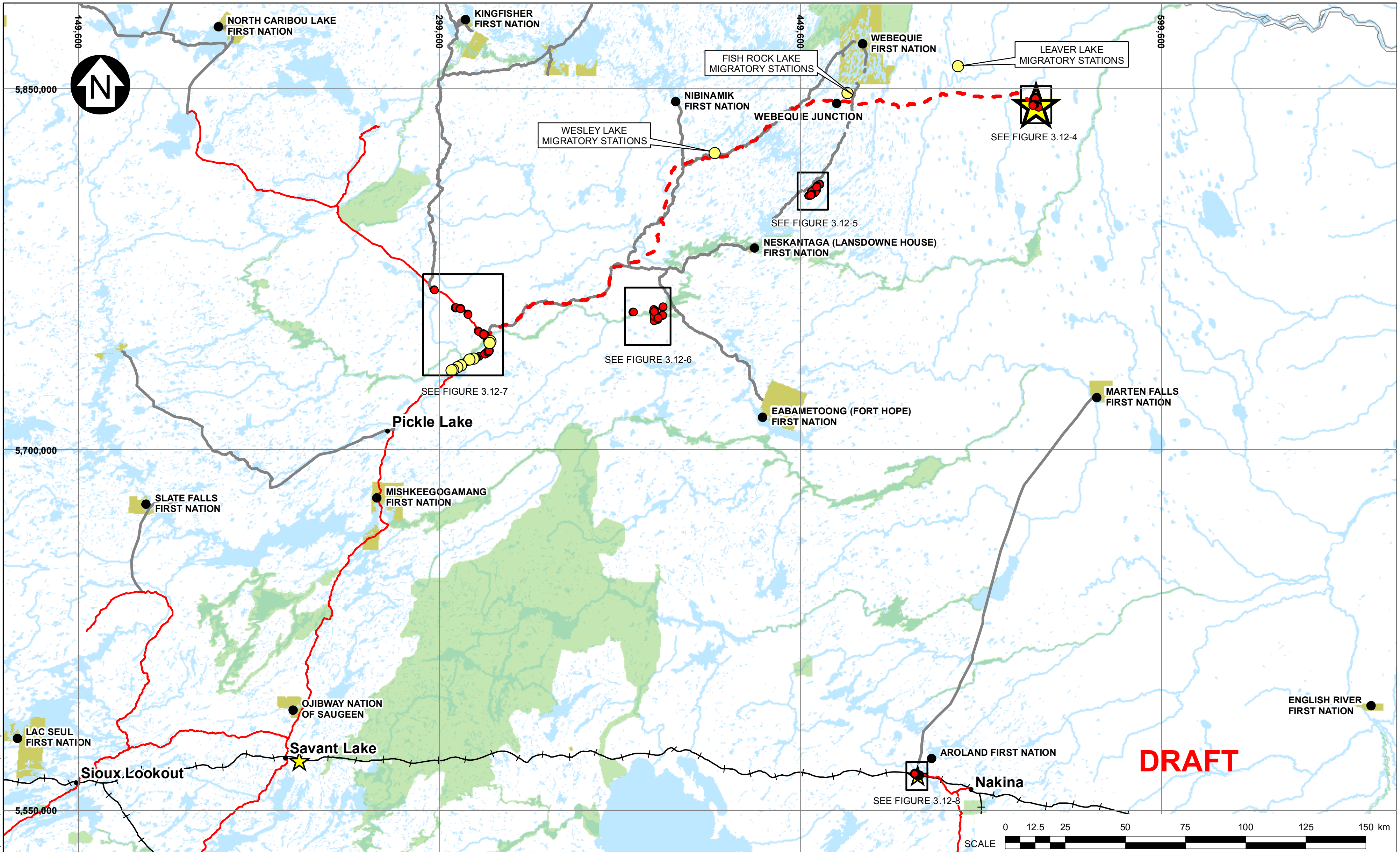
For the FNTB study, 14 plots were sampled using field crews and electronic equipment (e.g., song meters, remote camera traps, bat meters) and an additional 28 plots were sampled with only electronic equipment. Each plot was sampled for eight days for birds, mammals, aquatic and flying insects, fish, amphibians and snakes. For birds, 96 breeding species were detected, including three special concern SAR: Bald Eagle, Common Nighthawk and Olive-sided Flycatcher (Phoenix, 2013).

In 2009, AECOM (2010) conducted a preliminary baseline bird survey in the area of the mine site recording 31 species. Purple Sandpiper was the only species AECOM detected that was not documented in any other surveys for the area including BSC's ABBO. BSC concluded that the probability of Purple Sandpiper breeding in Ontario is low due to limited suitable habitat. Most likely this species was observed while migrating to its Arctic breeding grounds and was not breeding in the RSA.

3.12.3 Methods

3.12.3.1 Introduction

Five locations were selected for breeding bird surveys (BBS) and four locations for migration surveys (Figure 3.12-3). Methodologies were developed and applied for sampling for breeding birds and their habitat, as well as for birds during migration and are described in the following sections.



SAVED: I:\102\00390\01\A\GIS\Figs\A691_rA.mxd; Dec 20, 2013 6:17 PM; asimpson

LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- COMMUNITY
- BREEDING BIRD PLOT LOCATION
- MIGRATION SURVEY LOCATION
- EXISTING ALL-SEASON ROAD
- EXISTING WINTER ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- RAILWAY
- WATER
- PARK
- FIRST NATIONS RESERVE

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. SAMPLE PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011).
4. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	PAQ	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

BREEDING BIRD AND MIGRATION SURVEY LOCATIONS

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF NO. 34

FIGURE 3.12-3

REV A

3.12.3.2 Breeding Birds

Introduction

A list of bird species with potential for detection during field surveys in the RSA was compiled using The ABBO (Cadman et al. 2007), the survey done by AECOM (2010) and the OMNR's (2010) surveys (Table 3.12-2). Scientific names for the bird species appearing in this report are provided on Table 3.12-2. Sample plots were selected using representative proportional sampling of six major habitat categories based on FNLC and Ontario Land Cover (OLC) mapping in four locations along the proposed transportation corridor including the mine site (used FNLC) as well as the Cavell site (used OLC) as shown on Figure 3.12-3. Table 3.12-3 shows how the individual FNLC types were reclassified into the six major habitat categories. Both point counts and song meters were used to assess for breeding birds. The centre of a sample plot consisted of a song meter location or a point count location.

Figure 3.12-1 shows the FNLC composition of 14 rectangles (20 x 60 km) that were placed contiguously along the proposed transportation corridor, including the mine site at the east end, in order to determine habitat representation targets for sampling. This figure also shows the four sampling locations for the breeding bird field sampling: the PLNR area and the mine site area were chosen to represent the west end and east end of the RSA, respectively, and the Ozhisky Lake and Dearden Lake areas were chosen to represent the central portions of the proposed transportation corridor.

Each breeding bird sampling location was associated with the rectangles shown on Figure 3.12-1 as follows.

- PLNR sampling area - rectangles 1 and 2
- Ozhiski Lake sampling area - rectangles 3, 4, 5 and 6
- Dearden Lake sampling area - rectangles 7, 8, 9, 10 and 11
- Mine site sampling area - rectangles 12, 13 and 14

The relative abundance of each of the six major land cover classes was estimated for each of the four sample locations along the transportation corridor and was used as a target for field sampling of the variety of habitat types in those locations (Table 3.12-4). The six major land cover classes (habitat types) included Conifer Forest, Mixed Forest, Deciduous Forest, Disturbed Areas, Woody Wetland and Non-Woody Wetland. Habitat targets for sampling at the Cavell site were determined qualitatively through evaluation of OLC mapping and pre-sampling field observations.

Surveys took place June 3 through July 5, 2011 and from June 14 through July 1, 2012. In addition to assessing bird species by sight and sound, wind speed and direction, cloud cover, precipitation and temperature were recorded at each plot. The centre of each bird survey plot was also the centre of the vegetation sample plots used for the Vegetation Baseline Study (KP, 2013).

The online version of the ABBO (Cadman, et al., 2007) was used to produce a list of breeding bird species that are likely to occur within a 25 km radius of the Savant Lake area.

TABLE 3.12-2

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

BIRD SPECIES EXPECTED IN THE RSA

Print Dec/21/13 1:49:06

Common Name	Scientific Name	Source		
		AECOM[1]	Breeding Bird Atlas[2]	MNR[3]
Alder Flycatcher	*Empidonax alnorum*	x	x	x
American Bittern	*Botaurus lentiginosus*		x	x
American Black Duck	*Anas rubripes*		x	
American Crow	*Corvus brachyrhynchos*		x	x
American Golden Plover	*Pluvialis dominica*			
American Kestrel	*Falco sparverius*		x	x
American Pipit	*Anthus rubescens*			x
American Redstart	*Setophaga ruticilla*		x	x
American Robin	*Turdus migratorius*	x	x	x
American Three-toed Woodpecker	*Picoides dorsalis*		x	
American Wigeon	*Anas americana*	x	x	
Arctic Tern	*Sterna paradisaea*			x
Bald Eagle	*Haliaeetus leucocephalus*		x	x
Barred Owl	*Strix varia*		x	
Bay-breasted Warbler	*Setophaga castanea*		x	x
Belted Kingfisher	*Megaceryle alcyon*		x	x
Black Tern	*Chlidonias niger*			x
Black-and-white Warbler	*Mniotilta varia*		x	x
Black-backed Woodpecker	*Picoides arcticus*		x	x
Blackburnian Warbler	*Setophaga fusca*		x	x
Black-capped Chickadee	*Poecile atricapillus*		x	x
Blackpoll Warbler	*Setophaga striata*		x	x

Knight Piésold CONSULTING

TABLE 3.12-2

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

BIRD SPECIES EXPECTED IN THE RSA

Print Dec/21/13 1:49:06

Common Name	Scientific Name	Source		
		AECOM[1]	Breeding Bird Atlas[2]	MNR[3]
Black-throated Green Warbler	*Setophaga virens*		x	x
Blue Jay	*Cyanocitta cristata*			
Blue-headed Vireo	*Vireo solitarius*	x	x	x
Blue-winged Teal	*Anas discors*		x	x
Bohemian Waxwing	*Bombycilla garrulus*		x	x
Bonaparte's Gull	*Chroicocephalus philadelphia*	x	x	x
Boreal Chickadee	*Poecile hudsonicus*	x	x	x
Boreal Owl	*Aegolius funereus*			x
Brant	*Branta bernicla*			
Broad-winged Hawk	*Buteo platypterus*			x
Brown Creeper	*Certhia americana*		x	x
Bufflehead	*Bucephala albeola*		x	x
Cackling Goose	*Branta hutchinsii*		x	
Canada Goose	*Branta canadensis*		x	x
Canada Warbler	*Cardellina canadensis*		x	
Cape May Warbler	*Setophaga tigrina*		x	x
Cedar Waxwing	*Bombycilla cedrorum*	x	x	x
Chestnut-sided Warbler	*Setophaga pensylvanica*		x	x
Chipping Sparrow	*Spizella passerina*		x	x
Clay-colored Sparrow	*Spizella pallida*			x
Cliff Swallow	*Petrochelidon pyrrhonota*		x	
Common Goldeneye	*Bucephala clangula*		x	x
Common Grackle	*Quiscalus quiscula*		x	

Knight Piésold CONSULTING

TABLE 3.12-2

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

BIRD SPECIES EXPECTED IN THE RSA

Print Dec/21/13 1:49:06

Common Name	Scientific Name	Source		
		AECOM[1]	Breeding Bird Atlas[2]	MNR[3]
Common Loon	*Gavia immer*	x	x	x
Common Merganser	*Mergus merganser*	x	x	x
Common Nighthawk	*Chordeiles minor*	x	x	x
Common Raven	*Corvus corax*		x	x
Common Redpoll	*Acanthis flammea*		x	x
Common Tern	*Sterna hirundo*		x	x
Common Yellowthroat	*Geothlypis trichas*	x	x	x
Connecticut Warbler	*Geothlypis agilis*		x	x
Cooper's Hawk	*Accipiter cooperii*			
Dark-eyed Junco	*Junco hyemalis*	x	x	x
Downy Woodpecker	*Picoides pubescens*		x	x
Eastern Wood Pewee	*Contopus virens*			x
Fox Sparrow	*Passerella iliaca*		x	x
Golden Eagle	*Aquila chrysaetos*		x	
Golden-crowned Kinglet	*Regulus satrapa*	x	x	x
Gray Jay	*Perisoreus canadensis*	x	x	x
Great Blue Heron	*Ardea herodias*		x	x
Great Horned Owl	*Bubo virginianus*		x	x
Greater Scaup	*Aythya marila*			
Greater Yellowlegs	*Tringa melanoleuca*	x	x	x
Green-winged Teal	*Anas crecca*		x	x
Hairy Woodpecker	*Picoides villosus*	x	x	x
Hermit Thrush	*Catharus guttatus*	x	x	x

Knight Piésold CONSULTING

TABLE 3.12-2

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

BIRD SPECIES EXPECTED IN THE RSA

Print Dec/21/13 1:49:06

Common Name	Scientific Name	Source		
		AECOM[1]	Breeding Bird Atlas[2]	MNR[3]
Herring Gull	*Larus argentatus*		x	x
Hoary Redpoll	*Acanthis hornemanni*		x	
Hooded Merganser	*Lophodytes cucullatus*		x	
Horned Lark	*Eremophila alpestris*		x	
Iceland Gull	*Larus glaucoides*			x
Killdeer	*Charadrius vociferus*		x	x
Lapland Longspur	*Calcarius lapponicus*			
Least Flycatcher	*Empidonax minimus*		x	x
Least Sandpiper	*Calidris minutilla*		x	x
Lesser Scaup	*Aythya affinis*			
Lesser Yellowlegs	*Tringa flavipes*		x	x
Lincoln's Sparrow	*Melospiza lincolnii*		x	x
Long-eared Owl	*Asio otus*		x	x
Long-tailed Duck	*Clangula hyemalis*			
Magnolia Warbler	*Setophaga magnolia*		x	x
Mallard	*Anas platyrhynchos*	x	x	x
Merlin	*Falco columbarius*		x	
Mourning Warbler	*Geothlypis philadelphia*		x	x
Nashville Warbler	*Oreothlypis ruficapilla*		x	x
Nelson's Sparrow	*Ammodramus nelsoni*		x	
Northern Flicker	*Colaptes auratus*		x	x
Northern Goshawk	*Accipiter gentilis*		x	x
Northern Harrier	*Circus cyaneus*	x	x	x

Knight Piésold CONSULTING

TABLE 3.12-2

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

BIRD SPECIES EXPECTED IN THE RSA

Print Dec/21/13 1:49:06

Common Name	Scientific Name	Source		
		AECOM[1]	Breeding Bird Atlas[2]	MNR[3]
Northern Hawk Owl	*Surnia ulula*		x	
Northern Parula	*Setophaga americana*			
Northern Pintail	*Anas acuta*			
Northern Shoveler	*Anas clypeata*		x	
Northern Shrike	*Lanius excubitor*			x
Northern Waterthrush	*Parkesia noveboracensis*		x	x
Olive-sided Flycatcher	*Contopus cooperi*	x	x	x
Orange-crowned Warbler	*Oreothlypis celata*		x	x
Osprey	*Pandion haliaetus*		x	x
Ovenbird	*Seiurus aurocapilla*		x	x
Palm Warbler	*Setophaga palmarum*	x	x	x
Peregrine Falcon	*Falco peregrinus*			
Philadelphia Vireo	*Vireo philadelphicus*		x	x
Pileated Woodpecker	*Dryocopus pileatus*		x	x
Pine Grosbeak	*Pinicola enucleator*		x	x
Pine Siskin	*Spinus pinus*		x	x
Purple Finch	*Haemorhous purpureus*		x	x
Purple Sandpiper	*Calidris maritime*	x		
Red Crossbill	*Loxia curvirostra*			x
Red-breasted Merganser	*Mergus serrator*		x	
Red-breasted Nuthatch	*Sitta canadensis*		x	x
Red-eyed Vireo	*Vireo olivaceus*		x	x
Red-necked Grebe	*Podiceps grisegena*			x

Knight Piésold CONSULTING

TABLE 3.12-2

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

BIRD SPECIES EXPECTED IN THE RSA

Print Dec/21/13 1:49:06

Common Name	Scientific Name	Source		
		AECOM[1]	Breeding Bird Atlas[2]	MNR[3]
Red-tailed Hawk	*Buteo jamaicensis*		x	x
Red-winged Blackbird	*Agelaius phoeniceus*		x	
Ring-billed Gull	*Larus delawarensis*			x
Ring-necked Duck	*Aythya collaris*		x	x
Rose-breasted Grosbeak	*Pheucticus ludovicianus*		x	
Ruby-crowned Kinglet	*Regulus calendula*	x	x	x
Ruffed Grouse	*Bonasa umbellus*		x	x
Rusty Blackbird	*Euphagus carolinus*	x	x	x
Sandhill Crane	*Grus canadensis*		x	x
Savannah Sparrow	*Passerculus sandwichensis*		x	x
Scarlet Tanager	*Piranga olivacea*			
Semipalmated Plover	*Charadrius semipalmatus*		x	
Sharp-shinned Hawk	*Accipiter striatus*		x	x
Sharp-tailed Grouse	*Tympanuchus phasianellus*		x	x
Short-eared Owl	*Asio flammeus*		x	
Snow Goose	*Chen caerulescens*	x		
Snowy Owl	*Bubo scandiacus*		x	
Solitary Sandpiper	*Tringa solitaria*	x	x	x
Song Sparrow	*Melospiza melodia*		x	x
Spotted Sandpiper	*Actitis macularius*		x	x
Spruce Grouse	*Falcipennis canadensis*	x	x	x
Swainson's Thrush	*Catharus ustulatus*		x	x
Swamp Sparrow	*Melospiza georgiana*		x	x

Knight Piésold CONSULTING

TABLE 3.12-2

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

BIRD SPECIES EXPECTED IN THE RSA

Print Dec/21/13 1:49:06

Common Name	Scientific Name	Source		
		AECOM[1]	Breeding Bird Atlas[2]	MNR[3]
Tennessee Warbler	*Oreothlypis peregrina*		x	x
Tree Swallow	*Tachycineta bicolor*		x	x
Tundra Swan	*Cygnus columbianus*			
Veery	*Catharus fuscescens*			x
White-breasted Nuthatch	*Sitta carolinensis*			
White-crowned Sparrow	*Zonotrichia leucophrys*		x	x
White-throated Sparrow	*Zonotrichia albicollis*	x	x	x
White-winged Crossbill	*Loxia leucoptera*		x	x
White-winged Scoter	*Melanitta fusca*			
Wilson's Snipe	*Gallinago gallinago*			x
Wilson's Warbler	*Cardellina pusilla*	x	x	x
Winter Wren	*Troglodytes hiemalis*		x	x
Yellow Warbler	*Setophaga petechia*	x	x	x
Yellow-bellied Flycatcher	*Empidonax flaviventris*		x	x
Yellow-bellied Sapsucker	*Sphyrapicus varius*		x	x
Yellow-rumped Warbler	*Setophaga coronata*	x	x	x
	TOTAL	**31**	**122**	**114**

I:\1\02\00390\01\A\Report\Report 34, EA Volume 2 - EA Report\REV A\8 - Section 3 - Existing Environment\1 - Draft\Tables\[Table 3.12-2.xlsx]Table 3.12-2

NOTES:
1. SOURCE: AECOM (2010).
2. SOURCE: CADMAN ET AL. (2007).
3. SOURCE: PHOENIX (2013).

A	20DEC'13	ISSUED WITH REPORT NB102-390/1-34	PQ	KC	RAM
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

TABLE 3.12-3

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

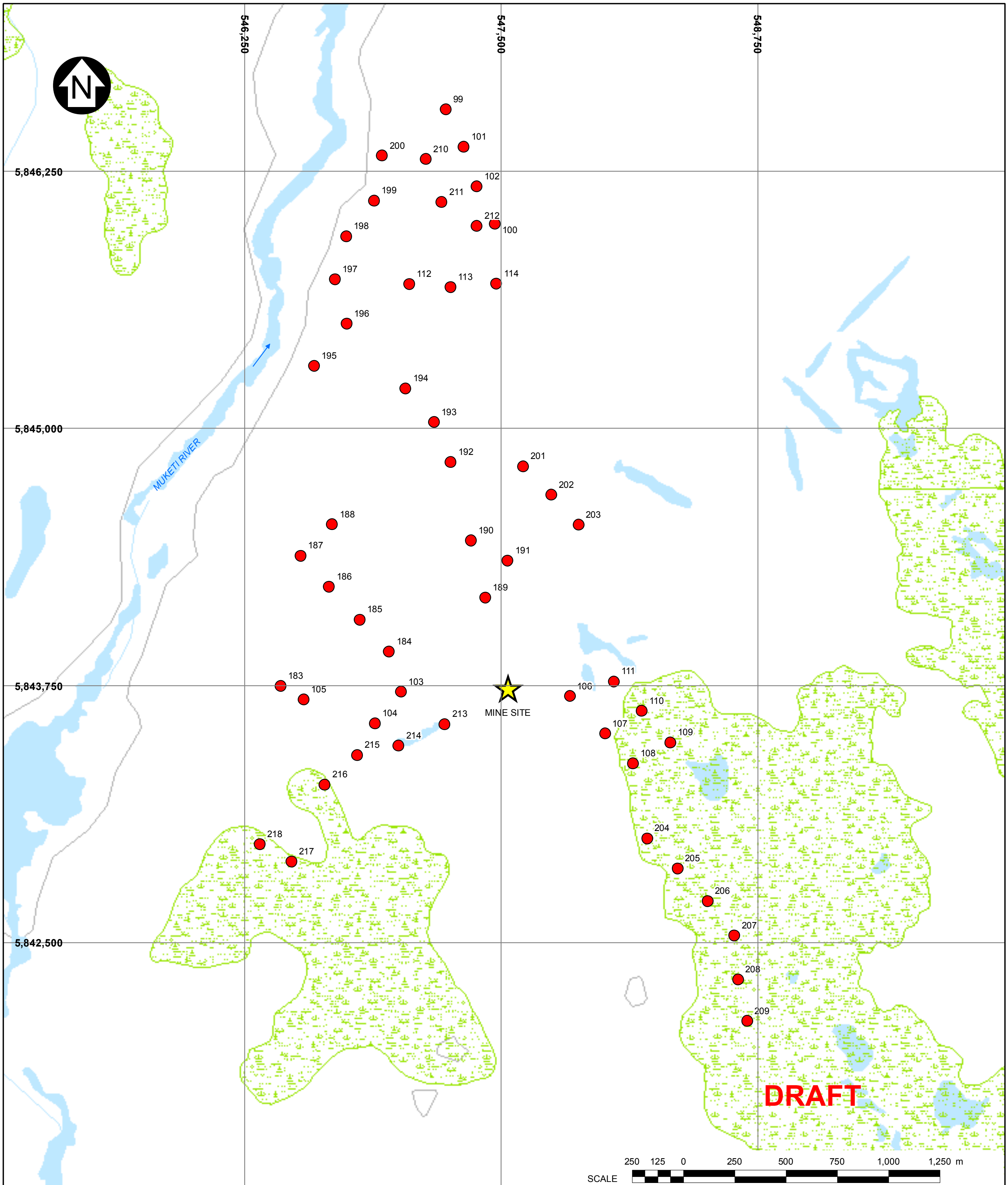
RECLASSIFICATION OF THE FAR NORTH LAND COVER CLASSES

Print Dec/21/13 1:49:52

Far North Cover Type	New Habitat Type
Disturbance - Non and Sparse Woody Disturbance - Treed and/or Shrub	Disturbed Areas
Coniferous Treed	Coniferous Forest
Deciduous Treed	Deciduous Forest
Mixed Treed Sparse Treed	Mixed Forest
Open Bog Open Fen	Non-Woody Wetland
Coniferous Swamp Sparse Treed Fen Thicket Swamp Treed Bog Treed Peatland	Woody Wetland

I:\1\02\00390\01\A\Report\Report 34, EA Volume 2 - EA Report\REV A\8 - Section 3 - Existing Environment\1 - Draft\Tables\[Table 3.12-3.xlsx]Table 3.12-3

A	20DEC'13	ISSUED WITH REPORT NB102-390/1-34	KC	PQ	RAM
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D



LEGEND:

- BREEDING BIRD PLOT LOCATION
- MINE SITE
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. BREEDING BIRD PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011). MIGRATORY BIRD PLOT LOCATIONS WERE COMPLETED BY KNIGHT PIESOLD LTD. (2013).
5. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).

A	20DEC'13	ISSUED WITH REPORT	KC	SWK	SRA	RAM
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

BREEDING BIRD PLOT LOCATIONS NEAR THE MINE SITE

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.12-4 REV A

SAVED: I:\102\00390\01\A\GIS\Figs\A692_rA.mxd; Dec 20, 2013 6:22 PM; asimpson

Point Counts

Point count protocols for the BBS are summarized as follows.

- Morning point counts were conducted for singing passerines and evening point counts were carried out for other bird species such as Common Nighthawks and owl species that are seldom heard in the morning
- Surveys started at sunrise and finished at 09:00 hours, and were not conducted when weather conditions reduced the detectability of birds
- Point count stations were visited twice, once in early June to mid-June, and again in late June to early July
- Point counts were conducted over a ten-minute period, and time of bird detection was subdivided into three, two, and five minute windows respectively in the event more detailed analysis was needed
- Each point count station was at least 200 to 250 m away from other point count stations

Song Meters

Wildlife Acoustic song meters (http://wildlifeacoustics.com) were used to record bird songs and calls using the point count protocols described above. The song meters were programmed to record for ten minutes at the following times: 0:00, 01:00, 03:00, 05:00, 05:30, 06:00, 07:00, 07:30, 21:00, 21:30, 22:00, 22:30, 23:00, and 23:30 hours.

Incidental Sightings

Incidental sightings included any new or notable species seen or heard outside of the point count surveys, including waterfowl. Waterfowl surveys were not standardized. Motor boats were taken into sheltered bays, weedy areas and small creeks to search for waterfowl, especially newly hatched young. Open water areas were scanned from shorelines using binoculars and spotting scopes (30x wide-angle, 20-60x zoom), usually in the late afternoon and evening when other surveys had been completed.

Analysis

Sound files obtained from the song meters were interpreted using Adobe Audition 2.0. Files were viewed as spectrograms and listened to with noise-reducing Bose headphones. Interpretations of the song files were carried out by the same personnel who conducted the field work. Bird species were identified by listening to two song files from the morning and two from the evening while using the spectrogram as an aid. The remaining song files were visually scanned and only two to three minutes of each file were listened to.

The wetland vegetation classification used by Reed (1998) and Lichvar et al. (2012) was adapted for classifying bird species into the following habitat categories:

- Obligate forest birds - of all the plots where these species were found, 99 - 100% of these plots were forest plots; conversely, 0 - 1% of these plots were wetland plots
- Facultative forest birds - of all the plots where these species were found, 67 - 98% of these plots were forest plots; conversely, 2 - 33% of these plots were wetland plots
- Generalists - of all the plots where these species were found, 34 - 66% of these plots were forest plots and 34 - 66% of these plots were wetland plots

- Facultative wetland birds - of all the plots where these species were found, 67 - 98% of these plots were wetland plots; conversely, 2 - 33% of these plots were forest plots
- Obligate wetland birds - of all the plots where these species were found, 99 - 100% of these plots were wetland plots; conversely, 0 - 1% of these plots were forest plots

These habitat criteria were applied to both common and uncommon bird species. Those species occurring in five or more plots were defined as common and species occurring in less than five plots were defined as uncommon. Both common and uncommon bird species were ranked from high to low based on their percent occurrence within forested plots (sum of conifer, mixed, and deciduous forest).

3.12.3.3 Migration

Migratory bird surveys took place May 9 to 20, 2011, September 13 to 25, 2011, and May 8 to 20, 2012. Four locations were surveyed in 2011 (spring and fall), and again in 2012 (spring). Migrants were identified by sight and sound starting before dawn and continuing throughout the day. Observers also recorded birds heard during the night. Binoculars were used to scan for birds, and spotting scopes (30x wide-angle, 20-60x zoom) were used to survey lakes and shorelines as well as to obtain better views of distant raptors. Criteria for choosing sites were based on their proximity to the LSA and geographical features (water bodies, ridges) that could funnel migrating birds into a smaller area for easier detection. Determination of migrants was based on the following criteria:

- Absence from the list of breeding bird species generated from KP field studies
- Shown as a migrant for the RSA on The Birds of North America Online (Cornell Laboratory of Ornithology, 2013)

3.12.3.4 Winter Track Surveys

Winter surveys for birds and mammals were conducted together from March 8 through 15, and March 22 through 28 in 2011, and February 8 through 14, 2012. Standard mammal tracking protocols used by Bayne et al. (2005) were adapted for these field studies. Surveys were conducted at least 12 hours after a snowfall, and all tracks that crossed a surveyor's path (track crossings) were identified and counted unless the surveyor could visually confirm it was the same animal doubling back. Evidence of birds observed while not conducting tracking surveys were recorded as incidental observations. Snow depth, temperature and work effort were also recorded, and survey sites and GPS tracks were logged with a hand-held GPS unit.

Surveys were carried out along the transportation corridor in the following four areas:

- Pickle Lake North Road area (PLNR, formerly Highway 808), north-east of Pickle and the southern portion of the existing winter road to kilometre 60
- Ozhiski Lake area from kilometer 60 to kilometer 112 on the winter road
- Dearden Lake area from kilometer 112 to near Webequie on the winter road
- Mine Site and proposed new road

Two types of 500 m transects were surveyed. The first type ran perpendicular to the existing winter road with surveyors snowshoeing in opposite directions into the bush from the same point on the road. The second type ran parallel to the existing winter road and consisted of consecutively run 500 m transects for a distance of one or two km.

Along the all-season road in the PLNR area, transects were established every five km and sample sites were accessed by truck. On the winter road, transects were established every seven km where the road was wide enough to safely park a truck. A helicopter was used to access the area between the end of the winter road and the mine site. In the Mine Site area, transects were assessed using a snowmobile. Finally, relative occurrence of species was quantified using two methods, including (1) presence of a species within a transect, and (2) number of track crossings per 24 hour period.

3.12.3.5 Raptor Surveys

Two observers surveyed for raptors and raptor nests along 15 km of trails on a daily basis while moving between sample sites collecting data for vegetation and breeding birds. The variety of habitats that occur within the mine site LSA were searched from June 8 through 12 and June 23 through 27, 2011, and from June 14 through 18 and June 26 through 29, 2012. Surveys were conducted during early and mid-mornings, mid-afternoon, and evenings. On some days, the same transect was surveyed twice depending on field work that took the observers back into a previously surveyed area.

Open bogs offered numerous vantage points for scanning treelines along the edges of the bogs to look for Eagle nests and other stick nests using binoculars (Szuba and Naylor, 1998). Open bogs are the most common habitat type in the mine site LSA.

In addition, the following habitats were targeted for raptor surveys.

- Jack Pine stand - 1-km transect
- Upland Black Spruce-Jack Pine stand - 500-m transect
- Mixed forest (Poplar, Black Spruce, Jack Pine) - 1-km transect

3.12.4 Results

3.12.4.1 Introduction

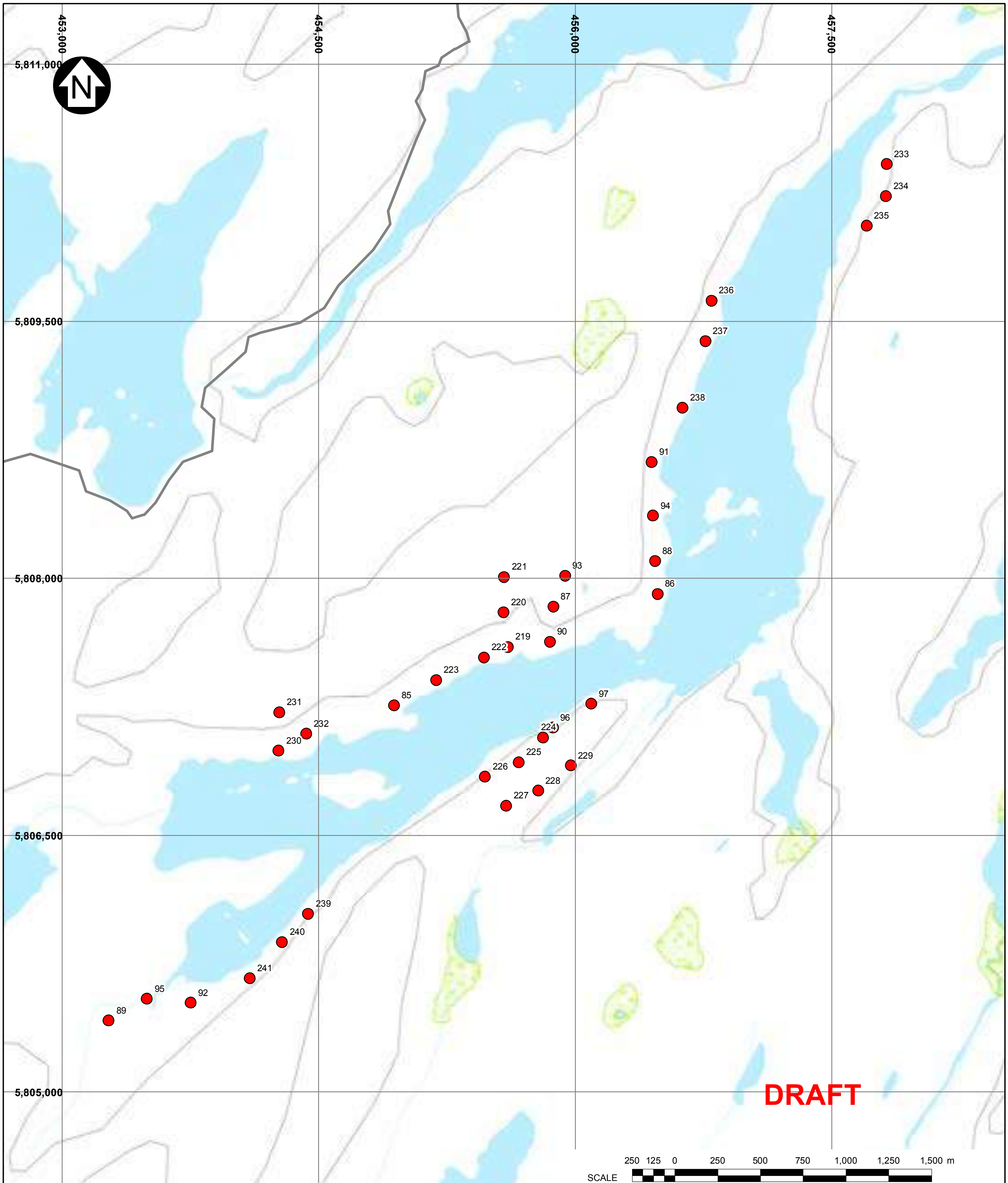
The 2000-2005 ABBO listed 122 possible bird species that breed in or near the RSA (Table 3.12-2). The MNR (Phoenix, 2010; 2013) also compiled a list of 96 breeding bird species for the eastern end of the RSA (Ring-of-Fire region) from field studies conducted in 2010 (Table 3.12-2). During the 2011 and 2012 field studies, 82 bird species were detected during the summer breeding season at the 176 sample plots distributed among five infrastructure locations and six major habitat types (Table 3.12-5). Combining the breeding bird results with the incidental and migratory bird sightings, the total number of bird species observed in the RSA was 130 (Table 3.12-6). In addition, 19 migrants and six bird SARs (special concern) were observed during the field studies.

3.12.4.2 Breeding Birds

<u>Survey Locations</u>

A variety of habitats were sampled at five locations for the BBS studies as follows.

- *Mine site* (N52.74162 W86.29674) - 48 plots were surveyed in 2011 and 2012 (Figure 3.12-4); 12 plots in conifer forest, 6 plots in woody wetlands and 30 plots in non-woody wetlands (Table 3.12-7).



SAVED: I:\1\02\00390\01\A\GIS\Figs\A693_rA.mxd; Dec 20, 2013 6:26 PM; asimpson

LEGEND:

- BREEDING BIRD PLOT LOCATION
- EXISTING WINTER ROAD
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. BREEDING BIRD PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011). MIGRATORY BIRD PLOT LOCATIONS WERE COMPLETED BY KNIGHT PIESOLD LTD. (2013).
5. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	KC	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

BREEDING BIRD PLOT LOCATIONS NEAR DEARDEN LAKE

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF NO. 34

FIGURE 3.12-5

REV A

Knight Piésold
CONSULTING

q^_i b=PKNOJS

kl ol kq=obpl ro` bp=i qaK
b^dibDp=kbpq=mol gb` q

_foa=pmb` fbp=i ` ^qfl kp=^ka=pb^pl k=l c=abqb` qfl k

mêáåí=a ÉÅLONLNP=NWQS WNR

d êçì éáåÖ	péÉÅáÉë	_ ëÉÉÇáåÖ=_áêÇ=pì êî Éóë					j áÖê~íçêó=~åÇ=t áåíÉê=_áêÇ=pì êî Éóë O			
		` ~î Éää	mi k o N	l òÜäâáá	a É~êÇÉå	j áåÉ=páíÉ	mi k o	t ÉëíÉó i ~âÉ	cáëÜ oçÅâ fëä~åÇ	i Éî Éê i ~âÉ
_ä~ÅâÄáêÇë	` çãã çå=d ê~ÅâäÉ								ë	
_ä~ÅâÄáêÇë	j É~Ççï ä~êâ=ëééK Q						ë			
_ä~ÅâÄáêÇë	o ÉÇJï áåÖÉÇ=_ä~ÅâÄáêÇ						ë			
_ä~ÅâÄáêÇë	o ì ëíó=_ä~ÅâÄáêÇ			ñ	ñ	ñ	ë		Ñ	ëÑ
` Üáâ~ÇÉÉë	_ä~ÅâJÅ~ééÉÇ=` Üáâ~ÇÉÉ	ñ	ñ		ñ	ñ	ë	Ñ		
` Üáâ~ÇÉÉë	_çêÉ~ä=` Üáâ~ÇÉÉ			ñ	ñ		ë	ëÑ	ëï	ëÑ
` çêî áÇë	^ã Éêáå~å=` êçï						ë			
` çêî áÇë	_äì É=g~ó						ë			
` çêî áÇë	` çãã çå=o ~î Éå	ñ	ñ	ñ	ñ	ñ	ëï	ëÑï	ëÑ	ëÑ
` çêî áÇë	d ê~ó=g~ó	ñ	ñ	ñ	ñ	ñ	ë	Ñ	ëÑï	ëÑ
` ê~åÉë	p~åÇÜáää=` ê~åÉ					ñ	ëÑ			ëÑ
` êÉÉéÉêë	_êçï å=` êÉÉéÉê	ñ	ñ	ñ	ñ	ñ	ë	ë	ë	ë
` êçëëÄáääë	t ÜáíÉJï áåÖÉÇ=` êçëëÄáää		ñ	ñ	ñ	ñ	ï	ëÑ	ëÑï	Ñ
cáåÅÜÉë	` çãã çå=o ÉÇéçää				ñ	ñ	ï			
cáåÅÜÉë	máåÉ=páëâáå					ñ				ë
cáåÅÜÉë	mì êéäÉ=cáåÅÜ						ë			
cäóÅ~íÅÜÉêë	^äÇÉê=cäóÅ~íÅÜÉê		ñ	ñ	ñ	ñ				
cäóÅ~íÅÜÉêë	i É~ëí=cäóÅ~íÅÜÉê	ñ	ñ	ñ	ñ	ñ				
cäóÅ~íÅÜÉêë	v Éääçï JÄÉääáÉÇ=cäóÅ~íÅÜÉê		ñ	ñ	ñ	ñ		ë		
cäóÅ~íÅÜÉêë	l äáî ÉJëáÇÉÇ=cäóÅ~íÅÜÉê		ñ	ñ	ñ	ñ	ë	ëÑ		ëÑ

q^_i b=PKNOJS

kl ol kq=obpl r o`bp=i qaK
b^di bDp=kbpq=mol gb`q

_foa=pmb`fbp=l ` ^qfl kp=^ka=pb^pl k=l c=abqb`qfl k

mêçàÉÅí=a ÉÅLONLNP=NWQSWR

d êçì éáåÖ	péÉÅáÉë	_ êÉÉÇáåÖ=_ áêÇ=pìêî Éóë					j áÖê~íçêó=åÇ=t áåíÉê=_ãêÇ=pìêîÉóë[O]			
		` ~î Éäà	mi k o[N]	l òÜäâáá	a É~êÇÉå	j åÉ=pãÉ	mi k o	t ÉëäÉó i ~âÉ	cäìÜ oçÅâ fëä~åÇ	i Éï Éê i ~âÉ
d êçëÄÉ~âë	måå É=d êçëÄÉ~â					ñ	ï		ï	
d êçì ëÉ	o ì ÑÑÉÇ=d êçì ëÉ[P]	ñ	ñ	ñ	ñ	ñ	ëÑ	Ñ	Ñ	ï
d êçì ëÉ	pÜ~êéJí~áäÉÇ=d êçì ëÉ					ñ	ï	ëï	ï	Ñ
d êçì ëÉ	péêì ÅÉ=d êçì ëÉ[P]		ñ				ëï	Ñ	ï	ëï
d ì ääë	_çå~é~êíÉDë=d ì ää						ë	ë	ëÑ	ëÑ
d ì ääë	e Éêêáå Ö=d ì ää			ñ				ë	ë	ë
d ì ääë	**o áåÖJÄáääÉÇ=d ì ää**						ëÑ			
e Éêçåë	^ã ÉêáÅ~å=_ áííÉêå					ñ				
gì åÅçë	a ~êâJÉóÉÇ=gì åÅç	ñ	ñ	ñ	ñ	ñ	ë			
h áåÖÑáëÜÉêë	_ ÉäíÉÇ=h áåÖÑáëÜÉê						ë		ëÑ	Ñ
h áåÖäÉíë	d çäÇÉåJÅêçï åÉÇ=h áåÖäÉí	ñ	ñ	ñ	ñ	ñ	ë	ëÑ		
h áåÖäÉíë	o ì ÄóJÅêçï åÉÇ=h áåÖäÉí		ñ	ñ	ñ	ñ	ë	ëÑ	ë	ë
i ~êâë	**e çêåÉÇ=i ~êâ**						ï			
i çåÖëéì êë	**i ~éä~åÇ=i çåÖëéì ê**						Ñ		ë	
i çåÖëéì êë	**påçï =_ ì åíáåÖ[Q]**						ï			
k áÖÜíÜ~ï âë	` çã ã çå=k áÖÜíÜ~ï â	ñ	ñ	ñ		ñ				
k ì íÜ~íÅÜÉë	o ÉÇJÄêÉ~ëíÉÇ=k ì íÜ~íÅÜ	ñ	ñ	ñ	ñ	ñ	ë	ëÑ		ë
k ì íÜ~íÅÜÉë	t ÜáíÉJÄêÉ~ëíÉÇ=k ì íÜ~íÅÜ							ë		
máéáíë	**^ã ÉêáÅ~å=máéáí**						Ñ		Ñ	
o ~éíçêë	^ã ÉêáÅ~å=h ÉëíêÉä						ë			

Knight Piésold
CONSULTING

q^_i b=PKNOJS

kl ol kq=obpl r o` bp=i qaK
b^di bDp=kbpq=mol gb` q

_foa=pmb` fbp=i l ` ^qfl kp=^ka=pb^pl kp=l c=abqb` qfl k

mêáåí=a~íÉW=LONLNP=NWQSWR

dêçì éáåÖ	péÉÅáÉë	_~ëÉäáåÉ=_áêÇ=pìêîÉóë					j áÖê~íçêó=~åÇ=t áåíÉê=_áêÇ=pìêîÉóë[O]			
		` ~îÉää	mi k o[N]	l òÜäâáá	a É~êÇÉå	j áåÉ=páíÉ	mi k o	t ÉëëÉó i ~âÉ	cäìÜ oçÅâ fëä~åÇ	i Éï Éê i ~âÉ
o~éíçêë	_~äÇ=b~ÖäÉ			ñ	ñ		ëÑ	ëÑ	ëÑ	ëÑ
o~éíçêë	_~êêÉÇ=l ïä						ë			
o~éíçêë	_çêÉ~ä=l ïä		ñ		ñ		ë	ë	Ñ	
o~éíçêë	**` ççéÉê\ë=e~ï â**						Ñ		ë	ë
o~éíçêë	dêÉ~í=eçêåÉÇ=l ïä						ë		Ñ	ëÑ
o~éíçêë	i çåÖJÉ~êÉÇ=l ïä						ë	ë		ë
o~éíçêë	j Éêäáå						ë		ë	
o~éíçêë	k çêíÜÉêå=e~êêáÉê						Ñ		ë	
o~éíçêë	k çêíÜÉêå=e~ï â=l ïä									Ñ
o~éíçêë	l ëéêÉó							Ñ	ë	
o~éíçêë	**mÉêÉÖêáåÉ=c~äÅçå**								ë	
o~éíçêë	oÉÇJí~áäÉÇ=e~ï â						Ñ		ë	Ñ
o~éíçêë	pÜ~êéJëÜáååÉÇ=e~ï â							Ñ		
pÜçêÉÄáêÇë	**^ãÉêáÅ~å=dçäÇÉå=mäçîÉê**						Ñ		Ñ	
pÜçêÉÄáêÇë	dêÉ~íÉê=vÉääçï äÉÖë		ñ			ñ	ë	ë	ë	ë
pÜçêÉÄáêÇë	i ÉëëÉê=vÉääçï äÉÖë						Ñ			
pÜçêÉÄáêÇë	pçäáí~êó=p~åÇéáéÉê					ñ	Ñ	ë		
pÜçêÉÄáêÇë	péçííÉÇ=p~åÇéáéÉê					ñ				
påáéÉë	t áäëçå\ë=påáéÉ		ñ			ñ		ë		ë
pé~êêçï ë	` ÜáééáåÖ=pé~êêçï	ñ	ñ			ñ	ë			ë

q^_i b=PKNOJS

kl ol kq=obpl ro`bp=qaK
b^di bD=kbpq=mol gb`q

_foa=pmb`fbp=i `^qfl kp=^ka=pb^pl k=l c=abqb`qfl k

mêçàÉÅí=kçK=NLNNP=NMQS WNR

dêçìéáåÖ	pé ÉÅáÉë	_êÉÉÇáåÖ=_áêÇ=pìêîÉóë					j áÖê~íçêó=~åÇ=t áåíÉê=_áêÇ=pìêîÉóë[O]			
		` ~îÉäó	mi ko[N]	l òÜäâá	aÉ~êÇÉå	j áåÉ=páíÉ	mi ko	t ÉëáÉó i ~âÉ	cáëÜ oçÅâ fëä~åÇ	i Éîêt i ~âÉ
pé~êêçï ë	cçñ=pé~êêçï		ñ	ñ	ñ	ñ		ë		ëÑ
pé~êêçï ë	i É=çåíÉDë=pé~êêçï						ë			
pé~êêçï ë	i áåÅçäåDë=pé~êêçï		ñ	ñ	ñ	ñ		ë		ë
pé~êêçï ë	k Éäëçåë=pé~êêçï					ñ				
pé~êêçï ë	p~î ~åå~Ü=pé~êêçï					ñ				
pé~êêçï ë	pçåÖ=pé~êêçï				ñ		ë		ë	ë
pé~êêçï ë	pï ~ãé=pé~êêçï			ñ	ñ	ñ		ë		ëÑ
pé~êêçï ë	**t ÜáíÉJÅêçï åÉÇ=pé~êêçï**					ñ	ë		ë	
pé~êêçï ë	t ÜáíÉJíÜêç~íÉÇ=pé~êêçï	ñ	ñ	ñ	ñ	ñ	ë	ëÑ	ë	ëÑ
pï ~ääçï ë	qêÉÉ=pï ~ääçï			ñ	ñ	ñ		ë	ë	ë
q~å~ÖÉêë	**pÅ~êäÉí=q~å~ÖÉê**	ñ								
qÜêì ëÜÉë	^ãÉêáÅ~å=oçÄáå		ñ	ñ	ñ	ñ	ë	ëÑ	Ñ	
qÜêì ëÜÉë	eÉêã áí=qÜêìëÜ	ñ	ñ		ñ	ñ	ë	ë	ë	ë
qÜêì ëÜÉë	pï ~áåëçåDë=qÜêìëÜ	ñ	ñ	ñ	ñ	ñ		Ñ	Ñ	
qÜêì ëÜÉë	s ÉÉêó	ñ								
s áêÉçë	_äì ÉJÜÉ~ÇÉÇ=s áêÉç		ñ	ñ	ñ	ñ		ë		
s áêÉçë	mÜáä~ÇÉäéÜá~=s áêÉç		ñ	ñ		ñ				
s áêÉçë	oÉÇJÉóÉÇ=s áêÉç	ñ	ñ	ñ	ñ					
t ~êÄäÉêë	` ~å~Ç~=t ~êÄäÉê			ñ		ñ		Ñ		
t ~êÄäÉêë	^ãÉêáÅ~å=oÉÇëí~êí	ñ		ñ	ñ	ñ				

Knight Piésold CONSULTING

q^_i b=PKNOJS

kl ol kq=obpl r o` bp=i qaK
b^di bD=kbpq=mol gb` q

_foa=pmb` fbp=i l ` ^qfl kp=^ka=pb^pl k=l c=abqb` qfl k

mêáåí=aÉÅLONLNP=NWQSWNR

dêçìéáåÖ	péÉÅáÉë	_êÉÉÇáåÖ=_áêÇ=pìêîÉóë					j áÖê~íçêó=~åÇ=t áåíÉê=_áêÇ=pìêîÉóë^O			
		` ~îÉää	mikoN	lòÜäâá	aÉ~êÇÉå	j ååÉ=pãÉ	mi ko	t ÉëäÉó i~âÉ	cäëÜ oçÅâ fëä~åÇ	i Éî Éê i~âÉ
t ~êÄäÉêë	_~óJÄêÉ~ëíÉÇ=t ~êÄäÉê		ñ	ñ	ñ					
t ~êÄäÉêë	_ä~ÅâJ~åÇJï ÜáíÉ=t ~êÄäÉê	ñ	ñ	ñ			ë	ëÑ		
t ~êÄäÉêë	_ä~ÅâÄìêåá~å=t ~êÄäÉê		ñ		ñ	ñ		Ñ		
t ~êÄäÉêë	_ä~Åâéçää=t ~êÄäÉê			ñ		ñ				
t ~êÄäÉêë	_ä~ÅâJíÜêç~íÉÇ=dêÉÉå=t ~êÄäÉê		ñ	ñ	ñ	ñ	ë			
t ~êÄäÉêë	` ~éÉ=j ~ó=t ~êÄäÉê	ñ	ñ	ñ		ñ		ë		
t ~êÄäÉêë	` ÜÉëíåìíJëáÇÉÇ=t ~êÄäÉê	ñ	ñ	ñ	ñ			ë		
t ~êÄäÉêë	` çã ã çå=vÉääçï íÜêç~í		ñ	ñ	ñ	ñ				
t ~êÄäÉêë	` çååÉÅíáÅìí=t ~êÄäÉê		ñ			ñ				
t ~êÄäÉêë	j ~Öåçäá~=t ~êÄäÉê	ñ	ñ	ñ	ñ	ñ		ë		ë
t ~êÄäÉêë	j çìêåáåÖ=t ~êÄäÉê	ñ		ñ						
t ~êÄäÉêë	k ~ëÜîáääÉ=t ~êÄäÉê	ñ	ñ	ñ	ñ	ñ		Ñ		
t ~êÄäÉêë	k çêíÜÉêå=m~êìä~		ñ							
t ~êÄäÉêë	k çêíÜÉêå=t ~íÉêíÜêìëÜ		ñ	ñ	ñ	ñ		ë	ë	ë
t ~êÄäÉêë	l ê~åÖÉJÅêçïåÉÇ=t ~êÄäÉê		ñ	ñ	ñ	ñ	ë	ëÑ		ëÑ
t ~êÄäÉêë	l îÉåÄáêÇ	ñ	ñ	ñ	ñ	ñ	ë	ë		
t ~êÄäÉêë	m~äã =t ~êÄäÉê		ñ		ñ	ñ		Ñ	ë	ë
t ~êÄäÉêë	qÉååÉëëÉÉ=t ~êÄäÉê	ñ	ñ	ñ	ñ	ñ		Ñ		
t ~êÄäÉêë	t áäëçåÛ=t ~êÄäÉê		ñ	ñ	ñ	ñ		ë		
t ~êÄäÉêë	vÉääçï =t ~êÄäÉê		ñ	ñ						ë

q^_i b=PKNOJS

kl ol kq=obpl r o` bp=i qaK
b^di b=ml fkq=kbpq=mol gb` q

_foa=pmb` fbp=l ` ^qfl kp=^ka=pb^pl k=l c=abqb` qfl k

mêáåí=aÉÅLONLNP=NWQS=WR

dêçìéáåÖ	péÉÅáÉë	_êÉÉÇáåÖ=_áêÇ=pìêîÉóë					j áÖê~íçêó=~åÇ=t áåíÉê=_áêÇ=pìêîÉóë[O]			
		` ~îÉäë	mi k o[N]	l òÜäâáá	aÉ~êÇÉå	j áåÉ=páíÉ	mi k o	t ÉëíÉó i ~âÉ	cäëÜ oçÅâ fëä~åÇ	i Éî Éê i ~âÉ
t ~êÄäÉêë	vÉääçï Jêìãé ÉÇ=t ~êÄäÉê	ñ	ñ	ñ	ñ	ñ	ë	ëÑ	ë	ëÑ
t ~íÉêÑçï ä	**^ãÉêáÅ~å=t áÖÉçå**								Ñ	
t ~íÉêÑçï ä	_äìÉJï áåÖÉÇ=qÉ~ä								ëÑ	ëÑ
t ~íÉêÑçï ä	**_ê~åí**								ë	
t ~íÉêÑçï ä	_ìÑÑäÉÜÉ~Ç						ë		ë	ë
t ~íÉêÑçï ä	` ~å~Ç~=dççëÉ				ñ	ñ	ëÑ		ë	ëÑ
t ~íÉêÑçï ä	` çããçå=dçäÇÉåÉóÉ						ëÑ	ëÑ		Ñ
t ~íÉêÑçï ä	` çããçå=i ççå		ñ	ñ	ñ		ë	Ñ	ëÑ	ëÑ
t ~íÉêÑçï ä	` çããçå=j ÉêÖ~åëÉê						ëÑ	ë	ë	
t ~íÉêÑçï ä	**i ÉëëÉê=pÅ~ìé**[Q]						ëÑ			
t ~íÉêÑçï ä	**dêÉ~íÉê=pÅ~ìé**[Q]									Ñ
t ~íÉêÑçï ä	dêÉÉåJï áåÖÉÇ=qÉ~ä									ë
t ~íÉêÑçï ä	**i çåÖJí~áäÉÇ=aìÅâ**							ë		ë
t ~íÉêÑçï ä	j ~ää~êÇ				ñ		ëÑ	ë	ëÑ	ëÑ
t ~íÉêÑçï ä	j ÉêÖ~åëÉê=ëééK									ëÑ
t ~íÉêÑçï ä	**kçêíÜÉêå=máåí~áä**								ë	
t ~íÉêÑçï ä	oÉÇJÄêÉ~ëíÉÇ=j ÉêÖ~åëÉê									Ñ
t ~íÉêÑçï ä	oáåÖJåÉÅâÉÇ=aìÅâ							ë	ë	ëÑ
t ~íÉêÑçï ä	**påçï =dççëÉ**						ë		Ñ	
t ~íÉêÑçï ä	**qìåÇê~=pï ~å**						ë			

q^_i b=PKNOJS

kl ol kq=obpl r o` bp=i qaK
b^di bD=kbpq=mol gb` q

_foa=pmb` fbp=i l ` ^qfl kp=^ka=pb^pl k=l c=abqb` qfl k

mêáåí=a ÉÅLONLNP=NWQSWR

dêçì éáåÖ	péÉÅáÉë	_êÉÉÇáåÖ=_áêÇ=pìêî Éóë					j áÖê~íçêó=~åÇ=t áåíÉê=_áêÇ=pìêî Éóë[O]			
		` ~î Éää	mi ko[N]	l òÜäëâá	aÉ~êÇÉå	j áåÉ=páíÉ	mi ko	t ÉëäÉó i ~âÉ	cáëÜ oçÅâ fëä~åÇ	i Éî Éê i ~âÉ
t ~íÉêÑçï ä	**t ÜáíÉJï áåÖÉÇ=pÅçíÉê**									ë
t ~ñï áåÖë	` ÉÇ~ê=t ~ñï áåÖ			ñ	ñ	ñ		Ñ		
t ççÇéÉÅâÉêë	^ã ÉêáÅ~å=qÜêÉÉJíçÉÇ=t ççÇéÉÅâÉê				ñ		ï	Ñ		ë
t ççÇéÉÅâÉêë	_ä~ÅâJÄ~ÅâÉÇ=t ççÇéÉÅâÉê				ñ	ñ	ëï	ë		
t ççÇéÉÅâÉêë	a çï åó=t ççÇéÉÅâÉê		ñ				ë			
t ççÇéÉÅâÉêë	e ~áêó=t ççÇéÉÅâÉê				ñ	ñ	ï	ë		
t ççÇéÉÅâÉêë	k çêíÜÉêå=cäáÅâÉê		ñ	ñ	ñ	ñ	ë	ëÑ		
t ççÇéÉÅâÉêë	máäÉ~íÉÇ=t ççÇéÉÅâÉê		ñ							
t ççÇéÉÅâÉêë	v ÉääçïJÄÉääáÉÇ=p~éëì ÅâÉê	ñ	ñ	ñ	ñ	ñ	ë	ëN		ë
t êÉåë	t áåíÉê=t êÉå	ñ	ñ	ñ	ñ	ñ	ë	Ñ	ë	ë

fWNyMOyMMPVMyMNy^ yo Éé çêíyo Éé çêí=PQ=b^ =s çä ã É=O=J=b^ =o Éé çêíyo bs =^ yU=J=p ÉÅíáçå=P=J=b ñáëíáåÖ=b åî áêçåã ÉåíyN=J=a ê~ÑíyqÄäÉëyxq~ÄäÉ=PKNOJSKñäëzq~ÄäÉ=QKO

kl qbpW

NK?mi ko?=obcbop=ql =qeb=mf` hi b=i ^hb=kl oqe=ol ^aK

OK=pb^pl kpW?Ñ?Z=c^iil=?ë?Z=pmofkd=?ï ?Z=t fkqboK

PK= l ri a=kl q=afpqfkdrfpe=or ccba=dol rpb=qo^` hp=col j =pmor` b=dol rpb=qo^` hp=fk=t fkqboK

QK=j b^al t i ^oh=pmmKZ *pqr okbii ^* =pmmKX=pkl t =_rkqfkd=Z *mi b` qol mebk^u=kfs^i fp* X=bppbo=p` ^r m=Z *^vqev^=^ccfkfp* X=dob^qbo=p` ^r m=Z *^vqe^=j ^ofi ^K*

RK=pmb` fbp=fk=_l i a=^ob=j l pq=ifhbiv=j fdo^kqp=Ekl kJ_obbabopFK

^	OMab` DNP	fppr ba=t fqe=obml oq=k NMOJPVMLNJPQ	h`	mn	po^
obs	a^qb	abp` ofmqfl k	mobmD	` ehD	^mmD

q^_ib=PKNOJT

kl ol kq=obpl ro` bp=qaK
b^di bÐ=kbpq=mol gb` q

krj _bo=l c=_foa=pmb` fbp=^ka=_obbafkd=_foa=mil qp=p^j mi ba=fk=b^` e=j ^gl o=e^_fq^q=qvmb

mêáåí=a ÉÅLONLNP=NWQPWQN

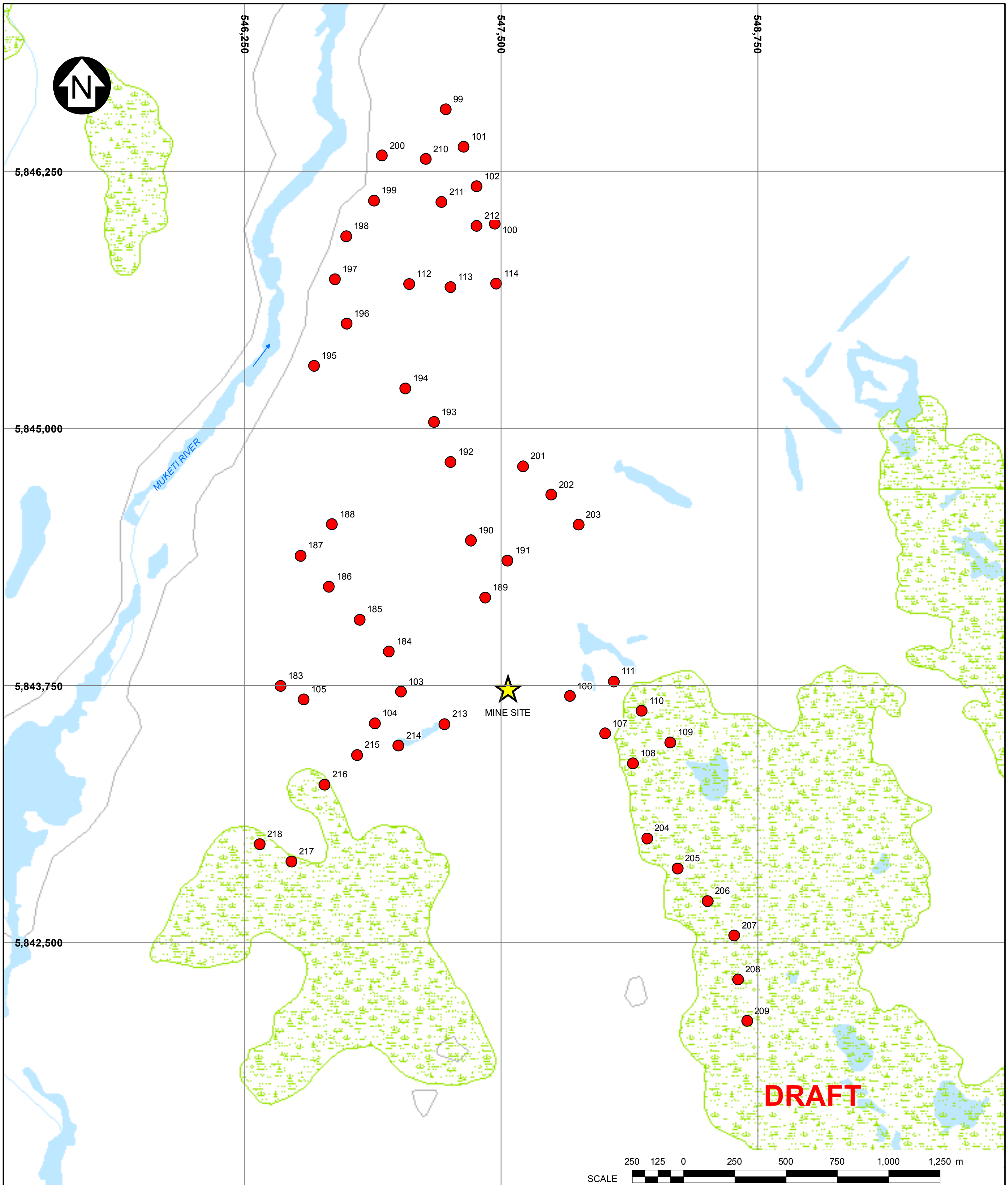
fåÑê~ëíêì Åíì êÉ i çÅ~íáçå	` çåáÑÉê=cçêÉëí		j áñÉÇ=cçêÉëí		aÉÅáÇì çì ë=cçêÉëí		a áëíì êÄÉÇ=^ êÉ~ë		t ççÇó=t Éíä~åÇ		kçåJï ççÇó=t Éíä~åÇ		qçí~ä péÉÅáÉë	qçí~ä mäçíë
	péÉÅáÉë	mäçíë	péÉÅáÉë	mäçíë	péÉÅáÉë	mäçíë	péÉÅáÉë	mäçíë	péÉÅáÉë	mäçíë	péÉÅáÉë	mäçíë		
j áåÉ	QQ	NO	M	M	M	M	M	M	PM	S	RR	PM	SQ	QU
aÉ~êÇÉå	QP	OS	OS	S	NT	O	M	M	OP	P	NS	N	RR	PU
l òÜáëá	PQ	NQ	OQ	S	OM	Q	M	M	OM	O	QM	S	RN	PO
mi ko[N]	PM	NN	OU	NM	V	N	ON	S	PU	NR	NS	P	RU	QS
` ~î Éää	NN	P	NR	O	S	N	ON	R	M	M	NO	N	OV	NO

fWyNyMOyMMPVMyMNy^yoÉéçêíyoÉéçêí=PQ=b^=s çäì ã É=O=J=b^=oÉéçêíyobs=^yU=J=pÉÅíáçå=P=J=bñáëíáåÖ=båî áêçåã ÉåíyN=J=aê~ÑíyqÄäÉëyq~ÄäÉ=PKNOJTKñäëñzq~ÄäÉ=QKP

kl qbpW

NK?mi ko?=obcbop=ql =qeb=mf` hi b=i ^hb=kl oqe=ol ^aK

^	OMab` DNP	fpprba=t fqe=obml oq=k_NMOJPVMLNJPQ	h`	mn	o^j
obs	a^qb	abp` ofmqfl k	mobma	` ehma	^mmma



LEGEND:

- BREEDING BIRD PLOT LOCATION
- MINE SITE
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. BREEDING BIRD PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011). MIGRATORY BIRD PLOT LOCATIONS WERE COMPLETED BY KNIGHT PIESOLD LTD. (2013).
5. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	KC	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

BREEDING BIRD PLOT LOCATIONS NEAR THE MINE SITE

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF NO. 34

FIGURE 3.12-4

REV A

SAVED: I:\102\00390\01\A\GIS\Figs\A692_rA.mxd; Dec 20, 2013 6:22 PM; asimpson

- *Dearden Lake* (N52.41207 W87.64963) - located 30 km south-east of the proposed transportation corridor (Figure 3.12-5); a total of 38 plots were surveyed in 2011 with 26 plots in conifer forest, six plots in mixed forest, two plots in deciduous forest, three plots in woody wetland and one plot in non-woody wetland (Table 3.12-7).
- *Ozhiski Lake* (N51.93233 W88.59309) - located 20 km south-east of the proposed transportation corridor (Figure 3.12-6); a total of 32 plots were surveyed in 2011 with 14 plots in conifer forest, six plots in mixed forest, four plots in deciduous forest, two plots in woody wetland and six plots in non-woody wetland (Table 3.12-7).
- *PLNR* (N 51.75605 W 89.70153) - data were collected along the PLNR 20 km north and south of the start of the winter road on both sides (Figure 3.12-7); a total of 46 plots were surveyed in 2011 with 11 plots in conifer forest, 10 plots in mixed forest, one plot in deciduous forest, six plots in disturbed areas, 15 plots in woody wetlands and three plots in non-woody wetland (Table 3.12-7).
- *Cavell Trans-load Facility* (N50.23823 W87.03740) - data were collected in 2012 on both sides of the old railway facility (Figure 3.12-8); a total of 12 plots were surveyed with three plots in conifer forest, two plots in mixed forest, one plot in deciduous forest, five plots in disturbed areas and one plot in non-woody wetland (Table 3.12-7).

RSA Overview

The six most frequently occurring breeding bird species for the RSA, in decreasing order, were Swainson's Thrush, White-throated Sparrow, Yellow-rumped Warbler, Ruby-crowned Kinglet, Hermit Thrush and White-winged Crossbill, all of which were found in more than 50% of the plots (Table 3.12-5). Eight species were found in 25 to 41% of the plots, 23 species were found in 10 to 24% of the plots, and the remaining 45 species were found in less than 10% of the plots (Table 3.12-5). Details of bird-habitat associations and occurrences at each survey location are provided below.

Habitat Associations

All bird species detected during the BBS were categorized according to their degree of association with the six major habitat types (Table 3.12-8). For the purposes of this report, the six habitats that these bird species could be associated with for this analysis included conifer forest, mixed forest, deciduous forest, disturbed areas, woody wetland and non-woody wetland. Based on their abundance in these habitats within the RSA, bird species were grouped into the following habitat strategies:

- Obligate forest species
- Facultative forest species
- Generalist species
- Facultative wetland species
- Obligate wetland species

Only the common bird species (frequency of 5+ plots; total of 51 species) are discussed here. Due to their low abundance throughout the RSA, the uncommon species (frequency of <5 species; total of 28 species) are not discussed here, however, they are listed by habitat strategy in Table 3.12-8.

Knight Piésold
CONSULTING

q^_i b=PKNOJU

kl ol kq=obpl r o` bp=i qaK
b^di bD=kbpq=mol gb` q

obi ^qfsb=cobnr bk` v=l c=abqb` qfl k=l c=_obbafkd=_foa=pmb` fbp=t fqe=j ^gl o=e^_fq^q=qvmbp

mêáåí=a ÉÅLONLNP=NMWNMRU

e~Äá~í=píê~íÉÖó	_áêÇ=péÉÅáÉë	j ~àçê=e~Äá~í=qóéÉ						qçí~ä	B=mêÉëÉåÅÉ áå=cçêÉëí	B=mêÉëÉåÅÉ áå=t Éíä~åÇ
		` çåáÑÉê cçêÉëí	j áñÉÇ=cçêÉëí	aÉÅáÇì çì ë cçêÉëí	a áëíì êÄÉÇ ^êÉ~ë	t ççÇó t Éíä~åÇ	kçåJï ççÇó t Éíä~åÇ			
` l j j l k										
l ÄäáÖ~íÉ=cçêÉëí péÉÅáÉë	d çäÇÉåJÅêçï åÉÇ=háåÖäÉí	NSKN	OUKS	MKM	MKM	MKM	MKM	QQKT	NMMKM	MKM
c~Åì ä~íáîÉ=cçêÉëí péÉÅáÉë	^ã ÉêáÅ~å=o ÉÇëí~êí	PKO	NQKP	OUKS	MKM	MKM	OKQ	QUKR	VRKM	RKM
	o ÉÇJÄêÉ~ëíÉÇ=k ì íÜ~íÅÜ	OTKQ	SQKP	QOKV	MKM	MKM	TKP	NQNKV	VQKU	RKO
	` ÉÇ~ê=t ~ñï áåÖ	UKN	NQKP	NQKP	MKM	MKM	OKQ	PVKN	VPKU	SKO
	` çã ã çå=o ~îÉå	QKU	MKM	OUKS	MKM	MKM	OKQ	PRKU	VPKO	SKU
	_ä~ÅâJÄ~ÅâÉÇ=t ççÇéÉÅâÉê	NKS	NMKT	NQKP	MKM	MKM	OKQ	OVKN	VNKS	UKQ
	_ä~ÅâJíÜêç~íÉÇ=d êÉÉå=t ~êÄäÉê	PKO	ORKM	OUKS	MKM	PKU	OKQ	SPKN	VMKM	NMKM
	o ì ÑÑÉÇ=d êçì ëÉ	SKR	OUKS	OUKS	MKM	PKU	QKV	TOKP	UTKV	NOKN
	j ~Öåçäá~=t ~êÄäÉê	ORKU	QOKV	TNKQ	MKM	TKT	NOKO	NSMKM	UTKS	NOKQ
	_êçï å=` êÉÉéÉê	OQKO	PRKT	OUKS	MKM	TKT	QKV	NMNKM	UTKS	NOKQ
	o ì ëíó=_ä~ÅâÄáêÇ	NKS	NQKP	MKM	MKM	MKM	OKQ	NUKP	USKT	NPKP
	k çêíÜÉêå=cäáÅâÉê	QKU	NTKV	NQKP	MKM	PKU	OKQ	QPKP	URKR	NQKR
	_~óJÄêÉ~ëíÉÇ=t ~êÄäÉê	SKR	ONKQ	OUKS	MKM	PKU	TKP	STKS	UPKR	NSKR
	l îÉåÄáêÇ	NVKQ	SMKT	RTKN	ORKM	NNKR	QKV	NTUKS	TSKU	VKO
	v Éääçï JÄÉääáÉÇ=p~éëì ÅâÉê	PPKV	ORKM	RTKN	MKM	NVKO	OOKM	NRTKO	TPKU	OSKO
	i É~ëí=cäóÅ~íÅÜÉê	NKS	POKN	MKM	MKM	NNKR	OKQ	QTKT	TMKT	OVKP
	t áåíÉê=t êÉå	QSKU	PRKT	QOKV	ORKM	NVKO	NQKS	NUQKO	SUKM	NUKQ

Knight Piésold
CONSULTING

TABLE 3.12-8

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

RELATIVE FREQUENCY OF DETECTION OF BREEDING BIRD SPECIES WITH MAJOR HABITAT TYPES

Print Dec/21/13 10:21:58

Habitat Strategy	Bird Species	Major Habitat Type						Total	% Presence in Forest	% Presence in Wetland
		Conifer Forest	Mixed Forest	Deciduous Forest	Disturbed Areas	Woody Wetland	Non-Woody Wetland			
Generalist Species	Tennessee Warbler	48.4	25.0	42.9	0.0	42.3	22.0	180.5	64.4	35.6
	Nashville Warbler	27.4	35.7	42.9	50.0	0.0	9.8	165.7	63.9	5.9
	White-winged Crossbill	80.6	21.4	28.6	0.0	50.0	31.7	212.4	61.5	38.5
	Northern Waterthrush	37.1	17.9	28.6	0.0	26.9	34.1	144.6	57.8	42.2
	Red-eyed Vireo	12.9	46.4	57.1	75.0	3.8	7.3	202.6	57.5	5.5
	Yellow-rumped Warbler	74.2	53.6	71.4	75.0	65.4	46.3	385.9	51.6	29.0
	Olive-sided Flycatcher	14.5	7.1	0.0	0.0	3.8	17.1	42.6	50.9	49.1
	Swainson's Thrush	80.6	7.1	100.0	100.0	65.4	31.7	384.9	48.8	25.2
	Gray Jay	37.1	17.9	14.3	0.0	50.0	29.3	148.5	46.6	53.4
	Ruby-crowned Kinglet	72.6	25.0	0.0	0.0	76.9	46.3	220.8	44.2	55.8
	American Robin	9.7	10.7	42.9	25.0	30.8	24.4	143.4	44.1	38.5
	Dark-eyed Junco	29.0	7.1	14.3	0.0	19.2	53.7	123.4	40.9	59.1
	Blue-headed Vireo	16.1	14.3	0.0	25.0	15.4	7.3	78.1	38.9	29.1
	Chipping Sparrow	1.6	21.4	0.0	25.0	7.7	4.9	60.6	38.0	20.7
	White-throated Sparrow	53.2	35.7	57.1	100.0	73.1	70.7	389.9	37.5	36.9
Facultative Wetland Species	Wilson's Warbler	12.9	0.0	14.3	25.0	15.4	14.6	82.2	33.1	36.5
	Black-backed Woodpecker	6.5	0.0	0.0	0.0	7.7	7.3	21.5	30.1	69.9
	Orange-crowned Warbler	6.5	0.0	0.0	0.0	7.7	7.3	21.5	30.1	69.9
	Hermit Thrush	35.5	28.6	14.3	75.0	61.5	65.9	280.7	27.9	45.4
	Common Nighthawk	11.3	14.3	14.3	100.0	11.5	19.5	170.9	23.3	18.2
	Philadelphia Vireo	4.8	0.0	0.0	0.0	19.2	0.0	24.1	20.1	79.9
	Yellow-bellied Flycatcher	19.4	0.0	0.0	0.0	53.8	29.3	102.5	18.9	81.1
	Black-and-white Warbler	3.2	7.1	0.0	50.0	0.0	2.4	62.8	16.5	3.9
	Wilson's Snipe	1.6	0.0	0.0	0.0	7.7	4.9	14.2	11.4	88.6
	Alder Flycatcher	6.5	7.1	0.0	50.0	46.2	26.8	136.6	10.0	53.4
	Greater Yellowlegs	1.6	0.0	0.0	0.0	0.0	14.6	16.2	9.9	90.1
	Connecticut Warbler	1.6	0.0	0.0	0.0	19.2	9.8	30.6	5.3	94.7
	Fox Sparrow	1.6	0.0	0.0	25.0	11.5	0.0	38.2	4.2	30.2
	Common Yellowthroat	1.6	0.0	0.0	0.0	7.7	29.3	38.6	4.2	95.8
	Palm Warbler	1.6	0.0	0.0	0.0	34.6	36.6	72.8	2.2	97.8

Knight Piésold
CONSULTING

TABLE 3.12-8

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

RELATIVE FREQUENCY OF DETECTION OF BREEDING BIRD SPECIES WITH MAJOR HABITAT TYPES

Print Dec/21/13 1:21:58

Habitat Strategy	Bird Species	Major Habitat Type						Total	% Presence in Forest	% Presence in Wetland
		Conifer Forest	Mixed Forest	Deciduous Forest	Disturbed Areas	Woody Wetland	Non-woody Wetland			
Obligate Wetland Species	Lincoln's Sparrow	0.0	0.0	0.0	0.0	15.4	56.1	71.5	0.0	100.0
	Swamp Sparrow	0.0	0.0	0.0	0.0	11.5	24.4	35.9	0.0	100.0
	Tree Swallow	0.0	0.0	0.0	0.0	11.5	9.8	21.3	0.0	100.0
	Savannah Sparrow	0.0	0.0	0.0	0.0	0.0	14.6	14.6	0.0	100.0
UNCOMMON										
Obligate Forest Species	Hairy Woodpecker	4.8	3.6	0.0	0.0	0.0	0.0	8.4	100.0	0.0
	Blackburnian Warbler	3.2	3.6	0.0	0.0	0.0	0.0	6.8	100.0	0.0
	American Three-Toed Woodpecker	3.2	0.0	0.0	0.0	0.0	0.0	3.2	100.0	0.0
	Blackpoll Warbler	3.2	0.0	0.0	0.0	0.0	0.0	3.2	100.0	0.0
	Pine Grosbeak	3.2	0.0	0.0	0.0	0.0	0.0	3.2	100.0	0.0
	Mourning Warbler	0.0	3.6	14.3	0.0	0.0	0.0	17.9	100.0	0.0
	Bald Eagle	1.6	0.0	0.0	0.0	0.0	0.0	1.6	100.0	0.0
	Boreal Owl	0.0	3.6	0.0	0.0	0.0	0.0	3.6	100.0	0.0
	Downy Woodpecker	0.0	3.6	0.0	0.0	0.0	0.0	3.6	100.0	0.0
	Song Sparrow	1.6	0.0	0.0	0.0	0.0	0.0	1.6	100.0	0.0
	Yellow Warbler	0.0	3.6	0.0	0.0	0.0	0.0	3.6	100.0	0.0
	Scarlet Tanager	0.0	3.6	0.0	0.0	0.0	0.0	3.6	100.0	0.0
	Veery	0.0	3.6	0.0	0.0	0.0	0.0	3.6	100.0	0.0
Generalist Species	Cape May Warbler	0.0	7.1	0.0	0.0	3.8	0.0	11.0	65.0	35.0
	Chestnut-sided Warbler	1.6	3.6	0.0	0.0	3.8	0.0	9.0	57.4	42.6
	Common Redpoll	1.6	0.0	0.0	0.0	0.0	2.4	4.1	39.8	60.2
Facultative Wetland Species	Pileated Woodpecker	0.0	3.6	0.0	0.0	7.7	0.0	11.3	31.7	68.3
	Boreal Chickadee	1.6	0.0	0.0	0.0	3.8	0.0	5.5	29.5	70.5
	Spotted Sandpiper	1.6	0.0	0.0	0.0	0.0	4.9	6.5	24.8	75.2
	Canada Goose	1.6	0.0	0.0	0.0	3.8	4.9	10.3	15.6	84.4

Knight Piésold CONSULTING

TABLE 3.12-8

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

RELATIVE FREQUENCY OF DETECTION OF BREEDING BIRD SPECIES WITHIN MAJOR HABITAT TYPES

Print Date: 1/21/13 10:15

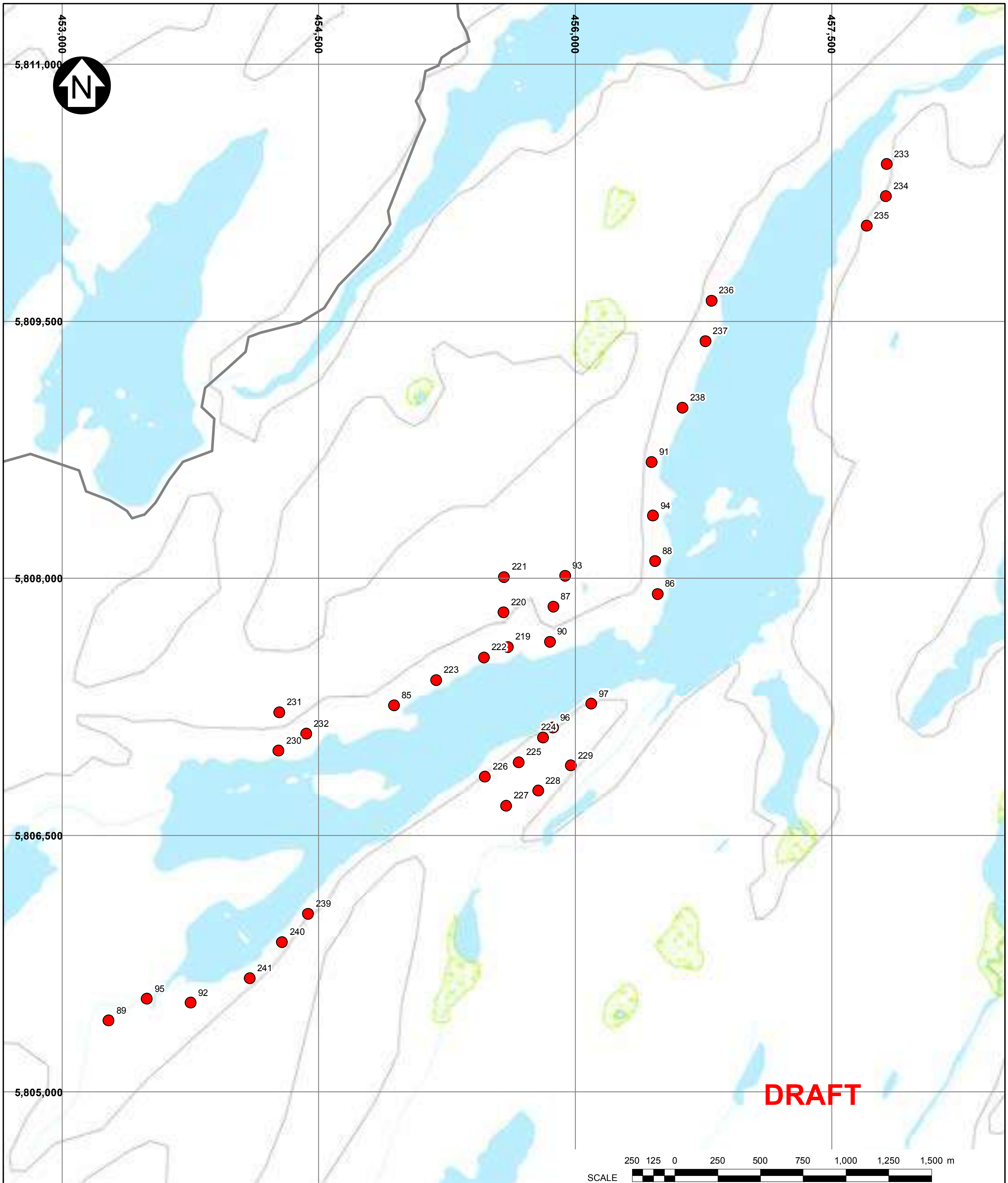
Habitat Strategy	Bird Species	Mapped Habitat Type						Total	% Presence in Forest	% Presence in Wetland
		Conifer Forest	Mixed Forest	Deciduous Forest	Disturbed Areas	Woody Wetland	Non-Woody Wetland			
Obligate Wetland Species	Canada Warbler	0.0	0.0	0.0	0.0	0.0	4.9	4.9	0.0	100.0
	Northern Parula	0.0	0.0	0.0	25.0	3.8	0.0	28.8	0.0	13.3
	Sandhill Crane	0.0	0.0	0.0	0.0	0.0	4.9	4.9	0.0	100.0
	White-crowned Sparrow	0.0	0.0	0.0	0.0	0.0	4.9	4.9	0.0	100.0
	Mallard	0.0	0.0	0.0	0.0	3.8	0.0	3.8	0.0	100.0
	Nelson's Sparrow	0.0	0.0	0.0	0.0	0.0	2.4	2.4	0.0	100.0
	Sharp-tailed Grouse	0.0	0.0	0.0	0.0	0.0	2.4	2.4	0.0	100.0
	Spruce Grouse	0.0	0.0	0.0	0.0	3.8	0.0	3.8	0.0	100.0
Total Number of Species		49	46	29	17	48	56			

I:\1\01\00390\01\A\Report\Report 34 - EA Volume 2 - EA Report\8 - Section 3 - Existing Environment\1 - Draft\Tables\[Table 3.12-8.xlsx]Table 4.4

NOTES:

1. FREQUENCY OF DETECTION OF BIRD SPECIES ARE MEASURED IN PERCENTAGES WITHIN A MAJOR HABITAT TYPE.
2. SAMPLE NUMBERS OF EACH HABITAT TYPE ARE AS FOLLOWS: CONIFER FOREST n=62, MIXED FOREST n=28, DECIDUOUS FOREST n=7, DISTURBED AREAS n=4, WOODY WETLAND n=26, NON-WOODY WETLAND n=41.
3. COMMON REFERS TO SPECIES THAT HAVE A FREQUENCY OF 5 OR MORE. UNCOMMON REFERS TO SPECIES THAT HAVE A FREQUENCY OF LESS THAN 5.

A	20DEC'13	ISSUED WITH NB102-3901-34	KC	PP	RAM
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D



LEGEND:

- BREEDING BIRD PLOT LOCATION
- EXISTING WINTER ROAD
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. BREEDING BIRD PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011). MIGRATORY BIRD PLOT LOCATIONS WERE COMPLETED BY KNIGHT PIESOLD LTD. (2013).
5. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	KC	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

BREEDING BIRD PLOT LOCATIONS NEAR DEARDEN LAKE

Knight Piésold CONSULTING

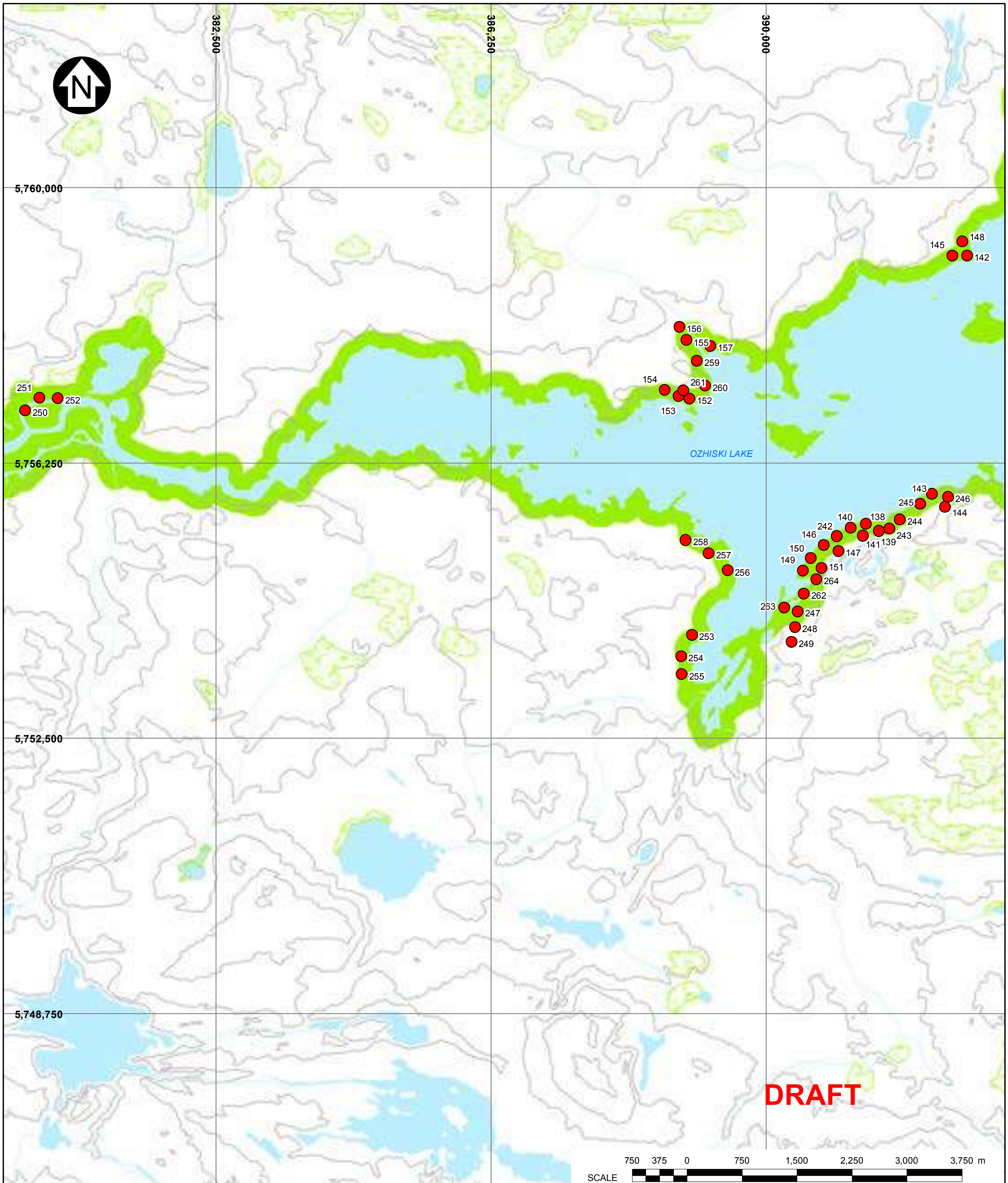
P/A NO. NB102-390/1

REF NO. 34

FIGURE 3.12-5

REV A

SAVED: I:\102\00390\01\A\GIS\Figs\A693_rA.mxd; Dec 20, 2013 6:26 PM; asimpson



LEGEND:

- BREEDING BIRD PLOT LOCATION
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- PROVINCIAL PARK

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. BREEDING BIRD PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011). MIGRATORY BIRD PLOT LOCATIONS WERE COMPLETED BY KNIGHT PIESOLD LTD. (2013).
5. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).

A	20DEC'13	ISSUED WITH REPORT	KC	SWK	SRA	RAM
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

NORONT RESOURCES LTD.

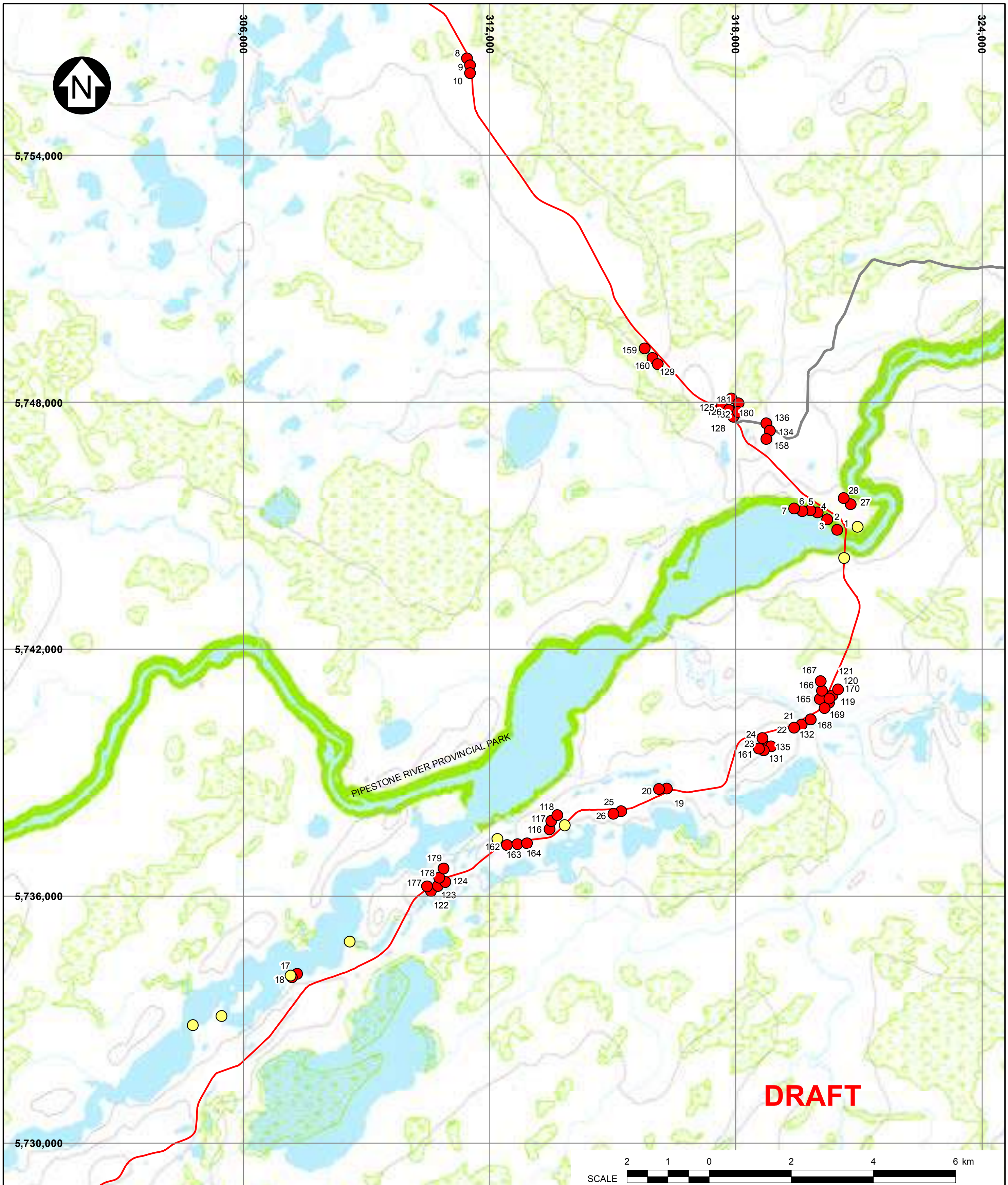
EAGLE'S NEST PROJECT

BREEDING BIRD PLOT LOCATIONS NEAR OZHISKI LAKE

Knight Piésold CONSULTING

P/A NO.	REF NO.	
NB102-390/1	34	
FIGURE 3.12-6		REV A

SAVED: I:\1102\00390\01\A\GIS\Figs\A694_rA.mxd; Dec 20, 2013 6:30 PM; asimpson



LEGEND:

- BREEDING BIRD PLOT LOCATION
- MIGRATORY BIRD PLOT LOCATION
- EXISTING ALL-SEASON ROAD
- EXISTING WINTER ROAD
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- PROVINCIAL PARK

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. BREEDING BIRD PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011). MIGRATORY BIRD PLOT LOCATIONS WERE COMPLETED BY KNIGHT PIESOLD LTD. (2013).
5. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).

A	20DEC'13	ISSUED WITH REPORT	KC	SWK	SRA	RAM
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

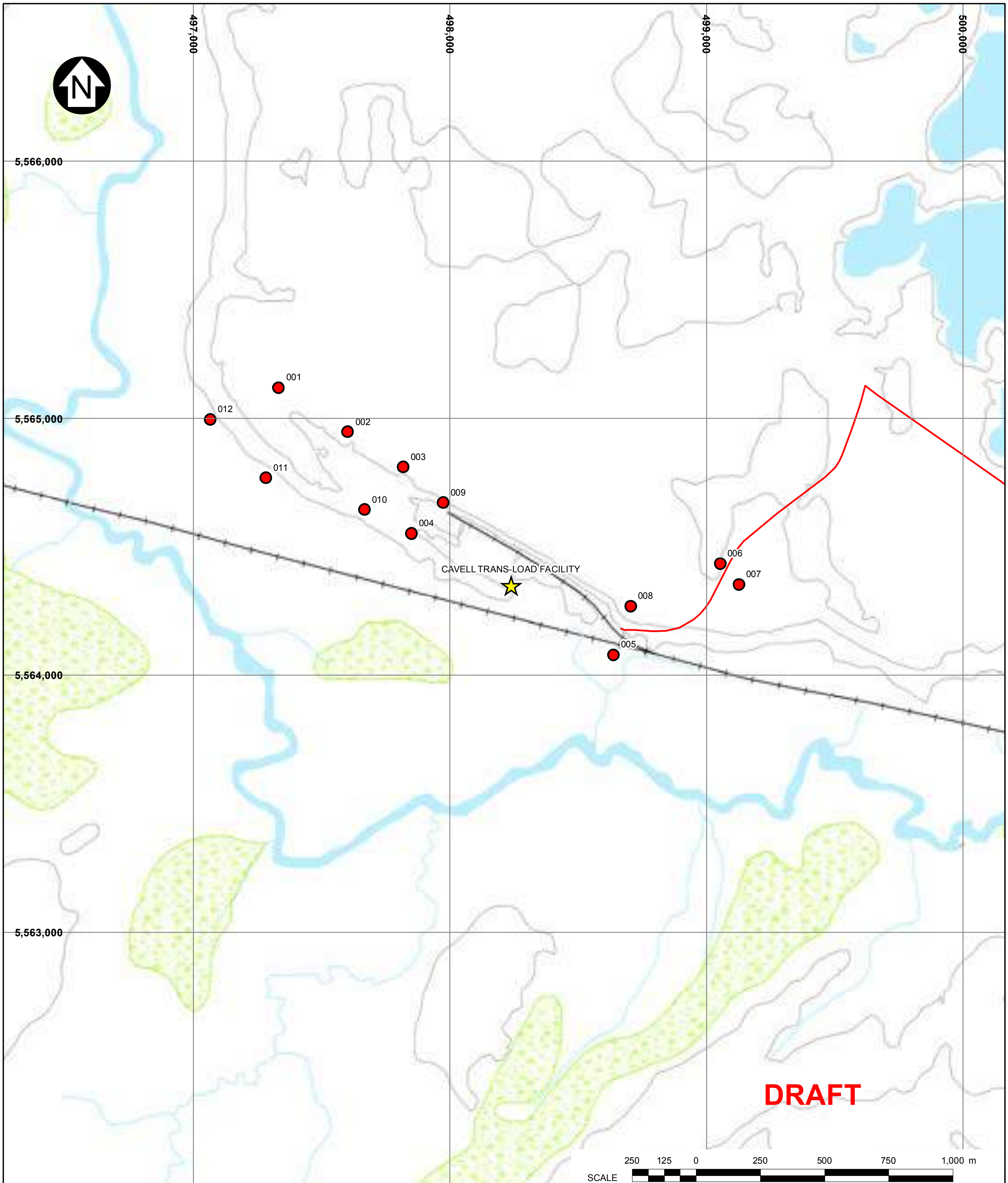
BREEDING BIRD AND MIGRATORY BIRD PLOT LOCATIONS NEAR THE PICKLE LAKE NORTH ROAD

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 3.12-7 | REV A

SAVED: I:\102\00390\01\A\GIS\Figs\A695_rA.mxd; Dec 20, 2013 6:34 PM; asimpson



LEGEND:

- BREEDING BIRD PLOT LOCATION
- CAVELL TRANS-LOAD FACILITY
- EXISTING ALL-SEASON ROAD
- RAILWAY
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- PROVINCIAL PARK

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. BREEDING BIRD PLOT LOCATIONS WERE COLLECTED BY KNIGHT PIESOLD LTD. (2010 AND 2011). MIGRATORY BIRD PLOT LOCATIONS WERE COMPLETED BY KNIGHT PIESOLD LTD. (2013).
5. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	KC	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

BREEDING BIRD PLOT LOCATIONS NEAR THE CAVELL AREA

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF NO. 34

FIGURE 3.12-8

REV A

SAVED: I:\102\00390\01\A\GIS\Figs\A696_rA.mxd; Dec 20, 2013 6:39 PM; asimpson

Obligate Forest Birds

Golden-crowned Kinglets are the only species in this group, and were the only birds that were found only in forest plots; exclusively in conifer and mixed forest. Within the mixed forest, they were found in Black Spruce and Balsam Fir pockets, which are their preference for breeding (Cadman et al., 2007).

Facultative Forest Birds

There are 16 bird species that fit into the facultative forest category (Table 3.12-8). The five most abundant species included the following:

- Winter Wren (37.8% relative frequency)
- Magnolia Warbler (25.6% relative frequency)
- Yellow-bellied Sapsucker (25.6% relative frequency)
- Ovenbird (22.8% relative frequency)
- Red-breasted Nuthatch (21.7% relative frequency)

Only the Ovenbird was found in all habitat types. It was also one of two species in this category, along with the Winter Wren, that was found in disturbed areas.

Generalists

There are 15 bird species that are categorized as generalists (Table 3.12-8). The five most abundant of these species include the following:

- Swainson's Thrush (62.8% relative frequency)
- White-throated Sparrow (60.6% relative frequency)
- Yellow-rumped Warbler (55.6% relative frequency)
- Ruby-crowned Kinglet (53.3% relative frequency)
- White-winged Crossbill (50.0% relative frequency)

Four species were found in all habitat types including Swainson's Thrush, Red-eyed Vireo, Yellow-rumped Warbler and White-throated Sparrow. Red-eyed Vireo was found in three non-woody wetland plots, which does not match with its association with a tree canopy closure of more than 25% as stated by Cadman et al. (2007).

Facultative Wetland Birds

There are 15 bird species included in this category (Table 3.12-8). The five most abundant species included the following:

- Hermit Thrush (50.6% relative frequency)
- Common Nighthawk (22.2% relative frequency)
- Yellow-bellied Flycatcher (21.7% relative frequency)
- Alder Flycatcher (21.1% relative frequency)
- Palm Warbler (19.4% relative frequency)

Hermit Thrush and Common Nighthawk were the only species found in all habitat types. However, many of the bird species in this group are known to be associated with wetlands including Yellow-bellied Flycatcher, Wilson's Snipe, Alder Flycatcher, Palm Warbler and Greater Yellowlegs.

Obligate Wetland Birds

The four species in this group included the following:

- Lincoln's Sparrow (18.9% relative frequency)
- Swamp Sparrow (10.6% relative frequency)
- Tree Swallow (6.1% relative frequency)
- Savannah Sparrow (3.3% relative frequency)

All four species were found in non-woody wetlands and all but the Savannah Sparrow were also found in woody wetlands.

3.12.4.3 Infrastructure Locations

Mine Site

Only three major habitat types occur in the mine site area: conifer forest, woody wetland, and non-woody wetland (Figure 3.12-4). The conifer forest plots were located mainly in Jack Pine stands growing on dry sandy upland soils with little undergrowth, while the woody wetland plots were located in the low-lying areas to the east and west of the conifer plots. The non-woody wetland plots were located in the bog areas to the south of the mine site. More bird species were detected in these bogs (55 species) than in the upland (44 species) and woody wetland sites (30 species) (Table 3.12-7), but there were also more plots established in the bogs. In addition, plots at the bog sites were sampled over the course of two field seasons (2011 and 2012), whereas all other plots at the mine site were sampled only during 2011.

Three SAR were found in the mine site LSA including Common Nighthawk, Olive-sided Flycatcher and Rusty Blackbird. Bird species richness at the mine site (64 species) was the highest of the five survey locations; however, the greatest number of sample plots (48) was also located here, which may have influenced this high species richness (Table 3.12-7).

Dearden Lake

Five major habitat types were sampled in the Dearden Lake area including conifer forest, deciduous forest, mixed forest, non-woody wetland and woody wetland (Figure 3.12-5). Most plots were located in conifer forests (26) (Table 3.12-7), which were dominated mainly by Black Spruce and Balsam Fir, unlike the Jack Pine forests at the mine site. This was likely due to differences in soil type and moisture, which at Dearden Lake was composed primarily of boulders covered by a thin layer of mineral soil.

In the Dearden Lake area, conifer forest had the highest bird species richness (43) while non-woody wetlands had the fewest (16) (Table 3.12-7). Bird species richness in the other three habitat types was intermediate to that in the conifer forests and non-woody wetlands. However, the high number of plots in the conifer forest relative to the other habitat types may have influenced the high bird species richness in this habitat type. Olive-sided Flycatcher and Rusty Blackbird were the only SAR detected in this area. A bird species richness of 55 for this area was less than for the mine site (64) and the PLNR (58), but was greater than the Ozhiski (51) and Cavell (29) sites.

Ozhiski Lake

The five habitat types sampled in the Dearden Lake area were also sampled in the Ozhiski Lake area (Figure 3.12-6), including conifer forest, deciduous forest, mixed forest, non-woody wetland and woody wetland. Similar to the mine site, non-woody wetlands had the highest bird species richness (40) and both woody wetland (20) and deciduous forest (20) had the lowest species richness (Table 3.12-7).

Bird species richness was lowest in the Ozhiski Lake area; only 51 bird species were detected compared to 64 (mine site), 58 (PNLR), and 55 (Dearden Lake) bird species at the other sampling locations (Table 3.12-7). However, it is important to note that this was also the site with the fewest number of sample plots (32), which likely influenced this low species richness value. It was noted that the PLNR area and the Ozhiski Lake area had more species of wood warblers (23) than Dearden Lake and the mine site, probably due to the variety of wooded habitats available at the former two sites. SAR species found in this area included Bald Eagle, Common Nighthawk, Olive-sided Flycatcher and Rusty Blackbird. Three Bald Eagle nests were spotted from the central parts of the lake, although only two could be approached close enough to determine that the nests were in use.

PLNR

The area sampled at the west end of the transportation corridor included habitats on each side of the PLNR, 20 km both north and south of the start of the winter road (Figure 3.12-7). This was the only location where all six major habitat types were sampled (Table 3.12-7). The highest bird species richness was found in the woody wetlands (38), but that habitat type was also the most intensively sampled (15 plots). High species richness was also found in the conifer forest (30 species; 11 plots) and the mixed forest (28 species; ten plots). The lowest species richness was found in the deciduous forest (nine species), but only one sample plot was obtained there (Table 3.12-7). This area had the second highest number of bird species (58) but also had the second highest number of plots (46), two less than at the mine site (48). SAR species found in this area included Common Nighthawk and Olive-sided Flycatcher.

Cavell Site

Five major habitat types were sampled in this area (Figure 3.12-8), which was the only area of the five survey locations without samples in the woody wetlands. Because much of this former gravel pit had been disturbed, the greatest number of plots was located in disturbed habitat (five plots) (Table 3.12-7). The highest bird species richness was associated with this disturbed habitat but this may also be due to the high number of plots in that habitat. A total of 29 bird species within 12 plots was found in the Cavell area.

Only ten species of wood warblers and one vireo (Red-eyed) were found at this site, which was less than at the four other survey locations. Also, in contrast to the other sites, there were no Ruby-crowned Kinglets, Yellow-bellied Flycatchers, American Robins or Northern Flickers observed. Also missing were five warbler species and two sparrow species that were located at all of the other sites. At the other survey locations, four to nine sparrow species were detected compared with only two sparrow species (White-throated Sparrow and Chipping Sparrow) in the Cavell area. The Scarlet Tanager and Veery were detected only in the Cavell area. SAR species observed at this site included only Common Nighthawk.

Savant Lake

No field data were collected at Savant Lake for this baseline report; however, field data for the area around Savant Lake is available through the ABBO. These data are reliable for the 25 km radius that was used to define the polygon surrounding Savant Lake. In total, 112 breeding bird species were identified in the ABBO, including five SAR: Bald Eagle (special concern), Barn Swallow (threatened), Canada Warbler (special concern), Common Nighthawk (special concern) and Olive-sided Flycatcher (special concern) (Appendix C).

3.12.4.4 Migratory Birds

Introduction

Birds that migrate through the RSA on route to and from areas to the north of the RSA are likely to utilize stopover areas within the RSA for feeding and resting. Four locations within close proximity of the proposed transportation corridor were surveyed for the presence of migratory bird species during both spring and fall. A total of 93 bird species were observed during spring migration and 61 during fall migration (Table 3.12-6). From these field studies, it is estimated that 19 bird species do not breed in the RSA, but do utilize some portion of the RSA during migration. This includes nine waterfowl species, one seabird species, one raptor species, one shorebird, and seven others (Table 3.12-6).

Leaver Lake Survey Location

Leaver Lake (N 52.88399 W 86.77403) was chosen on the advice of First Nation guide Roy Spence. Located halfway between Webequie and the mine site, it had two productive and relatively large lakes about 100 m apart, Leaver and Jade Lakes. The narrow stretch of land between the two water bodies channelled passerines through the observation area, while the large lakes provided food and resting areas for waterfowl (Figure 3.12-8).

Both Leaver Lake and Jade Lake had more migrating waterfowl compared to other lakes surveyed. Species that favour open water bodies (oceans, large lakes) such as White-winged Scoters and Long-tailed Ducks used the lakes to feed and rest in the evenings before flying north early in the morning. Green-winged Teal, Ring-necked Duck (flock of 20), and Mallards were also seen in the spring. Greater Scaup and Red-breasted Mergansers, along with large mixed flocks (100+ individuals) congregated on both lakes in the fall.

Leaver Lake may attract waterfowl because of the large shallow areas with wild rice growing near the center and south end of the lake. Wild Rice was sown in the 1970s (Spence, personal communication, 2012) and, although not growing thick enough to provide shelter for waterfowl, it did indicate that the water levels were shallow enough to allow diving ducks to easily see food items below the surface.

More bird species were observed in the spring than in the fall (29 species vs. 23 species), likely due to the shorter spring migration window, which results in most species moving through in a shorter period of time compared to the fall. There were also more warbler species seen in the spring (five species) compared with fall (two species). In the fall, Yellow-rumped Warblers migrated through in flocks exceeding 50 individuals. This is consistent with results from established migratory stations where Yellow-rumped Warblers make up 94% of the warblers detected (Calvert et al., 2009).

Overall, Leaver and Jade Lakes seemed to be highly productive compared to other lakes in the region. The near-shore fish nursery areas and a sucker spawning stream running between the two lakes reflect this productivity, as do the waterfowl, the plentiful choruses of frogs and toads and the opportunistic birds and mammals feeding on spawning suckers.

Fish Rock Lake Survey Location

The main observation site on Fish Rock Lake (N 52.78207 W 87.45678) was an island with views of the thermal-producing ridges to the south (for migrating raptors) and open views to the north and west. It was approximately six km northeast of the proposed Webequie Junction development (Figure 3.12-3).

Numerous Bald Eagles were observed during the spring of 2011 and 2012 migrating over Fish Rock Lake. There is no record of this particular migration route either in the literature or on any of the websites that track radio-tagged Bald Eagles.

There were large numbers of Canada Geese and ducks using the lake to the west of Fish Rock Lake. At dawn, they would fly across the north end of Fish Rock Lake in flocks of 20 to nearly 200 and land in the water body to the east, where they could be heard calling throughout the day. In the evening, they would fly back to the lake to the west. Gunshots were heard each night when the geese and ducks returned.

Hunters were not camped on Fish Rock Lake during the surveys due to safety concerns (Spence, personal communication, 2012). However, a large numbers of goose feathers on the island where the surveys took place indicated that the location has been used by hunters to clean geese. In summary, this area seems to provide a good staging place for waterfowl in the fall, and a regular eagle migration route in the spring.

Wesley Lake Survey Location

Wesley Lake (N 52.55180 W 88.26757) was halfway between Webequie and the start of the winter road at PLNR, and was a few kilometers to the west of the proposed all-season road. The higher terrain and views to the north and east facilitated detection of migrants (Figure 3.12-3).

The Wesley Lake area was found to be productive for warbler species. A total of 13 warbler species were detected during the spring and fall surveys combined. They were often observed in flocks of ten to 40 birds intermixed with Boreal Chickadees, Red-breasted Nuthatches, Golden-crowned Kinglets and many Ruby-crowned Kinglets. In the fall, most of these flocks moved through between 08:00 and 10:00, feeding in the trees and shrubs along the lakeshore, gradually making their way south.

Yellow-rumped Warblers made up the majority of warbler species as also observed by Calvert et al. (2009). Given the large number of birds flitting and hiding in the trees (three to four birds in the binocular's field of view), and the increased difficulty in identifying warblers in their fall plumage, it is likely that more species of warblers were present.

Six species of waterfowl were observed on the lake. The largest groups included eight Common Mergansers and five Common Goldeneyes. The remainder of the waterfowl observed were represented by one or two individuals, including a Long-tailed Duck. Despite clear views to the ends of the lake from a high vantage point, no other flocks of birds were seen or heard.

PLNR Survey Location

PLNR (N 51.75605 W 89.70153) was chosen since it is the start of the winter road. The eskers, river and lakes in the area provided a variety of easily accessible bird habitat. Productive viewing locations were found along the esker portion of the PLNR, which was bounded by water bodies on both sides (Figure 3.12-3). In the fall of 2010, there was cursory migratory work at Badesdawa Lake from late August to the third week in September.

The area near the junction of the winter road and the PLNR appears to be an important stopover and migratory route for terrestrial birds, waterfowl and shorebirds. There is a diversity of habitat for terrestrial species in the area including conifer swamp, mature jack pine forest, young jack pine forest, mixed forest, deciduous forest, alder thicket wetland and shoreline shrub thicket. In addition, there are many lakes and streams that provide feeding and resting areas to meet the needs of waterfowl and shorebirds. The flat wide valley system of the nearby Pipestone River provides numerous resting and feeding spots for several bird species on and along the associated lakes and rivers. The valley also provides a flyway for waterfowl and raptors.

Weather conditions during the fall 2011 surveys were poor with heavy rains. Sleet and snowstorms grounded birds that would likely have migrated straight through. In the fall, Canada Geese flocks of 30 to 160 individuals were seen flying southwest along this flyway several times per hour, even during snow storms. Two Snow Geese were observed in a flock of 100+ Canada Geese as the flock circled to land in the Badesdawa Lake marshes at dusk. Bald Eagles, Red-tailed Hawks, Merlins, American Kestrels, Cooper's and Sharp-shinned Hawks were also observed flying southwest in the fall along the river and adjacent ridges.

During the fall surveys, water levels had dropped by over a metre compared to during the spring surveys. The exposed mud flats and shallow waters proved to be good feeding and resting sites for shorebirds flying south from their Arctic breeding grounds. They included American Golden Plover, Greater and Lesser Yellowlegs, Solitary Sandpiper, and mixed flocks of 'peeps', which were seen feeding along the lake and river in the snow. Peeps are similar-looking shorebirds that are difficult to identify to species without better views of the birds.

A flock of 45 Tundra Swans was observed on the north side of Shred Lake during the spring surveys in 2011. Roy Spence (personal communication, 2011) stated that this swan species is regularly seen moving through the area at this time of year. Waterfowl like Scaup, Common Mergansers, Buffleheads and Common Goldeneye were observed in the waterways along the PLNR.

Four species of owls, which are early breeders and mostly stay in the area year round, were detected in the spring. Long-eared Owls were heard calling in the conifer forest north of the PLNR near the Pipestone River and at a location a few hundred metres southwest of the winter road. Barred Owls were heard calling in the forest along the esker ridges. Great Horned Owls and Boreal Owls were also heard. A Meadowlark (either Eastern or Western), which was likely blown off its usual migration route by a few hundred kilometres, was also observed in the PLNR area.

3.12.4.5 Winter Birds

Track Surveys

Four bird species (or species groups) were detected in the RSA based on winter track surveys including the following:

- Common Raven
- Owl species
- Ruffed or Spruce Grouse
- Sharp-tailed Grouse

Table 3.12-9 shows the association between bird species detected in the RSA and the major habitat types. Ruffed or Spruce Grouse (unable to distinguish tracks from each other) were the only species that were found in all five major habitat types. Sharp-tailed Grouse was detected in three habitat types including mixed forest, disturbed areas and non-woody wetlands. Owl species and Common Ravens were detected only in disturbed areas and non-woody wetlands, respectively. These habitat types had the greatest number of bird species detections (three). Conifer forests and woody wetlands each had only one bird species detection.

Table 3.12-10 shows the frequency of bird species tracks detected during winter at the four survey locations along the transportation corridor. Only Ruffed/Spruce Grouse was found at all four locations. Sharp-tailed Grouse was detected at all locations except the mine site, Common Raven was found only in the PLNR area and the western section of the transportation corridor (km 61 to km 110), and owl species were only found at the PLNR sites. All four bird species/groups were detected with winter tracking at the PLNR sites, whereas only one was detected at the mine site (Ruffed/Spruce Grouse). All but the owl species were found in the km 61 to 110 section of the corridor, and only Ruffed/Spruce Grouse plus the Sharp-tailed Grouse were found along the section of the corridor from km 110 to km 220.

3.12.4.6 Incidental Observations

Most of the incidental observations of birds during winter were associated with the PLNR. The following summarizes observations made in this area.

- Small flocks of passerines were seen feeding on sand that had been spread on the existing all-season road
- In numerous spots, Pine Grosbeaks and White-winged Crossbills were seen in groups of three to nearly a dozen
- Mixed flocks of Snow Buntings and Horned Larks were observed along the existing all-season road, or flying in the openings created by the large hydro corridor along the road
- Snow Buntings were also seen in the first 50 to 60 km (from the west) of the transportation corridor; they were mainly seen along the open sections by the non-woody wetlands (bogs and fens)
- In places where dirt and sand had been exposed by the graders smoothing the winter road, mixed flocks of Common Redpolls, Pine Grosbeaks and White-winged Crossbills were observed; Black-backed Woodpeckers, American Three-toed Woodpeckers, and Hairy Woodpeckers were also seen

Knight Piésold
CONSULTING

q^_i b=PKNOJV

kl ol kq=obpl r o` bp=i qaK
b^di bD=kbpq=mol gb` q

t fkqbo=qo^` h=cobnr bk` v=l c=_foa=pmb` fbp=l ` ` r oobk` b=t fqefk=qeb=j ^gl o=e ^_fq^q=qvmbp=fk=qeb=op^

mêáåí=a ÉÅLONLNP=NMWNMWP

` çã ã çå=k~ã É	` çåáÑÉêçìë=cçêÉëí EãZNVF			j áñÉÇ=cçêÉëí EãZUF			a äëíìêÄÉÇ=^êÉ~ë EãZVF			t çç Çó=t Éíä~åÇ EãZNPF			kçåJ çç Çó=t Éíä~åÇ EãZOUF		
	@ëéçíë	Béäçíë	qê~Åâë=L OQ=Üêë	@ëéçíë	Béäçíë	qê~Åâë=L OQ=Üêë	@ëéçíë	Béäçíë	qê~Åâë=L OQ=Üêë	@ëéçíë	Béäçíë	qê~Åâë=L OQ=Üêë	@ëéçíë	Béäçíë	qê~Åâë=L OQ=Üêë
oì ÑÑÉÇ=dêçìëÉ	T	PTB	NMKT	P	PUB	NMKM	N	NNB	MKQ	P	OPB	RKN	O	TB	MKT
pÜ~êéJí~áäÉÇ=dêçìëÉ				N	NPB	NKM	O	OOB	OKM				N	QB	OKM
lï äëéÉÅáÉë							N	NNB	MKT						
` çã ã çå=o~îÉå													O	TB	MKS

fW\N\MO\MMPVM\MN\^ yoÉéçêíyoÉéçêí=PQ=b^=sçäìã É=O=J=b^=oÉéçêíyobs=^yU=J=pÉÅíáçå=P=J=b ñáëíáåÖ=bå îáêçåã Éåíy\N=J=aê~Ñíyq~ÄäÉëyq~ÄäÉ=PKNOJVKñäëñzq~ÄäÉ=OKR

^	OMab` DNP	fppr ba=t fqe=obmloq=k_NMOJPVMLNJPQ	h`	mm	o^j
obs	a^qb	abp` ofmqfl k	mobmÛa	` ehÛa	^mmÛa

TABLE 3.12-10

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

WINTER TRACK FREQUENCY OF BIRD SPECIES OCCURRENCE AT THE SURVEY LOCATIONS

Print Dec/21/13 10:39:38

Common Name	PLNR[1] Area (n=27)			Transportation Corridor - km 61 to km 110 (n=25)			Transportation Corridor - km 111 to km 220 (n=11)			Transportation Corridor - km 221 to km 297 (n=14)		
	#plots	%plots	Tracks / 24 hrs	#plots	%plots	Tracks / 24 hrs	#plots	%plots	Tracks / 24 hrs	#plots	%plots	Tracks / 24 hrs
Ruffed or Spruce Grouse	4	15%	12.4	7	28%	6.4	2	18%	2.0	3	21%	2.0
Sharp-tailed Grouse	2	7%	5.3	1	4%	2.0	1	9%	3.0			
Common Raven	1	4%	0.4	1	4%	0.6						
Owlspecies	1	4%	0.7									

I:\1\02\00390\01\A\Report\Report 34 - EA Volume 2 - EA Report\Rev A\8 - Section 3 - Existing Environment\1 - Draft\Tables\Table 3.12-10.xlsx]Table 4.6

NOTES:

1. "PLNR" REFERS TO PICKLE LAKE NORTH ROAD.

A	20DEC'13	ISSUED WITH REPORT NB102-390/1-34	KC	PQ	RAM
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Some incidental observations of birds along the km 110 to km 220 of the transportation corridor were also recorded.

- Pine Grosbeaks and White-winged Crossbills were observed mainly where there was a significant amount of conifer forest
- Boreal Chickadees occasionally were heard in conifer trees
- Gray Jays were observed in conifer forests, but would fly into open wetlands to perch on small trees
- Common Ravens, usually as a pair or small group, were often spotted along the edges of sparse forest, non-woody wetland, and conifer forest. On the PLNR, they were observed flying along the road or perched on hydro poles each of the nine days the road was travelled in 2011 and 2012. They were also common along the km 61 to 110 section of the winter road, although the open habitat with adjacent conifer stands may have made them easier to detect.

3.12.4.7 Raptor surveys

No Raptor species or raptor nests were observed within the mine site LSA, but the following raptors were observed within the RSA.

- American Kestrel
- Bald Eagle
- Barred Owl
- Boreal Owl
- Cooper's Hawk
- Great Horned Owl
- Long-eared Owl
- Merlin
- Northern Harrier
- Northern Hawk Owl
- Osprey
- Peregrine Falcon
- Red-tailed Hawk
- Sharp-shinned Hawk

3.12.4.8 Species at Risk

Six bird species observed in the RSA are listed as SAR-Special Concern at either the federal level or the provincial level and include Bald Eagle, Canada Warbler, Common Nighthawk, Olive-sided Flycatcher, Peregrine Falcon and Rusty Blackbird. All species were observed during the spring and fall migration period except for Common Nighthawk (not observed during either period) and Peregrine Falcon, which was detected only during spring migration (Table 3.12-11).

q^_ib=PKNOUNN

kl ol kq=obpl ro`bp=i qaK
b^di bD=kbpq=mol gb`q

_foa=pmb`fbp=l c=`l k`bok=Jl `^qfl k=^ka=pb^pl k=l c=_pbos^qfl k

mêáåí=aÉÅLONLNP=NMWPSWOR

péÉÅáÉë	_êÉÉÇáåÖ=_áêÇë					j áÖê~íçêó=_áêÇë			
	`~îÉäë	mi koN	l òÜäâââ	aÉ~êÇÉå	j ääÉ	mi koN	t ÉëäÉó=i ~âÉ	i Éî Éê=i ~âÉ	cäçÜ=o çÅâ
_~äÇ=b~ÖäÉ			ñ	ñ		ëÑ	ëÑ	ëÑ	ëÑ
`~å~Ç~=t~êÄäÉê			ñ		ñ		Ñ		
`çãã çå=káÖÜíÜ~ïâ	ñ	ñ	ñ		ñ				
l äáîÉJëáÇÉÇ=cäóÅ~íÅÜÉê		ñ	ñ	ñ	ñ	ë	ëÑ	ëÑ	
mÉêÉÖêáåÉ=c~äÅçå								ë	
oìëíó=_ä~ÅâÄáêÇ			ñ	ñ	ñ	ë		ëÑ	Ñ

fWJNJMOJMMPVMJMNJ^yoÉéçêíyoÉéçêí=PQ=b^=säçäìãÉ=O=Jb^=oÉéçêíyobs=^yU=Jp ÉÅíáçå=P=Jb ñáëíáåÖ=båîáêçåãÉåíyN=Ja ê~Ñíyq~ÄäÉëyq~ÄäÉ=PKNOUNNKñäëñzq~ÄäÉ=QKT

kl qbpW

NK?mi ko?=obcbop=ql =mf`hi b=i ^hb=kl oqe=ol ^aK

OKþ fdo^ql ov=_foap=^ob=abqb`qba=fk=pb^pl kpl=t ebob=?ë?Z=pmofkd=^ka=?Ñ?Z=c^ii K

^	OMab`DMP	fppr ba=t fqe=obml oq=k_NMOUPVMMNJPQ	h`	mm	o^j
obs	a^qb	abp`ofmqfl k	mobm?a	`eh?a	^mm?a

Rusty Blackbird

The Rusty Blackbird is listed as SAR-Special Concern at the Federal level. It breeds in coniferous-dominated wooded streams, swamps and bogs, and may have declined by as much as 85% since the early 1970s (Avery, 2013). It was detected at most survey locations during migration and during the breeding season (Table 3.12-11).

Rusty Blackbirds were not detected during the breeding season in the southern portions of the RSA (PLNR and the Cavell Site). The ABBO indicates that they are either absent or at very low densities in those areas. During spring migration, they were observed in the PLNR area in moderate numbers (six individuals over a ten minute period). At Lever Lake, they were seen during both spring and fall migration.

Bald Eagle

Bald Eagles are listed as SAR-Special Concern at the Federal Level. During the spring of 2011 and 2012, a large number of migrating Bald Eagles were observed from Fish Rock Island, which is located on Fish Rock Lake. In 2011, 92 Eagles were observed during a three-day period, and in 2012, 215 of them were seen (Figure 3.12-9). Most of these birds were flying towards the north and northwest and a few were flying eastward.

Eagles were observed from 22:00 to 01:00 with fewer seen at mid-day, followed by more activity in the afternoon. A greater number of Eagles were seen during the 2012 surveys, despite the similarity in wind speed, wind direction, temperature and cloud cover conditions between the surveys. To date, no information on this particular Eagle migration route has been found in the literature or noted in radio-tagged studies.

During fall migration, there were only two Bald Eagles observed from Fish Rock Island either because they do not return using the same migration route, or because the migration was not taking place during our surveys. Roy Spence (personal communication, 2012) suggested that in the spring, the Eagles may be following the chain of streams where suckers are spawning for feeding purposes. Since this food source is not available in the fall, the Eagles may be utilizing a different route where food is more plentiful.

Three Bald Eagle nests were found on Ozhiski Lake (Figure 3.12-10). Eagles were observed sitting on two of the nests. The third nest was too far away to determine if an eagle was on the nest, however, an adult Eagle was spotted perched near the third nest.

Common Nighthawk

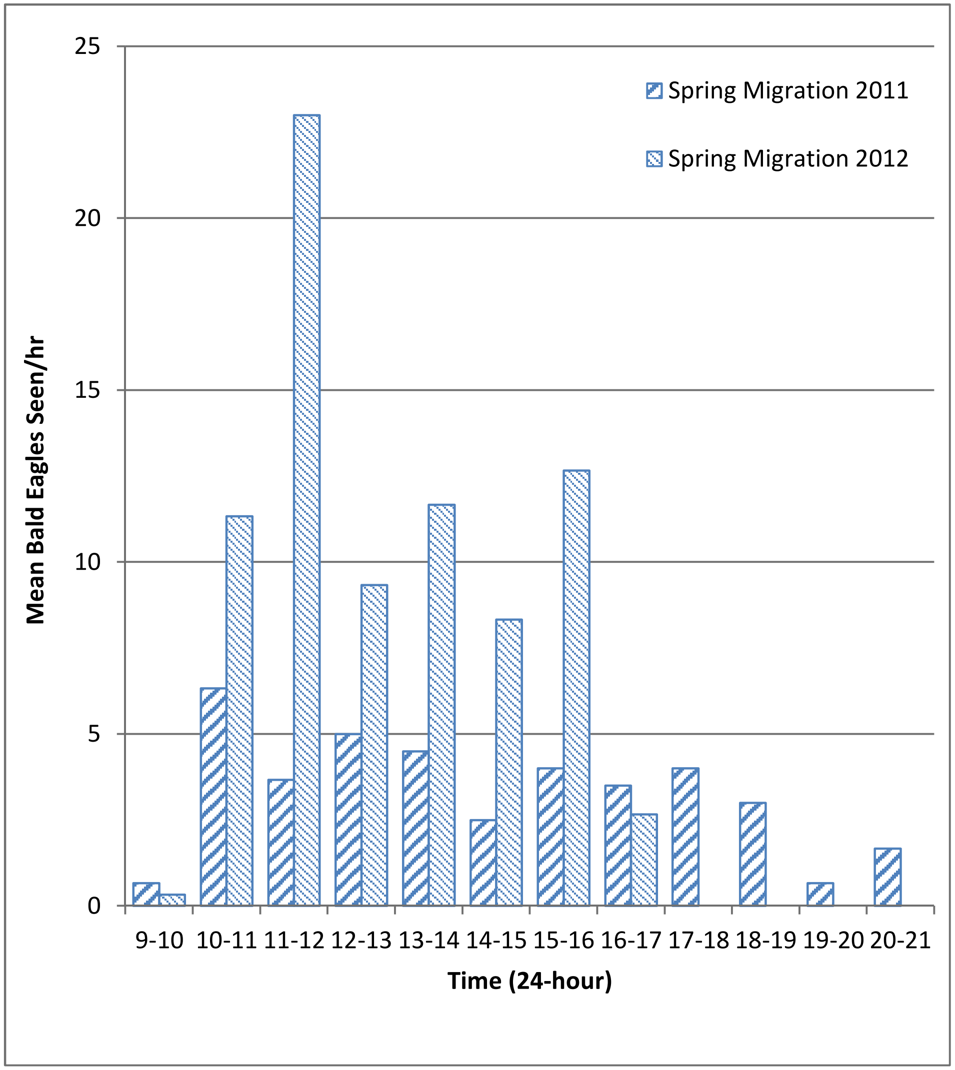
The Common Nighthawk is listed as SAR-Special Concern at the Provincial level. They usually nest on open areas with little to no ground vegetation (COSEWIC, 2007a), and were observed during the breeding season at all sites except Dearden Lake. Several nests were detected near the mine site (Figures 3.12-11 and 3.12-12), but nests were not found at any other sites. All nests were located in areas that had been cleared such as pathways, roads, and old drilling sites. In the PLNR area, although available Nighthawk nesting habitat was plentiful, no nests were found.

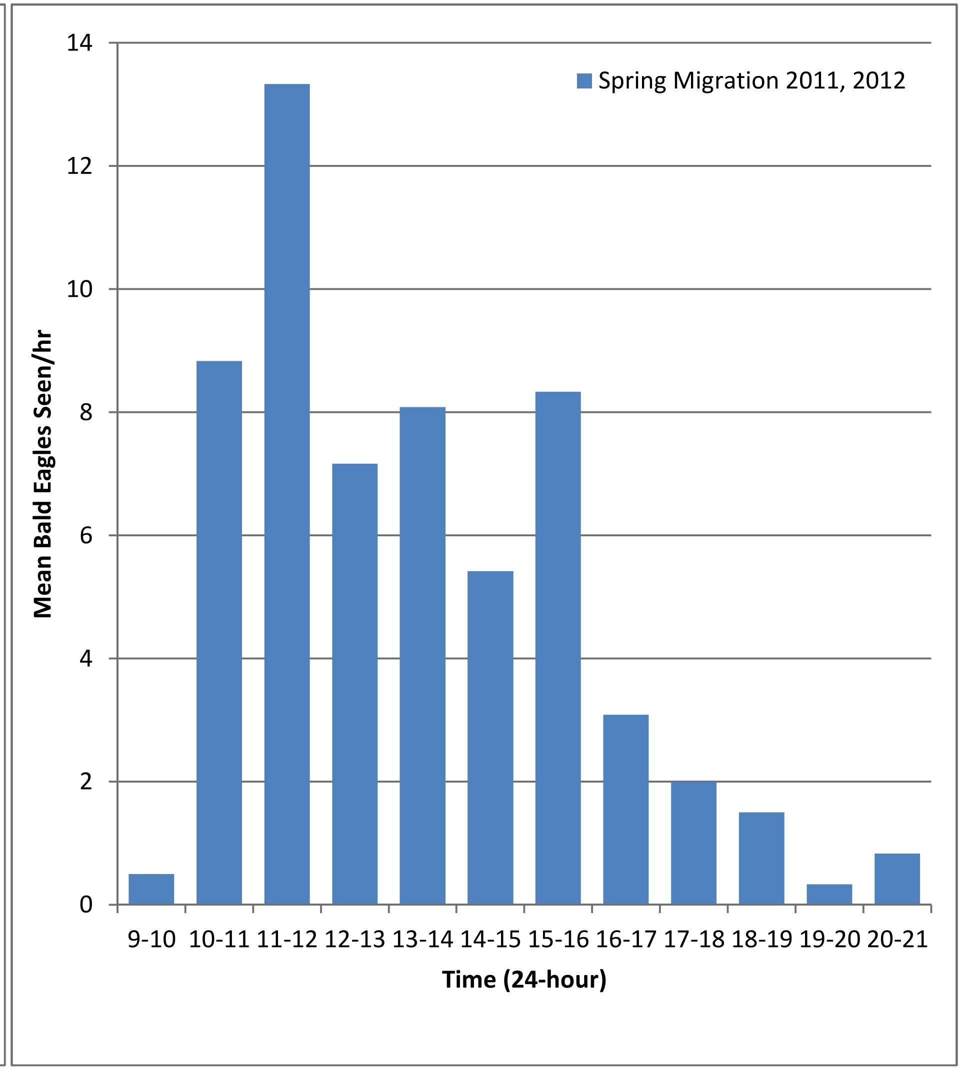
Olive-sided Flycatcher

The Olive-sided Flycatcher is a SAR-Special Concern at the Provincial level and is a Threatened SAR at the Federal level. Its breeding habitat is in coniferous and mixed forests around water bodies and wet areas where it can perch in the tops of trees and snags (COSEWIC, 2007b). The Cavell area was the only location where it was not detected. Most Olive-sided Flycatchers were detected in the mine site area (13 detections) compared with only two to four detections at the other three locations. The abundance of favourable habitat (wetlands and streams) at the mine site likely accounts for the relatively high number of individuals detected there.

Canada Warbler

The Canada Warbler is a Threatened SAR at the Federal level and a SAR-Special Concern at the Provincial level. Like the other SAR bird species, its populations have declined in the last 40 years across Canada (Cadman et al., 2007) including a decline of 44% over the last ten years. Ontario populations have declined at about half of that amount during the last ten years although low sample sizes make the estimate less robust.





NOTES:

1. BALD EAGLE SURVEYS OCCURRED FROM MAY 13 TO 15 IN 2011 AND MAY 14 TO 17 IN 2012.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	KC	PQ	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

MEAN NUMBER OF BALD EAGLES PER HOUR (2011 - 2012)

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF. NO. 34

FIGURE 3.12-9

REV A

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

BALD EAGLE NEST ON OZHISKI LAKE

Knight Piésold CONSULTING

P/A NO.	REF. NO.
NB102-390/1	34

FIGURE 3.12-10 REV A

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	KC	PQ	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

COMMON NIGHTHAWK NEST WITH TWO EGGS ON OLD DRILLING SITE

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF. NO. 34

FIGURE 3.12-11

REV A

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	KC	PQ	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

COMMON NIGHTHAWK SITTING ON NEST

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF. NO. 34

FIGURE 3.12-12

REV A

A	20DEC'13	ISSUED WITH REPORT	KC	PQ	RAM
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

From 80 to 85% of the Canada Warbler's breeding range is in Canada (COSEWIC, 2008). According to the ABBO, its abundance is highest in the southern shield region (Algonquin Park and shoreline region of Lake Superior) and is lower in the Ring of Fire region. For example, the probability of detection in the Ring of Fire region is 10% versus 68% in the southern shield region.

The low abundance in northern Ontario regions explains, at least in part, why only four birds were detected in the RSA during the breeding season (three in the Ozhiski Lake area and one at the mine site). All sites where the Canada Warbler was detected during the breeding season had a well-developed shrub layer, which they favour for breeding (COSEWIC, 2008).

One Canada Warbler was detected during fall migration near Wesley Lake flying with a mixed flock of warblers. During migration, this species is associated with forest edges and riparian habitats with a well-developed shrub layer (COSEWIC, 2008), which matches the habitat along the shoreline of Little Lake where it was observed.

Peregrine Falcon

Peregrines are listed as SAR-Special Concern at the Federal and Provincial levels. They usually nest on cliff ledges close to large bodies of water. In the RSA it appears that there is very little of this kind of habitat. In addition, in the ABBO, there are no records of Peregrines breeding in the RSA area. Thus, it is not surprising that this species was not detected during the breeding season.

However, at Fish Rock Lake, two Peregrine Falcons were observed on May 13, 2011 and again the following year on May 14, 2012. Both times they were seen either flying along the shoreline of the lake or perched in treetops overlooking the lake. Usually they return to nest sites in late March and begin egg-laying in late April (COSEWIC, 2010). The individuals observed in the RSA may have been late migrants heading to their nesting grounds in northern Quebec or Nunavut.

3.12.5 Summary

In total, 130 bird species were observed during the field studies including six species at risk (special concern): Bald Eagle, Canada Warbler, Common Nighthawk, Olive-sided Flycatcher, Peregrine Falcon and Rusty Blackbird. The six most frequently occurring breeding bird species for the entire RSA (>50% frequency), in decreasing order, were Swainson's Thrush, White-throated Sparrow, Yellow-rumped Warbler, Ruby-crowned Kinglet, Hermit Thrush and White-winged Crossbill.

The number of breeding bird species observed in the six major habitat types included the following.

- Non-woody wetlands - 56 species
- Coniferous forest - 49 species
- Woody wetlands - 48 species
- Mixed forest - 46 species
- Deciduous forest - 29 species
- Disturbed areas - 17 species

All breeding bird species were grouped into the following habitat strategy categories depending on their occurrence within the six major habitat types.

- Obligate forest birds - one species
- Facultative forest birds - 16 species

- Generalist birds - 15 species
- Facultative wetland birds - 15 species
- Obligate wetland birds - four species

Results obtained from the breeding bird surveys for each of the survey locations are summarized below:

- Mine Site
  a. Three major habitat types occur in the mine site area including conifer forest, woody wetland, and non-woody wetland
  b. More bird species were detected in the non-woody wetlands (bogs; 55 species) than at the forest sites (44 species) and woody wetland sites (30 species)
  c. Three SAR were found in the mine site area including Common Nighthawk, Olive-sided Flycatcher, and Rusty Blackbird
  d. Bird species richness (64 species) was the highest of all five infrastructure locations
- Dearden Lake
  e. Five major habitat types are common including conifer forest, deciduous forest, mixed forest, non-woody wetland, and woody wetland
  f. Conifer forest had the highest bird species richness (43) while non-woody wetlands had the lowest (16)
  g. Two SAR were found in this area, including Olive-sided Flycatcher and Rusty Blackbird
  h. Bird species richness of 55 was less than for the mine site (64) and the PLNR (58), but was greater than the Ozhiski (51) and Cavell (29) sites
- Ozhiski Lake
  i. Five major habitat types are common including conifer forest, deciduous forest, mixed forest, non-woody wetland, and woody wetland
  j. Bird species richness was lowest in the Ozhiski Lake area
  k. Non-woody wetlands had the highest bird species richness (40) and both woody wetland (20) and deciduous forest (20) had the lowest species richness
  l. Four SAR were found in this area, including Bald Eagle, Common Nighthawk, Olive-sided Flycatcher and Rusty Blackbird
- PLNR
  m. This was the only location where all six major habitat types were common
  n. The highest bird species richness was found in the woody wetlands (38)
  o. High species richness was also found in the conifer forest (30) and the mixed forest (28)
  p. This area had the second highest number of bird species (58)
  q. SAR species found in this area included Common Nighthawk and Olive-sided Flycatcher
- Cavell Site
  r. Five major habitat types were common in this area; only woody wetlands were absent
  s. The most common habitat type was disturbed areas
  t. Highest bird species richness was associated with disturbed habitat
  u. Lowest species richness was associated with deciduous forest
  v. A total of 29 bird species were detected in the Cavell area
  w. The only SAR at this site was Common Nighthawk

- Savant Lake
    x. No field data were collected at Savant Lake for this baseline report; however, field data for the area around Savant Lake are available through the ABBO
    y. 112 breeding bird species have been identified including five SAR: Bald Eagle, Barn Swallow, Canada Warbler, Common Nighthawk and Olive-sided Flycatcher. All of these species have special concern status except for Barn Swallow, which is threatened.

From these field studies, it is estimated that 19 bird species do not breed in the RSA but do utilize some portion of the RSA during migration. These species include nine waterfowl, one seabird, one raptor, one shorebird, and seven others.

A total of 14 bird species were observed during the winter. Five were detected from winter track surveys including Ruffed, Spruce and Sharp-tailed Grouse, owl species (one group) and Common Raven, and nine were recorded from incidental observations, primarily along the transportation corridor.

Although a total of 14 raptor species were observed within the RSA, there were no raptors or raptor nests found in the mine site area.

3.13 FISHERIES AND AQUATIC RESOURCES

Lakes, rivers and streams are some of the major features of the boreal landscape in northern Ontario and the networks of lakes and watercourses within the Project area drain the land surface into James Bay or directly into Hudson Bay. One of the many investigations undertaken for the Project involved a baseline aquatic environment assessment to determine the current condition of fish and aquatic habitat in areas anticipated to be affected by the Project development. A Regional Study Area (RSA) was delineated to encompass the greater area potentially affected by the Project over the long-term. Within the RSA, three local study areas (LSA) were defined to focus baseline assessment field work and monitoring programs and include the immediate mine site, the transportation corridor, and the trans-load facility. The surface water quality, sediment quality, benthic macro invertebrate communities, fish communities and fish habitat characteristics were assessed during the baseline program conducted from 2011 through 2013. This summary provides a description of the existing fish and aquatic baseline conditions at each study area evaluated. These data fulfill the assessment scope outlined in the Project's ToR (MOE, 2013), the requirements of the EIS Guideline (CEA Agency, 2012) and Addendum (CEA Agency, 2013). A technical supporting document that provides additional detail regarding the study methods, results and discussion is available in Appendix 6.

3.13.1 Study Area

3.13.1.1 Regional Study Area

The RSA boundary was selected to examine the potential of the Project to contribute to cumulative impacts on the aquatic resources within the larger landscape in northern Ontario. The primary criteria used for the selection of the RSA included:

- Drainage patterns of the contributing watersheds in the Attawapiskat, Winisk, and Ekwan River watersheds
- Spatial extent of potential impacts to fish and aquatic resources resulting from the Project and all other development projects in these watersheds.
- A detailed review of historic and current existing information regarding the distribution, relative abundance, seasonal movement, and diversity of fish and aquatic fauna in areas expected to be influenced by Project activities.

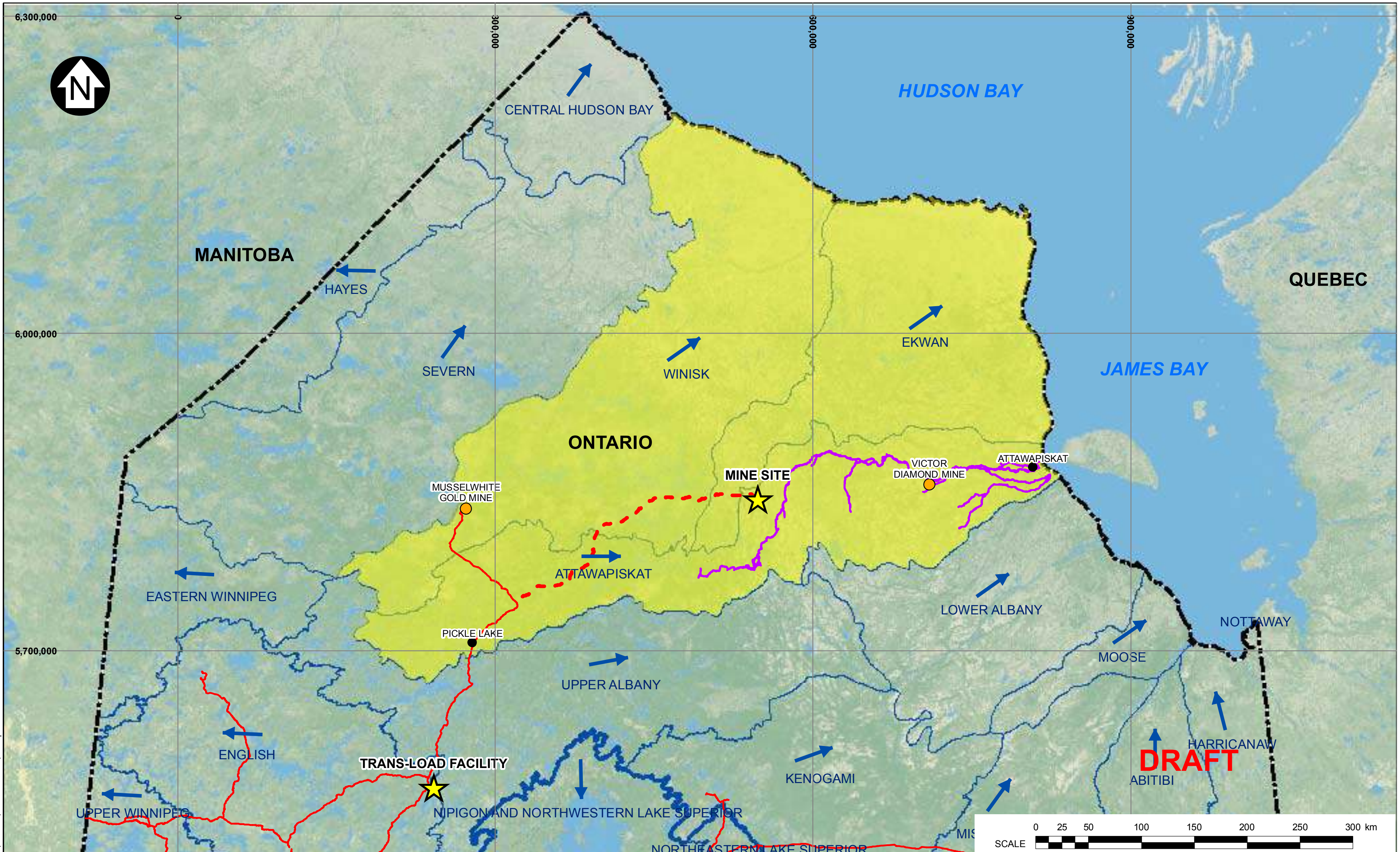
A summary of the watersheds within the RSA, including watershed area and the major tributaries assessed during this program is outlined in Table 3.13-1.

Table 3.13-1 Study Area Watershed Summary

Watershed	Area (ha)	Major Tributaries Surveyed
Attawapiskat	5,658,981	Pineimuta River, Muketei River, Attawapiskat River
Winisk	7,948,594	Fishbasket River, Wapitotem River
Ekwan	5,194,302	Ekwan River

NOTES:

1. WATERSHED AREA DATA PROVIDED BY NATURAL RESOURCES CANADA.



SAVED: I:\1102\00390\01\A\GIS\Figs\A697_rA.mxd; Dec 20, 2013 7:06 PM; asimpson

LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- OTHER MINE PROJECT
- COMMUNITY
- EXISTING ALL-SEASON ROAD
- MAJOR WATERSHED DIVIDE
- ATLANTIC OCEAN - HUDSON BAY DRAINAGE DIVIDE
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- PROVINCIAL BORDER
- ATTAWAPISKAT RIVER
- REGIONAL STUDY AREA
- WATERSHED FLOW DIRECTION

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013).
4. MAJOR WATERSHED DATA PROVIDED BY: NATURAL RESOURCES CANADA.
5. BASE MAP IMAGERY PROVIDED BY ESRI GIS ONLINE (http://www.arcgis.com)

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	DKK	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

AQUATIC RESOURCES REGIONAL STUDY AREA

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.13-1 | REV A

3.13.1.2 Local Study Area

Aquatic resource LSAs were identified for the Project include the mine site, the transportation corridor, and the trans-load facility. These areas were selected based on the Project footprint and local drainage patterns of rivers and other water bodies. The mine site LSA encompasses a portion of the Muketei River, as well as the streams and water bodies in the area. The transportation corridor LSA includes an area immediately upstream of the corridor, and extends downstream to include large river systems or water bodies with high connectivity to aquatic overwintering habitat.

The baseline mine site assessments were conducted within the selected aquatic resources LSA. The transportation corridor LSA includes the major watercourses and lentic systems within a large scale area sensitive to potential Project related effects.

The trans-load facility is within the Upper Albany River watershed, close to the English River watershed divide. Two water bodies with surface areas less than 0.06 ha each are located on the eastern edge of this property, with no apparent surface connectivity to surrounding watercourses. The fish communities were assessed in these ponds. Due to the small size and limited connectivity of these water bodies, the aquatic resources LSA at the trans-load facility is limited to these two ponds.

3.13.2 Background

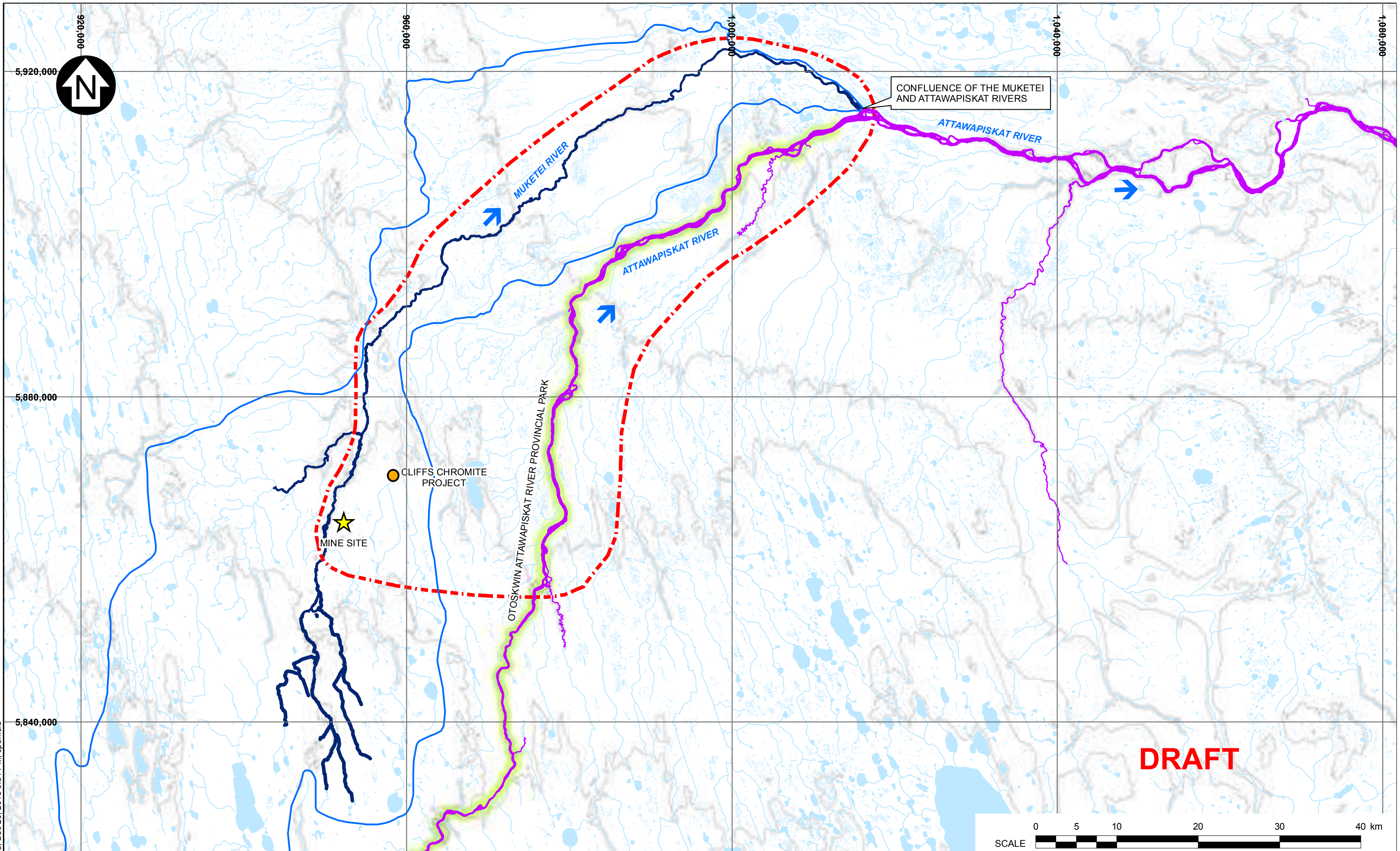
The majority of relevant historical data collection in this the Project RSA, has been completed by the Ontario Ministry of Natural Resources (MNR) over the last 25 years. The MNR studies primarily focused on the large lakes and rivers of northwestern Ontario. The completed surveys were typically species-specific, targeting sport fish such as walleye (*Sander vitreus*) and northern pike (*Esox lucius*) (Marshall and Jones, 2011). There are relatively little data collected from the thousands of small to medium sized water bodies and streams in this region, especially in the northeast. Baseline benthic invertebrate and fisheries data in the Project region are limited to anecdotal and historical collections by the MNR. A list of anticipated fish species present in the area was generated using MNR and Royal Ontario Museum (ROM) species distribution data (Holm et al., 2010).

The Mushkegowuk Environmental Resources Centre (MERC) recently sampled 60 water quality stations on the Attawapiskat River upstream, downstream and adjacent to the DeBeers Canada, Victor Diamond mine. These stations were selected based on changes in the river morphology and aquatic habitat features near the mine. The most upstream MERC water quality monitoring station is located approximately 90 km downstream of the Muketei and Attawapiskat River confluence. These data are useful to provide a general characterization of the conditions far downstream from the Project area, in that region of the Attawapiskat River

The distribution of one fish species at risk has been confirmed within the Project area. Lake sturgeon (*Acipenser fulvescens*) are the largest Ontario freshwater fish species, and Ontario's only member of the sturgeon family. There are three lake sturgeon populations within Ontario:

- Northwestern Ontario
- Great Lakes/Upper St. Lawrence River
- Southern Hudson Bay/James Bay

Figure 3.13-1 shows the aquatic regional LSA, figure 3.13-2 shows the subregional context of the mine site aquatic LSA. Figures 3.13-3 and 3.13-4 show the aquatic resources LSA.



LEGEND:

- MINE SITE
- CLIFFS CHROMITE PROJECT
- ATTAWAPISKAT RIVER (MAIN CHANNELS)
- MUKETEI RIVER (MAIN CHANNELS)
- MUKETEI RIVER SUBWATERSHED
- RIVER/STREAM/DRAINAGE
- WATER
- PROVINCIAL PARK
- AQUATIC RESOURCES LOCAL STUDY AREA
- FLOW DIRECTION

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N.
3. CLIFFS CHROMITE PROJECT LOCATION IS THE OPEN PIT FROM THE CONCEPTUAL MINE SITE LAYOUT (AUGUST 2012).

SAVED: I:\1102\00390\01\A\GIS\Figs\A698_rA.mxd; Dec 20, 2013 6:31 PM; spenfold

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	RAC	SWK	SRA	RAM

NORONT RESOURCES LTD.

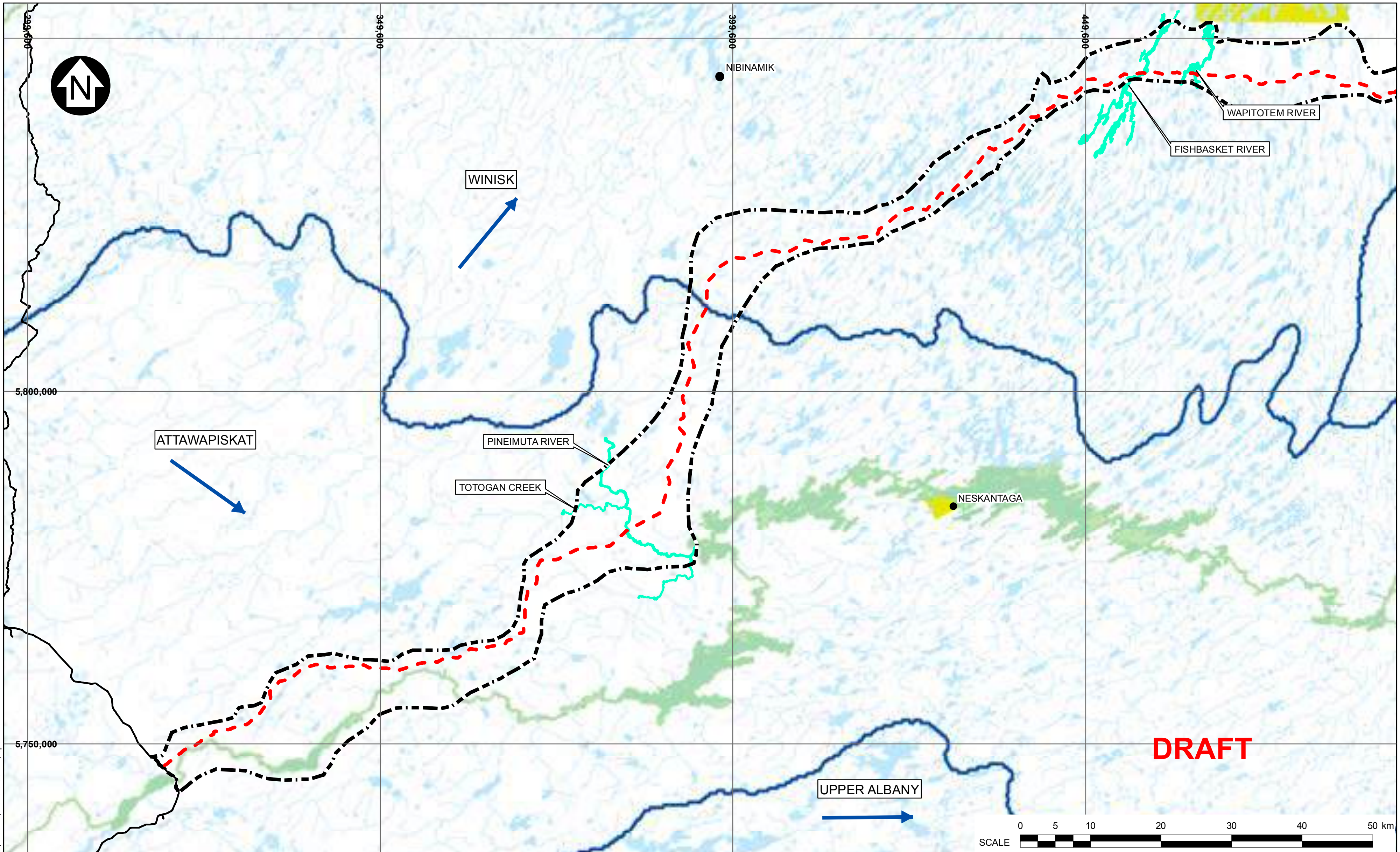
EAGLE'S NEST PROJECT

SUBREGIONAL CONTEXT OF THE MINE SITE AQUATIC LOCAL STUDY AREA

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 3.13-2 | REV A



LEGEND:

- COMMUNITY
- WATERSHED FLOW DIRECTION
- NORTHERN ONTARIO RESOURCE TRAIL
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- RIVER/STREAM/DRAINAGE
- WATER
- MAJOR WATERSHED DIVIDE
- MAJOR WATERCOURSE
- FIRST NATIONS RESERVE
- OTOSKWIN-ATTAWAPISKAT RIVER PROVINCIAL PARK - WATERWAY
- TRANSPORTATION CORRIDOR LOCAL STUDY AREA

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013).
4. MAJOR WATERSHED DATA PROVIDED BY: NATURAL RESOURCES CANADA.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	DKK	SWK	SRA	RAM

NORONT RESOURCES LTD.

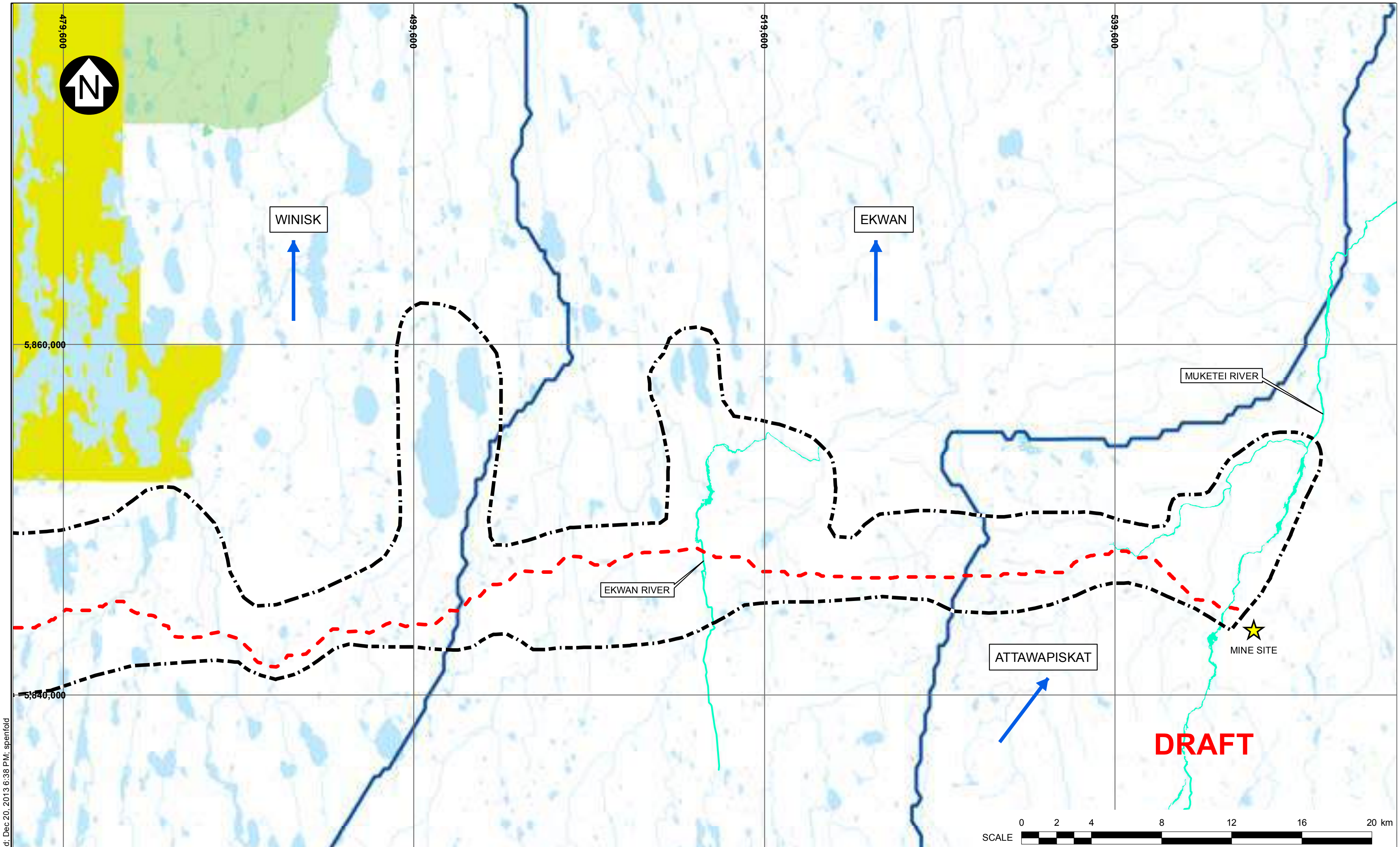
EAGLE'S NEST PROJECT

TRANSPORTATION CORRIDOR AQUATIC RESOURCES LOCAL STUDY AREA (1 OF 2)

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 3.13-3 | REV A



LEGEND:

- MINE SITE
- WATERSHED FLOW DIRECTION
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- RIVER/STREAM/DRAINAGE
- WATER
- MAJOR WATERSHED DIVIDE
- MAJOR WATERCOURSE
- TRANSPORTATION CORRIDOR LOCAL STUDY AREA
- FIRST NATIONS RESERVE
- PROVINCIAL PARK

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013).
4. MAJOR WATERSHED DATA PROVIDED BY: NATURAL RESOURCES CANADA.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	DKK	SWK	SRA	RAM

SAVED: I:\1102\00390\01\A\GIS\Figs\A700_rA.mxd; Dec 20, 2013 6:38 PM; spenfold

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

TRANSPORTATION CORRIDOR AQUATIC RESOURCES LOCAL STUDY AREA (2 OF 2)

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 3.13-4 | REV A

Provincially, the first two populations are listed as threatened on the Species at Risk in Ontario (SARO) List by the Committee on the Status of Species at Risk in Ontario (COSSARO). The Eagle's Nest Project lies within the Southern Hudson Bay/James Bay population distribution area, which COSSARO lists as being of special concern (MNR, 2013).

Eight lake sturgeon populations within Canada have been ranked by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as endangered, threatened or special concern. Five of these populations are within Ontario. The Southern Hudson Bay/James Bay population has been identified as special concern by COSEWIC and is currently being considered for listing under the federal Species at Risk Act (SARA) (DFO, 2006).

3.13.3 Methods

Methodologies for the baseline aquatic assessment were developed based on standard aquatic assessment protocols. These protocols were focused on three primary aquatic components including: sediment quality, benthic invertebrate community, and fish and fish habitats. Aquatic assessment procedures for these aquatic components were adapted from the following sources:

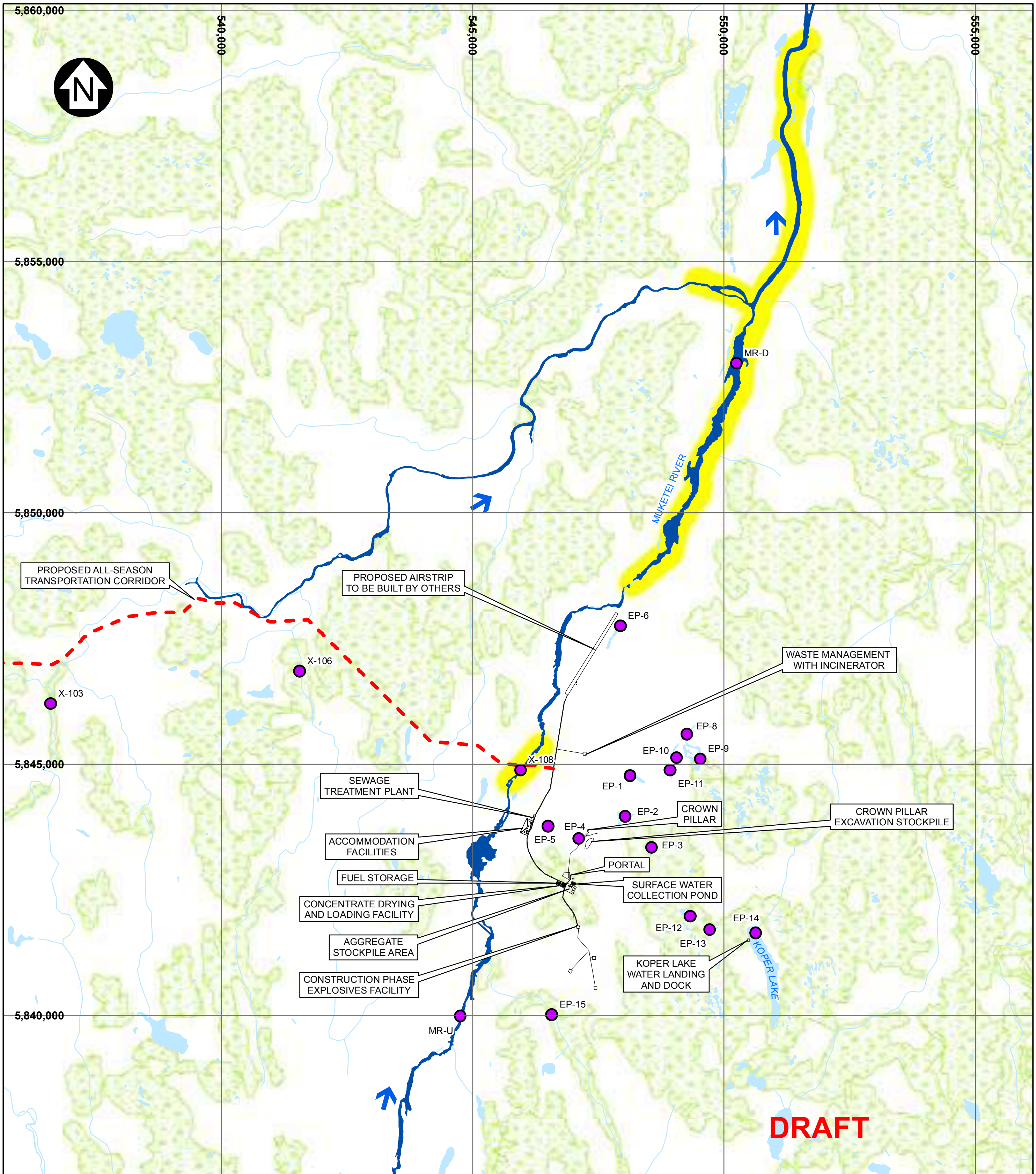
- Ontario Stream Assessment Protocol (OSAP), (Stanfield, 2010)
- MNR Broad-scale Fish Community Monitoring Program (BSM), (Sandstrom et al., 2010)
- MNR Riverine Index Netting Manual of Instructions, (Jones and Yunker, 2009)
- Environment Canada (EC) Metal Mining Technical Guidance for Environmental Effects Monitoring, (EC, 2011)

Methodologies were also developed in consultation with Fisheries and Oceans Canada (DFO) and the Ontario Ministry of Natural Resources (MNR). During this consultation period, these regulators agreed that detailed assessments of all the streams located within the proposed study areas was not required to characterize the aquatic environment. Detailed description of methodologies for sediment quality, benthic invertebrate community, and fish and fish habitats as well as all assessment locations investigated during 2010 (n=8 sites), 2011 (n=108 sites) and 2012 (n=58 sites) efforts are provided in the Baseline Aquatic Environment Report (Appendix 6).

3.13.3.1 Mine Site

Baseline aquatic sampling was conducted at 15 stations near the mine site during the 2011 spring and summer period, and during the summer of 2012. The stations included lotic watercourses and lentic environments such as the shallow ponds and lakes in the LSA.

The Muketei River is located in the Attawapiskat watershed that generally flows from the south-west to the north-east. The Attawapiskat River receives input from the Muketei River at the confluence of the two rivers located approximately 80 km north-east of the mine site. The Muketei River is considered the main receiver of potential mine influences, therefore, baseline sampling stations were positioned upstream, downstream, and adjacent to the mine site along the river. Upstream sampling station EP-15, south of the mine site is located on a tributary of the Muketei River. Stream station EP-05 reports to a beaver pond east of the proposed mine site camp and is in the immediate vicinity of other mine infrastructure. These stations provide baseline data to characterize the lotic environments near the mine site. Figure 3.13-5 shows the mine area sample locations.



LEGEND:

- FLOW DIRECTION
- AQUATIC ASSESSMENT LOCATION
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- PROPOSED INFRASTRUCTURE
- MUKETEI RIVER (MAIN CHANNELS)
- STREAM
- WATER
- WETLAND
- FISH SAMPLING AREA

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES, LAND INFORMATION ONTARIO (LIO), (2009). ALL RIGHTS RESERVED. STREAM NETWORKS OBTAINED FROM NATURAL RESOURCES CANADA (2010).
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. INFRASTRUCTURE INFORMATION AND PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.

SCALE 1 0.5 0 1 2 3 4 5 km

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

MINE SITE AREA SAMPLE LOCATIONS

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.13-5 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	DKK	SWK	SRA	RAM

SAVED: I:\102\00390\01\A\GIS\Figs\A701_rA.mxd; Dec 20, 2013 6:40 PM; spenfold

The lacustrine environments located in close proximity to the mine site include many ponds, with Koper Lake (EP-14) providing the largest lentic habitat in the area. Assessments of these water bodies took place during the late summer of 2011 (KP, 2011).

3.13.3.2 Transportation Corridor

Noront has proposed the development of an east-west transportation corridor that would include an all-season road connecting the mine site to existing provincial infrastructure near the community of Pickle Lake. Initial fisheries assessments were conducted on a number of lakes and rivers along this corridor during the fall of 2010 to establish a preliminary estimate of fish diversity and a relative estimate of fish abundance (KP, 2010). Building on the initial work conducted during 2010 extensive efforts was made during 2011 and 2012 to further characterize the baseline aquatic conditions of the transportation corridor. The 2011 late spring – early summer studies focussed on assessing watercourses on the existing winter road between the Northern Ontario Resource Trail (NORT), north of Pickle Lake and Webequie First Nation. These assessments included watercourses crossing the existing winter road up to the point where the road turns north to the First Nation community of Webequie and along the proposed corridor, which is approximately 30 km southwest of Webequie (KP, 2011). Surveys conducted during 2012 included some additional watercourses between Webequie First Nation and the NORT, as well as a fish usability study in the Muketei River (KP, 2012).

The sample locations were divided into two types of aquatic assessments along the transportation corridor. Assessments were divided between focussed assessments and detailed assessments. The focussed aquatic assessment stations (FAAS) characterized fish habitat conditions utilizing short duration assessments that did not require an overnight camp at the crossing locations. Following discussions with the MNR and DFO, FAAS were conducted at approximately 60% of the stations along this corridor. These assessments focussed primarily on small streams and some medium sized watercourses. Data collected at these stations included:

- In-situ water quality parameters
- Description of stream morphology, riparian vegetation and upland habitat
- Description of the aquatic vegetation and substrate

The detailed aquatic assessment stations (DAAS) were selected to include all large watercourses, most medium sized watercourses, and some small streams to characterize the regional aquatic environment. Detailed assessments were completed at approximately 40% of the stations along this transportation corridor. These assessments typically included multiple site visits and were composed of:

- In-situ water quality monitoring
- Collection of surface water and sediment quality samples for laboratory analysis
- Description of stream morphology, riparian vegetation and upland habitat
- Stream flow monitoring
- Benthic macroinvertebrate community survey
- Fish habitat mapping
- Fish community surveys, utilizing multiple collection methods

As per guidance from DFO, the DAAS along the corridor defined an Area of Investigation (AOI) that was subdivided into three zones:

- From each station coordinate (A minimum of 50 m upstream)
- From each station coordinate (A minimum of 250 m downstream)
- At each station coordinate, in suitable habitat adjacent to existing structures (e.g., corduroy bridges) where present

Sampling transects were established at these distances upstream, downstream, and at the station location. Surface water quality samples were obtained at each DAAS when the in-situ parameters were measured. Aquatic sediment samples were collected at each of the three transects in the AOI. Benthic macroinvertebrate samples were collected concurrently with the aquatic sediment samples at each transect. The fish community survey and habitat mapping occurred throughout the full reach of the AOI following benthic macroinvertebrate sampling.

3.13.3.3 Trans-load Facility

The two water bodies located at the trans-load facility site were sampled for surface water quality and fish community (KP, 2011). Sediment quality and benthic invertebrate community sampling was not conducted on these ponds as they appear isolated from the surrounding watercourses, and Project related impacts to these environments are likely minimal..

3.13.4 Results

This section summarizes the results of aquatic sediment, benthic invertebrate and fish and fish habitat surveys conducted for the Project. The assessments are broken down by geographic region and include the following assessment areas:

- Mine Site – Lotic and Lentic Environments
- Transportation Corridor - Attawapiskat West Watershed
- Transportation Corridor - Winisk Watershed
- Transportation Corridor - Ekwan Watershed
- Trans-load Facility

3.13.4.1 Aquatic Sediment Quality

Mine Site - Lotic Environments

The sediment quality monitoring program was designed to characterize baseline conditions in the Muketei River and aquatic sediment samples were collected at stations X103, X108, and EP-15. These samples were analyzed for pH, TOC, and total metals. The sediment of the Muketei River was slightly acidic, which is typical of drainage basins dominated by upland coniferous vegetation. Metals such as mercury and cadmium were reported near or below the laboratory method detection limits at most survey locations. All TOC results exceeded the PSQG-LEL criteria. This is likely attributable to the abundant organic material sources in this area. Sediment quality results from Station X108 show the most criteria exceedances including P, TOC, As, Cr, Mn, and Ni. Manganese was the only parameter that exceeded the PSQG-SEL.

Mine Site - Lentic Environments

The pools, ponds, and lakes near the mine site are characterized by acidic sediments associated with coniferous organic inputs. Several parameters were detected above their respective sediment quality criteria, including: TOC, As, Cd, and Zn. Station EP-04 and Station EP-12 reported the most regulatory criteria exceedances. Station EP-04, located nearest to the ore body, reported the third highest cadmium concentration and the only zinc concentration that exceeded the PSQG-LEL. Station EP-12, positioned next to the winter snowmobile trail between the exploration camps and Koper Lake, is directly under a regularly used helicopter flight path. The results for Station EP 12 had cadmium and arsenic concentrations that exceeded the relevant criteria.

Transportation Corridor - Attawapiskat West Watershed

The 12 streams sampled within the Attawapiskat West watershed show slightly acidic sediment conditions. There were several parameter concentrations detected above their respective quality criteria, including: P, TOC, As, Cr, Fe, Mn, and Ni. Station X009 reported a manganese concentration above all other station results within the watershed. Stations X020, X023 and X025 reported the only chromium concentrations detected above the PSQG-LEL. These stations also reported elevated concentrations of Fe, Mn and Ni concentrations above quality criteria.

Transportation Corridor - Winisk Watershed

Sediment quality samples from seven streams in the Winisk watershed show slightly acidic sediment conditions. The most frequent parameters with quality criteria exceedances were P and TOC. Station X040 reported six parameters with concentrations above their respective criteria, including: TOC, Cr, Cu, Fe, Mn, and Ni. Station X040 reported many elevated metals concentrations compared to the other stations sampled.

East-West Transportation Corridor - Ekwan Watershed

The Ekwan watershed contained two sediment sample locations with acidic sediment. There were three parameters detected above the quality criteria: P, TOC, and Mn. The manganese concentration exceeded the PSQG-SEL.

Trans-load Facility

The trans-load facility was not sampled for sediment quality, since there were only two small ponds near the property and they are unlikely to be impacted by the Project.

3.13.4.2 Benthic Invertebrates

Mine Site - Lotic Environments

The Muketei River is characterized by fine substrates comprised of coarse and fine sand with overlying organic material. These fine substrates are ideal habitat for burrowing benthic taxa such as dipterans. The larvae and pupae of the most dominant taxa, Chironomidae, are an important food source for a variety of aquatic organisms. Dominance of these taxa may be interpreted to indicate marginal water quality and increased taxonomic identification resolution will allow for additional interpretation.

The invertebrate densities were variable between stations, with Station MR-U showing the lowest Total Benthic Invertebrate Density (TID). Station MR-U also showed the lowest percent

Ephemeroptera, Pleacoptera, and Trichoptera Index (EPT) taxa of all stations within the watershed. Station X108 showed the lowest %OD taxa (Oligochaeta and Diptera) and highest % EPT taxa of the Muketei River stations. There was high taxa diversity within all stations, showing a low evenness value, which is attributed to the high percentages of taxa within the oligochaeta and dipteran groups.

Given their location, Station MR-U should be considered the reference area and Station X108 should be considered the exposure area if the mine becomes subject to the *Metal Mining Effluent Regulations (*MMERs). In accordance with *Environmental Effects Monitoring (*EEM) data analysis protocols, the benthic community assemblages from these stations were compared and they were found to be significantly different. These results suggest an alternate reference area that closely matches the Station X108 environment should be selected for any future studies.

Mine Site - Lentic Environments

The mine site area aquatic assessment focussed on baseline benthic invertebrate conditions of the lotic systems. Benthic invertebrate sampling was not conducted in the lentic aquatic environments near the mine site. Particle size distribution analysis was conducted on sediment quality samples from the lentic environments. Results show fine substrates dominate these stations and that they are primarily composed of silt and clay.

Transportation Corridor - Attawapiskat West Watershed

The benthic environments of the surveyed Attawapiskat watershed streams were dominated by fine substrates, including: silt, fine, and coarse sand. There was a mix of slow moving, lower gradient watercourses and higher energy, erosional streams in this region. The streams sampled for benthic invertebrates in this watershed showed a range of TID values, with Station X023 reporting a TID with the least number of invertebrates. This station was located at a location with a hard bottom that had limited available soft substrates for burrowing taxa. These taxa typically made up the majority of the taxa at the watershed stations. Station X020 on Totogan Creek and Station X023 detected the highest %EPT composition, indicative of faster flowing environments with higher oxygen levels. Chironomids were the most abundant taxa detected in this watershed, with high diversity and low evenness values between stations.

East-West Transportation Corridor - Winisk Watershed

The Winisk watershed is characterized by high topographical relief, creating higher energy streams, with some slow moving depositional streams that have been influenced by beaver impoundments. This variety of stream environments provides a range of substrate materials with rock and coarse sand within higher energy locations and fine sand, silt, and clay within lower energy locations. The TID values were highest at Station X054 and at Station X037. These sample areas were characterized by deep, slow moving channels connected to lakes and were found to be dominated by taxa typically found in high densities in these areas (e.g., Oligochaeta and Chironomidae). The highest %EPT taxa were detected at Station X069 and Station X079. Both of these stations are located within high energy system with sand and/or boulder substrates that are ideal for EPT taxa. There was relatively high taxa diversity within stations; however, the range of invertebrates belonging to the OD taxa produced a low evenness value for the watershed.

Transportation Corridor - Ekwan Watershed

Four stations were sampled for benthic invertebrates in the Ekwan watershed, two of which (Station X086 and Station X093) were successfully sampled for substrate particle size distribution. The remaining sites contained substrate dominated by aquatic vegetation roots, wood debris and organic material, unsuitable for particle size distribution analysis. These stations were typically, low gradient, beaver impounded environments. Station X086 was unlike the other Ekwan watershed stations. This station was further to the east within a fast flowing environment with coarse sand substrate. The substrate at Station X093 was dominated by silt and clay, with relatively high TID values, primarily comprised of OD taxa. The most abundant family in the Ekwan watershed belonged to the *Sphaeriidae* family, attributed to the high number of individuals collected at Station X086. Less than 25% of the community proportions included EPT taxa. Relatively high diversity was shown at these stations, although the range of taxa distributed within the bivalvia and dipteran groups produced a low evenness value.

Trans-load Facility

The trans-load facility was not sampled for benthic invertebrates, since there were only two small ponds near the property and they are unlikely to be impacted by the Project.

3.13.4.3 Fish Community and Fish Habitat

Overview of Sampling Efforts

A total of 23 different fish species were sampled throughout the LSA during targeted fisheries investigations conducted from 2010 through to 2012. The majority of fish diversity (19 of 23 species) was observed along the transportation corridor within the Atawapiskat and Winisk watersheds. The information outlined in Table 3.13-2 offers an overview of the fish and fish habitat sampling efforts conducted during 2010 through 2012 along the Transportation Corridor, Mine Site and the Trans-load Facility

Table 3.13-2 Fish and Fish Habitat Assessment Summary

Year	Month	Study Area
2010	September 09 to 19	Transportation Corridor Mine Site (Muketei River)
2011	May 29 to June 28	Transportation Corridor (Existing winter road NORT to Webequie FN)
2011	August 15 to September 04	Transportation Corridor (Webequie FN to Muketei River) Mine Site (Exploration Property stations incl. Muketei R.) Trans-load Facility
2012	June 21 to 27	Mine Site (intensive study of Muketei River)
2012	September 19 to 24	Transportation Corridor (Additional stations Pickle Lake North Highway to Webequie FN)

<u>Mine Site - Lotic Environments: Muketei River and Tributaries</u>

Fish community sampling during 2010, 2011 and 2012 detected 15 fish species within the Muketei River. Walleye (*Sander vitreus*) and pearl dace dace (*Margariscus margarita*) were the most abundant species in the sampled areas. Walleye was one of the target species of the fish usability study and as a result the number of walleye collected is attributable to the increased species-specific effort used to collect walleye for this study.

The Muketei River has a wide variety of fish habitats ranged from fast flowing reaches, dominated by boulders and coarse substrate, to broad, slower moving lake-like basins with heavily vegetated shallow margins. Suitable spawning habitat for walleye, lake whitefish (*Coregonus clupeaformis*), and lake sturgeon (*Acipenser fulvescens*) were evident in the fast flowing areas where the water was highly oxygenated. Northern pike (*Esox lucius*), yellow perch (*Perca flavescens*), and other small-bodied fish species are provided suitable spawning and rearing habitat in the wetland environments of the wide Muketei River sections. During summer low flow periods some higher gradient sections may pose barriers to fish passage. In-stream cover is provided by boulders as well as logs and other wood debris. The Muketei River banks are steep, with limited overhanging canopy to provide cover.

The 2012 fish usability study targeted walleye and white sucker (*Catostomus commersonii*). The mercury concentration in walleye body muscle tissue indicates baseline concentrations are equal to or exceed 0.26 µg/g in nearly half of the reported results. Ages of the sampled walleye ranged between 8 and 21 years, with the highest mercury concentrations detected in those individuals older than 13 years of age. There were no other metals of concern detected in the walleye tissue samples. White sucker tissue analysis showed mercury levels below the MDL (10 µg/g) for all but two samples which had concentrations equal to the MDL. All other metals concentrations were below their respective MDL.

<u>Mine Site - Lentic Environments</u>

Fish community sampling conducted during 2011 detected six fish species within the pools, ponds, and lakes near the mine site. Finescale dace (*Chrosomus neogaeus*) were the most abundant species collected in these water bodies. Koper Lake was the only water body in this area where sport fish (northern pike) or panfish (yellow perch) were detected.

There was limited canopy cover provided by the sparse spruce and tamarack trees growing along the margins of these water bodies. Undercut banks were present at most of these water bodies, attributed to the Sphagnum dominated riparian vegetation growing at the static water level. The undercut banks and dense aquatic vegetation growing along the margins of these water bodies provide suitable fish spawning and juvenile rearing habitat. These water bodies were primarily isolated pools with limited connectivity to other streams or other watercourses. Koper Lake was the only water body that had an outlet stream (Koper Creek).

<u>Transportation Corridor - Attawapiskat West Watershed</u>

Fish community sampling conducted during 2011 detected 17 fish species in the surveyed streams of the Attawapiskat West watershed. Finescale dace and brook stickleback (Culaea inconstans) were the most abundant species collected in these water bodies.

Low gradient streams with fine substrates were the dominant habitat surveyed in this watershed. Beaver activity influenced the majority of these streams, contributing to the amount of in-stream cover and providing suitable fish spawning and juvenile rearing habitat. Dense aquatic submergent and emergent vegetation was noted at most stations, with additional stream cover provided by grasses, sedges, alder and willow along the riparian zone. The beaver dams and corduroy bridge crossings on these watercourses will likely provide barriers to fish passage during periods of low flow. These will also restrict connectivity between habitats and impeded stream flow. Removal of these crossings would improve fish habitat and connectivity of these environments.

East-West Transportation Corridor - Winisk Watershed

There were 17 fish species detected in the surveyed streams of the Winisk watershed. The most abundant fish species collected were finescale dace and brook stickleback. High topographical relief created a range of energy conditions from higher energy streams to slow moving depositional streams that have been influenced by beaver impoundments. Suitable spawning habitat for walleye, white sucker and current-loving species (e.g., sculpins) were noted in the fast flowing environments, which had boulders and coarse sand substrates. Connectivity to lakes and wetlands provided spawning and rearing habitat for northern pike, yellow perch, and a variety of small-bodied fish species. Corduroy bridge crossings were located at the majority of the sampling sites stations. These streams may limit fish passage during periods of low flow and reduce connectivity to adjacent water bodies.

Transportation Corridor - Ekwan Watershed

Fish community sampling conducted in the surveyed watercourses of the Ekwan watershed detected the presence of three species, including: lake chub (Couesius plumbeus), longnose dace (Rhinichthys cataractae) and northern pike. Limited capture success was realized at these stations, which is indicative of the stream habitat and water quality. In-situ dissolved oxygen measured at Station X099 was 3.32 mg/L and is likely unsuitable to support a fish community. In-stream cover consisted of floating and emergent aquatic vegetation as well as logs and debris.

Trans-load Facility

The trans-load facility contains two small water bodies, each with a surface area less than 0.06 hectares. These ponds were sampled using a dip net, where finescale dace was the fish species detected. These water bodies do not appear to have surficial connectivity to other watercourses or water bodies in the surrounding area. It is assumed that these ponds receive water from surface drainage and possible groundwater sources. Suitable habitat for all life stages of small-bodied fish species is present in these ponds.

3.14 SPECIES OF CONCERN

The baseline studies for the Project were used to identify species with conservation concerns in the Project RSA. Generally most species identified were not considered rare or endangered, however some species were ranked as either rare, a species of special concern (e.g. Lake Sturgeon, Bald Eagle), or in some cases have been assessed as being threatened (e.g. Woodland Caribou, Wolverine). This section reports on the status of rare plants, mammals, bird and fish species encountered in the area anticipated to be affected by Project activities.

Table 3.14-1 Status of Rare Flora and Fauna associated with the Project

Fauna or Flora	Species encountered	Conservation Status (Provincial)	Conservation Status (Federal)
Rare Plants	None encountered in RSA, although known from general area	Not applicable	Not applicable
Rare Mammals	Woodland Caribou	Threatened	Threatened
	Wolverine	Threatened	Threatened
Rare Birds	Rusty Blackbird	Special Concern	Special Concern
	Bald Eagle	Special Concern	Special Concern
	Common Nighthawk	Special Concern	Special Concern
	Olive-sided Flycatcher	Special Concern	Threatened
	Canada Warbler	Special Concern	Threatened
	Peregrine Falcon	Special Concern	Special Concern
Rare Fish	Lake Sturgeon	Special Concern	Special Concern

3.14.1 Rare Plant Species and Communities

The MNR's Natural Heritage Information Centre (NHIC) was contacted to obtain a list of rare plant species and rare plant communities in the Project RSA. A list of rare plant communities is not currently available, however a list of rare plant species including coordinates of known locations was provided and the baseline assessment shows the locations of these rare plant species for the Kenora District and a 90 km buffer from the Project infrastructure that was used to identify the set of rare plant species applicable to this study. None of these plant species were observed during the field studies conducted for this Project.

3.14.2 Rare Mammal Species

Two species of mammal encountered during baseline investigations are considered species that warrant special status due to conservation concerns. These species included the Forest-dwelling Woodland Caribou and Wolverine.

3.14.2.1 Woodland Caribou

In Ontario and nationally, woodland caribou are classified as threatened with extinction. Ontario's Woodland Caribou Conservation Plan was produced as a government policy response to recommendations from the Ontario Woodland Caribou Recovery Team (OMNR, 2009) and the Ontario Woodland Caribou Science Review Panel (Suffling et al., 2008). The goal of the plan is "to maintain self-sustaining, genetically connected local populations of Woodland Caribou (forest-dwelling boreal population) where they currently exist, improve security and connections among isolated mainland local populations, and facilitate the return of Caribou to strategic areas near their current extent of occurrence" (OMNR, 2009).

The Caribou Conservation Plan is guided by these principles (OMNR 2009):

- Adaptive management which combines science and the use of new information to continuously improve management over time.
- Ecosystem-based management that considers all the natural factors that affect and sustain Caribou.
- A healthy boreal forest that supports self-sustaining Caribou populations.
- The precautionary principle, which means that incomplete information should not be used as a reason for delaying conservation action.
- A focus on the long-term sustainability of Caribou ranges including the consideration of cumulative impacts.
- Consideration of Caribou population health and habitat condition in resource development decisions.
- A science-based approach to Caribou recovery that recognizes existing knowledge and its limitations.
- A commitment to incorporating Aboriginal Traditional Knowledge in decision-making where available.
- Consideration of social, economic and environmental concerns in the context of long-term Caribou survival.

The Conservation Plan adopts a range management approach, in which "Caribou ranges will be the basis for evaluating habitat conditions and identifying caribou habitat, assessing population trends, and assessing and addressing cumulative impacts. Therefore delineation of Caribou ranges by the OMNR was necessary, and was completed for the Far North in 2013.

The Federal Recovery Strategy for the Woodland Caribou (Environment Canada, 2012) has the stated goal "to achieve self-sustaining local populations in all boreal Caribou ranges throughout their current distribution in Canada, to the extent possible. Achieving the recovery goal would allow for local population levels sufficient to sustain traditional Aboriginal harvesting activities, consistent with existing Aboriginal and treaty rights of Aboriginal peoples of Canada." The report sets a timeline of "a number of decades" to achieve recovery.

Critical habitat for boreal Caribou is identified as:

- The area within the boundary of each boreal Caribou range that provides an overall ecological condition that will allow for an ongoing recruitment and retirement cycle of habitat, which maintains a perpetual state of a minimum of 65% of the area as undisturbed habitat.
- Biophysical attributes required by boreal Caribou to carry out life processes.

The Recovery Strategy identifies 65% undisturbed habitat in a range as the disturbance management threshold, however this threshold is considered a minimum threshold because at 65% undisturbed habitat there remains a significant risk (40%) that local populations will not be self-sustaining.

The Recovery Strategy provides broad strategies and general approaches to achieve the population and distribution objectives, which will assist in the development of subsequent range plans and action plans by the responsible jurisdictions, in collaboration with Environment Canada.

3.14.2.2 Wolverine

The Wolverine is listed as a threatened species under Ontario's Endangered Species Act, 2007, which protects the species from being killed, captured, and taken in Ontario. The Wolverine is classed as a "fur bearer" under Ontario's Fish and Wildlife Conservation Act, however trapping and hunting is closed in all areas.

The most easterly Wolverine populations in North America are currently located in Ontario. Thus, Ontario Wolverine are strategically important for the maintenance of the national western population and the recovery of the national eastern population. The Ontario Wolverine Recovery Strategy focuses on the following goals:

- Attain Wolverine range occupancy across the province
- Enhance connectivity with adjacent populations
- Achieve self-sustaining populations at levels that will allow genetic exchange with the national western population and support emigration to the eastern population
- Attain population levels able to withstand future commercial harvest

In order to meet these goals, the following objectives have been established:

- Protect and manage Wolverine populations and their associated habitat
- Reduce or eliminate known threats to Wolverine populations and their habitat within Ontario's recovery range
- Increase understanding of Wolverine ecology, threats to their habitat and Wolverine survival through inventory, monitoring and research
- Integrate Ontario Wolverine conservation efforts with those of other jurisdictions (provincial, territorial, and federal), ministries and First Nations; and ensure consideration of Wolverine conservation objectives in land use and resource management planning processes
- Generate support and develop partnerships for Wolverine conservation by promoting education, awareness and stewardship of Wolverine and their habitat

Although Wolverine were once distributed throughout the province, recovery efforts should be focused within the three recovery zones in northern Ontario. This recovery range includes areas currently occupied by Wolverine as well as those where the species is known to be recolonizing. These zones are key to promoting connectivity between the nationally defined western and eastern Wolverine populations. The recovery zones were delineated on the basis of a number of criteria including the following:

- Current Wolverine distribution
- Historic Wolverine range

- Ontario Ecoregion boundaries
- The southern boundary of the zone of continuous Woodland Caribou distribution
- Variation in Wolverine status, degree and type of threat, and/or appropriateness of management tools

3.14.3 Rare Bird Species

Six bird species observed in the RSA are listed as SAR-Special Concern at either the federal level or the provincial level and include Bald Eagle, Canada Warbler, Common Nighthawk, Olive-sided Flycatcher, Peregrine Falcon and Rusty Blackbird. All species were observed during the spring and fall migration period except for Common Nighthawk (not observed during either period) and Peregrine Falcon, which was detected only during spring migration.

3.14.3.1 Rusty Blackbird

The Rusty Blackbird is listed as SAR-Special Concern at the Federal level. It breeds in coniferous-dominated wooded streams, swamps and bogs, and may have declined by as much as 85% since the early 1970s (Avery, 2013). It was detected at most survey locations during migration and during the breeding season.

Rusty Blackbirds were not detected during the breeding season in the southern portions of the RSA (PLNR and the Cavell Site). The ABBO indicates that they are either absent or at very low densities in those areas. During spring migration, they were observed in the PLNR area in moderate numbers (six individuals over a ten minute period). At Lever Lake, they were seen during both spring and fall migration.

3.14.3.2 Bald Eagle

Bald Eagles are listed as SAR-Special Concern at the Federal Level. During the spring of 2011 and 2012, a large number of migrating Bald Eagles were observed from Fish Rock Island, which is located on Fish Rock Lake. In 2011, 92 Eagles were observed during a three-day period, and in 2012, 215 of them were seen. Most of these birds were flying towards the north and northwest and a few were flying eastward.

Eagles were observed from 22:00 to 01:00 with fewer seen at mid-day, followed by more activity in the afternoon. A greater number of Eagles were seen during the 2012 surveys, despite the similarity in wind speed, wind direction, temperature and cloud cover conditions between the surveys. To date, no information on this particular Eagle migration route has been found in the literature or noted in radio-tagged studies.

During fall migration, there were only two Bald Eagles observed from Fish Rock Island either because they do not return using the same migration route, or because the migration was not taking place during our surveys. Roy Spence (personal communication, 2012) suggested that in the spring, the Eagles may be following the chain of streams where suckers are spawning for feeding purposes. Since this food source is not available in the fall, the Eagles may be utilizing a different route where food is more plentiful.

Three Bald Eagle nests were found on Ozhiski Lake. Eagles were observed sitting on two of the nests. The third nest was too far away to determine if an eagle was on the nest, however, an adult Eagle was spotted perched near the third nest.

3.14.3.3 Common Nighthawk

The Common Nighthawk is listed as SAR-Special Concern at the Provincial level. They usually nest on open areas with little to no ground vegetation (COSEWIC, 2007a), and were observed during the breeding season at all sites except Dearden Lake. Several nests were detected near the mine site, but nests were not found at any other sites. All nests were located in areas that had been cleared such as pathways, roads, and old drilling sites. In the PLNR area, although available Nighthawk nesting habitat was plentiful, no nests were found.

3.14.3.4 Olive-sided Flycatcher

The Olive-sided Flycatcher is a SAR-Special Concern at the Provincial level and is a Threatened SAR at the Federal level. Its breeding habitat is in coniferous and mixed forests around water bodies and wet areas where it can perch in the tops of trees and snags (COSEWIC, 2007b). The Cavell area was the only location where it was not detected. Most Olive-sided Flycatchers were detected in the mine site area (13 detections) compared with only two to four detections at the other three locations. The abundance of favourable habitat (wetlands and streams) at the mine site likely accounts for the relatively high number of individuals detected there.

3.14.3.5 Canada Warbler

The Canada Warbler is a Threatened SAR at the Federal level and a SAR-Special Concern at the Provincial level. Like the other SAR bird species, its populations have declined in the last 40 years across Canada (Cadman et al., 2007) including a decline of 44% over the last ten years. Ontario populations have declined at about half of that amount during the last ten years although low sample sizes make the estimate less robust.

From 80 to 85% of the Canada Warbler’s breeding range is in Canada (COSEWIC, 2008). According to the ABBO, its abundance is highest in the southern shield region (Algonquin Park and shoreline region of Lake Superior) and is lower in the Ring of Fire region. For example, the probability of detection in the Ring of Fire region is 10% versus 68% in the southern shield region.

The low abundance in northern Ontario regions explains, at least in part, why only four birds were detected in the RSA during the breeding season (three in the Ozhiski Lake area and one at the mine site). All sites where the Canada Warbler was detected during the breeding season had a well-developed shrub layer, which they favour for breeding (COSEWIC, 2008).

One Canada Warbler was detected during fall migration near Wesley Lake flying with a mixed flock of warblers. During migration, this species is associated with forest edges and riparian habitats with a well-developed shrub layer (COSEWIC, 2008), which matches the habitat along the shoreline of Little Lake where it was observed.

3.14.3.6 Peregrine Falcon

Peregrines are listed as SAR-Special Concern at the Federal and Provincial levels. They usually nest on cliff ledges close to large bodies of water. In the RSA it appears that there is very little of this kind of habitat. In addition, in the ABBO, there are no records of Peregrines breeding in the RSA area. Thus, it is not surprising that this species was not detected during the breeding season.

However, at Fish Rock Lake, two Peregrine Falcons were observed on May 13, 2011 and again the following year on May 14, 2012. Both times they were seen either flying along the shoreline of the lake or perched in treetops overlooking the lake. Usually they return to nest sites in late March and begin egg-laying in late April (COSEWIC, 2010). The individuals observed in the RSA may have been late migrants heading to their nesting grounds in northern Quebec or Nunavut.

3.14.4 Rare Fish Species

The distribution of one fish species at risk has been confirmed within the Project area. lake sturgeon are the largest Ontario freshwater fish species, and Ontario's only member of the sturgeon family. There are three lake sturgeon populations within Ontario:

- Northwestern Ontario
- Great Lakes/Upper St. Lawrence River
- Southern Hudson Bay/James Bay

Provincially, the first two populations are listed as threatened on the Species at Risk in Ontario (SARO) List by the Committee on the Status of Species at Risk in Ontario (COSSARO). The Eagle's Nest Project lies within the Southern Hudson Bay/James Bay population distribution area, which COSSARO lists as being of special concern (OMNR 2013).

Eight Lake Sturgeon populations within Canada have been ranked by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as endangered, threatened or special concern. Five of these populations are within Ontario. The Southern Hudson Bay/James Bay population has been identified as special concern by COSEWIC and is currently being considered for listing under the federal Species at Risk Act (SARA) (Golder 2011).

3.15 SOCIO-ECONOMIC SETTING

The Project is located in Northwestern Ontario in the Ring of Fire region, approximately 530 km northeast of Thunder Bay and 300 km north of Nakina. The mine site is located in a region that has seen limited industrial development. The Project (inclusive of the mine site, transportation corridor and trans-load facility) traverses the traditional territories of several First Nations including:

- Webequie First Nation
- Marten Falls First Nation
- Nibinamik First Nation
- Neskantaga First Nation
- Eabametoong First Nation
- Mishkeegogamang First Nation
- The Ojibway Nation of Saugeen

The closest communities to the mine site are:

- Webequie First Nation - approximately 75 km to the northwest
- Marten Falls First Nation – approximately 125 km to the south
- Neskantaga First Nation- approximately 125 km to the south-southwest

The nearest public infrastructure to the mine site is a winter road located approximately 100 km to the west of the mine site. Thunder Bay is the closest major regional centre. A majority of the First Nation communities in the study area are considered remote communities as they are only accessible by air or winter road.

Traditional and non-traditional land uses in the region include hunting, trapping and fishing. Recreational activities consist of tourist lodges, fly-in camps and self-directed recreational activities.

The cornerstone of the local economy within the region has traditionally been the natural resource industry including mining and forestry. Information contained in the following sections has been summarized from the Socio-economic Baseline TSD 14.

3.16 STUDY APPROACH

3.16.1 Study Scope

The focus of the baseline assessment was on understanding the baseline socio-economic environment related to eight principal social and economic components presented in this report in Sections 3.17 to 3.24:

- Population and Demographics
- Education and Training
- Livelihood and Employment
- Local and Regional Economy
- Human Health and Well-Being
- Community Infrastructure and Public Services
- Government Policies, Planning and Initiatives
- Land and Resource Use

The spatial boundaries for the socio-economic baseline assessment were defined as areas within which the Project has the potential to cause direct or indirect effects on the socio-economic environment. Regional Study Area (RSA) and Local Study Area (LSA) were defined for the socio-economic baseline assessment as summarized in Table 3.16-1 and shown on Figures 3.16-1 and 3.16-2.

Table 3.16-1 Study Areas for the Socio-Economic Baseline Assessment

Topic	RSA	LSA
Population and demographics	Thunder Bay and Kenora Districts	First Nations communities: Webequie, Marten Falls, Attawapiskat, Neskantaga, Nibinamik, Eabemetoong, Ojibway Nation of Saugeen, Mishkeegogamang, Aroland; municipalities of Greenstone, Pickle Lake and Ignace
Education and training		
Local and regional economies		
Community services and public infrastructure		
Human health and well-being	North West LHIN	Northwestern Health Unit, Thunder Bay District Health Unit
Traditional and non-traditional land and resource use	Kenora District and Land and Resource Use LSA	Land and Resource Use LSA

The availability and source of socio-economic data to some degree define the local and regional study areas identified in Table 3.16-1.

3.16.2 Methodology

The methodology for the collection of data presented in Sections 3.17 to 3.24 is discussed below.

3.16.2.1 Primary Data Collection

Primary data are collected from first-hand experience. In the context of socio-economic studies, this includes information obtained from community individuals, key informants or focus groups. Noront has been engaging with the potentially affected communities since 2009, and in 2012 and 2013 the company made efforts to negotiate memorandums of understanding (MOUs) with the potentially affected First Nation communities. The MOUs outlined the agreed upon terms of engagement on consultation and data collection, as well as long-term participation in the Project. To date, only the Aroland First Nation has signed an MOU with Noront. Noront conducted socio-economic workshops and Aboriginal Traditional Knowledge (ATK) interviews in the community of Webequie; however, without the completion of an MOU or equivalent approval of the Chief and Council, Noront has not been able to make use of this primary data. Noront remains committed to establishing agreements with each of the First Nations in the LSA.

LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- CONCENTRATE HAUL ROUTE
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- WATER
- RING OF FIRE CLAIM AREA
- SOCIO ECONOMIC RSA
- NWLHIN HEALTH RSA
- LAND AND RESOURCE USE RSA

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N.
3. ACTIVE CLAIM BOUNDARIES BY OTHERS WERE PROVIDED BY THE MINISTRY OF NORTHERN DEVELOPMENT AND MINES (AUGUST 2012).
4. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (NOVEMBER 26, 2013).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	JSP	AS	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

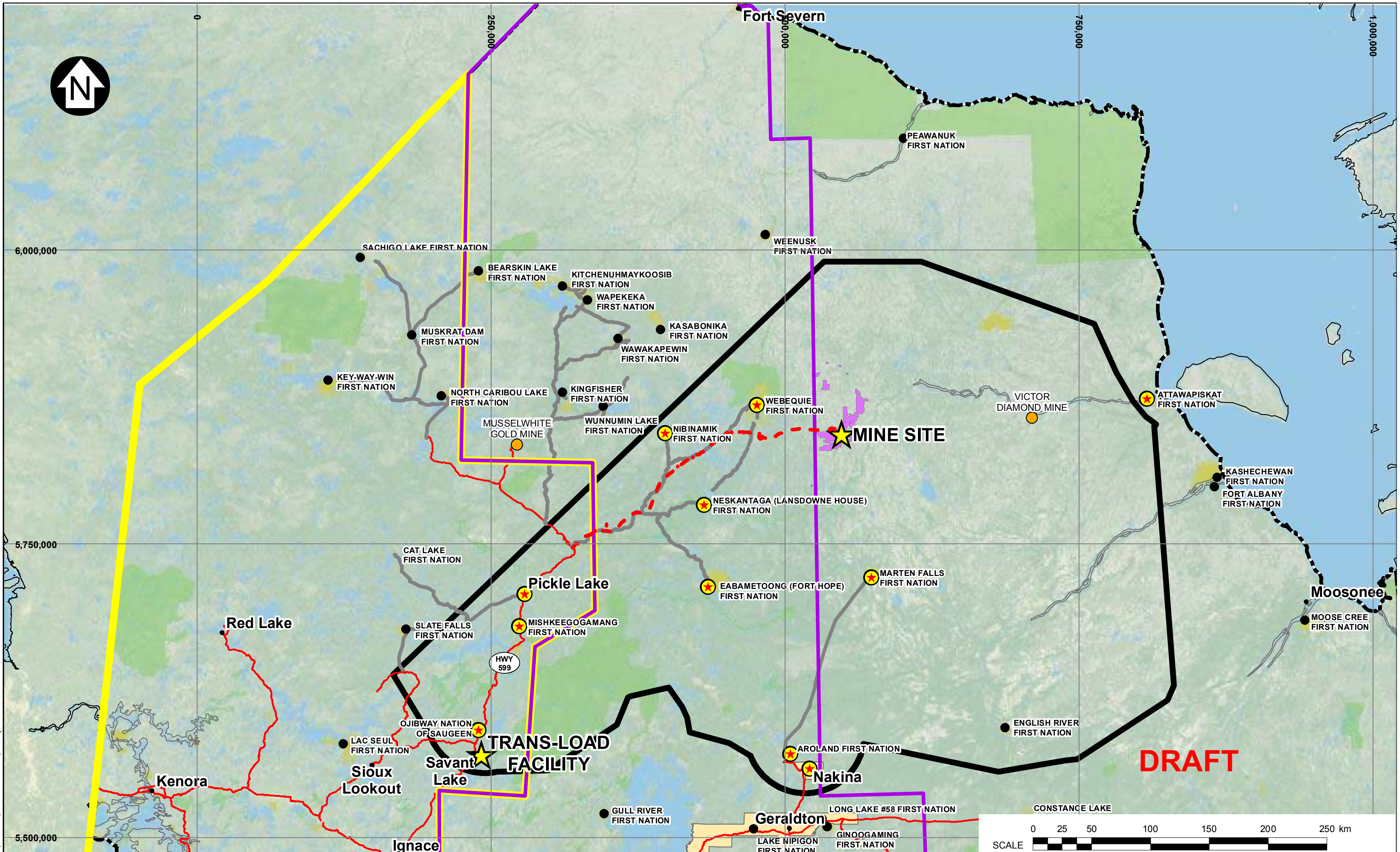
SOCIO-ECONOMIC REGIONAL STUDY AREAS

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 3.16-1 | REV A

SAVED: I:\1102\00390\01\A\GIS\Figs\A648_rA.mxd; Dec 18, 2013 2:25 PM; spenfold



LEGEND:

- PROJECT LOCATION
- COMMUNITY
- COMMUNITY LOCATED WITHIN SOCIO-ECONOMIC LSA
- OPERATING MINE
- MAJOR ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- EXISTING WINTER ROAD
- WATER
- FIRST NATIONS RESERVE
- MINERAL CLAIMS HELD BY NORONT
- MINERAL CLAIMS HELD BY OTHERS
- LAND AND RESOURCE USE LSA
- MUNICIPALITY OF GREENSTONE
- PARK
- NORTHWESTERN ONTARIO HEALTH UNIT BOUNDARY (HEALTH AND WELL BEING LSA)
- THUNDER BAY DISTRICT HEALTH UNIT BOUNDARY (HEALTH AND WELL BEING LSA)

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (NOVEMBER 26, 2013).
4. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).
5. ACTIVE NORONT CLAIM BOUNDARIES WERE PROVIDED BY NORONT RESOURCES LTD. (MAY 23, 2013).
6. ACTIVE CLAIM BOUNDARIES BY OTHERS PROVIDED BY MINISTRY OF NORTHERN DEVELOPMENT AND MINES (AUGUST 2012).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

SOCIO-ECONOMIC REGIONAL STUDY AREAS

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.16-2	REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	JSP	AS	SRA	RAM

SAVED: I:\102\00390\01\A\GIS\Figs\A650_rA.mxd; Dec 21, 2013 12:05 AM; asimpson

3.16.2.3 Secondary Data Collection

A range of secondary data sources were utilized to establish socio-economic baseline conditions. The key sources of secondary information utilized in the assessment include the following:

- Statistics Canada Census Data for 2001, 2006 and 2011
- Statistics Canada's Profile for the National Household Survey (NHS) Special Collection for 13 Indian reserves and Indian settlements in Northern Ontario, 2011
- Government surveys and reports (housing, economic development, resource use, etc.)
- Government websites (Ministry of Natural Resources, Ministry of Northern Development and Mines, Aboriginal Affairs and Northern Development Canada, etc.)
- Local First Nation and community websites

The majority of the data presented within the baseline assessment is available to the public.

3.16.2.4 Data Limitations

There were three main socio-economic data limitations:

- Limitations inherent in the 2006 and 2011 Census data made available to the public by Statistics Canada
- Availability of secondary information specific to the First Nation communities located in the LSA
- Availability of primary data relating to traditional land and resource use

Please note that random rounding is required of Statistics Canada to ensure that confidentiality is maintained in the responses collected. Therefore, in some instances this has prevented data from summing properly in the tables included in this report.

There were several communities located within the LSA that were incompletely enumerated during the 2011 Census including:

- Attawapiskat First Nation
- Eabametoong (Fort Hope) First Nation
- Webequie First Nation
- Nibinamik (Summer Beaver) First Nation
- Neskantaga (Lansdowne House) First Nation

The data and conclusions presented are reliant on the quality and availability of publically available secondary data.

3.16.2.5 Data Presentation

Detailed socio-economic information is presented in the Socio-economic Baseline TSD 14. A summary of the baseline for each section is provided in Sections 3.17 to 3.24.

3.17 DEMOGRAPHICS

Demographic information is presented in this section that interprets population data.

3.17.1 Population

The total population of the RSA in 2013 is estimated at 207,888, which represents approximately 1.5% of the total population in the Province of Ontario. The largest population centres within the RSA are the cities of Thunder Bay, Dryden and Kenora. These three population centres account for over 80% of the total population residing within the RSA.

The Thunder Bay and Kenora Districts, as well as the municipalities of Greenstone, Pickle Lake and Ignace have experienced declines in population between 2006 and 2011 (Tables 3.17-1 and 3.17-2). This decline in population contrasts with the 5.7% increase across the Province of Ontario between 2006 and 2011.

Table 3.17-1 Population Change in the RSA between 2001 and 2013

District	2001	2006	2011	2013*,2
Kenora Population Count	61,802	64,419	57,607	59,187
% Change from Previous Census	NA	4.2	-10.6	NA
Thunder Bay Population Count	150,860	149,063	146,057	148,701
% Change from Previous Census	NA	-1.2	-2.0	NA
Ontario Population Count	11,410,046	12,160,282	12,851,821	13,473,073
% Change from Previous Census	NA	6.6	5.7	NA

NOTES:
1. SOURCE: MANIFOLD DATA MINING INC. SUPERDEMOGRAPHICS 2013.
2. THE 2013 POPULATION ESTIMATE IS NOT DIRECTLY COMPARABLE TO THE CENSUS POPULATION, SO ANY PERCENTAGE CHANGE CANNOT BE COMPARED.

Table 3.17-2 Population Change within the Municipalities, 2001 to 2013

Municipalities	2001	2006	2011	2013*
Greenstone Population Count	5,662	4,906	4,724	4,781
% Change from Previous Census	NA	-13.4	-3.3	NA
Ignace Population Count	1,709	1,431	1,202	1,153
% Change from Previous Census	NA	-16.3	-16.0	NA
Pickle Lake Population Count	399	479	425	416
% Change from Previous Census	NA	20.1	-11.3	NA
Ontario Population Count	11,410,046	12,160,282	12,851,821	13,473,073
% Change from Previous Census	NA	6.6	5.7	NA

NOTES:
1. SOURCE: MANIFOLD DATA MINING INC. SUPERDEMOGRAPHICS 2013.
2. NA = NOT AVAILABLE

The total registered First Nation population with the LSA is 10,461. There are 53 First Nation communities located in the Kenora District including eight of the nine First Nation communities located within the LSA. Aroland First Nation, being the exception, is located in the Thunder Bay District. Several of the First Nation communities have experienced population increases from 2006 to 2011 including Aroland, Mishkeegogamang, Ojibway Nation of Saugeen, and Webequie; the other First Nation communities experienced population declines during the same period (Table 3.17-3).

Table 3.17-3 Population Totals and Trends by First Nation Community (2001 to 2011)

First Nation Community	2001	2006	2011	% Change 2001 to 2006	% Change 2006 to 2011	% Change 2001 to 2011
Aroland	346	325	361	-6.1	11.1	4.3
Attawapiskat	1293	NA	NA	NA	NA	NA
Eabametoong	1001	1144	1085	0.14	-0.05	8.4
Marten Falls	NA	221	190	NA	-0.14	NA
Mishkeegogamang	470	500	578	6.4	15.6	23.0
Neskantaga	270	265	240	-0.02	-0.09	-11.1
Nibinamik	276	362	335	0.31	-0.07	21.4
Ojibway Nation of Saugeen	NA	98	100	NA	0.02	NA
Webequie	600	614	670	0.02	0.09	11.7

NOTES:
1. SOURCE: STATISTICS CANADA, 2002, 2007, 2013.
2. NA = NOT AVAILABLE.

3.17.2 Age and Gender

According to the 2011 Census the gender breakdown in the RSA (Kenora Census Division) is 50.2% males and 49.8% females (Statistics Canada, 2012). The gender breakdown within the LSA communities is presented in Table 3.17-4.

Table 3.17-4 Gender Breakdown of LSA Communities (2011)

Community	Total	Male	Female	Male (%)	Female (%)
Aroland First Nation	325	175	155	53.8%	46.2%
Attawapiskat First Nation	NA	NA	NA	NA	NA
Eabametoong First Nation	1080	550	530	50.9%	49.1%
Marten Falls First Nation	190	NA	NA	NA	NA
Mishkeegogamang First Nation	575	320	255	55.7%	44.3%
Neskantaga First Naiton	240	115	125	47.9%	52.1%
Nibinamik First Nation	335	160	175	47.8%	52.2%
Ojibway Nation of Saugeen	130	65	65	50%	50%
Webequie First Nation	670	340	330	50.7%	49.3%
Pickle Lake	416	225	191	54%	46%
Greenstone	4,781	2,454	2,327	51%	49%
Ignace	1,152	576	576	50%	50%

NOTES:
1. SOURCE: MANIFOLD DATA MINING INC. SUPERDEMOGRAPHICS 2013.

The communities in the LSA have population profiles similar to other Northern Ontario and rural communities in Ontario. Generally the adult population aged 20 to 44 makes up a smaller percentage of the total population than in Ontario, while a larger percentage of the population is aged 45 to 69 (Table 3.17-5). Pickle Lake has a substantially different age profile, with a substantially larger percentage of the population being less than 35 years old compared to Ontario, and a smaller percentage of population aged 55 and older. The median age in First Nation communities ranged between 19.5 and 28.1; below the median age of the rest of the LSA. A detailed breakdown of age cohorts for the First Nation communities is presented in Appendix B of the Socio-economic Baseline TSD 14.

Table 3.17-5 2013 Age Cohorts by Municipality in Comparison to Ontario

Age Cohort	Greenstone	Ignace	Pickle Lake	Ontario
Total Population	4,780	1,155	415	13,473,072
Average Age	40.6	44.7	32.5	39.9
Population age 0-4	270 (5.6%)	45 (3.9%)	40 (9.5%)	741,351 (5.5%)
Population age 5-9	299 (6.3%)	50 (4.3%)	30 (7.1%)	750,110 (5.6%)
Population age 10-14	299 (6.3%)	69 (6.0%)	25 (6.0%)	801,828 (6.0%)
Population age 15-19	343 (7.2%)	65 (5.6%)	35 (8.3%)	905,829 (6.7%)
Population age 20-24	199 (4.2%)	40 (3.5%)	50 (11.9%)	893,502 (6.6%)
Population age 25-29	231 (4.8%)	40 (3.5%)	40 (9.5%)	855,054 (6.3%)
Population age 30-34	251 (5.3%)	50 (4.3%)	30 (7.1%)	841,862 (6.2%)
Population age 35-39	304 (6.4%)	75 (6.5%)	15 (3.6%)	888,534 (6.6%)
Population age 40-44	339 (7.1%)	60 (5.2%)	30 (7.1%)	970,766 (7.2%)
Population age 45-49	344 (7.2%)	104 (9.0%)	20 (4.8%)	1,107,028 (8.2%)
Population age 50-54	454 (9.5%)	119 (10.3%)	35 (8.3%)	1,053,116 (7.8%)
Population age 55-59	414 (8.7%)	124 (10.7%)	25 (6.0%)	904,080 (6.7%)
Population age 60-64	355 (7.4%)	109 (9.4%)	20 (4.8%)	799,931 (5.9%)
Population age 65-69	225 (4.7%)	80 (6.9%)	5 (1.2%)	588,846 (4.4%)
Population age 70-74	174 (3.6%)	60 (5.2%)	10 (2.4%)	460,279 (3.4%)
Population age 75-79	139 (2.9%)	35 (3.0%)	5 (1.2%)	371,360 (2.8%)
Population age 80-84	85 (1.8%)	20 (1.7%)	0 (0%)	282,857 (2.1%)
Population age 85+	55 (1.2%)	10 (0.9%)	5 (1.2%)	256,739 (1.9%)

NOTES:

1. SOURCE: MANIFOLD DATA MINING INC. SUPERDEMOGRAPHICS 2013.

3.17.3 Dependency Ratios

Dependency ratios are indicators of the pressures on those in the labour force (assumed to be those between 15 and 65 years of age) from those not in the labour force (assumed to be those 0 to 14 years of age and those 65 and older). Monitoring changes in dependency ratios allows trend detection in the age composition of the population. Combined (Child and Elderly) dependency ratios in the LSA range between 28.6 and 32.4, which is similar to the provincial ratio of 31.7. First Nation communities had higher child dependency ratios and generally lower elderly dependency ratios than the Ontario average, reflecting the young age of the population.

3.17.4 Ethnicity and Language

The three municipalities in the LSA (Pickle Lake, Ignace and Greenstone) have a higher percentage of French ethnicity and Aboriginal ethnicity than the Ontario average, with Pickle Lake having a majority of Aboriginal ethnicity. The Kenora district has the largest concentration of Aboriginal people in an urban environment in Ontario (NTAB, 2013). Within each of the First Nation communities, 95% or more of the population self-identified as Aboriginal.

Aboriginal language by people in First Nation communities in the LSA was common, but this varies greatly between the communities. The percentage of people speaking Aboriginal language most often at home ranged from 1% for the Ojibway Nation of Saugeen to 93% for Webequie First Nation.

3.17.5 Mobility

Mobility refers to the rate of movement of individuals geographically, including movement within the LSA, intra-provincial movement, and movement between jurisdictions outside of Ontario. Ignace has a high percentage of people that have not moved in the past one or five years (79.5% and 92.7%, respectively). Pickle Lake has a substantially higher percentage of movers within the past five years that are from within Canada, as well as substantially higher percentage of movers within the past five years that are from within Ontario. People residing in the First Nation communities are less likely to move their residence.

3.17.6 Household Characteristics

Greenstone and Ignace have smaller average household sizes (2.3 and 2.2 persons, respectively) than the provincial average (2.6 persons).Pickle Lake has a larger household size (2.7 persons) than provincial average. This is likely due to the large percentage of population of a young age (24 years or less).

Within the First Nation communities located in the LSA, the average household size in 2011 was 3.65 persons and in 2006 the average household size was 3.63 persons, which is larger than the provincial average for both years. Webequie had the largest household size of the LSA at 4.6 persons per household in 2011 and 4.4 persons per household in 2006. Ojibway Nation of Saugeen had the smallest household size of the First Nation communities in the LSA with 2.8 persons reported per household in 2011 and 2.7 persons reported per household in 2006.

3.17.7 Aboriginal Traditional Knowledge

Aboriginal Traditional Knowledge (ATK) is information held by and unique to Aboriginal people and communities. When shared with project proponents, ATK can enhance the understanding of the social, economic, and natural environment. However, ATK is imparted and received with respect; it often represents generations of collective knowledge, and may illuminate cultural aspects that are meant to be held in private. Therefore, prior to the integration of ATK to the baseline setting of the Project, it is important that Noront has come to clear agreements with the First Nations as to how ATK will be obtained, and subsequently how it will be used and integrated to Project analysis and reporting.

Noront engaged with the First Nations of the LSA to collect ATK during the course of the data collection process. As of the date of this report, no protocol agreements have been finalized to allow for ATK integration. Nevertheless, it is understood through evidence provided during various engagement activities with the communities that traditional ways remain an important component of life in the LSA. Communities continue to practice traditional cultural customs such as community feasts, pow wows, harvesting off the land and healing ceremonies.

3.18 EDUCATION AND TRAINING

3.18.1 Educational Attainment

The level of education within a community is an important socio-economic measure that provides an indicator of the available workforce pool and their qualifications. Communities that have high educational attainment levels, in turn, have a large pool of qualified workers that can be drawn upon to support existing and proposed developments. The educational attainment within the RSA is summarized in Table 3.18-1. In the First Nations communities, there is a decreased level of institutional educational attainment compared to non-Aboriginal communities in the LSA, the RSA and Ontario overall.

Table 3.18-1 Educational Attainment Levels in the RSA (2013)

Highest Level of Schooling	Thunder Bay District		Kenora District		Ontario	
	Count	%	Count	%	Count	%
Total population 25 to 64 years	82,120	100	30,850	100	7,420,372	100
No certificate, diploma or degree	13,859	16.9	7,835	25.4	988,996	13.3
Certificate, diploma or degree	68,261	83.1	23,016	74.6	6,431,376	86.7
High school certificate or equivalent	20,535	25.0	7,818	25.3	1,860,402	25.1
Apprenticeship or trades certificate or diploma	10,212	12.4	3,834	12.4	639,635	8.6
College, CEGEP or other non-university certificate or diploma	20,372	24.8	6,639	21.5	1,635,944	22.0
University certificate, diploma or degree	17,142	20.9	4,725	15.3	2,295,395	30.9
University certificate or diploma below bachelor level	2,520	3.1	1,044	3.4	344,186	4.6
University certificate or degree	14,622	17.8	3,681	11.9	1,951,210	26.3
Bachelor's degree	8,937	10.9	2,473	8.0	1,213,282	16.4
University certificate or diploma above bachelor level	3,021	3.7	643	2.1	231,899	3.1
Degree in medicine, dentistry, veterinary medicine or optometry	291	0.4	103	0.3	51,409	0.7
Master's degree	1,817	2.2	412	1.3	393,556	5.3
Earned doctorate	556	0.7	50	0.2	61,063	0.8

NOTES:
1. SOURCE: MANIFOLD DATA MINING INC. SUPERDEMOGRAPHICS 2013.

In the LSA, most of the First Nation communities have elementary schools only. To pursue high school students are required to use distance education programs such as those run through the Washa Distance Education Centre, or attend secondary school off-reserve. The lack of secondary schools in each of the smaller communities is reflected in the rates of high school completion. Within some communities, the completion rate for apprentices and/or college diplomas is greater than high school completion, suggesting that the mature Aboriginal population is returning to school. This was noted by the City of Thunder Bay et al. (2013) based on 2006 Statistics Canada data, whereby approximately 11% of the Aboriginal population 35 years of age and older were attending school in 2006, compared to 5% of non-Aboriginal people in the same age group.

3.18.2 Training Opportunities

Various training opportunities are available to individuals wishing to pursue careers in the mining sector. These training and education opportunities are offered through various organizations that provide education, training and client services throughout northwestern Ontario. Training institutions include (City of Thunder Bay et al, 2013):

- Anishnabek Employment and Training Services (AETS)
- Confederation College
- Fort William First Nation Employment and Training Division
- Kiikenomaga Kikenjigewen Employment and Training Services (KKETS)
- Lakehead University
- Oshki-Pimache-O-Win (Oshki)
- Shooniya Wa-Biitong Training and Employment Centre for Treaty #3 Area (Shooniya)
- Sioux Lookout Area Aboriginal Management Board (SLAAMB)

The Ring of Fire Aboriginal Training Alliance (ROFATA) developed specifically in response to interest in training for mineral development in the Ring of Fire. The ROFATA was established in partnership with KKETS, Confederation College, and Noront. The ROFATA is an initiative assisting and supporting members of nine Matawa First Nation communities in pursuit of specialized training, and making informed career decisions in their transition from training to employment.

3.18.3 Community Perspectives

Through various discussions Noront has had with First Nations and the public in the LSA and RSA, it is evident that community members are interested in the potential employment opportunities resulting from the Project. Elders, adults and youth alike have expressed their interest in pursuing work with the Project and through induced/indirect jobs in the region. It was expressed that long term goals for youth will give them something to strive and work towards and potentially keep them from engaging in dangerous activities such as drug and alcohol consumption.

3.19 LIVELIHOOD AND EMPLOYMENT

3.19.1 Employment

Within the RSA, the Thunder Bay district has a similar rate of unemployment in comparison to the rest of Ontario, while the Kenora District has greater unemployment (Table 3.19-1). All of the First Nation communities had a much higher unemployment rate than the non-Aboriginal communities in the LSA (Table 3.19-2). This is likely due to the lack of employment opportunities within the small communities due to a small private sector.

Table 3.19-1 RSA Workforce Characteristics by District (2013)

Characteristics	Thunder Bay District	Kenora District	Ontario
Population aged 15+	126,140	46,959	11,179,784
In labour force	78,132	30,177	7,416,901
Employed	72,026	26,905	6,827,414
Unemployed	6,107	3,271	589,487
Not in labour force	48,008	16,782	3,762,882
Participation rate (%)	61.9	64.3	66.3
Employment rate (%)	57.1	57.3	61.1
Unemployment rate (%)	7.8	10.8	8.0

NOTES:
1. SOURCE: MANIFOLD DATA MINING INC. SUPERDEMOGRAPHICS 2013.

Table 3.19-2 First Nation Community Labour Force

First Nation Community (Census Year)	Participation Rate	Employment Rate	Unemployment Rate
Aroland (2011)	58.1	34.9	40.0
Attawapiskat (2001)	49.0	34.0	29.3
Eabametoong (2011)	52.3	42.2	19.4
Marten Falls (2011)	50.0	45.5	0
Mishkeegogamang (2011)	65.6	28.9	52.6
Neskantaga (2011)	61.8	52.9	19.0
Nibinamik (2011)	59.1	50.0	15.4
Ojibway Nation of Saugeen (2011)	56.2	43.8	22.2
Webequie (2011)	55.2	37.9	31.3

NOTES:
1. SOURCE: STATISTICS CANADA, 2002 and 2013.

With respect to labour force by industry within the three municipalities located within the LSA:

- Greenstone and Ignace have a higher percentage of labour force active in:
  - z. Agriculture, forestry, fishing and hunting
  - aa. Mining and oil and gas extraction
  - bb. Accommodation and food services
- Greenstone and Pickle Lake have higher percentages of labour force active in educational services, health care and social services
- The three communities have a smaller percentage of labour force in most other industries, with a few notable exceptions:
  - cc. Greenstone is high in utilities and manufacturing
  - dd. Pickle Lake is high in retail trade, transportation and warehousing, and public administration

The majority of the employed workforce in the First Nation communities is engaged in the following occupations:

- Social Services/Government
- Sales/Service

- Trades
- Management
- Business

In each of the LSA municipalities, there has been a decrease in industrial employment, likely due to the decline in the forestry industry including pulp and paper mills.

3.19.2 Individual Income

The average personal income within the municipalities of the RSA is similar to the provincial average (Table 3.19-3).

As shown in Table 3.19-4 the average individual income within the First Nation communities is composed of a good portion of government transfers as well as market income. The average individual income within all of the First Nation communities is below the Ontario average.

Table 3.19-3 Personal Income Levels by Municipality Compared to Ontario (2012)

	Greenstone		Ignace		Pickle Lake		Ontario	
Characteristic	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Total population 15 years and over	3912	100	989	100	322	100	1,117,9784	100
Without income	83	2.1	34	3.4	54	16.8	529,207	4.7
With income	3,829	97.9	954	96.5	268	83.2	1,065,0577	95.3
Under $1,000	132	3.4	48	4.9	12	3.7	450,973	4.0
$1,000 to $2,999	129	3.3	59	6.0	8	2.5	374,266	3.3
$3,000 to $4,999	171	4.4	65	6.6	0	0.0	345,965	3.1
$5,000 to $6,999	81	2.1	22	2.2	9	2.8	369,441	3.3
$7,000 to $9,999	257	6.6	37	3.7	17	5.3	604,152	5.4
$10,000 to $11,999	101	2.6	52	5.3	0	0.0	434,815	3.9
$12,000 to $14,999	144	3.7	78	7.9	21	6.5	628,059	5.6
$15,000 to $19,999	234	6.0	118	11.9	30	9.3	946,898	8.5
$20,000 to $24,999	184	4.7	64	6.5	9	2.8	779,870	7.0
$25,000 to $29,999	236	6.0	40	4.0	39	12.1	699,008	6.3
$30,000 to $34,999	147	3.8	48	4.9	17	5.3	703,754	6.3
$35,000 to $39,999	261	6.7	48	4.9	0	0.0	637,580	5.7
$40,000 to $44,999	281	7.2	23	2.3	30	9.3	554,746	5.0
$45,000 to $49,999	245	6.3	18	1.8	8	2.5	468,157	4.2
$50,000 to $59,999	520	13.3	56	5.7	8	2.5	743,523	6.7
$60,000 to $74,999	434	11.1	132	13.3	46	14.3	1,043,726	9.3
$75,000 to $99,999	215	5.5	40	4.0	11	3.4	550,236	4.9
$100,000 to $149,999	50	1.3	6	0.6	2	0.6	234,729	2.1
$150,000 and over	6	0.2	0	0.0	0	0.0	80,678	0.7
Median income ($) of total population 15 years and over	$46,002		$22,560		$35,391		$32,269	
Average income ($) of total population 15 years and over	$52,693		$37,627		$52,583		$47,225	
Standard error of average income	$1,166		$1,540		$4,055		$71	

NOTES:
1. SOURCE: MANIFOLD DATA MINING INC. SUPERDEMOGRAPHICS 2013.

Table 3.19-4 Individual Income and Composition by First Nation Community

First Nation Community	Total Population Over 15 years	Average Income ($)	Composition	
			Market	Government
Aroland (2010)	215	17,627	57.8	43.0
Attawapiskat (2001)[1]	635	14,548	62	36
Eabametoong (2010)	640	19,159	61.2	38.3
Marten Falls	NA	NA	NA	NA
Mishkeegogamang (2010)[2]	255	20,643	61.1	37.6
Neskantaga (2005)[1]	160	18,442	68.0	30.0
Nibinamik (2010)	220	23,081	69.8	30.2
Ojibway Nation of Saugeen	NA	NA	NA	NA
Webequie (2010)	435	17,108	59.6	40.4
Ontario (2001/2006/2011)	-	(32,865/NA/42,264)	-	(NA/9.8/12.3)

NOTES:

1. SOURCE: AANDC, 2013a.

3.19.3 Mining Labour Force

The Mining Industry Human Resource Council`s (MiHR) research has shown that employment in the mining sector is more volatile than in many other industries in Canada (MiHR, 2011). Previous labour market forecasts produced by MiHR show that despite this volatility, future hiring requirements will be quite significant across Canada, even under contractionary (i.e., poor economic outlook) scenarios.

A number of labour force surveys have been carried out in the Thunder Bay and Kenora / Rainy River districts of northwestern Ontario in the past couple of years (North Superior Workforce Planning Board and MiHR, 2012; City of Thunder Bay et al., 2013; Northwest Training & Adjustment Board, 2012; MiHR and Northwest Training & Adjustment Board, 2012).

These surveys illuminated a consistent trend; that even in a conservative growth scenario, a healthy number of workers will be required by mining projects in northwestern Ontario inclusive of the Ring of Fire projects. The City of Thunder Bay's mining readiness strategy estimated that approximately 10,586 jobs (direct, indirect and induced jobs from mining projects in northwestern Ontario) are expected to be available annually in northwestern Ontario (City of Thunder Bay, 2013).

Furthermore, the MiHR and the North Superior Workforce Planning Board (NSWPB) conducted labour forecasts for the mining industry. In the Kenora and Rainy River Districts mining sector employment is forecasted to be almost 6,400 employees by 2022; while in the Thunder Bay District mining sector employment is forecasted to be almost 2,840 employees by 2022 (NSWPB and MiHR, 2012 and 2013).

NSWPB and MiHR (2012) described labour market that is forced to look beyond the region for mining positions and particularly so for positions requiring advanced training or education. There are not enough identified workers with the necessary skills or qualifications to fill all the projected demands.

3.20 LOCAL AND REGIONAL ECONOMY

3.20.1 Forestry

The Ministry of Natural Resources (MNR) manages forestry activities on Crown land in Ontario. The MNR has divided the forests into Forest Management Units (FMUs), which are managed by individual forest companies. The concentrate haul road and Savant Lake Trans-load facility are located within the Caribou and English River FMUs. The individual forest companies operate under Sustainable Forest Licences (SFLs), which are issued by the MNR. The SFL for the Caribou and English River FMUs is Resolute Forest Products. These FMUs are an important contributor of spruce, pine, and tamarack to mills in Sioux Lookout, Savant Lake, Hudson, Ignace, Dryden, and Thunder Bay (MNR, 2008 and 2009).

3.20.2 Mining

Mineral exploration activities are prevalent in the Ring of Fire and surrounding areas. There are over 30,000 claims in the Ring of Fire Region. There are three mines operating in the Kenora District; 2 gold mines (Musselwhite Mine and Red Lake Gold Mines); and one diamond mine (Victor Mine). There is one platinum group metal mine operating in Thunder Bay District, the Lac des Iles Mine.

Figure 3.20-1, shows active mining claims and dispositions within the RSA.

3.20.3 Hunting and Trapping

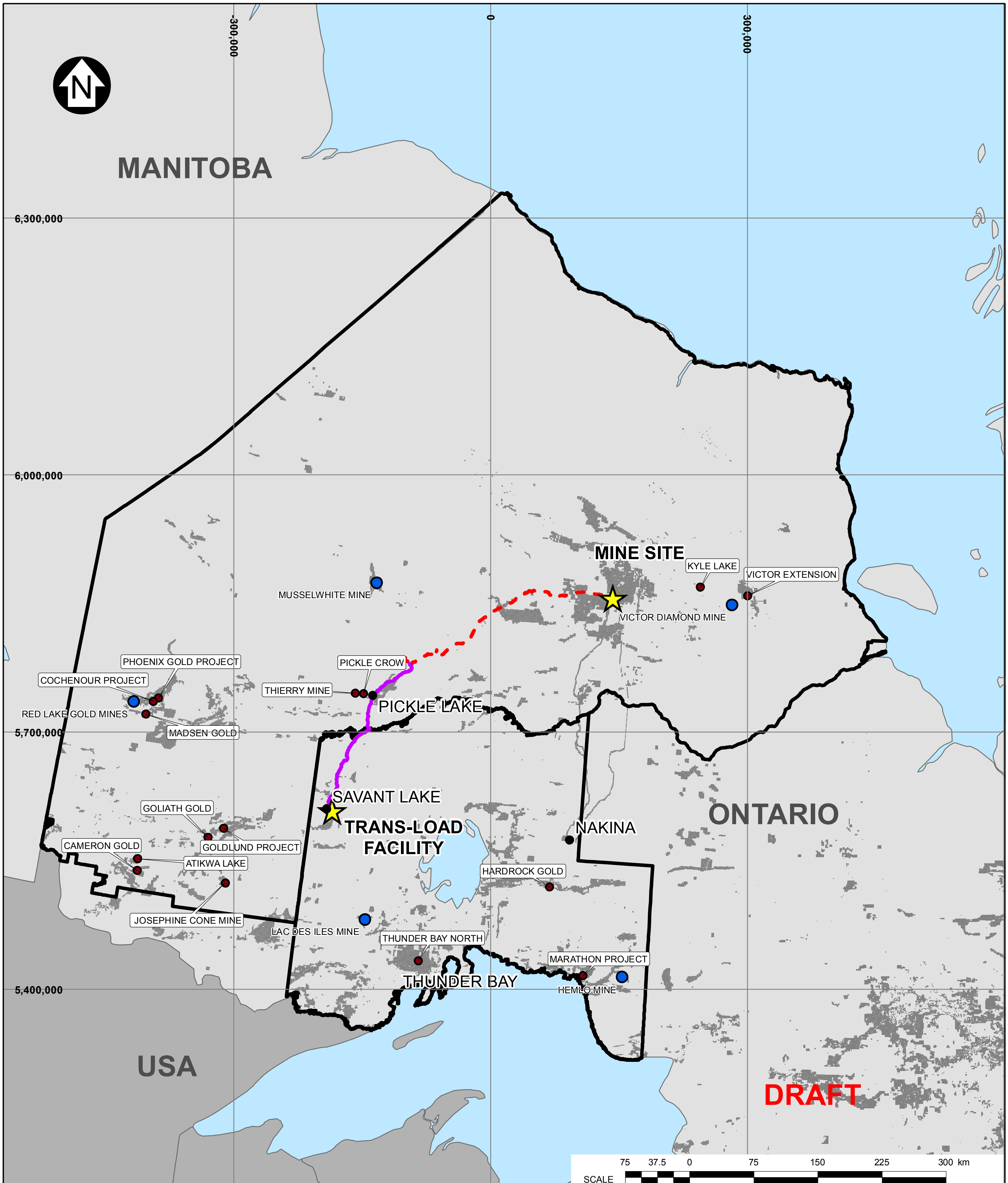
The MNR has set up a series of 95 Wildlife Management Units (WMU) across the province to manage recreational hunting activities. The Project is situated within WMUs 01C, 01D, 16A and 16B. To manage wildlife resources MNR issues outdoor cards, hunting licences, validation tags and seals. Moose and black bear are hunted in the area; Woodland Caribou protected under the *Endangered Species Act* and are no longer harvested by the non-Aboriginal population.

The management of wild furbearing mammals on Crown land is regulated by the MNR through the allocation of registered traplines. The mine site is located within trapline GE160. Trapping the area typically harvests fur bearers such as beaver, marten, and fisher.

3.20.4 Fishing

The Project is situated within three Fisheries Management Zones; 2, 3, and 4, which are managed by the MNR. Species of sport fish managed in these three zones include Walleye, Sauger, Northern Pike, Muskellunge, Largemouth and Smallmouth Bass, Yellow Perch, Lake Whitefish, Splake, Lake Trout, Rainbow Trout, Brook Trout, Brown Trout and Sunfish, Crappie and Lake Sturgeon. Most of the recreational fishing in the area is directed at Walleye and Northern Pike. Harvesting of Lake Sturgeon is not permitted in these zones.

There are numerous outpost camps and lodges in the area that draw in non-residents. Many of the outposts are only accessible by float plane.



LEGEND:

- ADVANCED MINERAL PROJECTS
- MINING OPERATIONS
- MINE SITE AND TRANS-LOAD FACILITY
- CONCENTRATE HAUL ROUTE
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- WATER
- ACTIVE CLAIMS
- POPULATION AND DEMOGRAPHICS, ECONOMIC AND COMMUNITY SERVICES AND PUBLIC INFRASTUCTURE RSA

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N.
3. ACTIVE CLAIM BOUNDARIES BY OTHERS WERE PROVIDED BY THE MINISTRY OF NORTHERN DEVELOPMENT AND MINES (AUGUST 2012).
4. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (NOVEMBER 26, 2013).
5. ADVANCED MINERAL PROJECTS AND MINING OPERATIONS PROVIDED BY THE ONTARIO MINING ASSOCIATION (2013).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

MINERAL EXPLORATION AND DEVELOPMENT ACTIVITY

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 3.20-1 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	JSP	SCP	RAC	RAM

3.20.5 Lodges and Outpost Camps

Tourism is an important component of the local economy within the LSA. Several lodges and outpost camps support fishing and hunting activities. There are many commercial tourism camps located in the study area as illustrated on Figure 3.20-2.

The lodges and outposts are operated out of Pickle Lake, Savant Lake, and various First Nation communities. The following is a list of outfitters that operate in the area as provided by the MNR (2013).

- Austin's Wilderness Lodge
- Albany River Outfitters/North of 51 Outposts
- North Albany Lodge
- North Caribou Camps
- North Star Air Ltd.
- Old Post and Village
- Osnaburgh Airways/Pickle Lake Outposts
- Arctic Watershed Outposts
- Leuenberger's Wilderness Outposts

Other lodges or facilities may also be operating within the LSA as this is not expected to be an all-inclusive list.

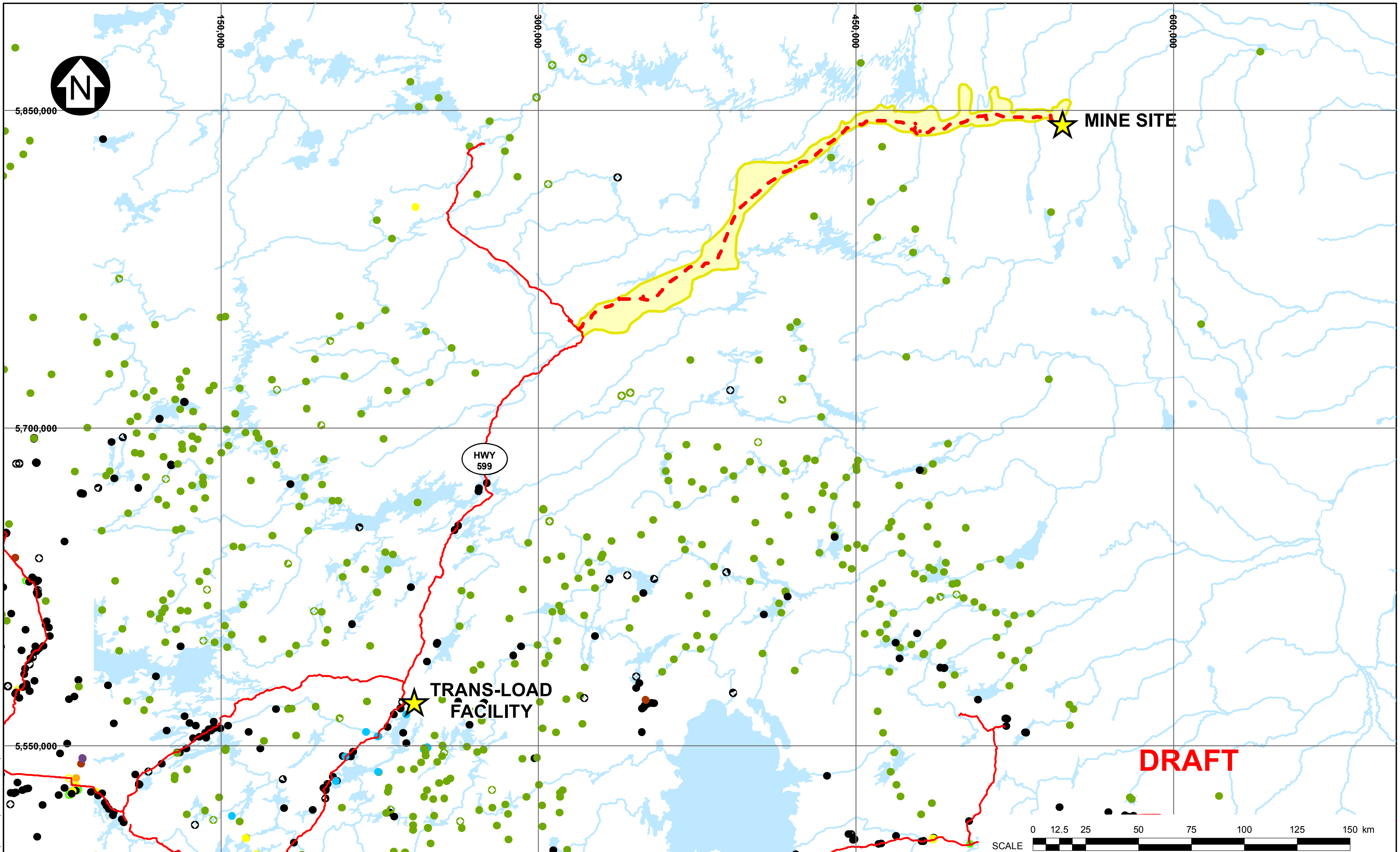
3.20.6 Local Economies

The local economies are dependent on the following sectors to greater or lesser extents:

- Government
- Mining
- Construction
- Transportation
- Renewable Resources
- Tourism, Arts and Sciences

High employment in health care and social services, public administration, and educational services indicate Greenstone as being a service centre hub for the area (supported by retail, accommodation and food services, finance and insurance).

The following sections provide a general overview of the contributions provided by each of these sectors to the local economies of the three municipalities.



LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- EXISTING ALL-SEASON ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- WATER
- AQUATIC RESOURCES LOCAL STUDY AREA

TOURISM ESTABLISHMENTS

- OUTPOST CAMP
- PLAYGROUND
- SHOOTING RANGE
- SKI HILL, NOT REMOTE
- STORE
- SUGAR SHACK
- TREE TAPPING
- COMMERCIAL CAMPGROUND
- COMMERCIAL PARKING LOT
- GOLF COURSE
- HORSE RIDING STABLE
- INN
- MAIN BASE LODGE
- MARINA/DOCK
- MUSEUM

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (NOVEMBER 26, 2013).
4. TOURISM ESTABLISHMENT AREA DATA PROVIDED BY THE OMNR (NOVEMBER 25, 2013).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

LODGES AND OUTPOST CAMPS

Knight Piésold CONSULTING

P/A NO.	REF NO.	
NB102-390/1	34	
FIGURE 3.20-2		REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	JSP	AS	RAC	RAM

SAVED: I:\1\02\00390\01\A\GIS\Figs\A651_rA.mxd; Dec 23, 2013 2:24 PM; skozmick

3.20.6.2 Government Sector

The Township of Ignace has an annual 2013 operating budget of $3.8 million, but operated a deficit of approximately $850,000 in 2012 (FIR, 2012). The Township employs eleven full time equivalent positions, with an additional 8 part time equivalents and 8 seasonal positions.

The Municipality of Greenstone has an annual 2013 operating budget of approximately $20 million, with an approximate $7 million capital budget. It developed a deficit of approximately $1.8 million in 2012. The Municipality employs 80 full time equivalents, 53 part time equivalents, and 43 seasonal positions (FIR, 2012).

The Township of Pickle Lake has annual 2013 operating budget of approximately $2 million, with a capital budget of approximately $475,000. In 2011 it ran a deficit of approximately $475,000. The Township employs 7 full time equivalents, 3 part time equivalents, and 3 seasonal positions.

3.20.6.3 Mining Sector

Table 3.20-1 summarizes the number of firms and jobs available within the three municipalities related to the mining supply, service and related sectors.

Table 3.20-1 Mining Supply/Service/Related Firms and Related Employment (2013)

Sector		Number of Firms/Jobs		
NAICS	**Description**	**Greenstone**	**Ignace**	**Pickle Lake**
212	Mining (except Oil and Gas)	0 / 0	- / 14	- / 45
213	Support activities for mining and oil and gas extraction	7 / 0	0 / 0	1 / 0
Related				
237	Heavy and civil engineering construction	2 / 20	0 / 20	1 / 0
238	Specialty trade contractors	6 / 0	3 / 0	- / 70
441	Motor vehicle and parts dealers	5 / <10	2 / 0	- / 24
444	Building material and garden equipment and supplies dealers	5 / <10	0 / <10	- / 0
445	Food and beverage stores	15 / 99	4 / 12	3 / 50
447	Gasoline stations	7 / <10	5 / 18	3 / 0
452	General merchandise stores	5 / <10	4 / <10	0 / 0
481	Air transportation	1 / 48	1 / 17	3 / 175
484	Truck transportation	20 / 47	7 / 12	0 / 0
485	Transit and ground passenger transportation	7 / 34	1 / 0	2 / 0
541	Professional, scientific and technical services	6 / 10	1 / 0	- / 0
621	Ambulatory health care services	13 / 43	1 / 22	0 / <10
721	Accommodation services	34 / 77	20 / 17	6 / 13
722	Food services and drinking places	3 / 63	1 / 30	- / 0
811	Repair and maintenance	13 / 20	8 / 27	1 / 0
812	Personal and laundry services	4 / 40	1 / 0	- / 0
Total		**153 / 521**	**59 / 199**	**20 / 382**

NOTES:

1. SOURCE: ONTARIO MINISTRY OF AGRICULTURE AND FOOD AND MINISTRY OF RURAL AFFAIRS IN PARTNERSHIP WITH EMSI.
2. JOBS ARE APPROXIMATE, AS FIGURES OF "<10" ARE ROUNDED TO 5.

3.20.6.4 Construction Sector

Table 3.20-2 summarizes the number of firms and jobs available within the three municipalities. Despite the greater number of firms in Greenstone and Ignace, Pickle Lake has a greater number of construction related jobs.

Table 3.20-2 Construction Firms and Related Employment (2013)

Sector		Number of Firms/Jobs		
NAICS	Description	Greenstone	Ignace	Pickle Lake
236	Construction of Buildings	10 / 26	4 / 36	1 / 0
237	Heavy and civil engineering construction	2 / 20	0 / 20	1 / 0
238	Specialty trade contractors	6 / 0	3 / 0	- / 70
Total		**8 / 46**	**3 / 56**	**1 / 70**

NOTES:
1. SOURCE: ONTARIO MINISTRY OF AGRICULTURE AND FOOD AND MINISTRY OF RURAL AFFAIRS IN PARTNERSHIP WITH EMSI.

3.20.6.5 Transportation Sector

Table 3.20-3 provides a summary of the transportation related firms by municipality.

Table 3.20-3 Transportation Firms and Related Employment (2013)

Sector		Number of Firms/Jobs		
NAICS	Description	Greenstone	Ignace	Pickle Lake
Sector				
481	Air transportation	1 / 48	1 / 17	3 / 175
482	Rail Transportation	1 / 28	- / 0	- / 0
483	Water Transportation	- / 0	- / 0	- / 0
484	Truck transportation	20 / 47	7 / 12	0 / 0
485	Transit and ground passenger transportation	7 / 34	1 / 0	2 / 0
486	Pipeline Transportation	- / <10	- / 0	- / 0
487	Scenic and sightseeing transportation	2 / <10	- / 0	- / 0
488	Support activities for transportation	2 / 17	1 / 0	- / 0
Total		**33 / 184**	**10 / 29**	**5 / 175**

NOTES:
1. SOURCE: ONTARIO MINISTRY OF AGRICULTURE AND FOOD AND MINISTRY OF RURAL AFFAIRS IN PARTNERSHIP WITH EMSI.

3.20.6.6 Renewable Resources

Table 3.20-4 provides a summary of the forestry related firms by municipality. Pickle Lake does not have any forestry related jobs as the community is located north of the Forest Management Planning Area.

Table 3.20-4 Forestry Related Firms and Related Employment (2013)

Sector		Number of Firms/Jobs		
NAICS	Description	Greenstone	Ignace	Pickle Lake
Sector				
113	Forestry and logging	15 / 27	10 / 73	- / 0
114	Fishing, hunting and trapping	2 / 10	- / 0	- / 0
115	Support activities for forestry	3 / 35	1 / 0	- / 0
Total		**20 / 72**	**11 / 73**	**0 / 0**

NOTES:

2. SOURCE: ONTARIO MINISTRY OF AGRICULTURE AND FOOD AND MINISTRY OF RURAL AFFAIRS IN PARTNERSHIP WITH EMSI.

3.20.6.7 Tourism, Arts and Cultural Industries

Table 3.20-5 provides a summary of the Tourism, Arts and Cultural Firms by municipality.

Table 3.20-5 Tourism, Arts and Cultural Firms and Related Employment (2013)

Sector		Number of Firms/Jobs		
NAICS	Description	Greenstone	Ignace	Pickle Lake
Sector				
721	Accommodation services	34 / 77	20 / 17	6 / 13
722	Food services and drinking places	3 / 63	1 / 30	- / 0
5615	Travel Arrangement and Reservation Services	1 / 0	1 / 0	- / 0
7121	Heritage institutions	1 / 0	- / 0	- / 0
7115	Independent artists, writers and performers	- / 0	1 / 0	- / 0
7111	Performing arts companies	1 / 0	- / 0	- / 0
5191	Other information services	1 / <10	1 / 0	- / 0
4511	Sporting goods, hobby and musical instrument stores	- / <10	2 / 0	- / 0
4539	Other miscellaneous store retailers	0 / 0	- / 11	- / 0
5111	Newspaper, periodical, book and database publishers	1 / <10	1 / <10	- / 0
5419	Other Professional, Scientific, and Technical Services	- / 0	- / 0	- / 0
6116	Other schools and instruction	6 / 0	1 / 0	- / 0
3152	Cut and Sew Apparel Manufacturing	- / 0	- / 0	- / 0
3271	Clay Product and Refractory Manufacturing	- / 0	- / 0	- / 0
4512	Book Stores and News Dealers	- / 0	- / 0	- / 0
5121	Motion Picture and Video Industries	- / 0	- / 0	- / 0
5122	Sound Recording Industries	- / 0	- / 0	- / 0
5414	Specialized Design Services	- / 0	- / 0	- / 0

Sector		Number of Firms/Jobs		
NAICS	Description	Greenstone	Ignace	Pickle Lake
7113	Promoters (presenters) of performing arts, sports and similar events	1 / 0	- / 0	- / 0
7114	Agents and Managers for Artists, Athletes, Entertainers, and Other Public Figures	- / 0	- / 0	- / 0
Total		**49 / 155**	**28 / 63**	**6 / 13**

NOTES:
3. SOURCE: ONTARIO MINISTRY OF AGRICULTURE AND FOOD AND MINISTRY OF RURAL AFFAIRS IN PARTNERSHIP WITH EMSI.

3.21 HUMAN HEALTH AND WELL-BEING

3.21.1 Population Health Status

3.21.1.1 Life Expectancy

Community specific life expectancy rates were not available for the purposes of this report. As a result the life expectancy rates of the North West LHIN, representing the RSA, Thunder Bay District Health Unit and Northwestern Health Unit, representing the LSA, are provided (Table 3.21-1).

Table 3.21-1 Life Expectancy at Birth in Years (2007-2009)

Location	Females	Males
RSA (North West LHIN)	81.1	76.2
LSA (Thunder Bay District Health Unit)	82.2	76.5
LSA (Northwestern Health Unit)	79.1	75.8
Ontario	83.6	79.2

NOTES:
1. SOURCE: NORTH WEST LHIN POPULATION HEALTH PROFILE, 2012.

3.21.1.2 Infant Health and Mortality

The infant mortality rate is higher in the RSA at 6.0 per 1,000 births than in Ontario where the infant mortality rate is 5.1 per 1,000 births. Infants in the RSA are less likely to be born pre-maturely (less than 37 weeks gestation) compared to the province as a whole. Approximately 6% (6.3%) of live births are pre-mature in the RSA, while 8.2% are reported to be pre-mature in Ontario (North West LHIN, 2012b). Similarly 5.9% of newborns are reported to be small for gestational age in the North West LHIN, while 17.0% are reported to be large for gestational age (North West LHIN, 2012b). In Ontario, 9.0% of newborns are reported to be small for their gestational age and 10.4% of newborns are reported to be large for gestational age (North West LHIN, 2012b).

Women living in the RSA who gave birth during the reported 2009/2010 period were younger than all women giving birth in Ontario. Almost 13% (12.8%) of mothers were less than 20 years of age in the RSA, while in Ontario only 3.6% of mothers were less than 20 years of age (North West LHIN, 2012b). Conversely the RSA area has a lower percentage of mothers aged 35 years and older (11.4%) compared to Ontario (21.4%) (North West LHIN, 2012b).

3.21.1.3 Cause of Death and Death Rate

Mortality rates for the LSA and RSA are reported in Table 3.21-2. The LSA, on average, has a higher rate of mortality in people less than 75 years of age than the RSA and Ontario. This is also true of potentially avoidable mortality in the LSA. The leading cause of death in the RSA is ischaemic heart disease at 17.7% of deaths followed by lung cancer at 8.2%. Cancer and circulatory diseases accounted for the greatest number of deaths in the LSA. Cancers were the second highest cause of death in the RSA. Unintentional injuries accounted for a greater number of deaths in the LSA and RSA compared to the rest of Ontario. Suicides and self-inflicted injuries caused nearly three times the number of deaths in the LSA and RSA than the provincial average.

Table 3.21-2 RSA Mortality Rates (2006-2008)

Age Standardized Mortality Rate / 100,000 population	LSA		RSA	Ontario
	Northwestern Health Unit	Thunder Bay District Health Unit	North West LHIN	
Premature Mortality (death before 75 years)	381.2	307.9	332.0	239.0
Potentially Avoidable Mortality (death before 75 years that could have been prevented)	291.3	232.8	252.4	172.9

NOTES:
1. SOURCE: STATISTICS CANADA, 2013.

3.21.2 Mental Health

Mental health conditions commonly affecting the LSA and RSA population (extrapolated from research regarding overall Aboriginal mental health) include depression, anxiety and bipolar disorder (NAHO, 2011). Access to services that may provide help in dealing with mental health concerns are limited in the LSA and slightly less so in the RSA; generally individuals residing in remote or rural locations are required to travel to urban centres to access care (CMHA Ontario, 2009). This results in many mental health issues going undiagnosed and treated. The federal government offers a number of programs to First Nation peoples both on and off-reserve.

3.21.3 Substance Abuse

Limited information is available on substance abuse in the LSA and RSA. According to the Northwestern Health Unit, smoking rates (daily or occasional) have slightly decreased between 2003 and 2005, however there is a greater prevalence to smoking in the LSA and the RSA compared to Ontario overall. Female and male daily or occasional smoking is relatively even in the LSA, in the RSA female smoking rates have slightly increased between 2003 and 2005 while male smoking rate have decreased during the same time period.

Heavy drinking is more prevalent in the LSA than the RSA and Ontario. According to the Canadian Community Health Survey (CCHS) conducted in 2003 and 2005, both residents of the LSA and RSA are more likely than Ontario residents to consume five or more drinks on one occasion 12 or more times a year.

Addiction issues have been identified as concerns within the LSA during several consultation events. Addictions concerning prescription drugs and alcohol have been identified as primary concerns for communities.

3.21.4 Sexual Health

Chlamydia is the most common sexually transmitted infection (STI) in northwestern Ontario (Northwestern Health Unit, 2013). Youth (ages 15 to 19 years) who are sexually active in northern Ontario are approximately 50% likely to always use a condom when engaging in sexual activities. Youth pregnancy rates (per 10,000 population) in northern Ontario are higher when compared to Ontario overall with a rate of 9.1 pregnancy for youth aged 10 to 14 years (6.5 in Ontario overall) and a rate of 506.4 pregnancy for youth aged 15-19 years (429.1 in Ontario overall) (Barnett, R., et al, 2005). The incidence of sexually transmitted diseases is also higher in northern Ontario compared to Ontario overall. Incidence rate of sexually transmitted disease for youth aged 10 to 19 years old, in 2000/2001, in northern Ontario was 37.3, compared to Ontario overall at 29.9 (Barnett, R., et al, 2005).

3.21.5 Crime and Policing

In eight of the nine primary First Nation communities of the LSA, Nishnawbe-Aski Police Service (NAPS) is responsible for policing and maintaining public order in the communities. NAPS is the largest First Nations police force in Canada and the second largest in North America. The remaining communities of the LSA are policed by the Ontario Provincial Police.

Most incidents involving a police response involve “assists”, where the police provide any type of assistance to members of the public. These may include attending motor vehicle accidents or visits by community members to the Police station with information. The average number of total incidences reported in the LSA First Nation communities between March 30, 2011 and April 1, 2012 is 750 (NAPS, 2012).

3.21.6 Food Security

Food costs in the LSA communities are generally higher than that of the RSA and the rest of Ontario. This is particularly true for remote First Nation communities in the LSA. The high cost of food impacts the ability of individuals in the communities to purchase sufficient healthy products to feed themselves and their families.

Food quality and quantity in First Nation LSA communities is generally limited in the grocery stores available. The food is shipped to the community on a regular basis; however, perishable items generally do not have a long shelf life once they reach the community. Given the requirement to ship food to the communities (majority of the time by air) the cost of the food is high relative to costs for the same item in other areas of the RSA and the province. For example, the cost of bread in remote LSA communities can average around $4.75, where as in Thunder Bay comparable bread would cost on average $3.00. Without high disposable incomes, residents in the LSA have a difficult time purchasing adequate quality food for consumption.

Traditional foods are still consumed by residents in the LSA. These foods typically consist of fish, geese and moose. Although not everyone is able to harvest traditional foods, traditional foods are provided during community feasts and through informal community food sharing programs.

3.21.7 Recreational Activities

Participation in various physical activities is important in maintaining a healthy lifestyle. Recreational activity information for First Nation communities is currently unavailable however many of the communities do have recreational facilities including a gymnasium, hockey arena and outdoor playing fields. Hockey is a popular sport in the LSA and RSA as it is in Canada overall.

3.22 COMMUNITY INFRASTRUCTURE AND PUBLIC SERVICES

3.22.1 Transportation

There are currently no highways, roads, or trails into the mine site. The proposed all-season road will generally follow the existing winter road corridor between the Pickle Lake North Road and Webequie First Nation. It will branch off towards the mine site at a location roughly 30 km southwest of the community of Webequie. The existing Pickle Lake North Road and Highway 599 will be used to connect the new all-season road to the trans-load facility, which will be located near the community of Savant Lake. The trans-load facility will be located approximately 5 km east of the community of Savant Lake on the CNR mainline.

The Municipality of Greenstone (Amalgamated communities of Beardmore, Nakina, Geraldton and Long Lac) and Aroland are located off of Highway 11. Aroland is accessible via Hwy 643, which connects to Highway 11.

Both Pickle Lake and Savant Lake are located on Highway 599, which connects to the TransCanada Highway (Highway 17). Highway 599 turns into the Pickle Lake North Road (former Highway 808 or Northern Ontario Resource Trail), which links the winter roads and Musselwhite Mine to the provincial highway system. The Pickle Lake North Road terminates at Windigo Lake. The First Nation Communities of Webequie, Neskantaga, Nibinamik and Eabametoong all share portions of the main winter road that joins to the Pickle Lake North Road.

Highway traffic volumes are monitored by the Ministry of Transportation (MTO). Traffic volumes experienced along Highway 599 are shown in Table 3.22-1.

Table 3.22-1 Highway 599 Average Annual Daily Traffic (AADT)

From	To	Distance (km)	2010 AADT
Highway 17	Sec Highway 642	59.7	400
Sec Highway 642	Kenora/Thunder Bay district Boundary	35.1	140
Kenora/Thunder Bay district Boundary	A Pit 3.1 km north of the Sturgeon River Bridge	12.0	140

From	To	Distance (km)	2010 AADT
A Pit 3.1 km north of the Sturgeon River Bridge	Sturgeon River culvert	43.6	120
Sturgeon River culvert	Austin's Road - Pashkokogan Lake Rd.(E)	72.2	120
Austin's Road – Pashkokogan Lake Rd.(E)	Thunder Bay/Kenora District Boundary	24.0	130
Thunder Bay/Kenora District Boundary	Rat Rapids Bridge	9.1	130
Rat Rapids Bridge	Pickle Lake Road	35.1	230
Pickle Lake Road	Central Patricia - End of Hwy 599	0.6	650

NOTES:
1. SOURCE: MTO, 2013.

3.22.2 Housing

Most homes in First Nation communities are single detached homes. Aroland First Nation is the only community in which residents indicated they owned the dwellings in which they reside. Most of the homes in the First Nation communities were constructed before 2001 and a majority require major repairs.

Privately occupied dwellings in Greenstone and Ignace are largely single detached houses, whereas Pickle Lake has a larger percentage of semi-detached, small apartments, and other dwellings. The average number of rooms and bedrooms per dwelling in the three communities do not differ substantially from Ontario's averages.

A large percentage of housing stock built in the three communities is between 30 and 70 years old. Relatively little housing stock has been constructed since 1980 in the three communities. Dwelling occupants in the three communities indicated a lower incidence of their dwelling units requiring regular maintenance only, and a higher percentage of units requiring either minor or major repairs as compared to Ontario. Dwelling unit values in the three communities are substantially lower (less than 25%) of the average values in Ontario.

The Kenora District Services Board (KDSB) administers rent-geared-to-income assistance to eligible households in the Kenora District. There are 1,130 units in the district of which 528 are owned by the KDSB, 560 are owned by non-profit providers, and 42 rent supplement units. KDSB and rent supplement units are rent-geared-to-income only. Non-profit providers offer both market rent and rent-geared-to-income. However, the KDSB has no rent-geared-to-income units in Ignace. Ignace does have 17 rent-geared-to-income units owned and managed by the Métis Nation of Ontario.

In the Greenstone area, social housing is a function of the District of Thunder Bay Social Services Administration Board (TBDSSAB).The TBDSSAB is responsible for the funding and administration of approximately 4,300 social housing units owned and managed by 24 non-profit housing providers, or made available by private landlords as part of the rent supplement program. The housing projects are located throughout the District of Thunder Bay and vary in building type, amenities, unit size and rent type.

3.22.3 Schools

3.22.3.1 Schools and Educational Programs in LSA Aboriginal Communities

The schools located within the First Nation communities in the LSA are operated by local education authorities. Table 3.22-2 shows the type of schools, enrollment and programs available to residents of each First Nation community.

Table 3.22-2 Schools and Programs Available within First Nation Communities

First Nation Community	Education Centres and Programs		
	School Name (Enrollment)	Grades Taught	Other Educational Programs
Aroland	Johny Therriualt Memorial School (75)	JK to Grade 8	High School Completion by Washa Distance Education Centre and KiHS Program; Geraldton High School
Attawapiskat	JR Nakogee Elementary School (400) Vezina Secondary School (175)	JK to Grade 8 Grade 9 to 12	
Eabametoong	John C. Yesno Education Centre (200)	JK to Grade 9	Washa Distance Education Centre and KiHS Program
Marten Falls	Henry Coaster Memorial School (80)	JK to Grade 8	Washa Distance Education Centre and KiHS Program
Mishkeegogamang	Missabay Community School (160) Charlie Neekan Memorial School (NA)	JK to Grade 8 JK to Grade 8	Washa Distance Education Centre
Neskantaga	Neskantaga Elementary School (45)	JK to Grade 8	KiHS Program
Nibinamik	Nibinamik Education Centre (NA)	JK to Grade 8	KiHS Program
Ojibway Nation of Saugeen	Ojibway Nation of Saugeen Public School (20-30)		KiHS Program
Webequie	Simon Jacob Education Centre (210)	JK to Grade 11	Simon Jacob Education Centre Washa Education Centre and KiHS Program

NOTES:
1. SOURCE: 211NORTH, 2013.

3.22.3.2 Schools in the Non-Aboriginal Communities and RSA

Table 3.22-3 presents a list of school boards in the three municipalities within the RSA. There are several Post-Secondary Education Institutions located in the Kenora and Thunder Bay districts as shown in Table 3.22-4.

Table 3.22-3 School Boards within the RSA

Community	School Board
Greenstone	Superior Greenstone District School Board Web: www.sgdsb.on.ca
	Superior North Catholic District School Board Web Page: www.sncdsb.on.ca
	Conseil scolaire de district catholique des Aurores boréales Web: www.csdcab.on.ca
	Conseil scolaire public du Grand Nord de l'Ontario Web: www.cspgno.ca
	Ginoogaming First Nation & Long Lake 58 Education Authority Phone: 807-876-4914
	Biinjitiwaabik Zaaging Aniahnaabek Education Authority Web: http://www.rockybayfn.ca
Pickle Lake	Keewatin Patricia District School Board Web: www.kpdsb.on.ca
Ignace	Keewatin Patricia District School Board Web: www.kpdsb.on.ca
Thunder Bay District/Kenora District	Keewatin Patricia District School Board Web: www.kpdsb.on.ca
	Kenora Catholic District School Board Web: www.kcdsb.on.ca
	Thunder Bay Catholic District School Board Web: www.tbcdsb.on.ca
	Lakehead District School Board Web: www.lakeheadschools.ca
	Conseil scolaire de district catholique des Aurores boréales Web: http://www.csdcab.on.ca/

Table 3.22-4 Post-secondary Educational Institutions in Kenora and Thunder Bay Districts

Institution	Main Campus Location
Lakehead University www.lakeheadu.ca	Thunder Bay, ON
Hearst University http://www.uhearst.ca/	Hearst, ON
Confederation College http://www.confederationc.on.ca/	Thunder Bay, ON
Academy of Learning Career and Business College http://www.academyoflearning.com/ON/Home.aspx	Thunder Bay, ON
Transport Training Centres of Canada Inc.	Sudbury, ON; Thunder Bay, ON;

Institution	Main Campus Location
http://www.ttcc.ca/	Timmins, ON
GCF Inc. http://www.gcfi.net/	Greenstone, ON
Northern Ontario School of Medicine http://www.nosm.ca/	Sudbury, ON; Thunder Bay, ON

3.22.3.3 Remote Education Opportunities

Contact North is a not-for-profit corporation funded by the Government of Ontario through the Ministry of Training, Colleges and Universities. Contact North works in partnership with Ontario's 24 public colleges, 22 public universities and over 250 public essential skills and training providers to increase and improve online and distance learning opportunities for Ontarians in over 600 small, rural, remote, Aboriginal and Francophone communities across the province. Contact North locations within the RSA are summarized in Table 3.22-5.

Table 3.22-5 Contact North Locations

Municipality	Address	Services
Greenstone	Located within Geraldton Composite High School 500 Second Street West, PO Box 368 Geraldton, ON P0T 1M0	Audio, Video, e-Learning, Wheelchair Access, High-speed Internet
Pickle Lake	Located within Township Community Centre Library 14 Koval Street Pickle Lake, ON P0V 3A0	Audio, e-Learning, High-speed Internet
Ignace	Located within Crossroads Employment Training and Resource Centre 312 Pine Street, Annex Ignace, ON P0T 1T0	Audio, Video, e-Learning, High-speed Internet
Kenora	Located within Confederation College 900 Golf Course Road Kenora, ON P9N 3X7	Audio, Video, e-Learning, Wheelchair Access, High-speed Internet
Thunder Bay	Thunder Bay Operations Centre Located within Woodgate Building 1139 Alloy Drive, Suite 104 Thunder Bay, ON P7B 6M8	Audio, Video, e-Learning, Wheelchair Access, High-speed Internet

NOTES:
1. SOURCE: CONTACT NORTH, 2013.

3.22.4 Health Facilities

In Ontario, the Ministry of Health and Long-term Care is responsible for providing public health services to all residents. The local health unit that oversees Greenstone, Pickle Lake, Ignace and the Thunder Bay/Kenora Districts is the North West Local Health Integration Network (North West LHIN). The North West LHIN is a non-profit organization established in June 2005. They work with health care providers, communities and the public to set priorities and plan health services in

Northwestern Ontario. They will oversee the integration and coordination of local health services to make it easier for clients/patients to access the care they need. The North West LHIN is also responsible for allocating funding for the following health services in Northwestern Ontario:

- Hospitals
- Community Care Access Centres (CCACs)
- Community support service organizations (e.g. homemaking, personal assistance, etc.)
- Long-term care homes
- Community Health Centres
- Community mental health and addictions agencies.

An overview of the local hospitals, health facilities, programs and services is provided in Table 3.22-6.

The Northern Health Programs (NHP) of Underserviced Area Program (UAP) is one of a number of supports provided by the Ministry of Health and Long Term Care to help rural, remote and northern communities recruit and retain health professionals. The program is intended to enhance access to health care services in small rural and northern areas of the province.

Table 3.22-6 Local Hospitals, Health Facilities, Programs and Services

Municipality	Facility/Program/ Service	Description	Capacity
Greenstone	Geraldton District Hospital	Fully accredited, progressive health care organization committed to providing high quality services to residents of Greenstone (Geraldton, Longlac, Nakina, Beardmore, Caramat) and surrounding First Nations communities. 24 hour emergency department, heliport. Services provided include clinical nutrition, diagnostic imaging (x-ray & ultrasound), laboratory, low risk obstetrics, outreach chemotherapy, rehabilitation (PT & OT), social work, and telemedicine.	23 acute care beds, 26 long term care beds
	North Horizon Health Centre	Centralized location for the Community Care Access Centre, Dental Office, Diabetes Education Centre, Geraldton Medical Group, Greenstone Family Health Team, Nutrition Services, Thunder Bay District Health Unit	N/A
	North West Community Care Access Centre	OHIP covered services in Longlac funded by LHIN through the Ministry of Health and Long-Term Care. Connectors to home care, long-term care destinations, and other services in the community.	N/A
	Dilico Ojibway Child and Family Services	Dilico Anishinabek Family Care provides a range of responsive individual, family and community programs and services for the complete life journey of all Anishinabek people. There is a district office in Longlac.	N/A

Municipality	Facility/Program/ Service	Description	Capacity
	Greenstone Family Health Team	Comprehensive multidisciplinary care to members and visitors of the Municipality of Greenstone. Team consists of a Nurse Practitioner, Registered Practical Nurse, Registered Dietitian, Social Worker, Health Educator and Administrative Staff.	N/A
	Nakina Medical Clinic	N/A	N/A
	Beardmore Regional Health Centre	N/A	N/A
Pickle Lake	Mishkeegogamang Health & Social Services (run out of Sioux Lookout)	A new Health Centre was opened on Mishkeegogamang First Nation in May 1998, replacing the previous nursing station. The clinic is staffed by a doctor for one week out of every five, and by nurses year-round. Routine health care, like immunizations and dispensing of medications, is done at the health centre. For needs beyond the scope of the clinic, people travel to Winnipeg or Thunder Bay. Medical vans with local drivers take people to appointments or to the hospital. Severely ill patients are flown out of Pickle Lake by air ambulance.	N/A
	Pickle Lake Health Clinic	Facility which boasts an emergency treatment room and regular daily patient services.	N/A
Ignace	Mary Bergland Community Health Centre	Health care services are provided by Physicians, Nurse Practitioners, Registered Nurses, Aboriginal Health Service Worker, Health Promoter, Tele-health Technician, foot care specialists, massage therapists. Other services available include Physiotherapy, Chiropody, Lab specimen collection, screening programs for blood sugar and blood pressure.	N/A
Kenora	Lake of the Woods District Hospital	The Lake of the Woods District Hospital meets the immediate healthcare needs of residents of the City of Kenora, as well as a large surrounding area, including several First Nations Communities. 24-hour emergency department and helicopter service (helipads on 5 First Nation reserves and 5 district communities).	Medical/surgical unit is an acute care inpatient unit with 25 medical and 4 elective surgical beds
Thunder Bay	Thunder Bay Regional Health Sciences Centre	Thunder Bay Regional Health Sciences Centre is a state-of-the-art acute care facility serving the healthcare needs of people living in Thunder Bay and Northwestern Ontario.	375 acute care beds; emergency department with approximately 95,000 annual visits; 28 bed Post Anesthetic Recovery Unit; 40 bed Day Surgery Recovery area

Municipality	Facility/Program/ Service	Description	Capacity
Kenora District / NAN territory	Tikinagan Child and Family Services	Tikinagan Child and Family Services work in 30 First Nations in Northwestern Ontario. In partnership with these communities, their role is to mentor young parents, support families and protect children.	Serving approximately 17,000 people located in 30 remote First Nation communities in Northwestern Ontario. They also serve Pickle Lake, Savant Lake and Allanwater and the First Nation populations in Sioux Lookout and Red Lake

NOTES:
1. SOURCE: TBRHSC, 2013.
2. SOURCE: TC&FS, 2013.

The First Nation communities within the LSA have a nursing station, health centre or hospital, depending on the size of the resident population within the community (Table 3.22-7). Attawapiskat is the only community with a hospital, the other communities have Medical Transportation Programs that oversee and assist patients that require transportation to regional health centres, which are located in larger centres such as Sioux Lookout, Thunder Bay and Geraldton.

Table 3.22-7 Health Care Facilities within First Nation Communities

First Nation Community	Health Centre/Services
Aroland	Aroland Health Centre
Attawapiskat	James Bay General Hospital – Attawapiskat Wing and access to the Ontario Teleconference Network
Eabametoong	Health Centre and access to the Ontario Teleconference Network
Marten Falls	Health Centre and access to the Ontario Teleconference Network
Mishkeegogamang	Health Centre and access to the Ontario Teleconference Network
Neskantaga	Health Centre and access to the Ontario Teleconference Network
Nibinamik	Nursing Station and access to the Ontario Teleconference Network
Ojibway Nation of Saugeen	Health Centre and access to the Ontario Teleconference Network
Webequie	Nursing Station located within the community and access to the Ontario Teleconference Network

NOTES:
1. SOURCE: 211NORTH, 2013.

3.22.4.1 Ambulance Services

The Greenstone Region has numerous health related services available to the residents, including ambulance services and a 911 emergency telephone service.

The Superior North EMS is an emergency medical service operated by the City of Thunder Bay, with oversight from Thunder Bay City Council and the Ministry of Health and Long Term Care. Although the Headquarters is located in the City of Thunder Bay, there are 17 EMS Stations throughout the District of Thunder Bay from which emergency medical services are provided (includes Beardmore, Geraldton, Longlac, Nakina). Every community and unorganized area in the District of Thunder Bay is serviced by Superior North EMS paramedics.

Superior North EMS employs approximately 190 people, (170 full and part time paramedics, and 20 leadership and administrative personnel) who deliver provincially mandated emergency medical services to approximately 169,000 people.

The Pickle Lake Ambulance is overseen by the Kenora District Services Board and is operated by several full-time employees and volunteers. Patients are transported to the Pickle Lake Medical Clinic where the doctor or nurse on call provides the necessary treatment. Serious cases that cannot be treated in Pickle Lake are air lifted to another hospital. Pickle Lake offers local 911 service.

Ignace offers ambulance services as well as local 911 service. The closest medical facility is in the Dryden Regional Health Centre, which is 110 kilometres west of Ignace.

The Northwest EMS is responsible for providing emergency pre hospital care in the District of Kenora. They have 9 stations and 96 Primary Care Paramedics.

3.23 GOVERNMENT POLICIES, PLANNING AND INITIAITVES

3.23.1 Land Use Planning

The land use policy areas pertinent to the Project are shown on The Crown Policy Land Use Atlas (MNR, 2013a). The Project is situated within, or borders, six land use policy areas as summarized in Table 3.23-1.

Table 3.23-1 Summary of Applicable Land Use Policy Areas

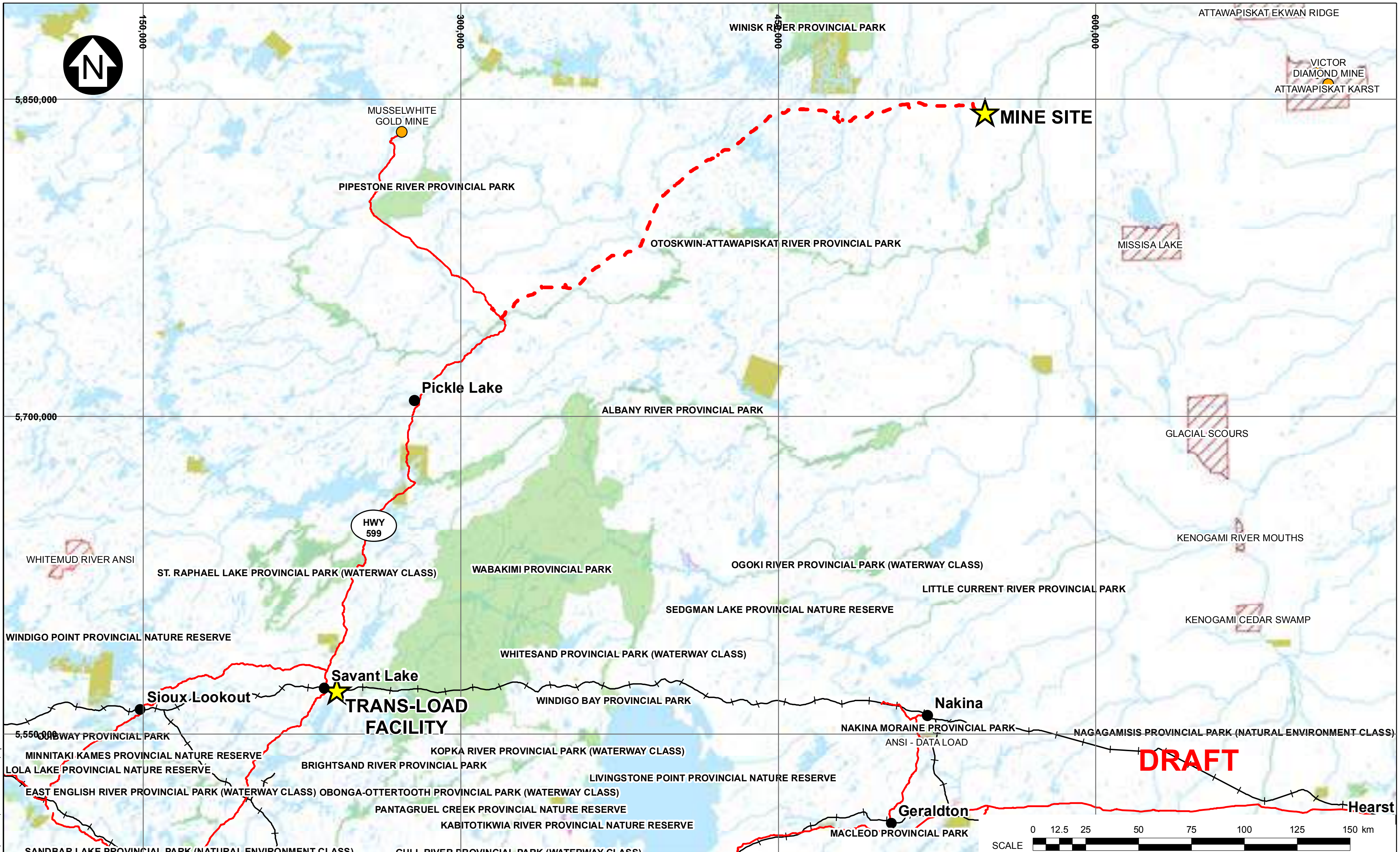
Policy Area	Name	Designation	Applicable Project Component(s)
P2287	St. Raphael	Provincial Park (Waterway)	Concentrate Haul Road (Hwy 599)
P3705	Pipestone River	Provincial Park	Concentrate Haul Road (Hwy 599)
P3706	Pipestone River	Provincial Park	Concentrate Haul Road (Hwy 599)
P2657	Albany River	Provincial Park (Waterway)	Concentrate Haul Road (Hwy 599)
G2515	Sioux Lookout	General Land Use Area	Concentrate Haul Road (Hwy 599) Savant Lake Trans-Load Facility
E2283a	Miniss	Enhanced Management Area	Concentrate Haul Road (Hwy 599)

NOTES:

2. SOURCE: MNR, 2013a.

Development in the Far North is governed by the *Far North Act*, 2010. The Project will be subject to the provisions of the *Far North Act*, which requires the development of community based land use plans. These plans are intended to foment joint planning between First Nations and the province, and must be approved by each First Nation and the MNR. Currently, there are no approved community based land use plans established within the area of proposed Project development.

The majority of the RSA, including the mine site, transportation corridor and trans-load facility are located in unsurveyed territory within the Kenora and Thunder Bay Districts. Incorporated areas include the Township of Pickle Lake and the Municipality of Greenstone. Incorporated municipalities in Ontario are required to prepare Official Plans under the *Ontario Planning Act* (1990). The Official Plans are developed to guide local development. These Official Plans are not expected to have a direct bearing on the Project.



LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- COMMUNITY
- MINING PROJECT
- RAILWAY
- EXISTING ALL-SEASON ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- WATER
- PARK
- FIRST NATIONS RESERVE
- CROWN GAME PRESERVE
- NATIONAL WILDLIFE AREA
- EVALUATED WETLAND

AREAS OF NATURAL AND SCIENTIFIC INTEREST

- ANSI, EARTH SCIENCE
- ANSI, LIFE SCIENCE
- CANDIDATE ANSI, EARTH SCIENCE
- CANDIDATE ANSI, LIFE SCIENCE

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (NOVEMBER 26, 2013).
4. ACTIVE CLAIM BOUNDARIES WERE PROVIDED BY NORONT RESOURCES LTD. (MAY 23, 2013).
5. ACTIVE CLAIM BOUNDARIES PROVIDED BY MININISTRY OF NORTHERN DEVELOPMENT AND MINES (AUGUST 2012).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	PAQ	AS	RAC	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

CONSERVATION AREAS AND PROVINCIAL PARKS

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 3.23-1 | REV A

SAVED: I:\1\02\00390\01\A\GIS\Figs\A652_rA.mxd; Dec 18, 2013 2:52 PM; spenfold

3.23.2 Provincial Parks

As shown on Figure 3.23-1 above there are several Provincial Parks located in proximity to the proposed development areas including the following:

- Otoskwin-Attawapiskat River Provincial Park
- Winisk River Provincial Park
- Albany River Waterway Provincial Park
- St. Raphael Waterway Provincial Park
- Pipestone River Provincial Park
- Wabakimi Provincial Park
- English River Provincial Park
- Brightsand River Provincial Park

None of the new development for the Project crosses any of the parks; the proposed all-weather transportation corridor comes in close proximity to Otoskwin-Attawapiskat River Provincial Park in three locations.

3.24 TRADITIONAL LAND USE

First Nation communities in the LSA continue to practice traditional land use activities. These activities include traveling both on land and in water, tending to traplines in their traditional territories, fishing, hunting, and gathering various plants for food and medicines.

Animals typically harvested by individuals in the LSA include (but are not limited to):

- Marten
- Moose
- Beaver
- Fisher
- Caribou
- Lynx
- Cisco
- White Fish
- Pickerel
- Canada Goose
- Various Water Fowl
- Various Berries and Medicinal Plants

Members of the First Nations also travel to camps on their traplines. These camps serve as a home base while out on the land and as a place of retreat. Several First Nation community members own outposts camps and rent them out for recreational purposes.

Culturally significant locations include historically important sites, such as meeting places, burial sites, spiritual sites, and any area deemed as special or important by the local population. Although, Noront is aware that such sites exist, the location of these sites was not confirmed prior to the publication of this report.

During the various consultation events held by Noront, the community members expressed their interest in continuing to protect the land around the Project. The land is an important and strong connection for LSA residents to their culture and it is important to the residents of the LSA to maintain the integrity of the land so that today's younger and future generations will be able to continue to use the land and practice their culture.

Section 4

Assessment of Alternatives

Knight Piésold
CONSULTING
www.knightpiesold.com

TABLE OF CONTENTS

PAGE

TABLES

FIGURES

4 – ASSESSMENT OF ALTERNATIVES

4.1 INTRODUCTION

The *Ontario Environmental Assessment Act (OEAA)* requires a description of potential Project alternatives and rationale for the selection of the preferred Project alternatives. The *OEAA* refers to two types of alternatives:

- Alternatives to the undertaking
- Alternative methods of carrying out an undertaking

The "*alternatives to"* are defined as functionally different ways of approaching and dealing with a problem or opportunity, while "*alternative methods"* are defined as different ways of performing the same activity (MOE, 2009). Similarly, the CEA Agency (2007) identifies alternatives to the undertaking and "*alternative means"* rather than alternative methods. Alternative means or methods can include consideration of alternative technologies, alternative methods of applying specific technologies, alternative sites for a proposed undertaking, alternative design methods and alternative methods of operating any facilities associated with a proposed undertaking (MOE 2009).

Within the federal EIS Guidelines, the CEA Agency (2012) acknowledged that the criteria and process to assess alternatives was also to be developed and consulted on during the preparation of the provincial environmental assessment Terms of Reference (ToR). The CEA Agency indicated that if federal guidance on the alternatives assessment differed from the approach in the provincial ToR, the process and the criteria consulted on in the ToR would take precedence. Therefore, the emphasis in this alternatives assessment has been to apply provincial nomenclature (e.g., "alternative method") and processes as outlined in the ToR (*OEAA* Section 6(2)(a) and *OEAA* 6.1(2)).

It is neither practicable nor necessary to evaluate alternative methods for every aspect of the Project. This section of the report focuses on assessing alternative methods for those aspects of the Project that have the greatest potential for adverse environmental effects.

4.2 EVALUATION OF ALTERNATIVES

4.2.1 Criteria for Evaluation of Alternatives

The Ontario Ministry of Environment's Code of Practice: Preparing and Reviewing Environmental Assessments in Ontario (MOE, 2009) and Section 7 of the EIS Guidelines (CEA Agency, 2012) outline the screening criteria for evaluating alternatives. The performance criteria applied in the evaluation of alternatives for the Eagle's Nest project gave consideration to the factors outlined by the MOE (2009) and the CEA Agency (2012). The criteria utilized are summarized in Table 4.2-1.

Table 4.2—1 Criteria for Evaluation of Alternatives

Performance Criteria Applied in the Evaluation of Alternatives	Factors to Consider in Choosing Alternatives (from MOE, 2009 and CEA Agency, 2012)
Technical Feasibility	• Is the alternative a viable solution to the problem or opportunity to be addressed? • Are the technologies to be used proven and technically feasible? • Are the alternatives within Noront's ability to implement? • Can the alternative be implemented within the defined study areas? • Are the alternatives appropriate to the Project?
Economic Viability	• Is the alternative practical, financially realistic and economically viable?
Biophysical Environmental Acceptability	• Could the alternative affect any sensitive environmental features? • Is the alternative consistent with government policies? Can the alternative meet the purpose of the *OEAA* and *CEAA 1992; amended in 2010*, with other relevant planning objectives, policies and decisions, and provincial government priority initiatives?
Socio-economic Acceptability	• Is the alternative consistent with government policies? Can the alternative meet the purpose of the *OEAA* and *CEAA 1992; amended in 2010*, with other relevant planning objectives, policies and decisions, and provincial government priority initiatives? • What are the potential impacts to Aboriginal and other communities? • Are there any adverse impacts on potential or established Aboriginal or Treaty rights?

The performance criteria are discussed in additional detail in the following sections.

4.2.2 Technical Feasibility

Technical feasibility considers the applicability, integrity and reliability or expected technical performance of a given alternative. Available technology and technical approaches available to the Project are evaluated to determine if they will be effective, if required. New technologies will be considered if they are supported by case studies or strong theoretical investigations. The performance of each alternative will be determined as follows:

- **Preferred** - Will be predictably effective with contingencies if the alternative does not perform as expected
- **Acceptable** - Likely to be effective based on theoretical considerations and contingencies are available if the alternative does not perform as expected
- **Unacceptable** - The effectiveness of the alternative appears uncertain or relies on unproven technology

4.2.3 Economic Viability

Economic viability explores whether or not a given alternative (alternative to or alternative method) is financially sustainable. Each aspect of the Project has a cost implication. The economic viability of the Project is evaluated on the basis of investor attractiveness, acceptability of return on investment and financial risk. The performance of each alternative is determined as follows:

- **Preferred** - Will provide a competitive return on investment with manageable or acceptable financial risk
- **Acceptable** - Will provide an acceptable return on investment and manageable or acceptable financial risk
- **Unacceptable** - Cannot be financially supported by the Project, due to an unacceptable return on investment and/or unmanageable financial risks

4.2.4 Biophysical Environmental Acceptability

The biophysical environmental acceptability considers the overall biophysical environmental effects of the Project, the ability to mitigate effects, and the site's amenability to reclamation. In addition, consideration is given to government policies and guidelines as benchmarks, where applicable. The assessment also considers potential positive effects. The performance of each alternative is determined as follows:

- **Preferred** - Will minimize adverse effects to the physical and biological environments without mitigation
- **Acceptable** - Will minimize adverse effects to the physical and biological environments with mitigation
- **Unacceptable** - Expected to potentially cause a significant adverse effect to the physical or biological environment that cannot be reasonably mitigated

4.2.5 Socio-economic Acceptability

The socio-economic acceptability will be evaluated to determine the potential for negative or positive impacts to the socio-economic environment. This evaluation will include existing uses and practices, aspects of the cultural or built heritage and Aboriginal treaty rights. The performance of each alternative is determined as follows:

- **Preferred** - Will minimize adverse effects to the socio-economic environment without mitigation and will provide the greatest positive effects
- **Acceptable** - Will minimize the adverse effects to the socio-economic environment with mitigation
- **Unacceptable** - Expected to cause a significant adverse effect to the socio-economic environment that cannot be reasonably mitigated

4.2.6 Identification of the Preferred Alternative

The identification of the preferred alternative includes the consideration of both the short term effects of each alternative through the Project's construction and operations phases, as well as the long term effects of the Project's decommissioning and closure and post-closure phases.

The procedural steps that were followed in addressing the selection of alternative methods are summarized in CEA Agency, 2012, shown in Figure 4.2-1 and outlined below.

1. The alternative methods to carry out the Project will be identified. Alternative will be defined as various technically and economically feasible ways the project can be implemented or carried out.
   - Each alternative method will be described in sufficient detail for the assessment
   - Criteria will be developed to determine the technical and economic feasibility of each alternative method
2. The alternative methods that are technically and economically feasible will be identified.
   - If an alternative method is not considered technically or economically feasible, it will be considered unacceptable and not assessed further
3. For each technically and economically feasible alternative method:
   - The potential environmental effects will be identified
   - The elements of each alternative method that could produce environmental effects will be defined in sufficient detail to allow a comparison with the environmental effects of the Project
4. A preferred method will be identified based on the relative consideration of environmental effects, as well as technical and economic feasibility.
   - Determine and apply criteria that identify alternative methods as unacceptable on the basis of significant adverse environmental effects
   - Determine and apply criteria to examine the environmental effects of each acceptable alternative method in order to identify a preferred alternative

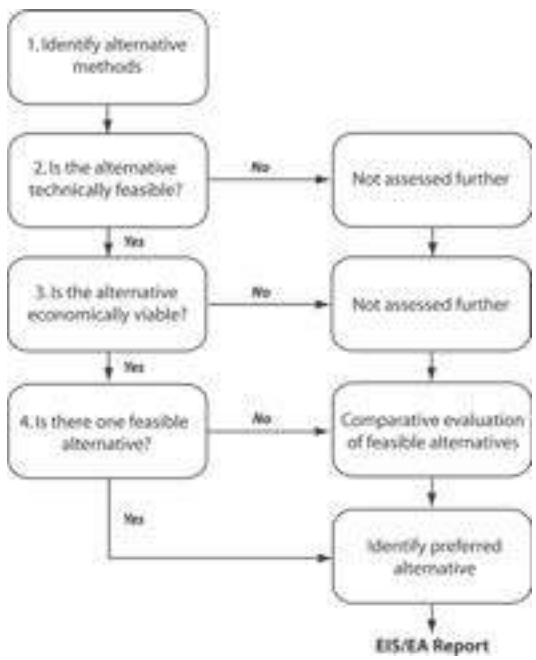


Figure 4.2—1 Section of Preferred Alternative Method

The evaluation of alternatives has been undertaken and incorporates discussions and comments received during consultation with Aboriginal communities, government reviewers and the general public. Information collected during these engagement activities has helped to determine the choice of alternatives considered and the relative importance of the individual performance objectives.

4.3 PURPOSE OF THE PROJECT

The purpose of the Project is to extract, process and ship an average of approximately 150,000 tonnes per year of nickel-copper-platinum-palladium concentrate over a 11-year mine life. All mining and related activities will be undertaken in an environmentally and socially sustainable manner, while still providing a competitive rate of return to Noront's investors and sharing Project benefits directly with the local First Nation communities. In addition, Noront proposes to extract aggregate rock from underground workings, which will be used in the construction of the all-season road and other mine site infrastructure.

The purpose and the need for the Project provide the context for the consideration of the alternatives. The rationale for the Project is outlined in Section 1.4 and the need for the Project can be summarized as follows:

- There is a strong global demand for nickel-copper-platinum-palladium metals
- The development of the Project has the potential to generate many socio-economic benefits to local First Nation communities, to the Province of Ontario, and more broadly to Canadians
- Development of the Project has support from the Government of Ontario as it has called the Ring of Fire "one of the most promising mineral development opportunities in Ontario in almost a century" (OMF, 2013)

4.4 ALTERNATIVES TO THE PROJECT

The alternatives to the Project are the functionally different ways to meet the project need and achieve the project purpose (CEA Agency, 2012).

The number of alternatives to most mining projects is limited because the ore bodies have a fixed location and the only way to proceed with the project is to mine the ore body at its current location. The purpose of the Project is to produce nickel-copper-platinum-palladium concentrate and this purpose can only be accomplished through the mining and processing of ore. As such, the only feasible alternative to proceeding with the Project is the Do Nothing Alternative. The Do Nothing Alternative was compared against the base-case, which is to proceed with the Project.

4.4.1 Proceeding with the Project

The feasibility study prepared for the Project demonstrates that it is technically feasible to develop the Project and meet the Project objectives (Micon, 2012). In terms of economic viability, proceeding with the Project would provide a competitive return on investment and is the preferred alternative.

Proceeding with the Project will have both positive and negative effects on the biophysical and socioeconomic environment. The majority of the biophysical effects will be restricted to the mine site and along the transportation corridor. Potential negative biophysical effects could include the alteration of the landscape, loss of aquatic and wildlife habitat, and potential impacts to the wetland ecosystem. Project operations may also result in nuisance effects, such as increased noise and air contaminants from the transportation of concentrate and equipment to the mine site. Most of these effects would be considerably reduced once mitigation measures are applied. Land disturbance that will result from proceeding with the Project cannot be completely avoided, but will be minimized to the extent practical by appropriate Project design. The Project design will include utilizing a compact site arrangement and conducting progressive reclamation (to the extent practical) prior to decommissioning and closure. Minimizing surface disturbances will be aided by moving processes underground that other mines would normally place on surface. Examples include all concentrator processes and the backfill plant. More significant is the decision to place all tailings underground. This latter design decision has the additional benefit of eliminating the discharge of process water to the environment.

The Project will help collect valuable environmental data in an understudied region of northern Ontario through its monitoring programs. A full description of the Project's potential biophysical effects is provided in Section 6.

The socio-economic effects of the Project will extend regionally and are expected to be net positive. The project will result in:

- New infrastructure
- Local and regional economic development opportunities
- Training and employment opportunities
- Increased household and individual incomes
- Community benefits through impact and participation agreements with potentially affected First Nations.

Construction of an all-season transportation corridor into the Ring of Fire is expected to facilitate infrastructure improvements within the region. All-season spur roads from the communities could become more affordable for local First Nation communities that currently rely on the winter roads and air access. If all-season spur roads are built by others to the communities, the cost of living of these communities will be lowered substantially. The road may also facilitate the provision of lower-cost grid power and/or fibre optic cable connections to the communities - both of which are initiatives under consideration for the region. Construction of the all-season road into the Ring of Fire will also benefit Noront and other mineral resource companies, substantially lowering the cost of both mineral exploration and mineral development in the region.

Potential negative socio-economic effects will be experienced to the greatest extent within the LSA. Negative effects may include:

- The potential loss of cultural heritage resources
- An increase in health related risks
- Strain on First Nation and Public infrastructure (due to increases in population and usage)
- Social issues such as increased drug or alcohol abuse that can be associated with increased personal income
- Alterations to traditional lands and land uses and increased hunting and fishing pressure on local resources due to improved access

The benefits of employment, improvements to access and electrical power supply are seen to provide an overall net benefit from the development. Mitigation measures will address the potential negative effects of the Project on the local communities, and have already resulted in choosing alternative transportation corridor alignments to avoid culturally sensitive areas and caribou habitat.

In terms of socio-economic acceptability, proceeding with the Project as planned is the preferred alternative. A full description of the Project's potential socio-economic effects is provided in Section 7.

Proceeding with the Project would also be consistent with a number of government policies and initiatives. For example, the Ring of Fire Secretariat was developed to work with and consult with Aboriginal peoples, northern Ontarians and the mining industry to encourage responsible and sustainable economic development in the region. In addition, the Government of Ontario has publicly stated that it supports responsible mining developments in the Ring of Fire (Government of Ontario, 2012c). The Government of Canada has demonstrated its support for mineral exploration through initiatives such as the Mineral Exploration Tax Credit and, more specifically to the Ring of Fire, the Federal Economic Development Initiative for Northern Ontario (CMF, 2013). This demonstrates the federal government's commitment to sustainable mining across Canada (including the Ring of Fire) as a means of benefiting the Canadian economy and local communities.

Proceeding with the Project can meet the purpose of the *CEAA 1992; amended in 2010* and the *OEAA.* The purpose of the *OEAA* is the betterment of the people of the whole or any part of Ontario by providing for the protection, conservation and wise management of the environment in Ontario.

4.4.2 The Do Nothing Alternative

The Do Nothing Alternative would involve abandoning the Project and not mining the ore deposit. This is considered as the "no project" scenario and the case for comparison to the other alternative to the Project. Abandoning the Project is considered an unacceptable alternative as it would not meet the Project goals of providing a competitive return on investment to Noront's shareholders who have invested considerable funds into the Project (economic feasibility).

If the Do Nothing Alternative was selected, none of the potential positive or negative effects of the Project would occur and the existing conditions of the biophysical and socio-economic environment would remain unchanged. The Do Nothing Alternative would result in a loss of opportunities for the local and regional First Nation communities and the predicted socio-economic benefits of the Project would not occur (socio-economic acceptability).

During various engagement events, including Open Houses, communities and stakeholders have indicated their desire for improvements to the local and regional economy through the creation of jobs and other subsidiary businesses that would support the Eagle's Nest Mine and, ultimately, other mines in the ROF. Matawa Tribal Council has indicated their support for development in the ROF as a means to improve the conditions for their communities. The development of the ROF would not only bring in mining projects, but would provide improved infrastructure to the area including electric hydro power and roads (First Nations Voice, 2013).

4.4.3 Selection of Preferred Alternative

Proceeding with the Project is the preferred alternative as the Project has been proven technically feasible, economically viable and has strong community and government support. Abandoning the Project would fail to fulfill the need and purpose of the Project by foregoing employment opportunities for local communities, and potential tax revenues to the Government of Ontario and the Government of Canada. The Project is not expected to have significant negative effects on the biophysical or socio-economic environment and the potential positive socio-economic effects of the Project would provide excellent opportunities for local and regional First Nations.

As such, the “Do Nothing Alternative” receives an unacceptable rating of economic feasibility, and therefore is not assessed further.

4.5 ALTERNATIVE METHODS OF CARRYING OUT THE PROJECT

The definition applied to alternative methods of carrying out the Project is provided in Section 4.1. The objective of the environmental assessment is to ensure that specific components of the Project are developed in an economic, technical and environmentally sound manner. The alternative that is both technically and economically feasible and has the least possible potential adverse effects on the biophysical and socio-economic environment will be selected as the preferred option.

A list of alternative methods was prepared that are realistic within the context of developing a new mine in northern Ontario. The level of detail for each alternative is generally conceptual. However, alternatives are described to a point where meaningful comparisons of the concepts can be made.

The assessment of alternative methods focuses on components of the Project that have the greatest potential for adverse environmental effects or were raised through First Nations or Government consultation. It is generally not practical or necessary to evaluate alternative methods for every aspect of the Project.

4.5.1 Pre-Screening of Alternative Methods

The potential alternative methods for the Project were screened to eliminate methods that are not technically feasible or economically viable. In some cases, only one alternative is applicable to the Project and is the preferred alternative. In these cases, a detailed evaluation is not warranted. A preliminary screening of alternative methods was included in the ToR and additional screening was undertaken during the preparation of the EIS/EA Report. The pre-screening of alternatives was a result of scoping and feasibility level studies and consultation with communities and other groups.

A summary of the alternative methods screening results are outlined in Table 4.5-1.

Table 4.5—1 Summary of Alternative Methods Screened from the EA

Alternative Method	Screening Results
Mining Method	Underground mining is the only economically viable alternative given the ore body geometry. The upper most section of the mine could be extracted from surface, however this approach would require a larger area and the increased environmental impact does not outweigh the underground alternative.
Surface Tailings Disposal	Tailings disposal in a surface impoundment (tailings storage facility) was not considered to be a technically acceptable alternative, nor would it be environmentally or socially acceptable.
Waste Rock Disposal	Waste rock not suitable for use as aggregate due to ARD/ML concerns will be disposed of underground with tailings.

Alternative Method	Screening Results
Mine and Mill Wastewater Management	Noront plans to recycle mine and processing wastewater, minimizing freshwater requirements and eliminating any discharge of wastewater from the mine. The amount of water to be contained in cemented backfill and paste tailings yields a net intake of water and eliminates the usual discharge to a tailings pond or treatment and discharge to the environment.
Method of Concentrate Shipment	The alternative methods of concentrate shipment by hovercraft, canal system and airship were evaluated and not considered to be economically viable or technically proven (in the case of the latter two options).
Use of a Winter Road for Concentrate Shipment	In order to support the economic viability of the Project, year-round access to the mine site will be required. The working capital and higher risks of relying on a winter road proved unacceptable.
Type of power source at mine site	Alternative methods for generating power using hydroelectricity, wind and solar power were assessed and not considered to be technically or economically viable as a primary power source for a Project life of 11 years. Diesel-electric is the only technically feasible and economically viable alternative to start the Project. Noront would certainly utilize grid power if it was supplied to the region by the Province.
Location of Power Source	Locating the diesel power generators at the mine site is the logical alternative, given the decision to extend the all-season road access to the mine site. The TOR identified the possibility of locating generators at Webequie Junction, but use of Webequie Junction and a winter road/slurry pipeline connected to the mine site was not preferred. This option was also not supported by the Webequie First Nation.
Explosives Handling and Storage	During the construction phase, manufacturing and storage of explosives will take place on site. Off-site production will not be possible as the all-season road will not have been completed. During the operations phase of the mine, the explosives for the underground mining will be manufactured off-site and transported to the mine site along the all-season road. Other alternatives for the supply and handling of explosives during the operations phase were not as economically viable. In particular, the plant and/or magazines would have to be built in a peat bog at a relatively higher cost and the on-site explosive plant would result higher energy costs.

Alternative Method	Screening Results
Construction Methods	Standard construction techniques using industry standard best practices will be employed. No alternative construction methods were found that will increase the economic viability of the Project or decrease potential impacts to the biophysical and socio-economic environments.
Location of Surface Infrastructure	The proposed locations of surface infrastructure are not within sensitive environments and, to the maximum extent possible, are located within the existing footprint of previously disturbed areas (i.e., trans-load facility). Infrastructure was positioned at locations where the foundation conditions are acceptable and that the drainage work will be relatively simple. The locating of facilities at the mine site makes use of higher ground to minimize construction on the peat bog. Placing the tailings dewatering system and/or backfill plant on surface was deemed acceptable, but not the preferred alternative, since there is an intention to keep process wastes underground. No other alternatives or competing criteria were identified.
Hazardous Waste Management	Hazardous waste will be stored on-site in sealed containers in a lined, bermed area for shipment off site to licensed facilities. This is standard practice for remote mine sites and construction of a lined hazardous waste disposal facility on-site, requiring long-term monitoring, would not be economically viable or socially acceptable.
Storm Water Management	All of the surface infrastructure will be located in well drained upland environments. The management of surface water is expected to be straight-forward and no relevant alternatives were developed.

The rationale for the exclusion of the alternative methods listed in Table 4.5-1 from further assessment is discussed in the following sections.

4.5.1.1 Mining Methodology

The Eagle's Nest deposit is a near-vertical pipe-like structure measuring (at surface) 200 m on strike by 60 m wide and extending down to a depth of 1,200 m. The deposit is open at depth, with inferred resources down to 1,600 m. Due to the shape, orientation and depth of the deposit, it is ideally suited to underground mining. The development of an open pit would result in large quantities of waste rock in relation to the quantity of ore (a very high stripping ratio) and would not be an economically viable mining method. An open pit mine would also create a much larger surface imprint for areas to store waste rock and tailings ponds, as well as larger surface facilities.

There are various alternative underground mining methods that could be used in the Project and all are considered equivalent in terms of potential environmental and socio-economic impacts and were not evaluated separately. The factors that were considered in the selection of the preferred underground mining method for the Project during the feasibility study include:

- Spatial characteristics of the orebody
- Geologic and hydrologic conditions
- Geotechnical properties
- Economic considerations
- Technological factors
- Environmental concerns

Standard bulk stoping mining was considered appropriate given the competency of the host rock and the size and shape of the ore body. The access to the underground will be through the use of a twin ramp, which was considered more economically viable given the expanse and depth of peat bog at the mine site and the foundation requirements for a headframe and traditional shaft. The use of electrically powered underground haul trucks, using regenerative-braking, is preferred, which aided in the selection of underground mining.

4.5.1.2 Tailings Disposal

The Project will process 2,960 tonnes per day of ore. The processing waste will generate an estimated 9.5 million tonnes of tailings over the life of the Project. The ore body is known to contain sulphide bearing rocks and it is expected that the tailings will have the potential for acid rock drainage (ARD) and metal leaching (ML) (discussed in Technical Support Document 5).

In Canada, tailings are typically managed at least partly with surface facilities. In the case of this Project, both surface and underground tailings disposal options were investigated at a conceptual level of design.

Tailings would need to be deposited underwater if stored on surface in order to minimize the oxidation of the sulphide bearing tailings and the potential for ARD/ML. The topography at the mine site area is generally flat and the water table is close to surface in most locations.

A conceptual design for a surface facility was developed in order to assess the feasibility of constructing and operating a surface tailings management facility. A surface facility would include the construction and operation of several paddock style storage facilities to accommodate the tailings. It was estimated that a 300 x 300 m paddock would be required during each year of operation. In each paddock, the surface peat layer would be excavated to an average depth of 3 m and stockpiled for closure. The overburden would then be excavated an additional 5 m and be used in conjunction with rock to construct a low-height confining embankment that would extend 1 m above the ground surface. This concept assumes that the overburden material is suitable for embankment construction. If the material is not suitable, then rock fill would have to be acquired. The facility would be lined and dewatered. It was assumed that water management would be challenging.

The key factor against using a surface tailings pond construction is the need for a source of rock to construct the required tailings dams. There are no readily available sources of rock in the region, so the rock would have to be trucked to site at a high cost or excavated from underground. The Eagle's

Nest deposit is surrounded by non-ARD granodiorite, which is a good candidate for aggregate (Technical Supporting Document 5). However, mining the rock underground for aggregate would create very large openings, which become much more economical to use for tailings storage rather than for creating ponds on surface. In addition, the rock extracted to create the voids can be used to build roads, pads and other surface infrastructure.

The construction and operation of a tailings management facility on surface was determined to be technically feasible. The capital costs for the construction of a surface tailings management facility would include:

- Excavation, stockpiling and embankment fill placement (earthworks)
- Installation of impermeable liner (geomembrane)
- Tailings pumping system to surface
- Tailings distribution system on surface
- Reclaim water system

The closure costs considered:

- Dewatering of each paddock
- Decommissioning
- Applying a 2 m cover over each paddock

The estimated cost for the construction, operation and closure of a surface tailings management facility at the mine site was considered to be excessive for the Project. In addition, during consultation with First Nation communities and government regulators, the construction and operation of a surface tailings management facility did not receive positive feedback. There was concern over the stability of the facility at closure and the potential impacts to surface and groundwater, the wetland and aquatic ecosystems in the event of a malfunction or failure. As such, the use of a surface tailings management facility was not further assessed and underground tailings disposal alternative was selected as the preferred method.

4.5.1.3 Waste Rock Disposal

Development rock not suitable for aggregate due to potential ARD/ML concerns will be considered as potentially acid-generating (PAG) waste rock. Most of the non-ore bearing waste rock is not expected to have ARD/ML concerns. The ore, however, is hosted in sulfides. The contrast between the ore body and surrounding granodiorite is clearly visible and the mining process will be able to discriminate between ore and waste relatively easily. It is possible that PAG waste rock exists in the contact zone. As such, some PAG waste rock may be generated during the construction and operation phases when drilling and blasting the host rock close to the ore body.

Any PAG waste rock encountered during the operations phase will be disposed of underground in the aggregate stopes or as part of the cemented paste backfill tailings during initial operation. The long-term storage of waste rock on surface was not considered to be necessary or economically viable, since a permanent lined storage area would need to be constructed and run-off water from the facility would need to be monitored during operations and post-closure. No other alternative methods for disposal of waste rock were found to be economically viable or environmentally acceptable.

4.5.1.4 Mine and Mill Wastewater Management

An objective of the Project is to limit freshwater requirements and, in particular, limit the discharge of any water to the environment. During the operations phase, wastewater will be produced in the mine and mill from the following sources:

- Water from filter press in the surface concentrate drying facility (10 m^3/h)
- Seepage from uncemented tailings (18 m^3/h)
- Process water (70 m^3/h)
- Groundwater inflows to the underground workings (approximately 21 m^3/h)

The process plant will require approximately 150 m^3/h of water during operations. With recycling wastewater for process use, there will be a net deficit of water that will be made up with a freshwater supply.

Underground mine water is expected to contain suspended solids from general mining, ammonia residuals from explosive use and residual hydrocarbons from equipment use. The treatment of the wastewater in an underground facility to allow for recycling is technically feasible and economically viable.

If the wastewater were not recycled, it would need to be treated to meet water quality objectives and discharged to the environment. Another consequence of not recycling would be the requirement for a larger volume of freshwater for the processing facility. Recycling the mine and mill wastewater reduces the freshwater requirements and eliminates a discharge to the environment. This alternative is clearly preferred over other possible methods of mine and mill wastewater management and no other alternative methods were considered.

4.5.1.5 Concentrate Shipment

Several alternative methods for shipping concentrate from the mine site to a smelter facility were considered. The following alternative methods were screened out during the preparation of the ToR:

- Hovercraft were considered for moving concentrate and materials to and from the mine. The high costs to operate the required fleet of hovercraft make this option economically unviable. There is also high noise and greenhouse gas emissions associated with this option, since hovercraft consume a large amount of fuel to raise the craft and its load off the ground.
- The relatively flat terrain to the east of the mine site was evaluated for construction of a canal system and the use of barges. Factors against this alternative include the cost to build and operate a canal system, the necessity to limit water flow along the canal to protect the peat bog from drainage, and the short open water season. The use of a canal system was not considered to be economically viable.
- Airships were considered for accessing mining operations and transporting concentrate. No large capacity, commercially viable and proven reliable airships are currently in service. Plans to construct airships with 20 or 50 tonne payloads are under development, but even larger capacity airships would be required to meet the materials handling requirements of the Project. Given the uncertainty of availability, and unknown costs for operating a fleet of airships, this alternative was considered both technically and economically unviable.

4.5.1.6 Use of Winter Road for Access to the Mine Site during Operations

Access to the mine site will need to be developed to transport concentrate to market and to supply the equipment and materials required to build and operate the mine. The construction and operation of a winter road for the transportation of concentrate was considered as a possible alternative method.

There are existing winter roads to several First Nation communities in the region. The roads are in operation for a short period during the winter months. It was determined that in order to support the economic viability of the Project, year-round access to the mine site will be required. Using a winter road would require the stockpiling of large amounts of equipment, consumables, fuel and concentrate at the mine site. For example, the use of a winter road would require more than 40 million litres of fuel to be stored at the mine site Additional stockpiling of concentrate would be required at the trans-load facility. The use of a winter road would add significant financial risk to the Project as a mild winter would reduce the amount of materials and concentrate that could be shipped over the winter road. This would also require the movement of fuel and other consumables by aircraft. Because of these factors, the use of a winter road is not considered to be an economically viable alternative for the shipment of concentrate, consumables and equipment during the operations phase of the Project.

4.5.1.7 Type of Power Source

Hydroelectric, solar, natural gas and wind power alternatives were assessed during the preparation of the ToR. Solar and wind alternatives were not capable of providing a reliable and continuous power supply that is economically viable, given the Project's power requirements. The construction of a hydroelectric generating station is not considered economically viable as the capital cost to construct a station for a mine with an 11 year operation life would be prohibitive. In addition, the technical feasibility and possible location for a hydroelectric station has not been identified given the flat topography in the region.

Natural gas electricity generation was also considered unacceptable as a new pipeline and terminal facilities would need to be constructed. The construction of the pipeline and natural gas power plant would not be economically viable for the Project. The use of liquefied natural gas would also require the construction of a plant and specialized shipping and storage facilities. There would also be volume losses as the liquefied gas boils off during transport.

The preferred source of power for the Project is grid power from the existing Ontario power grid. Unfortunately, plans for supplying grid power to the Ring of Fire region have not yet been finalized by the province. The document "Ontario's Long-Term Energy Plan", released by the province on November 23, 2010, mentions power transmission to the region through the upgrading of the lines to Pickle Lake (MOEnergy, 2010). However, the provision of power to the Ring of Fire and local communities needs to be defined and no dates are noted by the MOEnergy (2010). It has been determined by Noront that it would not be economically viable for the company to construct a transmission line to connect the mine site to the existing grid at Pickle Lake. It is also unlikely that grid power could be provided in a way that would work with the Project schedule. Watay Power estimated the cost to extend power lines to the mine site from Pickle Lake at $200 million, however these numbers were preliminary (GoldCorp, 2012). Sharing the costs with other users does make this option attractive, but progress has not moved ahead quickly on this infrastructure decision.

Diesel generators were selected for power generation due to their proven capability to supply reliable, continuous and uninterrupted power supply to a remote mine site. Diesel power generation is technically and economically viable.

The specific siting of the diesel generators at the mine site was a function of respecting setbacks from human receptors (staff accommodations) and the desire to locate the generators next to the ore concentrate drying facility in order to take advantage of residual heat from the generators. Using several smaller generators would make them easier to sell if grid power is eventually extended to site.

4.5.1.8 Location of Mine Site Power Source

The mine site will require approximately 22 MW of power. The use of diesel generators is the only power source alternative that is considered to be technically feasible and economically viable. Off-site generators were considered for the Project when a concentrate pipeline was proposed at a drying and loading facility south of Webequie First Nation. In this case, the generator would be located at this facility and a transmission line would have been built to provide power to the mine site. The use of a concentrate pipeline is no longer the preferred alternative and a remote drying and transfer facility will not be built (Section 4.8). As such, the use of off-site generators and the construction of a power line to site are not considered to be economically viable alternatives.

4.5.1.9 Explosives Handling and Storage

During the construction phase, a qualified explosives contractor will be contracted to establish manufacturing, storage and delivery services of bulk ammonium nitrate fuel oil (ANFO. ANFO will be the primary blasting agent used for development of the ramps and other underground infrastructure. The explosives manufacturing plant will be sited and controlled according to Federal regulations. The small explosive quantities that will be used daily during construction make this a relatively small operation and the magazine can be located closer to the portal than what will be required during operations. Off-site production of explosives during the construction phase will not be possible as the all-season road will not have been completed. Other alternatives for the supply and handling of explosives during the construction phase were not considered as they would not be economically viable.

During the operations phase of the mine, the emulsion based explosives for the underground mining will be manufactured off-site and transported to the mine site along the all-season road. The explosives will be stored underground in licensed magazines that will meet Ministry of Labour (Occupational Health & Safety Act, Reg 854) and Natural Resources Canada (NRCan) requirements under the *Explosives Act* (Canada, 1985). It is economically more viable to have the explosives manufactured off-site during operations, since an explosive plant would otherwise have to be built on surface at a significant distance from the other facilities. This type of plant would also increase power requirements and be relatively expensive to build given the foundation conditions away from the mine site area (i.e., peat bog). Other alternatives for the supply and handling of explosives during the operations phase were not considered. Underground bulk emulsion will provide the high degree of fragmentation required to reduce primary crushing and meet production requirements and environmental targets for reduced losses associated with ANFO use during operations.

4.5.1.10 Location of Surface Infrastructure

Surface infrastructure will be located to maintain a compact and efficient site. A compact site will reduce surface disturbance and facilitate site reclamation at closure. The primary objective at the mine site is to locate the portal, surface processing facilities and camp facility on well-drained soil away from any wetlands or water bodies. As much as possible, site road locations were chosen to avoid wetland areas. To the maximum extent possible, infrastructure will also be situated away from sensitive habitats, such as streams and wetlands.

The surface processing facility is required to be located close to the underground infrastructure and the portal. The portal location is restricted by the vicinity of the underground infrastructure and the ore body. Within the required proximity to the ore body and underground infrastructure, there are only a few possible locations for the surface processing facilities and the portal due to the limited amount higher bedrock in the area.

The site layout shown on Figure 5.1-1 is the only practical location for the facilities, and no other environmentally acceptable or economically viable alternatives were found. The proposed locations will avoid sensitive environments, the foundation conditions will be acceptable, and the drainage works will be relatively simple. This site arrangement will also be allow the site roads to be located in predominantly well-drained upland areas. The location for the construction phase explosives plant was based on the required separation distance from the other facilities and no other acceptable locations are possible. The waste disposal facility will be located in an upland area with a separation distance from the accommodation facilities and surface processing facilities. Access to the waste disposal facility will be along the site road to the air strip. No other acceptable locations were found.

The location of the trans-load facility was chosen as it is a brownsfield site that was formerly used as a rail siding. The vegetation cover at the site has already been removed and the ground cover disturbed. The infrastructure needed at the trans-load facility will fit within the previously disturbed footprint. Access to the site is available from two existing forestry access roads, which may require minor upgrading. There is a previously used hydro-line corridor to the site that would be used for connection to the existing power grid. No other economically viable or more environmentally acceptable alternative locations for the trans-load facility were found.

4.5.2 Alternative Methods Assessed

Potentially available alternatives methods include those carried forward from the screening process and additional alternatives identified through the subsequent advancement of Project planning. The potentially available alternative methods carried forward into the environmental assessment process are summarized in Table 4.5-2 and are discussed in the following sections.

Table 4.5—2 Potentially Available Alternative Methods

Project Component	Alternative Method Assessed
Ore Production Rate	• Production rate of 2,960 t/d • Production rate of less than 2,960 t/d • Production rate of greater than 2,960 t/d
Ore Processing Location	• Off-site ore processing • Above ground milling and processing facility • Underground mill and processing facility
Concentrate Handling	• Transport by truck directly to smelter • Transport by truck to trans-load facility for loading to rail cars • Pipeline transport of concentrate
Tailings Management	• Tailings stored underground as cemented paste backfill • Underground storage of un-cemented tailings • Above ground storage in a tailings storage facility (TSF)
Location of Transportation Corridor	• Winter road to existing winter road network • All season north-south transportation corridor • All season east-west transportation corridor
Water Supply	• Groundwater sources • Surface water sources
Organic and Solid Waste Management	• On-site incineration • On-site landfill • Off-site disposal
Sewage Treatment	• Septic system • Sewage treatment plant

4.6 ORE PRODUCTION RATE

4.6.1 Basis of Production Rate

The mine plan is based on the Proven and Probable reserves of Eagle's Nest, and assumes continuous feed to the processing plant. The shape of the deposit and its suitability to a blast hole stoping method, along with other techniques that shorten normal stope cycle times, will allow the Eagle’s Nest mine to be highly productive for its size. A production rate of 2,960 tonnes per day has been proposed based on the following:

- The compact dimensions of the deposit will allow for transverse stoping from an access drift
- The relative high grade of the deposit, will provide suitable economic returns at this production rate

- The shape of the mineralization, allows a repetitious design that follows the same mining pattern from level to level
- The vertical nature of the deposit allows materials handling to be carried out using standard and automated processes that have relatively low labour requirements
- The competence of the host rock and mineralization allows conventional ground support methods and it is not expected that production will often be interrupted because of ground control issues

During the feasibility studies, the Eagle's Nest deposit was compared to active mines to provide a measure of the capacity of the mine. Micon (2012) compared the ratio of tonnes per vertical metre to each mine's production rate. For the proposed mine, the ratio is 0.80 tonnes per vertical metre relative to the production rate, which is comparable to operating mines in deposits that have similar geometry, mining methods and dimensions.

4.6.2 Alternative Ore Production Rates

The production rate of 2,960 tonnes per day could be increased or decreased during operations. Minor adjustments would not have an effect, so larger adjustments were considered. The following three alternative ore production rates were considered:

- **Alternative 1:** Production rate of 2,960 t/d
- **Alternative 2:** Production rate of less than 2,960 t/d
- **Alternative 3:** Production rate of greater than 2,960 t/d

The four performance objectives that were applied to the evaluation of alternative ore production rates are shown in Table 4.6-1.

Table 4.6—1 Ore Production Rate Alternatives

Performance Objective	**Alternative 1**	**Alternative 2**	**Alternative 3**
	Production rate of 2,960 t/d	**Production rate of less than 2,960 t/d**	**Production rate of greater than 2,960 t/d**
Technical Feasibility	Technically feasible	Technically feasible	Technically feasible but at greater capital and operating cost since systems would have to be scaled up.
	Acceptable	Acceptable	Acceptable
Economic Viability	Provides an acceptable return on investment.	Provides a lower return on investment. A production rate lower than 2,960 t/d is less financially viable.	Could provide a higher return on investment, but with higher capital cost and possibly higher operating cost as more levels would have to be mined simultaneously. Higher level of capital would be harder to finance.

Performance Objective	Alternative 1	Alternative 2	Alternative 3
	Production rate of 2,960 t/d	Production rate of less than 2,960 t/d	Production rate of greater than 2,960 t/d
	Acceptable	Unacceptable	Unacceptable
Biophysical Environmental Acceptability	Identical Project footprint and a balance between other options.	Identical Project footprint but longer duration of effect on environment.	Identical Project footprint but shorter duration of effect on environment.
	Acceptable	Acceptable	Acceptable
Socioeconomic Acceptability	Balance between other options.	Project benefit period will be longer.	Project benefit period will be shorter.
	Acceptable	Acceptable	Unacceptable
Summary Ranking	**Preferred**	**Unacceptable**	**Unacceptable**

At 2,960 t/d, stope cycle times are expected to be as much as 35% to 45% shorter than at other operations, due to the proposed use of longhole drilling, mass blasting techniques, high speed-short distance tramming, minimal remote mucking and the use of paste backfill. These methods will reduce the number of active workplaces and reduce the need to operate on multiple levels. It is expected that higher production rates will be possible at Eagle's Nest than what has typically been historically achieved.

Decreasing the production rate would be technically feasible and would have the advantage of increasing the mine life. A longer mine life would extend the positive socio-economic opportunities provided by the Project and would allow more time for exploration of other potential targets in the region. Decreasing the production rate would, however, reduce the economic rate of return on the Project and compromise the economic viability.

Alternatively, a higher annual production rate would increase the rate of return for the Project, but shorten the mine life. This option would also have a higher capital cost and it would shorten the socio-economic benefits of the project. In addition, increasing the production rate may be technically challenging from a mine planning perspective, since more levels would have to be mined at the same time (Micon, 2012).

4.6.3 Summary of Preferred Ore Production Rate

All production rate alternatives would require the same surface infrastructure, unless a significant change was made. A higher production rate and shorter mine life would reduce the length of time over which concentrate and equipment are hauled. This reduction in time would result in less impact to wildlife along the transportation corridor. Despite this benefit, all alternatives are considered equally acceptable in terms of potential effect to the biophysical environment.

All of the production rates provide significant socio-economic benefits to the region, which are maximized with a lower production rate as a result of a longer mine life and greater duration of socio-economic benefits (employment, skills development). A higher production rate will require a greater number of employees on site. It is not known whether the local communities have the capacity to maximize First Nation involvement with the Project.

The preferred 2,960 tonne per day production rate will provide a good balance between technical feasibility, maximizing return on investment, mine life and the sustainability and socio-economic benefits.

4.7 ORE PROCESSING

4.7.1 Ore Processing Methods

The underground mine operations will involve drilling, blasting and the movement of ore to a concentrator (mill). Twin ramps from surface will provide access and ventilation air to the mine workings and will be constructed adjacent to the ore body to connect the production levels. This ramp will be utilized to transport the ore to the underground mill. The process will involve conventional crushing, grinding, flotation and concentrate dewatering to produce a single concentrate. No viable alternative to the standard processing technology currently used throughout the industry were found.

4.7.2 Ore Processing Location Alternatives

The processing of ore off-site was considered as a potential alternative but was not considered to be economically viable. Off-site processing would require the shipment of 2,960 tonnes of ore per day. This would require a large truck fleet to transport 85 loads per day using typical long-haul highway trucks with a 35 tonne capacity.

Three potential alternatives for the location of the ore processing facilities were considered:

- **Alternative 1:** Above ground mill and processing facilities
- **Alternative 2:** Underground mill and processing facilities
- **Alternative 3:** A combination of above ground and underground processing facilities

On-site ore processing facilities could be located on surface near the mine portal or underground due to the structural suitability of the host rock. A combination of surface and underground facilities could also be considered.

The four performance objectives were applied to the evaluation of alternatives for the location of the ore processing facility (Table 4.7-1).

Table 4.7—1 Ore Processing Location Alternatives

Performance Objective	Alternative 1	Alternative 2	Alternative 3
	Above ground milling and processing facility	**Underground mill and processing facility**	**Above ground and underground processing facilities**
Technical Feasibility	Technically feasible, ore could be transported from the underground mine to a surface facility.	Technically feasible with manageable technical challenges. Underground facilities can take advantage of three dimensional layout options.	Technically feasible with manageable technical challenges. Ore handled and crushed underground and concentrate slurry could be piped to surface and dried.

Performance Objective	Alternative 1 Above ground milling and processing facility	Alternative 2 Underground mill and processing facility	Alternative 3 Above ground and underground processing facilities
	Acceptable	Acceptable	Acceptable
Economic Viability	Moderate construction cost with more facilities. Moderate operating costs with more material handling to bring ore to surface and transport waste back underground.	Higher cost to develop underground openings for all equipment. Moderate operation costs since concentrate drying cannot use excess heat from generators (which cannot go underground).	Underground milling more efficient as located closer to ore. Slurry can be moved to surface and waste heat from generators can be used to aid with drying the concentrate.
	Acceptable	Acceptable	Preferred
Biophysical Environmental Acceptability	Highest level of surface disturbance, due to the construction of required surface facilities.	Least surface disturbance. Underground facility would reduce the amount of ore handling. Higher energy use since heat recovery from the generators could not be used to dry the concentrate.	Low surface footprint. Majority of processing underground. Heat recovery from surface generators to dry concentrate will reduce energy use and fuel consumption.
	Acceptable	Acceptable	Preferred
Socioeconomic Acceptability	No socio-economic advantage	No socio-economic advantage	Utilizing waste heat from the generators is expected to have higher socio-economic acceptability.
	Acceptable	Acceptable	Preferred
Summary Ranking	**Acceptable**	**Acceptable**	**Preferred**

All of the alternatives are technically feasible and all of the alternatives are economically viable except the shipment of ore off-site, which would require the long distance trucking of 2,960 tonnes/day of ore. The cost of transporting all of the ore offsite for processing is not considered economically viable and would have a greater potential impact to the environment. Locating the process facilities underground would make use of the three dimensional layout options available in an underground location and increase efficiency. Warehouse space could be laid out to keep materials close to their respective process areas. An underground location would minimize the use of concrete foundations on surface and would decrease the overall surface footprint of the Project. The result of the alternative assessment does suggest that it may be more efficient to transport concentrate to the surface as a slurry rather than in trucks. The drying of concentrate could take place on surface as it is more economical to use waste heat from the generators to help dry the concentrate.

4.7.3 Summary of Preferred Ore Processing Location

The preferred alternative is to position the ore processing equipment both underground and on surface. Locating the mill underground increases efficiency by having it in closer proximity to the ore extraction and tailings disposal areas. An on-surface processing facility building would be located adjacent to the power plant at the portal area to make use of waste heat from the generators for the drying of concentrate. The surface building would house surface process equipment for concentrate dewatering, drying/cooling and storage, handling and load-out.

As indicated during consultation activities, the preference of communities along the transportation corridor is to minimize the amount of truck traffic from the mine site. This preference further diminishes the attractiveness of "whole ore" transport option to an off-site concentrator. Placing the majority of the facilities underground reduces the surface footprint and is the preferred alternative.

4.8 CONCENTRATE SHIPMENT

4.8.1 Concentrate Handling

Ore processing facilities will be located underground and concentrate will be pumped as a slurry from the underground processing facilities to the surface processing facility. The concentrate will then be dried and shipped to a smelter for further processing.

4.8.2 Concentrate Shipment Alternatives

The use of a concentrate slurry pipeline to an off-site drying and loading facility was initially considered as an alternative. At the off-site facility, the concentrate would be dried and loaded into trucks for transportation directly to a smelter or to a trans-load facility for loading into rail cars. A slurry pipeline of sufficient length to cross the wetland would be buried below the frost line, require instrumentation wells spaced along its length, and would require regular inspections to guard against leaks. Dewatering of the concentrate would be required at the end of the slurry pipeline. A slurry pipeline was proposed by Noront during the development of the ToR in conjunction with a winter road and transmission line between the mine site and a location south of Webequie. As outlined in Section 4.5.1, Noront determined during a subsequent feasibility study (Micon, 2012) that all-season access to the mine site was technically and economically feasible for the Project. A slurry pipeline cannot replace a road. As such, a slurry pipeline can be discounted on the basis that it cannot replace these other modes of transportation (not technically feasible). Use of a slurry pipeline in addition to another mode of transportation would be cost-prohibitive (economically not viable). In addition, feedback during community consultation at the time the slurry pipeline was under consideration was not favourable.

Three alternative methods were considered for the transportation of concentrate to a smelter for further processing:

- **Alternative 1:** Truck Transport Directly to Smelter
- **Alternative 2:** Rail Transport (New Railway from ROF to Existing Railway)
- **Alternative 3:** Truck Transport to Existing Railway

Alternative 1 would use trucks to haul ore from the mine site to its final destination at an existing smelter. This option would involve construction of the all-season road from the mine to the existing provincial highway system. A trans-load facility would not be required and the ore concentrate would remain in the trucks until the final destination is reached. The option is technically and economically viable and environmental effects and socio-economic suitability are expected to be acceptable.

Alternative 2 involves the construction of a new railway from the mine site to the CN railway. The CN railway leads to existing smelting facilities in Sudbury or to a port for shipment overseas. The concentrate would remain in the same rail cars from the mine to the final destination, and a railway siding rather than a trans-load facility would be needed. Railway is the least expensive option for transporting bulk commodities, when the initial cost of infrastructure is not considered. In this case, however, a 300 km new section of railway would need to be constructed. KWG Resources Inc. commissioned a desktop study on the cost of a railway from its Big Daddy chromite project in the ROF to the Cavell/Nakina area. The estimated cost was $1.5B (Tetratech, 2013). The construction of a $1.5B railway cannot be supported by the Eagle's Nest Project and is not considered to be economically viable. In addition, the time required to permit and construct the rail line would be a significant risk to the Project schedule.

Alternative 3 includes construction of a road and transport of the concentrate by truck to an existing railway. This option also requires construction of a trans-load facility to transfer the concentrate from trucks to rail cars. Noront has estimated the cost of an all-season road to be in the order of $400 million.

The four performance objectives were applied to the evaluation of alternatives for the shipment of concentrate (Table 4.8-1).

Table 4.8—1 Concentrate Shipment Alternatives

Performance Objective	Alternative 1	Alternative 2	Alternative 3
	Truck Transport Directly to Smelter	**New Railway from ROF to CN Rail Line**	**Truck Transport to Existing CN Rail Line**
Technical Feasibility	Simplest option, with least infrastructure required (no trans-load facility needed).	Technically feasible. A more complex option, requires construction of rail line over a long distance.	Technically feasible, requires the construction of an off-site trans-load facility.
	Preferred	Acceptable	Acceptable
Economic Viability	Reduced cost of facilities outweighed by higher cost for truck purchases and truck operation over the life of mine.	Construction of a railway from the ROF to the existing CN railway is not economically viable.	Acceptable construction cost, moderate operating cost. Lowest cost option overall and financially supportable by the Project.
	Unacceptable	Unacceptable	Preferred
Biophysical Environmental Acceptability	Highest amount of fuel consumed and most air emissions and traffic.	Reduced use of fuel and air emissions through the use of rail transport.	Reduced use of fuel and air emissions through the use of rail transport. Less truck traffic.
	Acceptable	Acceptable	Acceptable

Performance Objective	Alternative 1 Truck Transport Directly to Smelter	Alternative 2 New Railway from ROF to CN Rail Line	Alternative 3 Truck Transport to Existing CN Rail Line
Socioeconomic Acceptability	Provides the transportation infrastructure most suited to communities if spur roads are constructed. Acceptable effects from trucks hauling concentrate a longer distance as the additional road traffic will be on southern highways.	Mixed socio-economic acceptability. Railway to the ROF is less amenable to remote communities who would like to connect to the provincial highway system. Greater long-term regional economic opportunities with the railway (i.e., lower shipping costs of bulk commodities such as chromite).	Provides the transportation infrastructure most suited to communities if spur roads are constructed. Less favourable, but still acceptable to other mining interests in the ROF.
	Acceptable	Acceptable	Preferred
Summary Ranking	**Unacceptable**	**Unacceptable**	**Preferred**

Each of the concentrate handling alternatives is considered to be technically feasible. Construction of the railway, however, presents an unacceptable cost to the Project. The simplest option is to use truck transport to ship the concentrate directly from the mine site to smelter. However, the cost to purchase more trucks and the higher operating costs make this option more expensive to the Project compared to constructing the trans-load facility and using rail to transport the concentrate to the smelter. Trucking the concentrate directly to a smelter would require a larger fleet of trucks with a greater amount of fuel consumed per kilometre travelled than rail and would result in higher maintenance costs. The use of rail transport is more economically viable, but the trans-load facility would need to be located on the existing rail system as close to the mine as possible.

4.8.3 Summary of Preferred Concentrate Shipment Alternatives

The use of truck and rail transport (Alternative 3) is the preferred alternative. The combination of truck and rail transport is the most efficient option and will have the lowest operating costs. This alternative will also support community development initiatives as well as mining interests in the region.

4.9 TAILINGS MANAGEMENT

4.9.1 Underground Tailings Disposal

Due to the swell factor of crushed and ground rock, tailings generally require a larger space underground for disposal than the voids created by mining. At most underground mining operations, there is a need for at least some tailings to be disposed of on surface. However, the Project's planned extraction of aggregate from underground stopes will provide sufficient extra void volume to allow all tailings to be stored underground.

The use of paste backfill is common practice in the mining industry for the underground disposal of tailings. Paste backfill integrates tailings and other wastes into a backfill material that is disposed of underground. This reduces or eliminates the need for surface disposal of tailings and/or waste rock. Paste backfill is an engineered mixture of fine solid particles that can be combined with or without a binding agent and water. Typically the percent solids range from 70% to 85% by weight (MEND, 2013). The particles in a paste mixture will not settle out of the mixture if allowed to remain stationary. As such, it can be disposed of in underground stopes with or without binder. The binder is added when there is a strength requirement for the backfill.

The underground environment is well suited to the disposal and storage of sulphide tailings as it typically provides low oxygen conditions during operations. At closure, when the underground workings will be permanently flooded, the potential oxidation of the sulphide tailings and release of acidity and metals will be significantly reduced (MEND, 2006).

The movement of water and air through and around the paste backfill essentially determines the extent of oxidation, and thus the rate at which metals or soluble minerals may be released to the mine water and groundwater prior to the flooding of the underground workings at closure. Utilizing tailings in backfill has the following benefits relative to other backfill materials:

- Reduction or elimination of surface tailings disposal
- Reduction in the potential for tailings to oxidize or leach due to (Levens et al., 1996):
- Low permeability of tailings due to fine grained homogenous particle size
- High water retention due to high capillary suction
- High saturation results in less available oxygen

The addition of cement to the paste can increase the short or long-term physical strength of the backfill. This reduces the permeability of the paste and the potential leachate production. The addition of cement provides an initially alkaline environment, which reduces the solubility of many metal ions (MEND, 2006).

4.9.2 Alternative Methods of Paste Backfill

Alternative methods and types of backfill include:

- **Alternative 1:** Underground disposal of tailings as un-cemented paste backfill
- **Alternative 2:** Underground disposal of tailings as cemented paste backfill
- **Alternative 3:** Underground disposal of un-cemented and cemented paste backfill where needed

The four performance objectives were applied to the evaluation of alternative methods and types of paste backfill (Table 4.9-1).

Table 4.9—1 Alternative Methods and Types of Paste Backfill Tailings

Performance Objective	Alternative 1 Un-cemented paste backfill	Alternative 2 Cemented paste backfill	Alternative 3 Un-cemented and cemented paste backfill
Technical Feasibility	Technically feasible. Un-cemented paste can be backfilled into any open stope, however there are requirements for structural fill so backfilled stopes will stand up as the stope between them is recovered.	Technically feasible. Provides structural support in mined out production stopes so adjacent ore can be mined. Reduces the potential for leaching of minerals.	Provides structural support in mined out production stopes where needed.
	Unacceptable	Acceptable	Acceptable
Economic Viability	Higher cost alternative since not using cemented backfill as structural support changes the mining method and would require leaving pillars between larger open stopes. Will reduce the extraction ratio which will impact Project economics.	High cost alternative. Allows for greater amount of ore extraction by providing structural support. Not all backfill paste needed for structural support. Extra cost to cement paste that will not be needed for structural support. Leaching in uncemented paste fill is low, since granodiorite rock is relatively impermeable so ground water is unlikely not reach the paste fill.	Optimizes use of cemented paste tailings to meet structural support requirements without unnecessary cementing of paste. Best overall economics.
	Acceptable	Unacceptable	Preferred
Biophysical Environmental Acceptability	Environmentally acceptable	Cement increases alkalinity and reduces permeability in the short term.	Environmentally acceptable. Same benefits as cemented where cemented paste used.
	Acceptable	Preferred	Acceptable
Socioeconomic Acceptability	Stakeholders generally support the underground disposal of tailings compared to surface disposal of tailings. No socio-economic advantage between alternative methods of underground disposal.		
	Acceptable	Acceptable	Acceptable
Summary Ranking	**Unacceptable**	**Unacceptable**	**Preferred**

4.9.3 Summary of Preferred Method of Paste Backfill

Each paste backfill alternative is technically feasible and is considered to be similar in terms of potential impacts to the biophysical and socio-economic environment. The mine will require aggregate material for construction and maintenance, so the development of aggregate stopes will be undertaken regardless of tailings disposal methods. The mining method will require structural support in mined out ore stopes, and the cementing of tailings will provide this structural support and be more cost effective than using aggregate or other cemented fill materials. Therefore, the preferred alternative is the use of cemented paste backfill where required for structural support and un-cemented paste backfill where the structural support is not required.

4.10 TRANSPORTATION CORRIDOR ALTERNATIVES

4.10.1 Access to the Mine Site

Year-round access to the mine site will be required to support the Project. Access to the Project will be provided by an all-season road from the mine site to the existing provincial road network. A trans-load facility will be built on the existing rail system. Truck and rail transport is presented as the preferred concentrate handling alternative.

4.10.2 All-Season Road Alternatives

Two alternative transportation corridors for the all-season road were assessed:

- **Alternative 1:** A north-south transportation corridor
- **Alternative 2:** An east-west transportation corridor

A brief description of each is provided below. A comparison of key facts for each option is provided in Table 4.10-1.

- **Alternative 1 -** The north-south transportation corridor alternative is an all-season road from the mine site to the existing provincial road network near Nakina, Ontario. The Project would use a trans-load facility that has been proposed by Canadian National Railway (CN) on their property at the Cavell site near Aroland First Nation. The facility would be built and operated by CN.

  This alternative collectively includes route options studied by Noront as well as a road alignment identified by Cliffs Natural Resources (2012). Noront has relied on the Cliffs north-south alignment where possible, supplemented by earlier work by Noront on various north-south transportation corridor routing alternatives. The total road length, number of crossings, and other key facts depend on the final routing, so the information presented on each alternative should be considered approximate.

- **Alternative 2 -** The east-west transportation corridor alternative is an all-season road from the mine site to the existing Pickle Lake North Road, approximately 60 km northeast of Pickle Lake, Ontario. A trans-load facility would be constructed as part of the Project on the CN mainline approximately 5 km east of Savant Lake, Ontario. The proposed trans-load facility would be located at a brownsfield site that was previously used as a forestry rail siding. The east-west transportation corridor discussed here is based on the latest alignment identified by Noront in this EIS/EA Report.

Table 4.10-1 summarizes the key facts of each alternative.

Table 4.10—1 Key Facts - All-Season Road Alternatives

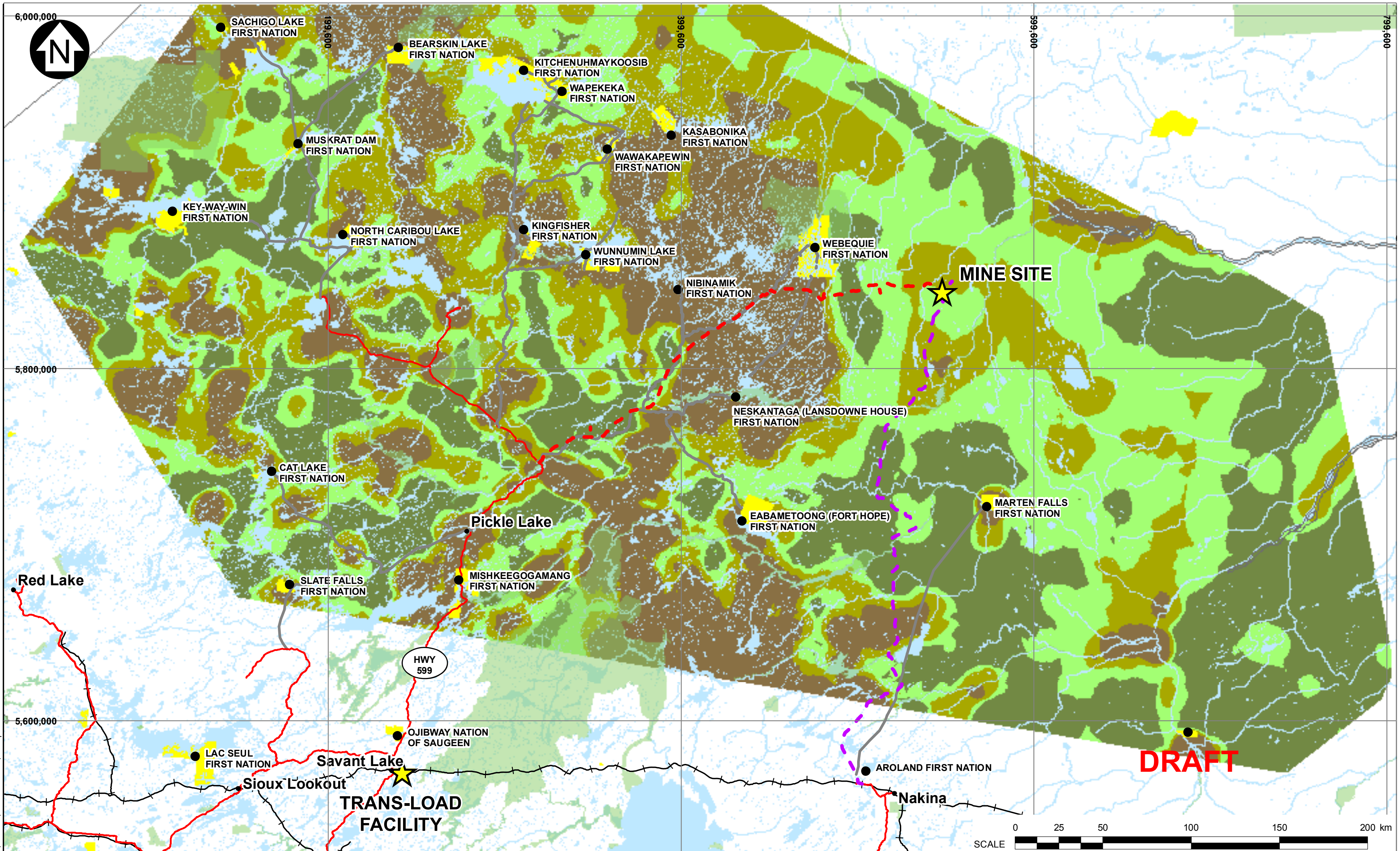
Component	North-South Alternative	East-West Alternative
Total Length of road construction (km)	320[1]	282
Total number of water crossings	100[2]	91[3]
Number of major river crossings	Ogoki River Albany River Attawapiskat River	None
Number of communities potentially serviced	0	4
Comment on available aggregate for road construction	Greater potential availability of aggregate, due to presence of esker deposits. In some locations this esker material may not be suitable for top coat of road, which will increase costs.	Reduced availability of aggregate relative to alternative. This will lead to higher aggregate costs.
Existing winter or all-season roads to support construction (km)	60 km of existing forestry road	200 km of existing winter road
Construction through wetland	Similar to other alternative	Similar to other alternative
Impact on caribou habitat	Much of road alignment is through areas deemed good habitat for caribou. Eskers are preferred habitat for wildlife mammals in the wetland.	Much of the road passes through fewer areas deemed good caribou habitat and follows an existing linear disturbance (winter road).
Relative cost	Expected to be higher than the alternative, due to greater number of major water crossings. These costs are partially offset by a shorter overall distance of new road construction and relative greater availability of aggregate.	Expected to be lower than other alternative, due to fewer major bridges.
Provincial waterway parks intersected	Ogoki River, Albany River and Otoskwin/Attawapiskat River Provincial Parks.	None
Relative First Nation support	Chief of Neskantaga First Nation has been outspoken against this option.	Several First Nations support this alternative; no major opposition has been recorded.

NOTES:

1. THE 320 KM NORTH-SOUTH ROUTE WAS PROPOSED BY CLIFFS NATURAL RESOURCES AND INCLUDES 260 KM OF NEW ROAD CONSTRUCTION AND THE UPGRADING OF 60 KM OF EXISTING FORESTRY ROADS.
2. THE TOTAL NUMBER OF WATER CROSSINGS ON THE NORTH-SOUTH ROUTE INCLUDES APPROXIMATELY 50 CONTINUOUSLY FLOW WATERCOURSES AND 50 WETLAND AREAS (CLIFFS, 2012).
3. THE TOTAL NUMBER OF WATER CROSSINGS ON THE EAST-WEST ROUTE BASED ON FIELD INVESTIGATION.

The general alignments of the east-west transportation corridor and north-south transportation corridor alternatives are shown on Figure 4.10-1.

The four performance objectives were applied to the evaluation of the alternative transportation corridors. A summary of assessment is shown in Table 4.10-2.



LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- COMMUNITY
- RAILWAY
- EXISTING ALL-SEASON ROAD
- EXISTING WINTER ROAD
- UPDATED PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR (SEE NOTE 4)
- PROPOSED NORTH-SOUTH TRANSPORTATION CORRIDOR (SEE NOTE 5)
- WATER
- PARK
- FIRST NATIONS RESERVE

LATE WINTER CARIBOU HABITAT

- HIGH
- GOOD
- LOW
- POOR

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CARIBOU LATE WINTER RSF DATA PROVIDED BY THE OMNR (NOVEMBER 14, 2012).
4. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY KIEWIT INFRASTRUCTURE ENGINEERS (NOVEMBER 26, 2013).
5. PROPOSED NORTH-SOUTH TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	ALR	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

LATE WINTER CARIBOU HABITAT WITHIN THE PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR AND PROPOSED NORTH-SOUTH ROUTE

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 4.10-1 | REV A

SAVED: I:\1102\00390\01\A\GIS\Figs\A555_rA.mxd; Dec 12, 2013 3:43 PM; asimpson

Table 4.10—2 All-Season Transportation Corridor Alternatives

Performance Objective	Alternative 1	Alternative 2
	North-south transportation corridor	East-west transportation corridor
Technical Feasibility	• Technically feasible • Additional geotechnical information is required. • Will require construction over peat near the mine site • Shorter existing road available • Several large water crossings required. • Eskers have been identified along this route. However, most are high in silt content and are not an ideal construction material, and their surface rights are currently held by another company (KWG Resources).	• Technically feasible • Additional geotechnical information is required. • Will require construction over peat near the mine site • Road construction will be aided by the existing winter road. • No major water crossings; most water crossings can use modular bridges and culverts. • Sufficient potential borrow sources and quarries have been identified along the road.
	Acceptable	Preferred
Economic Viability	• Higher construction cost due in part to three major crossings (>150 m) on the Ogoki, Albany, and Attawapiskat Rivers. • Lower operation cost as it will result in a shorter overall distance to the trans-load facility. • Overall higher combined capital and operating cost.	• Lower capital cost to construct. Longer length and aggregate haulage costs offset by fewer major crossings. • Higher operating cost due to longer distance to trans-load facility. • Overall lower combined capital and operating cost.
	Acceptable	Preferred
Biophysical Environmental Acceptability	• Three major river crossings required (Ogoki, Albany and Attawapiskat). • Impacts to the wetland due to potential change in hydrologic conductivity and moisture regime. Can be mitigated by road design. • Greater potential displacement of high value caribou habitat (see discussion below). • Shorter new road length, but within a new undisturbed corridor. • Crosses three Provincial Waterway Parks (Ogoki River, Albany River and Otoskwin/Attawapiskat River Provincial Parks).	• One large river crossing (Pineimuta River). • Impacts to the wetland due to potential change in hydrologic conductivity and moisture regime. Can be mitigated by road design. • Less disturbance of high value caribou habitat (see discussion below). • Longer new road length, but within an existing disturbed corridor. • No Provincial Park encroachments.

Performance Objective	Alternative 1	Alternative 2
	North-south transportation corridor	East-west transportation corridor
	Acceptable	Preferred
Socioeconomic Acceptability	• A resolution to support a north-south road via Marten Falls was signed in April 2012 by leaders of the Marten Falls, and other First Nation communities not located along either proposed transportation corridor. • Two remote First Nation communities could benefit from a north-south road by building connector spurs to their communities. • The Chief from Neskantaga First Nation expressed his strong concern over the North-South route in the media. • First Nations have also expressed concern regarding archaeological sites along the rivers being crossed and the eskers being used. • The Matawa Tribal Council has been outspoken about the concern over a new road into their traditional lands.	• Noront has consulted with several communities that have expressed a general desire to realize positive impacts from an east-west road in the region and development in the Ring of Fire. • Four remote First Nation communities (Nibinamik, Neskantaga, Webequie, and Eabametoong) have clearly expressed to Noront their desire for an east-west transportation corridor. As well, Kasabonika Lake FN, Wunnumin Lake FN, and Kingfisher Lake FN have expressed interest to connect to an east-west all-season road by permitting and constructing spur roads. • The Matawa Tribal Council has been outspoken about the general concern over a new road into their traditional lands. • The interests expressed by the First Nations most likely to be affected by an east-west corridor make this route the less contentious choice.
	Unacceptable	Preferred
Summary Ranking	**Unacceptable**	**Preferred**

The four performance objectives are discussed in more detail in the following sections.

4.10.3 Technical Feasibility of All-Season Road Alternatives

Technical studies of alternative access corridors were initiated by Noront in 2009. An initial desktop study using regional maps and satellite data was conducted to examine potential routes from the east, west, and south using several methods of transportation (SNC-Lavalin, 2009). The initial study concluded that an east-west road to the Pickle Lake North Road would be preferred from a constructability perspective and a north-south road to Nakina would be preferred from a life of mine net present value (NPV) perspective.

A second desk-top study using satellite imagery and maps was conducted to examine road and concentrate pipeline options from the mine site to Pickle Lake and Nakina (SNC, 2010). This study ranked a north-south route from Nakina through Marten Falls higher than an east-west route from Pickle Lake via Webequie based on perceived socio-economic benefits to Marten Falls First Nation and construction difficulty. However, the study ranked the north-south route lower in terms of environmental acceptability, the use of existing infrastructure, and the cost to construct.

Initial studies expressed concerns about the feasibility of constructing an all-season road across the wetlands in the final 100 km of an east-west route to the mine site. This concern would equally apply to a north-south alternative. The use of a slurry pipeline was, therefore, proposed to transport concentrate from the mine site to an off-site drying and loading facility 90 km west of the mine site at Webequie Junction, a site approximately 25 km south of Webequie First Nation. A winter road was proposed to follow the concentrate pipeline for the transportation of materials to and from the mine site (Micon, 2011). Route investigations were made by air and on the ground in 2010 and 2011 to confirm the technical feasibility of these alternatives. The preliminary all-season road corridor was proposed to, as much as possible, follow the existing winter road from the Pickle Lake North Road to south of Webequie First Nation in order to minimize potential impacts to the environment (Noront, 2011).

During the feasibility study for the Project, it was determined that the slurry pipeline and winter road over the final 100 km to the mine site were not technically and economically feasible. In addition, consultation activities with First Nation communities documented concern on the potential environmental impacts associated with a pipeline. Therefore, the feasibility study for the Project recommended an all-season road from the Pickle Lake North Road to the mine site (Micon, 2012). The use of techniques to construct road over peat was proposed as a technically feasible means of addressing road building issues over the poor ground within areas of muskeg (Nuna Logistics, 2011). A trial road to support exploration activities was successfully built at the mine site using these techniques. General locations for sources of aggregate rock were also identified, which addressed previous concerns on the technical feasibility of building an all-season road directly to the mine site (Tetra Tech, 2012).

A feasibility report was compiled for an all-season east-west road to the mine site. The report confirmed the technical feasibility of the route and proposed an initial road alignment generally following the existing winter road (Nuna Logistics, 2012a).

4.10.4 Economic Viability of All-Season Road Alternatives

The initial desktop study of road routing alternatives (SNC-Lavalin, 2010) provided comparable capital costs for the construction of an all-season road on the east-west and north-south corridors. The results of this study suggested that both alternatives would be economically viable. A feasibility level capital budget estimate for the construction of an east-west all-season road from the Pickle Lake North Road to the mine site was developed based on preliminary engineering and quantities, geotechnical input, constructability and logistics (Nuna Logistics, 2012b). The capital budget estimates did not integrate information from field geotechnical investigations to confirm aggregate and borrow source locations, and subsurface conditions along the road or at proposed bridge locations. The capital budget estimate for the construction of an east-west road was $437,882,020 (+25 % / -10 %) and was considered to be economically viable.

A rail vs. road trade-off study was completed for KWG Resources Ltd., Canada Chrome Corporation in 2013 (Tetra Tech, 2013). The report provided an economic trade-off study for a rail and road option along a 330 km north-south alignment from Nakina to near the mine site. The study concluded that the road was the preferred option. The direct and non-direct capital costs for the construction of an all-season north-south road were estimated to be $1,050,000,000. The lower estimated cost of constructing an east-west road is preferred.

4.10.5 Biophysical Environmental Acceptability of All-Season Road Alternatives

While both roads have relatively comparable terrestrial footprints, the east-west transportation corridor is preferable on the basis that:

- The majority of the road will be located within an existing disturbed corridor
- It will displace less high value caribou habitat than the alternative
- There will be fewer major water crossings
- Fish habitat compensation options are available with the replacement of existing winter road corduroy-style crossings (which restrict or block fish passage) with properly engineered bridges and culverts
- There is no infringement on provincial waterway parks

A key consideration in the comparison of biophysical environmental acceptability is effects on caribou habitat. Resource Selection Function (RSF) modelling, completed by Golder Associates on behalf of the Ontario Woodland Caribou Resource Selection Function Working Group (Golder Associates, 2012), indicates that caribou already avoid the area around the existing east-west winter road corridor. Based upon existing information, the north-south transportation corridor would pass through more high quality caribou habitat than the east-west corridor, as shown on Figure 4.10-1 and in Table 4.10-3.

4.10.6 Socio-Economic Acceptability of All-Season Road Alternatives

Socio-economic acceptability, as it relates to the all-season road alternatives, includes consideration of the:

- Effect on local and regional access
- Stated or perceived community acceptability
- Effects on the regional economy, including business opportunities, tourism and recreation
- Consistency with established and planned resource management objectives
- Avoidance of damage to heritage resources

Both routes would provide social-economic benefits to local First Nation communities through increased local and regional access. However, the east-west route would provide benefit to a greater number of remote communities who could construct all-season spur roads to provide year-round access. Such access would result in various socio-economic benefits, including a lower cost of living. Four of the remote Matawa Tribal Council communities have expressed interest in forming a consortium to build an east-west all-season road. The east-west route is also more compatible with plans to supply grid power to the region from Pickle Lake.

Archaeological studies were performed around the mine site and the only artifact found was on an esker near the existing airstrip (Woodland Heritage, 2011). More studies would be required to determine whether the eskers south of the mine site, which would be used for a north-south road, also contain archaeological artifacts. The eskers were used as an historical transportation route into the area and it is reasonable to assume that the eskers host archeological resources. The other main historical transportation route through the area was along the major rivers. First Nation communities have already raised concerns that archaeological sites along the rivers may be compromised by the development of a north-south road and that the route will have significant adverse impacts on their lands, the environment and their way of life (Neskantaga, 2012).

Table 4.10—3 Caribou Habitat on the East-West and North-South Transportation Corridors

Season/ Habitat Quality	East-West Route Area		North South Route Area		Difference
	ha	%	ha	%	%
SPRING					
High	16960	11	78025	52	40
Good	56172	38	26373	17	-20
Low	17254	12	28159	19	7
Poor	57897	39	18789	12	-27
SUMMER					
High	5,619	4	66,967	44	40
Good	40,347	27	27,205	18	-9
Low	40,644	27	32,728	22	-6
Poor	61,673	42	24,447	16	-25
EARLY WINTER					
High	13,294	9	56,157	37	28
Good	49,331	33	45,111	30	-3
Low	28,020	19	29,944	20	1
Poor	57,638	39	20,135	13	-26
LATE WINTER					
High	40,736	27	48,497	32	5
Good	35,169	24	45,319	30	6
Low	19,599	13	40,839	27	14
Poor	52,779	36	16,691	11	-25

The Municipality of Greenstone has expressed support for a north-south route, but the First Nation communities of Aroland and Marten Falls have expressed concern about high traffic volumes if the existing Anaconda Road was used as part of the route. The Anaconda road is used to access the winter road to Marten Falls and used by Aroland to access their traditional lands.

Noront has consulted on the transportation corridor alternatives during meetings, Open Houses and other conversations with the Matawa Tribal Council communities that are most likely impacted by the Project. The communities along the east-west route are all in favour of having the existing winter road converted to an all-season road. In addition, they support the construction of a transmission line along this corridor to provide grid power to the region. The construction of an all-season road and grid power would benefit the communities by providing better access, by eliminating reliance on diesel power generators, and by providing new business and employment opportunities. Other communities have also expressed interest in the development of an east-west road, including Mishkeegogamang First Nation, Pickle Lake and Ignace. No communities have raised opposition to the use of an east-west route during consultation activities to date. Mishkeegogamang FN did express concern about increased traffic going through their community, but recognized that this can be mitigated and there will be benefits from potential employment opportunities.

4.10.7 Summary of Preferred Transportation Corridor Alternative

The east-west transportation corridor was selected as the preferred alternative in all performance objective categories. An east-west all-season road could be built at a lower capital cost, be a benefit to a greater number of remote First Nation communities, would not infringe in any Provincial Waterway Parks and have less impact to high quality caribou habitat.

Using the existing east-west winter road corridor would facilitate construction because of good winter access, and using this route would minimize environmental impacts by being close to an established and disturbed corridor. Deviations of up to several kilometres from the existing winter road may be necessary to avoid problematic ground conditions or sensitive cultural or environmental features. The ground conditions along the east-west corridor are considered to be generally homogenous, so there is no benefit from assessing substantially different alternative road alignments within the general corridor. Modifications to the road alignment within the corridor will be at a local scale. The final road alignment will be refined based on:

- Additional consultation with First Nation communities in the area
- Geotechnical investigations
- Minimizing the potential impacts to sensitive environments (e.g., wetlands, streams, rivers)

Geotechnical investigations are planned along the proposed east-west corridor and will be important in verifying the suitability of proposed borrow areas, quarries and ground conditions at the river crossings. The all-season road alignment within the east-west transportation corridor is discussed further in Section 5.

4.11 MINE SITE WATER SUPPLY ALTERNATIVES

4.11.1 Mine Site Water Requirements

Water at the mine site will be required for processing, domestic potable supply and fire protection. The processing facility will require 40 to 45 m^3/h and domestic supply requirements are estimated to be 6 m^3/h. Some of the processing water requirements are expected to be satisfied from inflow to the underground mine, but make-up water will be required.

4.11.2 Mine Site Water Source Alternatives

The two sources of make-up water at the mine site include groundwater or surface water.

- **Alternative 1:** Freshwater from Groundwater - The area around the portal and surface processing facilities is mapped by the Ontario Geological Survey (OGS) as a massive to bedded diamicton till, with clayey silt to clay matrix, low to moderate clast content and discontinuous layers or lenses of stratified gravel, sand, silt and/or clay (Barnett et al 2013). Data collected during site investigations are consistent with this assessment and show that the overburden in this area is silt and clay-rich and varies in thickness from approximately 4 to 7 m (KP, 2013b). The hydraulic conductivity was estimated to be around 10^{-5} m/s in the monitoring wells installed in the till material during baseline hydrogeology studies (KP, 2013c). Given the thickness of the till deposit and the lack of continuity of suitable sand and gravel lenses, the groundwater pumping rates at the portal area are expected to be low and the till is not likely a viable location to meet water supply needs.

The OGS mapping identifies a glaciofluvial ice-contact deposit to the north of the mine site and on the other side of the Muketei River. This unit is described as a glaciofluvial deposit of stratified sand and gravel. This type of deposit typically hosts aquifers suitable for water supply needs, but since it is across the Muketei River from the mine site it would require a pipeline to supply the mine. Given these circumstances, a groundwater source for the water needed at the mine site will likely involve drilling deeper groundwater wells. Additional hydrogeological investigations are required to confirm the amount of water that could be supplied from drilled wells.

- **Alternative 2:** Freshwater from a Surface Water Source - The Muketei River is located approximately 1.5 km to the west of the mine site. It has a catchment area upstream of the mine site of approximately 540 km^2. The river is one of the larger rivers in the mine site area. The peak discharge during spring was measured at over 30 m^3/s, while low flows of 0.6 m^3/s were measured during the summer (KP, 2013d). The process facility will require a maximum of 40 to 45 m^3/h (0.011 to 0.013 m^3/s), which is equal to approximately 2 % of the lowest flows measured and 0.04 % of the highest flows measured. As such, the water supply needs of the Project could be satisfied from the Muketei River and would represent a very low percentage of the total flow. Drawing water from the Muketei River would require construction of an intake structure and pipeline.

The four performance objectives were applied to the evaluation of the water supply alternatives (Table 4.11-1).

Table 4.11—1 Water Supply Alternatives

Performance Objective	Alternative 1 Groundwater Source	Alternative 2 Surface Water Source
Technical feasibility	Technically feasible to install one well or multiple wells in the area around the mine site. Additional hydrogeology investigations are required to confirm feasibility.	Technically feasible to install an intake structure and pipeline from the Muketei River to the processing facility. The river would be able to provide the required water volumes.
	Acceptable	Acceptable
Economic Viability	Economically viable. Installation of wells may cost more than the construction of an intake structure.	Economically viable. Similar cost as installation of wells.
	Acceptable	Acceptable
Biophysical Environmental Acceptability	Not expected to cause meaningful drawdown that would affect local surface waters.	Installation of an intake structure may cause a harmful alteration, disruption or destruction of fish habitat (HADD). Withdrawal of required volume of water would result in a negligible reduction in flow.
	Preferred	Acceptable
Socioeconomic Acceptability	Expected to be acceptable	Expected to be acceptable
	Acceptable	Acceptable

Performance Objective	Alternative 1	Alternative 2
	Groundwater Source	Surface Water Source
Summary Ranking	Preferred	Acceptable

4.11.3 Summary of Preferred Method for Mine Site Water Supply

The use of the surface water from the Muketei River is technically feasible, economically viable and would result in minimal impact to baseline flows in the river. A small intake structure would need to be built that may impact aquatic ecosystems locally, but these effects could largely be mitigated by proper design.

The use of groundwater wells is technically feasible at a conceptual level. This option is preferred since no in-water work will be required. Should groundwater wells not be suitable for supply of potable and process make–up water, an intake structure will be proposed in the Muketei River.

4.12 MINE SITE ORGANIC AND SOLID WASTE MANAGEMENT ALTERNATIVES

4.12.1 Mine Site Waste

A variety of domestic and industrial solid wastes will be generated during construction and operation of the mine site. The majority of wastes produced will be non-hazardous wastes suitable for a range of disposal methods.

4.12.2 Mine Site Waste Disposal Alternatives

Most remote Canadian mine sites utilize conventional below grade landfills for the disposal of non-hazardous wastes. Due to the high water table near the mine site, a conventional below grade landfill was considered to be an unsuitable alternative and the following mine site organic and solid waste management alternatives were assessed. All of the waste management alternatives would be used in combination with recycling.

- **Alternative 1:** Incineration of Waste On-site - Incineration involves the burning of suitable waste at very high temperatures to produce smaller volumes of bottom ash and fly ash (exhaust emissions) requiring final disposal. Toxicity Characteristic Leachate Procedure (TCLP) testing would be carried out on both the bottom ash and fly ash to determine if either of the waste residues is hazardous. The ash would be disposed of as non-hazardous or hazardous waste as appropriate. The primary benefits of incineration are the reduction in the volume of non-hazardous waste, including food wastes that can potentially attract scavenging birds and wildlife. Incineration is a partial solution for managing combustible, non-hazardous waste.
- **Alternative 2:** On-site Above Grade Landfill - An above grade landfill could be constructed using a sequence of alternating layers of compacted wastes and coarse fill cover material. The landfill would most likely be arranged in cells. Given the wet conditions at the site, it is expected that the landfill would need to be built on a pad above the existing ground surface. An inert landfill with this design is currently being used at the Victor Mine. Cover material would consist of quarried sand or aggregate generated during the construction phase and aggregate produced

during operations. Wastes deposited within the landfill would be covered daily in accordance with MOE guidelines. Based on the size of the Project, a 75 m by 75 m landfill area would provide sufficient capacity. The landfill would require environmental monitoring during operations, and for a period of time after closure.

- **Alternative 3:** Shipment of all Waste to an Off-site Licensed Landfill Operated by Others - The mine site will be accessed by an all-season road. All of the organic and solid waste produced could be trucked to a regulated landfill, such as the Pickle Lake Landfill, which is operated by the Corporation of the Township of Pickle Lake. Permission would be required from the landfill operator.

The four performance objectives were applied to the evaluation of the mine site waste disposal alternatives (Table 4.12-1).

Table 4.12—1 Mine Site Organic and Solid Waste Management Alternatives

Performance Objective	Alternative 1	Alternative 2	Alternative 3
	Incineration of waste on-site	**On-site landfill**	**Off-site licensed landfill operated by others**
Technical feasibility	A pre-engineered incinerator system would be installed. This option would address a portion, but not the entire waste stream. This option would reduce the volume of waste disposed of on- or off-site.	Technically feasible. Similar above ground landfills have been constructed at other mining operations.	Technically feasible to use trucks for the shipment of waste to an off-site facility. Requires on-site storage facilities.
	Acceptable	Acceptable	Acceptable
Economic Viability	Lower cost than the construction and operation of a landfill. Would reduce the amount of waste to be shipped.	Higher construction and operation cost. Would likely require monitoring following mine closure.	Higher operating cost associated with trucking waste, but no landfill will remain on-site.
	Preferred	Acceptable	Acceptable
Biophysical Environmental Acceptability	Incinerator to be compliant with Guideline A-7 for remote locations in northern Ontario (MOE, 2010). Would have small surface footprint and meet air quality guidelines.	Could generate leachate which would need to be managed and monitored.	Lowest potential for impacts to natural environment on site. Higher fuel consumption due to truck use.
	Acceptable	Acceptable	Acceptable
Socio-economic Acceptability	Pre-engineered facility that would meet air quality guidelines. Expected to be preferred compared to an on-site landfill or shipment of	Would create larger land disturbance at mine site and would continue to generate leachate following mine closure. Would require	Would increase traffic on access roads and increase rate of filling of landfill used. Would create business opportunities in the trucking

Performance Objective	Alternative 1 Incineration of waste on-site	Alternative 2 On-site landfill	Alternative 3 Off-site licensed landfill operated by others
	all waste off-site.	monitoring after closure.	and handling of waste to an off-site facility.
	Preferred	Acceptable	Acceptable
Summary Ranking	**Preferred**	**Acceptable**	**Acceptable**

4.12.3 Summary of Preferred Mine Site Waste Disposal Method

All of the alternatives are considered acceptable. The use of an incinerator on site is preferred as it would reduce the amount of waste that would need to be trucked off site and reduce the storage of wastes that might attract nuisance wildlife. An incinerator would also allow for the use of an inert landfill, which generates little to no leachate. Off-site disposal is also an acceptable means to manage waste from the site, if neither an incinerator nor the landfill was constructed.

4.13 MINE SITE SEWAGE TREATMENT ALTERNATIVES

4.13.1 Mine Site Sewage

The mine site will produce sewage and domestic wastewater during all phases of the Project. The highest volume of domestic wastewater and sewage will be generated at the accommodation facility. There will be comparatively less domestic wastewater produced at the portal and surface processing facility. Wastewater generated from underground facilities will be stored in holding tanks. The tanks will be pumped, as required, and treated together with the wastewater and sewage from the surface facilities.

4.13.2 Sewage Treatment Alternatives

Sewage treatment alternatives at the mine site includes:

- **Alternative 1** - The use of a septic system
- **Alternative 2** - A pre-engineered sewage treatment plant, such as the rotating biological compactor (RBC) currently installed at the exploration camp
- **Alternative 3 -** A conventional lagoon system.

A conventional lagoon system would require the construction of a large pond for primary settling, followed by treatment through a combination of aerobic and anaerobic digestion and ultraviolet digestion by sunlight. Sewage lagoons are used in cold climates at several locations, including at the community of Attawapiskat. However, a traditional in-ground lagoon was not considered to be economically viable at the mine site due to the high water table and construction costs. Therefore, the use of a septic system and sewage treatment plant were the only two alternative assessed.

- **Alternative 1:** Septic System - A septic system at the mine site would include a septic tank and tile field. The amount of wastewater and sewage generated at the accommodation facility would necessitate the installation of several large septic systems. A single system could be installed to treat the lower volume wastewater and sewage generated at the portal and surface processing facility.

- **Alternative 2:** Sewage Treatment Plant - Sewage treatment plants typically consist of pre-engineered and pre-fabricated components designed for treating wastewater using biological processes. The systems can be scaled to accommodate a range of capacities and treated effluent discharge requirements. The systems make use of aeration and growth media technology to maintain aerobic conditions in a digestion chamber. This ensures optimum conditions for micro-organisms to digest the sewage. By infusing oxygen, the micro-organisms multiply at an accelerated rate. The process is continuous if supplied with air. The increased biomass contributes to a better breakdown of solids, which results in a lower suspended solid content.

The four performance objectives were applied to the evaluation of alternatives for the treatment of sewage at the mine site (Table 4.13-1).

Table 4.13—1 Mine Site Domestic Wastewater and Sewage Management Alternatives

Performance Objective	**Alternative 1**	**Alternative 2**
	Septic System	**Sewage Treatment Plant**
Technical feasibility	Ground conditions and available soils are not well suited for a large septic tile bed.	Technology readily available in pre-packaged systems in a range of sizes. Well suited for the Project location.
	Acceptable	Preferred
Economic Viability	Higher construction costs for accommodation facility. Would likely require the importation of a large volume of fill suitable for bed construction. Lower construction cost for a system at the portal and surface processing facility. Lower operation cost.	Similar construction cost for installation of a system at the accommodation facility. Higher operating cost.
	Acceptable	Acceptable
Environmental Acceptability	Will require a larger physical footprint; performance expected to be acceptable and be protective of water quality.	Effluent will be treated to meet water quality guidelines.
	Acceptable	Acceptable
Socioeconomic Acceptability	Expected to be equivalent in terms of socio-economic acceptability.	Expected to be equivalent in terms of socio-economic acceptability.
	Acceptable	Acceptable
Summary Ranking	**Acceptable**	**Preferred**

4.13.3 Summary of Preferred Mine Site Sewage Treatment Method

The soil around the mine site is not suitable for the installation of a tile field and material would need to be transported to site. In addition, the high water table would require a significant amount of granular material to be available for construction of an elevated tile field. A septic system to meet the full demand at the mine site would result in a greater physical disturbance and the potential for ground and surface water impacts. Seepage to surface waters would be difficult to monitor.

A sewage treatment plant is the preferred alternative for the accommodation facility as they are compact, easy to install and operate, proven reliable and easy to remove/reclaim. The sewage treatment facility will be required to operate in compliance of regulated discharge limits.

The accommodation facility will be located over one kilometre away from the surface processing facility. A buried pipeline with pumps would be needed to transfer sewage and wastewater from the surface processing facility to the treatment plant at the accommodation facility. It is not considered to be economically feasible to install a second sewage treatment plant at this facility and a sewage haul truck will be used to transfer sewage and waste water from the mine site to the treatment facility.

Section 5

Description of the Preferred Undertaking

Knight Piésold
CONSULTING
www.knightpiesold.com

TABLE OF CONTENTS

TABLES

FIGURES

5 – DESCRIPTION OF THE PREFERRED UNDERTAKING

5.1 PROJECT COMPONENTS AND PHASES

This section describes the preferred undertaking selected by Noront, having given due consideration to both "alternatives to" the Project and "alternative means or methods" of carrying out the Project (Section 4).

The Project under assessment includes the following components/areas (Figure 1.2-2):

- Mine site
- Transportation corridor
- Trans-load facility

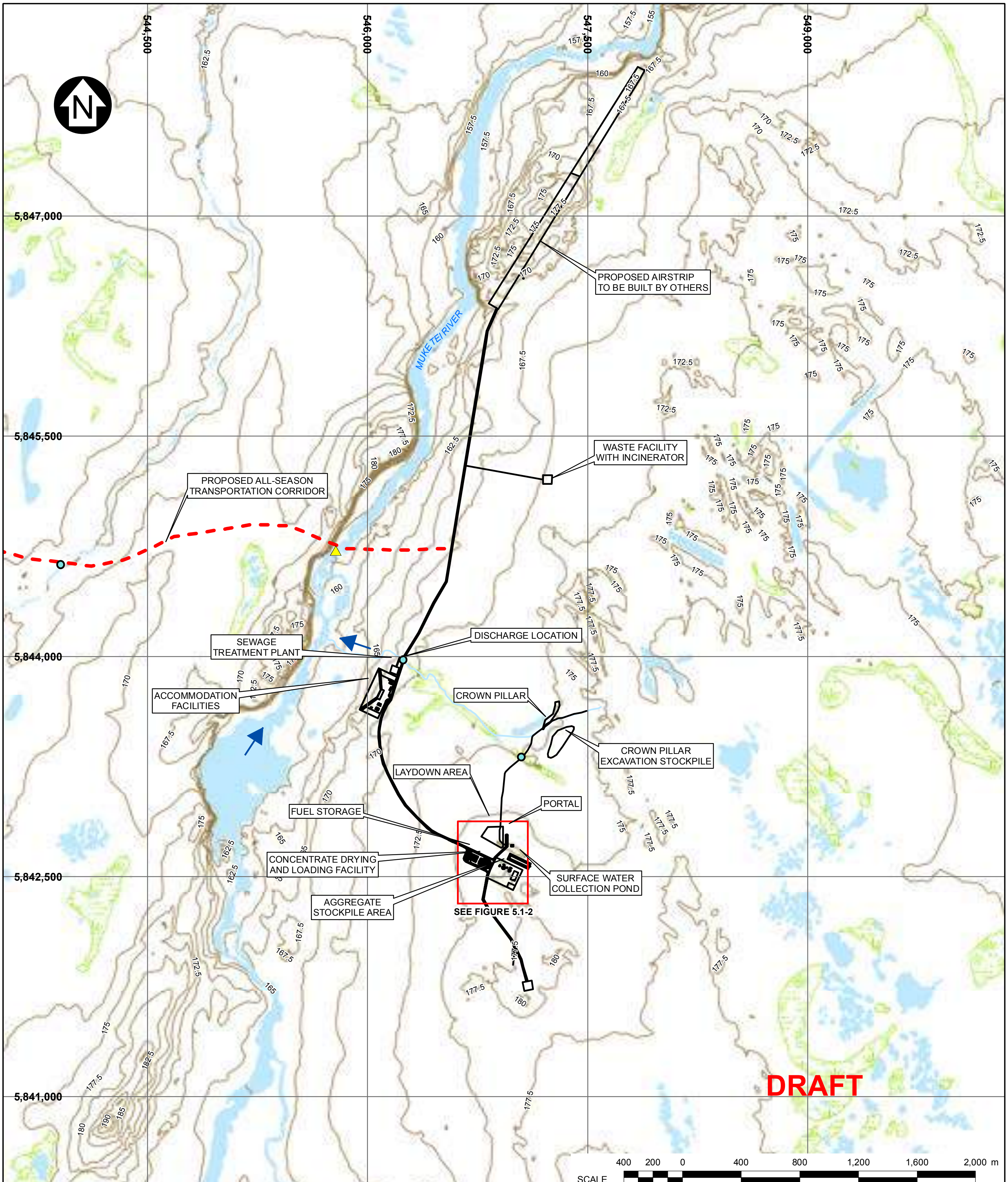
5.1.1 Mine Site

The mine site development area includes all underground and supporting facilities required to develop and operate the mine. The mine will produce a concentrate containing nickel, copper, and platinum group metals, and aggregate from underground sources. The overall mine site layout during the operation phase is shown on Figure 5.1-1 and the surface infrastructure detail is shown on Figure 5.1-2.

5.1.2 Transportation Corridor

All-season access to the Project site will be developed to transport concentrate to market and to supply the equipment and materials required to build and operate the mine. The transportation corridor will consist of the following components (Figure 1.2-3) relating to the period of mine construction, mine operations, and mine closure and post-closure:

- **Construction:**
  - The existing winter road to Webequie First Nation will be re-established and upgraded from the Pickle Lake North Road (formerly the Northern Ontario Resource Trail, or Highway 808) north of Pickle Lake to a location where it will be extended to the mine site
  - An extension of the existing winter road will be constructed and operated to connect the mine site to the existing winter road network south of the First Nation community of Webequie
  - The winter road from the Pickle Lake North Road to the mine site will be upgraded to an all-season road
- **Operations:**
  - The existing Pickle Lake North Road and Highway 599 will be used to connect the new all-season road to the trans-load facility, which will be located near the community of Savant Lake
- **Closure and post-closure:**
  - It is assumed that the all-season road will be left intact for use by others. If this road does require decommissioning, the road surface would be scarified and allowed to vegetate naturally. All culverts and bridges would be removed from the road and landfilled offsite.



LEGEND:

- PROPOSED CULVERT CROSSING
- PROPOSED BRIDGE CROSSING
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- PROPOSED INFRASTRUCTURE
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATERFLOW DIRECTION
- WATER
- WETLAND

NOTES:

1. BASE MAP PROVIDED BY SNC-LAVALIN GROUP INC. (2010).
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 2.5 METRES.
4. INFRASTRUCTURE INFORMATION PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.
5. PROPOSED ALL-SEASON TRANSPORATION CORRIDOR AND WATER CROSSING LOCATIONS PROVIDED BY KIEWIT INFRASTRUCTURE ENGINEERS (NOVEMBER 26, 2013).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

MINE SITE LAYOUT - OPERATION PHASE

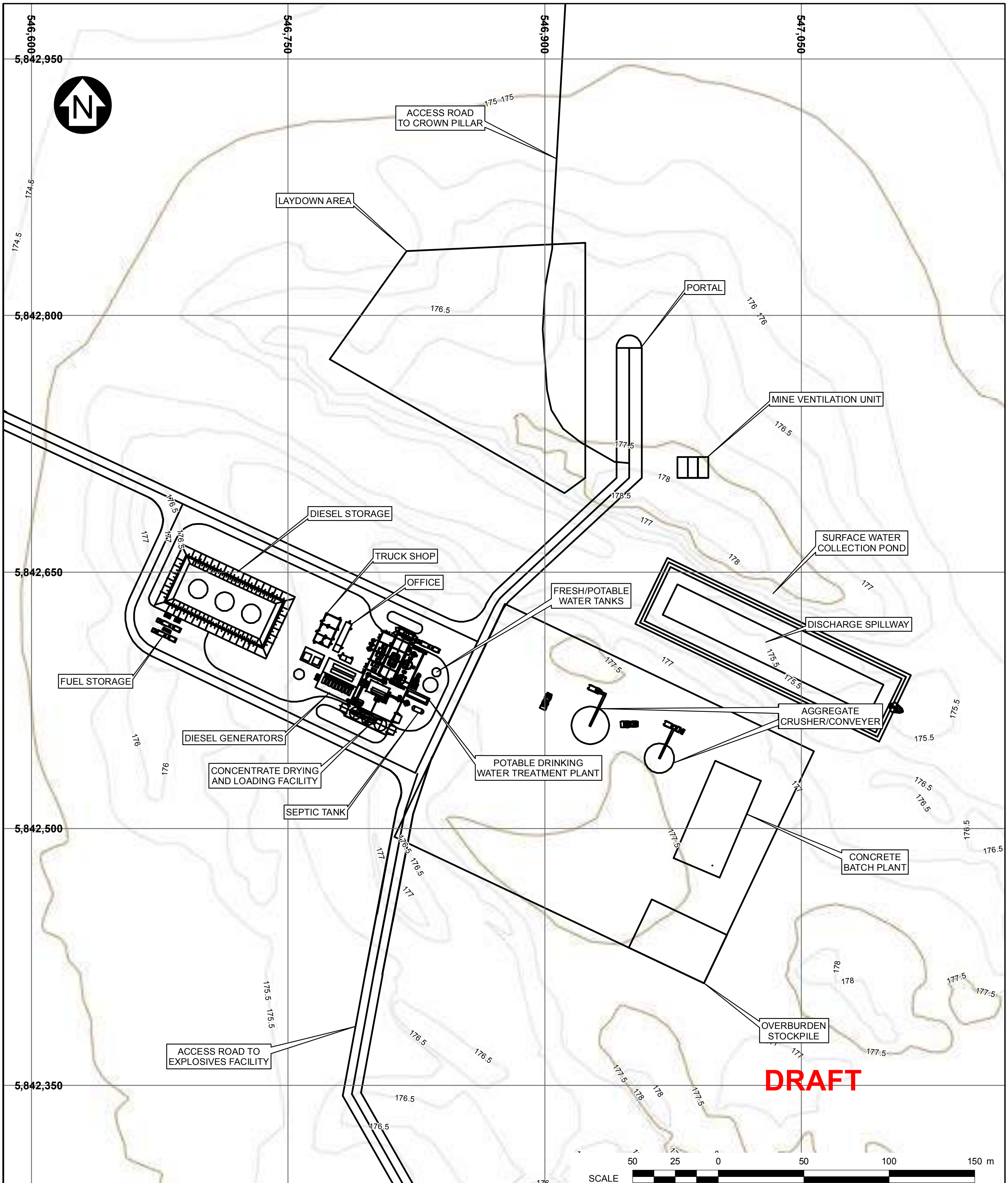
Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 5.1-1 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	DKK	SWK	SRA	RAM

SAVED: I:\102\00390\01\A\GIS\Figs\A272_rA.mxd; Dec 16, 2013 4:30 PM; skozmick



LEGEND:

- PROPOSED INFRASTRUCTURE
- MINOR CONTOUR
- MAJOR CONTOUR
- RIVER/STREAM/DRAINAGE

NOTES:

1. BASE MAP PROVIDED BY SNC-LAVALIN GROUP INC. (2010).
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 0.5 METRES.
4. INFRASTRUCTURE INFORMATION PROVIDED BY NORONT RESOURCES LTD. (MAY 2013), LOCATIONS ARE APPROXIMATE.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	ALR	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

MINE SITE SURFACE INFRASTRUCTURE DETAIL

Knight Piésold CONSULTING

P/A NO.	REF NO.	
NB102-390/1	34	
FIGURE 5.1-2		REV A

SAVED: 1:\1102\00390\01\A\GIS\Figs\A233_rA.mxd; Dec 16, 2013 4:08 PM; spenfold

The proposed all-season road will generally follow the existing winter road corridor between the Pickle Lake North Road and Webequie First Nation. It will branch off towards the mine site at a location roughly 25 km southwest of the community of Webequie (Figure 1.1-3). The final all-season road alignment will be based on:

- Maximizing the use of the existing winter road alignment
- Consultation with First Nation communities
- Terrestrial and aquatic environmental impact assessments
- Geotechnical investigations

5.1.3 Trans-load Facility

Concentrate produced at the mine will be trucked along the transportation corridor to the trans-load facility where it will be off-loaded and transferred into rail cars. It will then be shipped by rail for further processing to an existing smelter facility.

The trans-load facility will be located approximately 5 km east of the community of Savant Lake on the Canadian National Railway (CN) mainline. The location of the trans-load facility is shown on Figure 5.1-3 and the layout of the facility is shown on Figure 5.1-4. The facility will utilize a brownfield site that was formerly a rail siding used in the forestry industry.

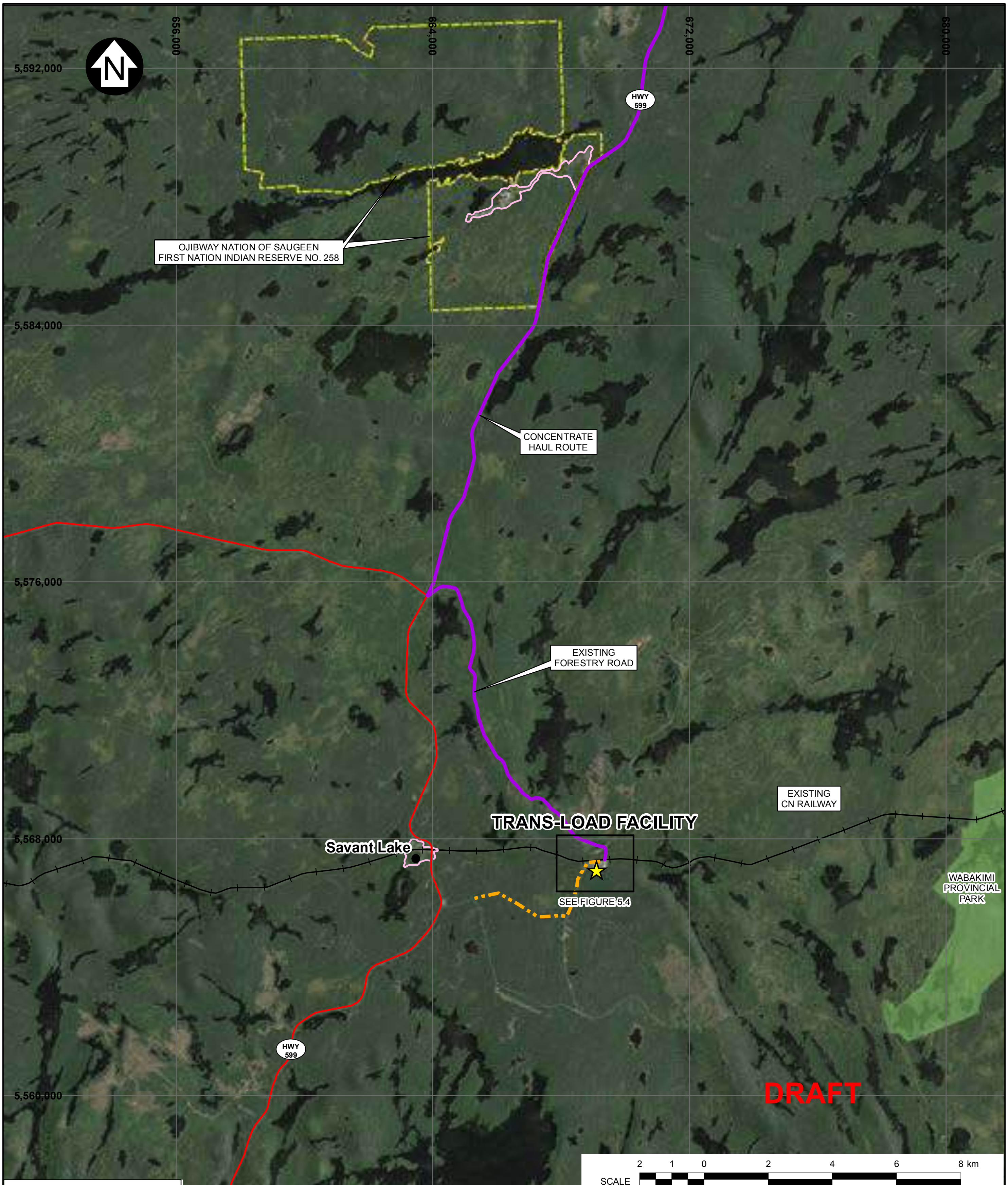
5.1.4 Project Phases

The Project is described and assessed according to the following Project phases:

- Construction
- Operation
- Closure and post-closure

Table 5.1-1 lists the temporary and permanent infrastructure to be constructed, operated and decommissioned at each of the Project areas.

Where possible, permanent components will be built at the onset of construction and will be used during both the construction and operation phases of the Project. Infrastructure for the construction phase will be removed once construction is complete.



LEGEND:

- COMMUNITY
- TRANS-LOAD FACILITY
- EXISTING ALL-SEASON ROAD
- CONCENTRATE HAUL ROUTE
- RAILWAY
- PROPOSED HYDRO CORRIDOR
- RIVER/STREAM/DRAINAGE
- WATER
- SETTLEMENT AREA
- FIRST NATIONS RESERVE
- PARK

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N.
3. IMAGERY: © ESRI DATA & MAPS [ONLINE] (2010). REDLANDS, CA: ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE. ALL RIGHTS RESERVED.

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

TRANS-LOAD FACILITY LOCATION

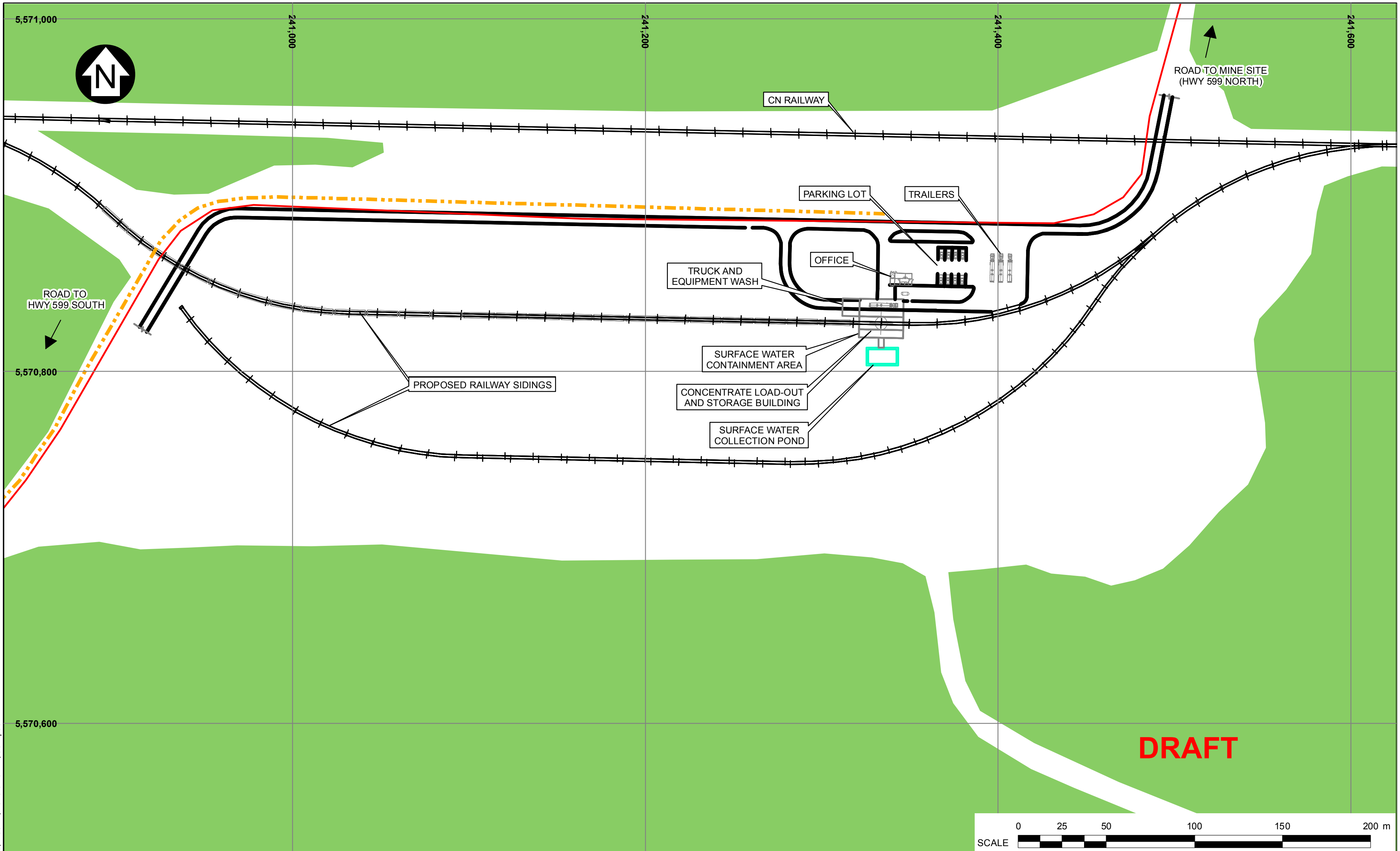
Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 5.1-3 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	RAC	SWK	SRA	RAM

SAVED: I:\1102\00390\01\A\GIS\Figs\A279_rA.mxd; Dec 12, 2013 4:29 PM; spenfold



LEGEND:

- EXISTING ALL-SEASON ROAD
- RAILWAY
- PROPOSED HYDRO CORRIDOR
- PROPOSED INFRASTRUCTURE
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- SURFACE WATER COLLECTION POND
- FORESTED AREA

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. INFRASTRUCTURE IS BASED ON INFORMATION PROVIDED BY TETRA TECH (APRIL 19 2012).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

TRANS-LOAD FACILITY LAYOUT

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 5.1-4 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	ALR	SWK	SRA	RAM

SAVED: I:\1102\00390\01\A\GIS\Figs\A275_rA.mxd; Dec 12, 2013 5:19 PM; asimpson

Table 5.1—1 Temporary and Permanent Facilities at each Project Area

Temporary Facilities	Permanent Facilities
Mine Site Area	
Temporary Facilities	**Permanent Facilities**
• Construction camp • Temporary power generators • Temporary laydown areas • Temporary Explosives manufacturing and storage on surface	*Underground Facilities:* • Mine facilities • Ore processing facility • Tailings management and storage facility • Workshops and maintenance facilities • Explosives storage *Surface Facilities:* • Concentrate drying, handling and loading facility • Domestic and hazardous waste management facilities, with incinerator • Sewage treatment plant • Surface water runoff collection pond(s) • Aggregate and overburden stockpiles • Potable and mine water supply • 22 MW diesel power generation facility • Fuel storage facilities • Accommodation and office facilities • Mine site access roads • Wash bays for surface equipment
All-Season Access Corridor	
Temporary Facilities	**Permanent Facilities**
• Winter road for construction • Laydown areas • Construction camps • Quarries and borrow sources	• All-season road • Quarries and borrow sources
Trans-load Facility	
Temporary Facilities	**Permanent Facilities**
• Construction camp • Laydown area • Temporary diesel generator (750 kW)	• Rail car siding • Concentrate loading and storage facility • Surface water runoff collection pond • Equipment storage shed • Wash pad for site equipment • Fuel storage tank • Power line to connect to existing electrical system • Potable water well and septic system • Office facilities

5.2 ENVIRONMENTAL DESIGN CONSIDERATIONS

Noront is committed to developing the Project in an environmentally and socially sustainable manner that will benefit the Company, the people of northwestern Ontario and, in particular, the First Nation communities in the vicinity of the Project. Within this mandate, Noront has designed the Project both to minimize its environmental footprint and prioritize the establishment of Project infrastructure that can provide lasting benefit to local communities.

A key consideration in the design of the Project is the challenge of establishing the mine and all-season road infrastructure over the wetlands in the region. Wetland soils are typically saturated, have low bearing capacities, and are often connected to nearby surface waters. Noront has undertaken the following measures to address this key design consideration and to minimize the Project's environmental footprint:

- The Project's overall surface footprint has been minimized by locating processing, maintenance facilities, and tailings disposal underground
- Surface facilities will be located primarily in upland areas
- Underground development rock will be used to generate aggregate for construction
- Tailings will be permanently stored within the underground workings as paste and cemented backfill, rather than within a tailings impoundment on surface
- All groundwater inflow into the underground workings will be used in the process and in the production of paste and cemented backfill tailings
- The Project will be a net consumer of water and there will be no regular discharge of mine or process water to surface during the operation phase
- Earthworks on surface will be minimal, likely utilizing only a single laydown pad
- The diesel power plant will be equipped with waste heat recovery to heat adjacent buildings, underground workings and to dry the concentrate
- The design of the process building minimizes pipe lengths and maintains separation between the concentrate load-out and aggregate haul traffic
- The underground mobile mining fleet will consist mainly of electrically powered equipment. This will reduce the Project's overall energy consumption and greenhouse gas emissions relative to a conventional diesel-powered fleet.

5.3 DEVELOPMENT SCHEDULE

The following project phases have been identified:

- **Construction:** Preparation of the site, construction of Project infrastructure, construction of mining and processing facilities, construction of the all-season access road, and the production and processing of aggregate from underground.
- **Operation:** Mineral extraction, aggregate extraction, processing of concentrate, production and processing of aggregate, and transportation of the concentrate to a trans-load facility.
- **Closure and post-closure:** Removal of Project infrastructure and rehabilitation of development areas to establish long-term physical and chemical stability; post-closure monitoring of site conditions to ensure closure objectives have been achieved.

The current schedule has the project definition phase concluding in 2014, with the acceptance of the environmental assessment by provincial and federal governments and the issuance of the key permits and authorizations required for mine construction. The Project will be constructed from January 2015 through December 2017, with mine production beginning in 2017. Mining will continue to 2028, and will be followed by two years of active closure and approximately 5 years of post-closure monitoring.

5.4 CONSTRUCTION PHASE

5.4.1 Construction Execution Strategy

The construction phase is expected to last approximately 36 months. This phase will begin with the establishment and upgrading of the existing winter road from the Pickle Lake North Road to 30 km southwest of Webequie. This work will be followed by the construction of a new 106 km long winter road to reach the mine site (Figures 5.4-1 and 5.4-2). This road work will allow for the staging of equipment and supplies needed for the construction of the mine site and the construction of the all-season road from the Pickle Lake North Road to the mine site.

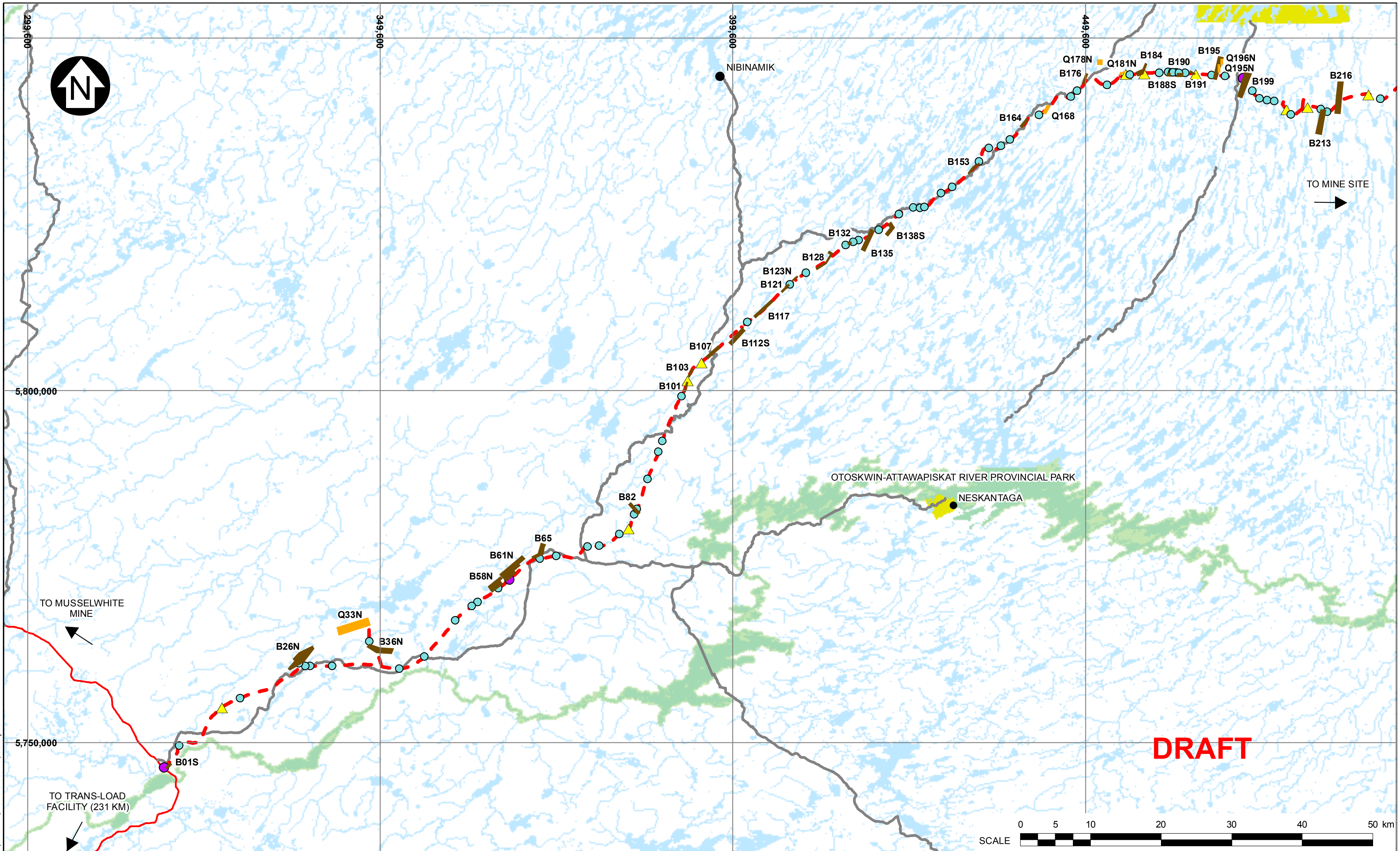
The all-season road construction will include the establishment of quarries and borrow sources at key locations along the road corridor. Rock extracted from the development of the underground infrastructure at the mine site will also be used for construction of the road.

Construction at the mine site will begin with the establishment of laydown area, site roads, and the development of the mine portal and ramps (Figure 5.4-3). Aggregate for site construction will be sourced from rock mined during the development of the underground infrastructure, because of the lack of suitable construction material in the overburden near the mine site. The aggregate rock will originate from granodiorite adjacent to the ore body, which has been shown to be non-acid generating (Non-PAG) and will not result in metal leaching (ML) (Technical Supporting Document 5). The laydown area used for construction equipment and materials will be the same as that used during the operation of the mine. A surface water collection pond will be constructed to collect surface runoff from the laydown area and to receive inflow water that will be pumped from the underground workings during initial development of the mine.

The existing exploration camp ("Esker Camp") will be utilized to support mine site construction activities. Water supply wells and the sewage treatment plant at Esker Camp will be used during construction until the new facilities are operational. During the second year of construction, the accommodation facilities will be moved to the mine site. During this time a new potable water supply will be established and a sewage treatment plant for the accommodation camp installed and commissioned.

Construction of the trans-load facility will be undertaken concurrent with the mine and road construction. The trans-load facility site is a brownfield area and ground surface preparation will be limited. Construction activities at the trans-load facility will include refurbishing and adding to the existing railway siding, installation of a power line from Savant Lake to the facility along an existing corridor, the establishment of the truck unloading and rail car loading facilities, and the construction of supporting offices and other infrastructure.

The construction schedule for the major Project components is outlined in Table 5.4-1. The layout of the mine site during the construction phase is shown on Figure 5.4-3.



SAVED: I:\1\102\00390\01\A\GIS\Figs\A238_rA.mxd; Dec 12, 2013 3:55 PM; asimpson

LEGEND:

- COMMUNITY
- PROPOSED CULVERT CROSSING
- PROPOSED BRIDGE CROSSING
- CONSTRUCTION CAMP
- EXISTING ALL-SEASON ROAD
- EXISTING WINTER ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- RIVER/STREAM/DRAINAGE
- WATER
- PROPOSED BORROW SOURCE
- PROPOSED QUARRY SOURCE
- FIRST NATIONS RESERVE
- PROVINCIAL PARK

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORATION CORRIDOR AND WATER CROSSING LOCATIONS PROVIDED BY KIEWIT INFRASTRUCTURE ENGINEERS (NOVEMBER 26, 2013).
4. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	ALR	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

TRANSPORTATION CORRIDOR SOUTHERN PORTION

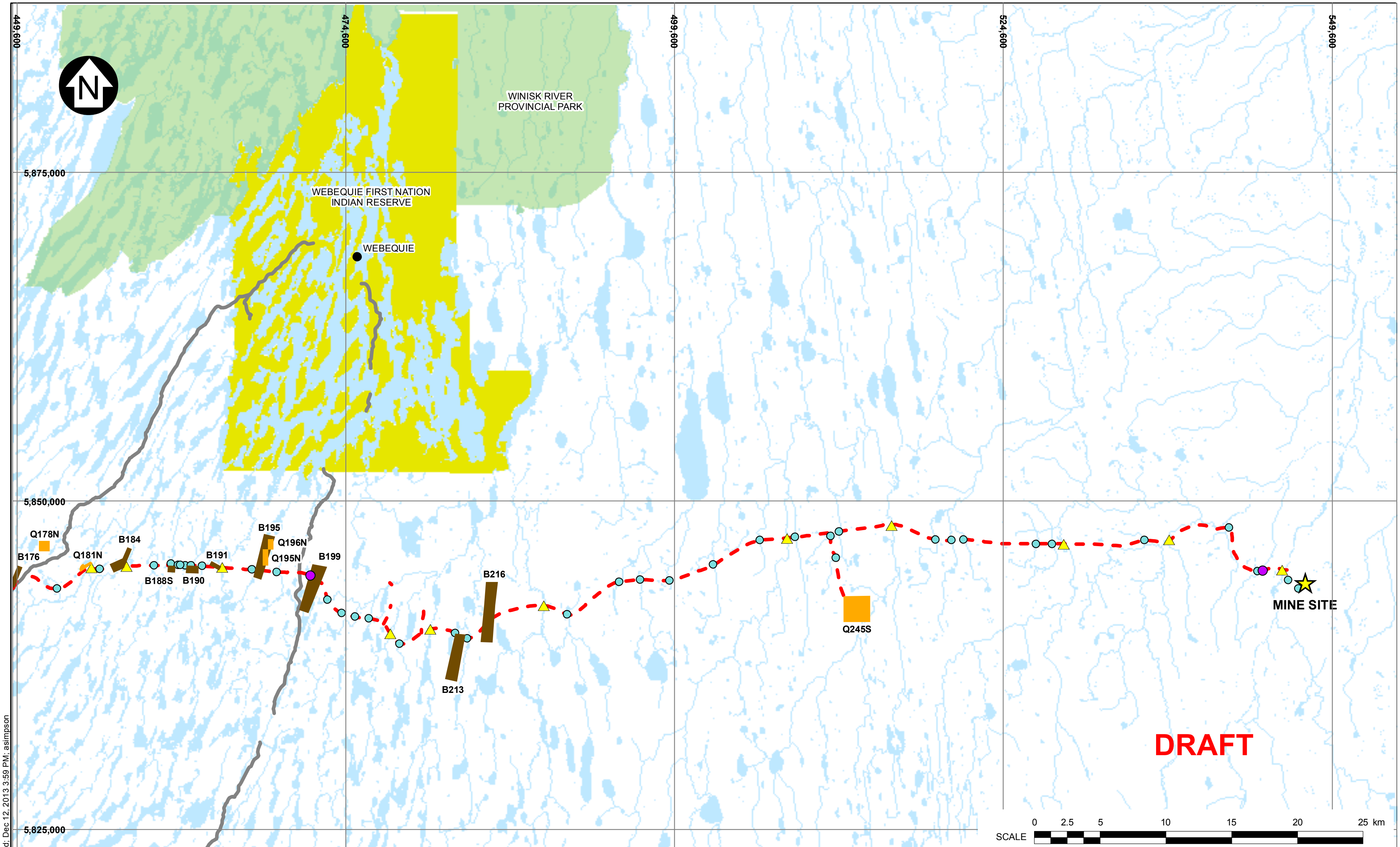
Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF NO. 34

FIGURE 5.4-1

REV A



LEGEND:

- MINE SITE
- COMMUNITY
- PROPOSED CULVERT CROSSING
- PROPOSED BRIDGE CROSSING
- CONSTRUCTION CAMP AND LAYDOWN AREA
- EXISTING WINTER ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- RIVER/STREAM/DRAINAGE
- WATER
- PROPOSED BORROW SOURCE
- PROPOSED QUARRY SOURCE
- FIRST NATIONS RESERVE
- PROVINCIAL PARK

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORATION CORRIDOR AND WATER CROSSING LOCATIONS PROVIDED BY KIEWIT INFRASTRUCTURE ENGINEERS (NOVEMBER 26, 2013).
4. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	ALR	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

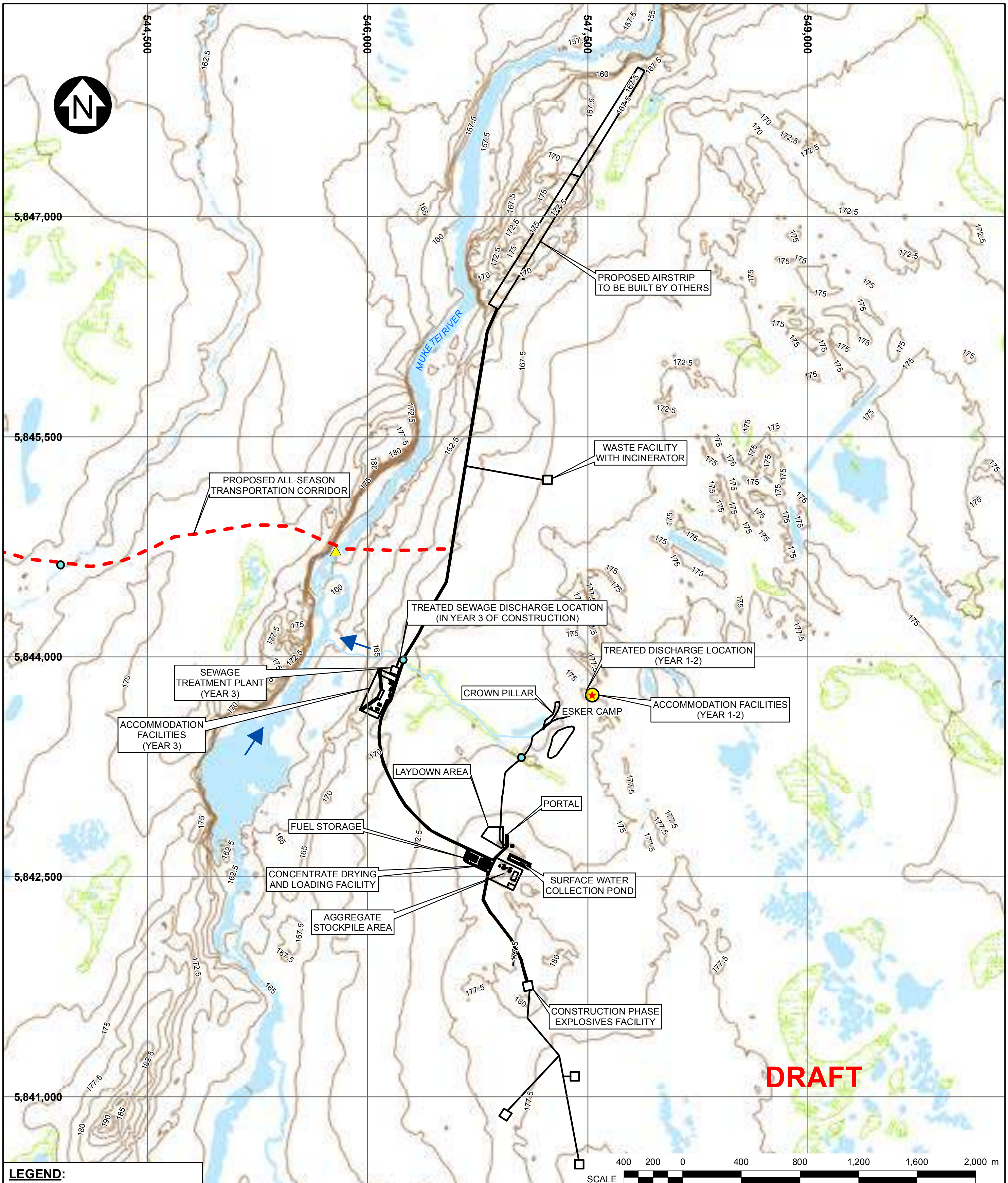
TRANSPORTATION CORRIDOR NORTHERN PORTION

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 5.4-2 | REV A

SAVED: I:\1102\00390\01\A\GIS\Figs\A239_rA.mxd: Dec 12, 2013 3:59 PM: asimpson



LEGEND:

- ESKER CAMP
- PROPOSED CULVERT CROSSING
- PROPOSED BRIDGE CROSSING
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- PROPOSED INFRASTRUCTURE
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATERFLOW DIRECTION
- WATER
- WETLAND
- CROWN PILLAR
- LAYDOWN AREA

NOTES:

1. BASE MAP PROVIDED BY SNC-LAVALIN GROUP INC. (2010).
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 2.5 METRES.
4. INFRASTRUCTURE INFORMATION PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.
5. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR AND WATER CROSSING LOCATIONS PROVIDED BY KIEWIT INFRASTRUCTURE ENGINEERS (NOVEMBER 26, 2013).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

MINE SITE LAYOUT - CONSTRUCTION PHASE

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	DKK	SWK	SRA	RAM

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF NO. 34

FIGURE 5.4-3

REV A

SAVED: I:\1102\00390\01\A\GIS\Figs\A273_rA.mxd; Dec 16, 2013 4:02 PM; spenfold

Table 5.4—1 Construction Schedule

	Permitting			Construction Phase												Operation Phase			
	Year -4			Year -3				Year -2				Year -1				Year 1			
	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Environmental Assessment and Construction Permitting	■	■	■																
Construction of Existing Winter Road				■															
Construction of Winter Road to Mine Site				■				■											
All-season Road Construction					■	■	■	■	■	■	■								
Construction of Mine Site Infrastructure				■	■	■	■	■	■	■	■								
Construction of Trans-load Facility Infrastructure								■	■	■	■								
Underground Aggregate Production								■	■	■	■	■	■	■	■				
Construction of U/G Processing												■	■	■	■				
Mining														■	■	■	■	■	■
Processing																■	■	■	■
Concentrate Transport																	■	■	■

5.4.2 Use and Extension of the Existing Winter Road

Road construction activities for the Project will start with the re-establishment of the winter road. This work will likely be undertaken by a consortium including the local First Nation communities. A close working relationship between Noront and this group will be important to ensure that Project activities are compatible with the current road operations and users. Following this, the new 106 km winter road will be constructed to the mine site.

Construction of the new winter road will be undertaken over a one month period starting in January of the first year of construction. The road will be re-established in the second year of construction. Winter road construction activities will include:

- Survey and layout of the road centreline and 30 m wide corridor
- Tree clearing within the 30 m corridor using feller bunchers
- Construction of the winter road surface using snow cats
- Flooding and freezing the road using water trucks
- Use of miscellaneous accessory equipment to support road construction

There is considerable local and Canadian experience in the construction and operation of winter roads. Several local First Nation contractors build and operate the winter road network to remote First Nation communities in northwestern Ontario. The James Bay winter road is an example of a successful community winter road that has also serviced the Victor Mine since 2006. There are many other examples of winter roads that are built and operated to service communities and mines in other provinces and territories. Noront and its contractors will draw from this experience and apply best management practices in the construction and operation of winter and all-season roads, including compliance with the following guidance:

- Environmental Guidelines for Access Roads and Water Crossings (MNR, 1990)
- Winter Roads Handbook (Saskatchewan Ministry of Highways and Infrastructure, 2010)
- Best Practice for Building and Working Safely on Ice Covers in Alberta (Government of Alberta, 2009)
- Environmental Guidelines for the Construction, Maintenance and Closure of Winter Roads in the Northwest Territories (Stanley Associates Engineering Ltd. and Sentar Consultants Ltd., 1993)
- A Field Guide to Ice Construction Safety (GNWT, 2007)

To facilitate annual construction of the new 106 km mine site winter road each year, it will be necessary to draw water from local watercourses and apply this water to the road surface to create a frozen road surface.

5.4.3 All-Season Road Construction

Shortly after the winter road construction starts, work will also commence on the development of the all-season road. By the third and final year of construction, it is expected that the all-season road will have been completed. The all-season road will be constructed over a 282 km distance from the terminus at the Pickle Lake North Road (km 0) to the mine site (km 282). A road construction concept and execution strategy was developed by Noront in consultation with experienced contractors and engineers. All-season road construction activities will include:

- Geotechnical field investigations
- Finalization of the road alignment
- Mobilization of equipment and materials
- Development and operation of camps and facilities
- Clearing, corduroying and ditching
- Aggregate and borrow source development
- Geotextile and Geo-grid installation
- Crushing for surfacing requirements

- Culvert installation
- Bridge installation
- Site services and maintenance support
- Helicopter and fixed-wing aircraft support for personnel movements
- Demobilization

5.4.3.1 Identification of the Preliminary Road Alignment

Desk top studies were completed prior to fieldwork to select the preferred road alignment within the previously selected east-west transportation corridor. This included looking at land cover data, previously completed feasibility studies for the road, the existing winter road alignment, and caribou habitat maps. In areas where no winter road existed (between Webequie Intersection and the mine site), a least cost path analysis was completed using GIS to select the preferred route from seven potential alternative routes (KP, 2012). The analysis involved ranking mapped land cover classes within GIS software and running an algorithm to determine the most efficient path between the start and end points. The algorithm examines the assigned values of cells surrounding a source cell to determine the least cost path to an adjacent cell. This process is then repeated until the program reached its destination cell. The land classes were divided into groups from least favourable to most favourable to simplify the analysis:

- Group 1 (least favourable; clear open water, turbid water and freshwater marsh) - The route cannot generally pass through Group 1 units, except at stream crossings.
- Group 2 (thicket swamp, coniferous swamp and treed peatland) - The route can pass through these units, but road construction costs would likely be extremely high.
- Group 3 (open fen, sparse treed fen, open bog and treed bog) - The route can pass through these units, but road construction costs would likely be high.
- Group 4 (sparse treed, coniferous treed and disturbed areas) - The road can generally pass through these units with moderate road construction costs.
- Group 5 (most favourable; deciduous treed, mixed treed sand and gravel and bedrock) - Group 5 units are generally amenable to road construction due to drained soil conditions, strong foundations and proximity to aggregate sources.

The resultant preferred alignment between Webequie Intersection and the mine site is about 40% on wetland features classified as Group 1, 2 or 3.

The road alignment between km 0 and km 200 was selected based on a review of mapping and aerial flyovers and will be further refined based on future geotechnical investigations during the detailed engineering design of the Project. Some adjustments to the alignment were made during October 2013, including rerouting at an area southeast of Webequie to accommodate a valued area of the community. Ongoing consultation with local First Nation communities during the review of the EIS/EA Report may identify other considerations that will affect the final road alignment. Changes to the alignment may result from further study, but the general location within the identified transportation corridor is not expected to change.

5.4.3.2 Roadbed Construction

Road engineers and constructors have identified three general types of terrain over which the all-season road will be constructed, they are as follows:

- Low Lying/Swampy (km 0 to 40) - The first section of the road beginning at the Pickle Lake North Road
- Till and glacial deposits (km 40 to 200) - This section of the road will generally follow eskers or till ridges
- Lowlands (km 200 to 280) - This land cover on this section of the road primarily consists of muskeg

These generalizations are used to simplify the assessment; however, it should be noted that there will be a combination of terrains throughout each of the sections. The general road construction techniques and environmental considerations will be adapted based on the type of terrain encountered.

The clearing width for the right-of-way corridor will be typically 30 m wide. As the felling and ditching occurs, select material will be used for fill areas, and for brush-matting and timber corduroying. The brush matting will be constructed by placing the trees and branches as the sub-base and covering with borrow material. Brush matting will be approximately 16 m wide.

The road bed structure will have the following general design basis:

- Road travel width: 8.5 to 10 m (including shoulders)
- Side slopes: Typically 3H:1V, flatter as required for road grade/slope stability
- Corduroy/brush mat/geogrid usage: Over muskeg the road design will utilize a combination of corduroy and brush mat and geotextile separator and geogrid layers as appropriate to provide sufficient support for the road structure
- Average road embankment thickness (subject to design):
    - Low Lying/Swampy: up to 1.5 m
    - Till and glacial deposits: up to 1 m
    - Lowlands: Varies up to 2.5 m (assuming; 3 m muskeg depth, 50% compression of muskeg and 1 m of roadbed above the muskeg surface)
- Road surfacing thickness: up to 0.2 m (subject to design)

The final road composition will vary depending on the in-situ ground conditions. The roadway geometrics and roadbed will be designed for a B-Train 8-axle truck with 62,500 kg maximum load limit.

Based on the design and construction of similar roads across bogs from geologically similar parts of the world, primary consolidation within wetter sections of road can be expected to be approximately 50% of the road bed thickness over a time period of between 10 and 100 days (FCE, 2010).

5.4.3.3 Bridge and Culvert Construction

The key objective of the surface water management plan for the road is to keep water levels from rising and introducing moisture into the base. Moisture could eventually undermine the roadbed and lead to failure in a storm event. Bridges and culverts are being considered for incorporation in the road design for the water crossings.

Bridges will be installed at larger watercourse crossings. Based on the current road alignment, there will be approximately 15 bridges required. The bridges will vary in length from 4 to 50 m. Water crossing details, including bridges are summarized in Table 5.4-2. Bridge locations are shown on Figures 5.4-1 and 5.4-2. Bridge construction will occur from January to April in the first and second years of construction.

Culverts will be installed at smaller watercourse crossings. There will be approximately 76 culvert water crossing based on the current road alignment. Bedding for all culverts will consist of 0.15 m of crushed aggregate. Lifts of structural fill will be compacted around the culvert to a level of 0.3 m above the top of culvert. Typical road construction methods will be used. Water crossing details, including culvert details, are summarized in Table 5.4-2. Culvert locations for watercourses are shown on Figures 5.4-1 and 5.4-2. The use of Enviro-Span™ modular culverts is also being investigated. In this case only the top arch is installed and the stream bed is not impacted.

Cross drainage culverts, in addition to watercourse culverts, will be installed across the road at regular intervals to maintain existing drainage patterns and ecological conditions. These culverts are not included in the tables or on the figures due to the large numbers required.

Bridges and culverts will be installed in a manner that is consistent with best management practices outlined in MNR, 1990.

5.4.3.4 Aggregate and Borrow Source Development

Aggregate for road construction will include material from borrow sources and crushed rock derived from quarries and underground from the mine. An initial list of 7 potential quarries and 29 potential borrow sources along the road corridor has been identified from desk top studies and preliminary field work. From this initial list, preferred locations will be refined based on First Nations consultation, habitat, archeological studies and geotechnical investigations. The borrow source and quarries site details are shown in Tables 5.4-3 and 5.4-4, respectively. The locations for the borrow sources and quarries are shown on Figures 5.4-1 and 5.4-2.

Prior to development of the selected borrow sources and quarries, the following activities will be completed to ensure proper site preparation:

- Borrow source locations will cleared of trees and vegetation. Tree clearing equipment will fell the trees and slash ground vegetation. Quarry locations will also require some tree clearing, but likely to a lesser extent than the borrow sources because much of the quarries are exposed bedrock.
- Borrow sources will require grubbing prior to excavating suitable base material. Grubbed material may be stockpiled at the limits of the borrow source. Quarry locations may require localized grubbing in areas where the bedrock outcrops just underneath the ground surface.
- Geochemical assessment of the quarry rock and borrow materials will be carried out prior to development. Only non-PAG and non-ML rock and borrow materials will be used for the Project.
- Quarries will be excavated using standard drilling, blasting and loading procedures
- Subsurface excavation of borrow sources will stop above the groundwater level (>1.5 m above) to avoid dewatering

- Subsurface excavation of quarries may, if material demand requires it, consist of excavating to a depth of approximately 6 m below the groundwater level. No dewatering will be completed, the rock will be removed by excavator and the pits will remain flooded. Best management practices will be used for sedimentation and erosion control.
- Aggregate may be processed at the quarry/borrow area location, depending upon the purpose and final placement location. Processing may include screening of sand and gravel through a grizzly to remove oversized material, or crushing and screening of rock and/or boulders to produce crushed rock.

Knight Piésold CONSULTING

TABLE 5.4-2

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

SUMMARY OF WATER CROSSINGS ALONG ROAD ALIGNMENT

Print Dec/17/13 18:43:44

Crossing ID	Road Chainage (km)	Easting (m)	Northing (m)	Water Crossing Assessment Date	Estimated Wetted Width (m)	Estimated Stream Depth (m)	Substrate Description	Bankfull Width (m)	Proposed Installation
X12-01	3.8	321,153	5,749,536	16-Oct-13	2.0	1.0	Organics	15	Culvert or Envirospan
X13-1	12.6	327,106	5,754,899	16-Oct-13	2.0	1.0	Organics	15	Bridge
X13-2	15.6	329,753	5,756,284	16-Oct-13	1.0	0.3	Organics	5	Culvert
X12-04	26.1	338,995	5,760,821	16-Oct-13	3.0	1.0	Organics/Rock	10	Culvert
X13-3	26.8	339,704	5,760,853	16-Oct-13	<1	<0.3	Organics	<1	Culvert
X12-06	29.9	342,793	5,760,840	16-Oct-13	4.0	2.0	Rock	10	Double Culverts
X12-07	39.5	352,311	5,760,464	16-Oct-13	2.0	1.0	Organics	20	Culverts
X13-4	43.5	355,886	5,762,200	16-Oct-13	2.0	1.5	Rock	10	Large Culverts
X13-49	50.3	363200	5,767,200	16-Oct-13	1.0	0.3	Organics	4	Culvert
X13-50	53.4	362580	5,769,220	16-Oct-13	1.0	0.3	Organics	4	Culvert
X13-5	54.4	363,446	5,769,934	16-Oct-13	3.0	1.0	Rock	5	Culvert
X13-7	58.0	366,356	5,771,873	17-Oct-13	<1	<0.5	Organics	<2	Culvert
X13-9	65.3	370,470	5,776,117	17-Oct-13	3.0	0.5	Organics	10	Culvert
X12-12	67.7	374,923	5,776,245	5-Nov-13	3.0	0.5	Organics	10	Culvert
X017	72.8	378,984	5,777,769	17-Oct-13	2.0	0.3	Organics	5	Culvert
X12-13	74.5	380,661	5,777,892	17-Oct-13	1.0	0.5	Organics	10	Culvert
X12-14	77.9	383,471	5,779,596	17-Oct-13	5.0	1.0	Organics	50	Envirospan
X12-15 (Pineimuta River)	79.4	384,765	5,780,405	17-Oct-13	50.0	1.0	Bedrock	75	Bridge
X13-10	81.6	385,579	5,782,375	17-Oct-13	1.5	1.0	Organics	10	Culvert
X13-11	82.4	385,992	5,783,098	17-Oct-13	2.0	1.0	Organics	15	Culvert
X13-12	87.1	387,470	5,787,412	17-Oct-13	4.0	1.0	Organics	30	Culvert (1 or 2)
X13-13	91.1	389,038	5,791,234	17-Oct-13	10-30	1.0	Organics	30	Culvert
X13-51	92.9	390104	5794195	17-Oct-13	1.0	0.5	Organics	5	Culvert
X13-14	99.7	392,351	5,799,132	17-Oct-13	2.0	0.5	Organics/Gravel	8	Culvert
X12-20	102.7	393,147	5,801,392	17-Oct-13	12.0	2-3	Organics/Gravel	15	Bridge
X13-15	105.5	395,031	5,803,975	17-Oct-13	12.0	3.0	Gravel	15	Bridge
X13-16	114.2	401,654	5,809,684	17-Oct-13	2.0	1.0	Organics	8	Culvert
X13-18	122.3	407,669	5,815,005	17-Oct-13	2.0	0.5	Organics	20	Culvert
X13-19	125.1	409,983	5,816,673	17-Oct-13	<1	<0.2	Organics	<1	Culvert
X13-20	132.1	415,591	5,820,587	17-Oct-13	1.0	<0.5	Organics	10	Culvert
X13-21	133.2	416,657	5,821,048	17-Oct-13	1.0	<0.5	Organics	2	Culvert
X13-22	134.0	417,422	5,821,269	17-Oct-13	3.0	0.5	Rock/Organics	4	Culvert
X12-33	137.2	420,271	5,822,753	17-Oct-13	4.0	0.5	Rock/Organics	6	Culvert
X12-34	140.8	423,192	5,825,147	17-Oct-13	2.0	0.5	Organics	15	Culvert
X12-35	143.1	425,148	5,825,927	16-Oct-13	4.0	0.5	Organics/Bedrock	10	Culvert
X12-36	144.1	426,083	5,825,875	16-Oct-13	-	-	-	-	Culvert
X12-37	144.7	426,745	5,825,977	16-Oct-13	-	-	-	-	Culvert
X12-38	147.9	429,098	5,827,985	16-Oct-13	15.0	0.2	Organics/Rock	20	Culvert
X12-39	149.7	430,696	5,828,834	16-Oct-13	25.0	0.2	Rock	25	Envirospan
X12-40	155.1	434,504	5,832,459	16-Oct-13	4.0	0.5	Rock	8	Culvert
X13-23	157.7	435,884	5,834,399	16-Oct-13	2.0	1.0	Rock	30	Culvert
X13-24	159.6	437,634	5,834,699	16-Oct-13	2.0	0.5	Rock	5	Culvert
X12-44	161.2	438,897	5,835,608	16-Oct-13	2 x 2 m wide ea.	1.0	Rock	15	2 Culverts
X12-45	166.8	442,999	5,839,096	16-Oct-13	2.0	0.5	Rock	5	Culvert
X12-46	172.5	447,530	5,841,681	16-Oct-13	2.0	0.5	Rock	5	Culvert
X12-47	173.7	448,406	5,842,475	16-Oct-13	2.0	1.0	Organics	20	Culvert
X12-49	179.1	452,641	5,843,302	18-Oct-13	1.0	1.0	Organics	10	Culvert
X12-50	182.2	454,996	5,844,793	18-Oct-13	15.0	2.0	Bedrock	20	Bridge
X12-52	182.9	455,813	5,844,814	18-Oct-13	-	-	-	-	Culvert
X13-25	184.9	457,884	5,845,014	18-Oct-13	35.0	3.0	Organics	50	Bridge
X13-26	187.1	460,042	5,845,071	18-Oct-13	1.0	1.0	Bedrock	1	Envirospan
X13-27	188.3	461,311	5,845,199	18-Oct-13	-	-	-	-	Culvert
X13-28	188.9	461,869	5,845,117	18-Oct-13	-	-	-	-	Culvert
X12-57	189.0	462,012	5,845,126	18-Oct-13	2.0	0.5	Rock	5	Culvert

Knight Piésold CONSULTING

TABLE 5.4-2

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

SUMMARY OF WATER CROSSINGS ALONG ROAD ALIGNMENT

Print Dec/17/13 18:43:44

Crossing ID	Road Chainage (km)	Easting (m)	Northing (m)	Water Crossing Assessment Date	Estimated Wetted Width (m)	Estimated Stream Depth (m)	Substrate Description	Bankfull Width (m)	Proposed Installation
X13-29	189.4	462,405	5,845,085	18-Oct-13	-	-	-	-	Culvert
X12-58	189.8	462,838	5,845,064	18-Oct-13	2.0	1.0	Organics/Rock	12	Culvert
X13-30	190.8	463,693	5,845,037	18-Oct-13	10.0	0.2	Rock	10	Envirospan
X-69	192.2	465,186	5,844,930	18-Oct-13	10.0	1.0	Bedrock	13	Bridge
X12-59	194.5	467,476	5,844,758	19-Oct-13	1.0	<1	Organics	10	Culvert
X12-60	196.3	469,341	5,844,582	19-Oct-13	2.0	1.0	Organics/gravel	6	Culvert
X13-39	201.3	473,206	5,842,482	19-Oct-13	5.0	2.0	Organics/gravel	25	Culvert
X13-40	202.8	474,279	5,841,455	19-Oct-13	12.0	0.5	Rock	15	Envirospan
X13-41	203.9	475,316	5,841,165	19-Oct-13	1.0	1.0	Rock	4	Envirospan/Culvert
X13-42	204.9	476,343	5,841,049	19-Oct-13	2.0	1.0	Organics/Rock	30	Culvert
X13-43	207.1	477,967	5,839,908	19-Oct-13	5.0	0.5	Rock	10	Bridge
X13-44	208.1	478,676	5,839,127	19-Oct-13	2 x 2 m wide ea.	1.0	Organics/Rock	15	2 Culverts
X13-45	210.8	481,004	5,840,221	19-Oct-13	5.0	0.5	Rock	10	Bridge
X13-46	212.8	482,930	5,839,917	19-Oct-13	2.0	1.0	Organics/Gravel	20	Culvert
X13-47	213.8	483,854	5,839,524	19-Oct-13	5.0	0.5	Rock	7	Envirospan
X12-66	220.4	489,634	5,842,016	19-Oct-13	5.0	1.0	Rock/Organics	9	Bridge
X12-67	222.3	491,425	5,841,336	19-Oct-13	2.0	1.0	Organics	6	Culvert
X12-70	227.2	495,385	5,843,807	19-Oct-13	3.0	0.2	Organics	20	Culvert
X12-71	228.7	496,965	5,843,994	19-Oct-13	2.0	1.0	Organics	50	2 Culverts
X12-73	230.9	499,201	5,843,923	19-Oct-13	1.0	1.0	Organics	20	Culvert
X12-74	234.5	502,536	5,845,129	19-Oct-13	3.0	1.0	Organics	21	Culvert
X12-75	238.5	506,077	5,847,019	19-Oct-13	2.0	2.0	Organics	30	Culvert
X13-33	240.6	508,138	5,847,169	19-Oct-13	15.0	2.0	Rock/Organics	20	Bridge
X13-34	241.2	508,754	5,847,237	19-Oct-13	3.0	1.0	Organics	10	Culvert
X12-80	244.6	512,107	5,847,659	19-Oct-13	3.0	2.0	Organics	20	Culvert
X12-82	248.6	516,086	5,848,143	19-Oct-13	4.0	1.0	Rock	10	Bridge
X12-83	252.2	519,442	5,847,053	19-Oct-13	3.0	2.0	Organics	10	Culvert
X12-84	253.4	520,640	5,847,002	19-Oct-13	2.0	2.0	Organics	50	Culvert
X12-85	254.3	521,569	5,847,034	19-Oct-13	20.0	2.0	Organics	60	Culvert
X12-86	259.9	527,076	5,846,715	19-Oct-13	2.0	2.0	Organics	15	Culvert
X12-87	261.1	528,316	5,846,704	19-Oct-13	2.0	2.0	Organics	20	Culvert
X12-88 (Black Creek)	262.0	529,171	5,846,707	19-Oct-13	12.0	2.0	Rock/Organics	16	Bridge
X12-89	268.2	535,337	5,846,997	19-Oct-13	<1	1.0	Organics	50	Culvert
X12-90	270.2	537,172	5,847,078	19-Oct-13	15.0	1.0	Rock	18	Bridge
X13-35	275.2	541,036	5,847,644	19-Oct-13	2.0	1.0	Organics	10	Culvert
X13-37	279.5	543,910	5,844,624	19-Oct-13	2.0	1.0	Organics	10	Culvert
X13-38 (Muketei River)	281.5	545,781	5,844,723	19-Oct-13	10.0	2.0	Rock	20	Bridge

I:\1\02\00390\01\A\Report\Report 34, EA Volume 2 - EA Report\REV A\10 - Section 5 - Project Description\1 - Draft\2 - Tables\[Table 5.4-2 - Water Crossing Summary.xlsx]Water Crossings

A	20DEC'13	ISSUED WITH REPORT NB102-390/1-34	MAS	ATJ	RAM
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

TABLE 5.4-3

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

ALL SEASON TRANSPORTATION CORRIDOR SUMMARY OF POTENTIAL AGGREGATE BORROW SOURCES ALONG ROAD ALIGNMENT

Print Dec/17/13 18:45:41

Borrow Source ID	Road Chainage (km)	Offset from Road Alignment (m)	Easting (m)	Northing (m)	Area (ha)
B01S	1	100	319,630	5,746,685	43.8
B26N	26	500	338,458	5,762,164	482.7
B36N	36	2,000	349,495	5,763,126	304.9
B58N	58	100	365,933	5,772,323	240.9
B61N	61	100	368,304	5,774,779	484.4
B65	65	0	372,411	5,777,027	181.3
B82	82	0	385,574	5,783,212	111.9
B101	101	0	392,944	5,800,502	54.2
B103	103	0	393,611	5,802,539	49.1
B107	107	0	396,768	5,805,392	122.4
B112S	112	300	400,229	5,807,701	195.8
B117	117	0	403,896	5,811,533	172.6
B121	121	0	407,020	5,814,478	57.1
B123N	123	100	408,392	5,815,853	28.1
B128	128	0	412,907	5,818,231	137.2
B132	132	0	416,121	5,820,880	21.9
B135	135	0	418,742	5,821,454	227.3
B138S	138	200	421,995	5,822,874	134.8
B153	153	0	433,712	5,831,540	79.7
B164	164	0	440,902	5,837,941	70.4
B176	176	0	449,553	5,844,323	65.2
B184	184	0	457,639	5,845,337	118.3
B188S	188	100	461,343	5,844,827	29.0
B190	190	0	462,940	5,844,798	54.9
B191	191	0	464,693	5,845,072	29.7
B195	195	0	468,367	5,845,936	249.0
B199	199	0	472,045	5,843,531	347.6
B213	213	0	482,978	5,838,268	312.3
B216	216	0	485,425	5,840,765	247.3

I:\1\02\00390\01\A\Report\Report 34, EA Volume 2 - EA Report\REV A\10 - Section 5 - Project Description\1 - Draft\2 - Tables\[Table 5.4-3 and 5.4-4 - Quarries and Borrow AreasCWM_16DEC2013.xlsx]Table 5.4-3

A	20DEC'13	ISSUED WITH REPORT NB102-390/1-34	MAS	CWM	RAM
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

TABLE 5.4-4

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

ALL SEASON TRANSPORTATION CORRIDOR SUMMARY OF POTENTIAL QUARRIES ALONG ROAD ALIGNMENT

Print Dec/17/13 18:48:31

ID	Road Chainage (km)	Offset from Road Alignment (m)	Easting (m)	Northing (m)	Area (ha)
Q33N	33	5,400	345,836	5,766,527	585.1
Q168	168	0	444,095	5,839,924	78.2
Q178N	178	1,900	451,680	5,846,553	60.8
Q181N	181	100	454,799	5,845,024	29.4
Q195N	195	400	468,457	5,845,727	47.3
Q196N	196	1,600	468,861	5,846,694	32.4
Q245S	245	6,000	513,429	5,841,840	398.8

I:\1\02\00390\01\A\Report\Report 34, EA Volume 2 - EA Report\REV A\10 - Section 5 - Project Description\1 - Draft\2 - Tables\[Table 5.4-3 and 5.4-4 - Quarries and Borrow AreasCWM_16DEC2013.xlsx]Table 5.4-4

A	20DEC'13	ISSUED WITH REPORT NB102-390/1-34	MAS	CWM	RAM
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

The final extent and location of borrow sources and quarries will be determined through detailed geotechnical investigations conducted during detailed engineering design.

Figures 5.4-4 and 5.4-5 show photos of a typical rock outcrop and a potential borrow source along the road corridor.

Figure 5.4-4 Typical Rock Outcrop along the Southern Portion of the Road

Figure 5.4-5 Typical Esker Deposit along the Southern Portion of the Road

The aggregate quantities required to construct the road (Table 5.4-5) were estimated based on the general terrain along the road alignment.

Material for road construction will be sourced generally from the closest available borrow source and/or quarry along the road alignment.

5.4.3.5 Road Construction Camp Facilities and Services

During road construction, camp facilities and laydown areas will be established at four key work areas, including at the Pickle Lake North Road at km 0, near km 50, near km 200 and at the existing Esker Camp (km 282). The proposed camp locations are shown on Figures 5.4-1 and 5.4-2. The construction of the all-season road and construction at the mine site is expected to require four, 40 to 50 person camps. Actual camp sizes will depend on the selected execution strategy.

Knight Piésold CONSULTING

TABLE 5.4-5

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

ALL SEASON TRANSPORTATION CORRIDOR ESTIMATED QUANTITIES FOR ROAD CONSTRUCTION

Print Dec/17/13 18:56:06

Road Segment (km)	General Terrain Description	Road Embankment Thickness (m)	Road Embankment Volume (m^3)			
			Road Base[3] (Bulk Fill)	Road Surface[4]		Total
				In-Situ Quarry Volume	Quarry Material	
0 to 40	Low Lying/Swampy	Up to 1.5	870,000	68,000	85,000	955,000
40 to 200	Till and Glacial Deposits	Up to 1	2,080,000	272,000	340,000	2,420,000
200 to 280	Lowlands	Up to 2.5	3,500,000	136,000	170,000	3,670,000
Totals			6,450,000	476,000	595,000	7,045,000

I:\1\02\00390\01\A\Report\Report 34, EA Volume 2 - EA Report\REV A\10 - Section 5 - Project Description\1 - Draft\2 - Tables\[Table 5.4-5 - Road Quantities and B Sources_16DEC2013.xlsx]Table 5.4-5

NOTES:
1. ADDITIONAL VOLUMES MAY BE REQUIRED FOR BRIDGE ABUTMENTS AND AT WATER CROSSINGS.
2. FOR VOLUME CALCULATIONS THE ESTIMATED MAXIMUM ROAD EMBANKMENT FOR EACH SEGMENT WAS USED.
3. ROAD BASE (BULK FILL) MATERIALS WILL BE SOURCED FROM BORROW AREAS, MAINLY COMPRISING GLACIAL OUTWASH DEPOSITS. NO EXPANSION FACTOR FROM EXCAVATION IS INCLUDED.
4. ROAD SURFACING MATERIAL WILL BE SOURCED FROM QUARRIES. AN EXPANSION FACTOR OF 20% HAS BEEN APPLIED TO MATERIAL FROM QUARRIES TO ACCOUNT FOR AN INCREASE IN VOLUME DUE TO MATERIAL EXPANSION DURING EXCAVATION.

A	20DEC'13	ISSUED WITH REPORT NB102-390/1-34	CAP	JAB	RAM
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Aggregate for the construction of the camps and facility pads will be obtained from the same borrow sources that will be used for road construction. A site service crew will be available at each camp and laydown area, as required. The crew will have integrated tool carriers, tractor and trailers, fuel trucks, graders, flat deck pickups, among other equipment. These crews will be vital in supporting construction activities and camp and laydown operations.

Other temporary facilities to support construction will include office trailers, a parts trailer, maintenance shops and necessary water, sanitary and power requirements. Suitable water sources will be identified. In some cases water may need to be hauled to each camp using water trucks. Camp sewage disposal methods will be determined and may include one or all of the following:

- Collection in holding tanks and transport to a sewage disposal facility at Pickle Lake
- Use of incinerating toilets
- Use of a package treatment plant

Mobilization of the camps will be done in winter, using the winter road. Preliminary site preparation will be performed in the fall before the first winter of road development, accessed by helicopter. The preferred option(s) for outfitting and developing the camps will be determined and permitted by the contractor(s) commissioned for road construction.

5.4.3.6 Road Construction Equipment Fleet

The road construction equipment fleet is expected to consist of the list shown in Table 5.4-6.

Table 5.4—6 Equipment Required for Road Construction

Equipment Description	Units at Peak
Bulldozers (Cat D8, D7 and D6)	6
Excavators (Cat 365 and 330)	6
Grader (Cat 14)	3
Loaders (Cat 966, 980, and 930)	5
Compactor (Cat CS563)	3
Water/Sand/Gravel Trucks	3
Articulated Haul Trucks (Cat 740)	8
Tri-Axle Trucks	30
Fuel/Lube Trucks	3
Mechanic/Welder Truck	3
Winch Tractor and Trailer	2
Crusher	2
Crane	1
Rock Drill	2

Other non-major equipment required for the all-season road construction may include crew buses, flat deck trucks, light towers, generators and sub-contractor equipment.

5.4.4 Mine Site Earthworks

The elements involved in construction of the mine site infrastructure will include:

- Mobilization/Demobilization
- Clearing
- Site road and pad construction
- Access road construction
- Bulk fuel storage facility construction including an HDPE-lined containment
- Surface runoff collection ponds
- Geo-grid procurement and installation
- Culvert installation
- Site services and maintenance support
- Helicopter and fixed-wing aircraft support for personnel movements

The mine site earthworks will consist of constructing pads for infrastructure and site roads connecting infrastructure. The roads and pads will be composed of aggregate sourced from underground mine development. Prior to the construction of these facilities, clearing and timber salvage will be required. The site road and pad area to be stripped is estimated to be 20 ha.

5.4.4.1 Mine Site Roads and Pads

Site roads constructed to connect mine site facilities will be 8 m in width. Roads will be constructed running west from the mine portal area and then north to the camp complex and the airstrip (to be operated by another company). Mine roads will be built with a 1.25 m thick base course that will include three layers of biaxial geo-grid to reinforce the road structure. The roads will be topped with a 0.2 m surfacing course.

Mine site pads will be constructed with a similar cross-section, but with only one layer of biaxial geo-grid placed beneath the base course.

The terrain around the mine site area is generally flat, but site roads will follow higher ground to the greatest extent possible. Site road alignments were chosen for constructability, durability and maintenance considerations. Roads built on wet ground will require ongoing maintenance and will need to have additional material added over time. Where required, a modified road construction method will be used that places felled trees across the road path (corduroy). Geotextiles will be applied to a wider road width so the loads are spread across a greater width. Culverts and ditches will be installed frequently where necessary to ensure the road does not impede the natural flow of water through the wetland.

5.4.4.2 List of Major Equipment

The major equipment required for mine site construction is outlined in Table 5.4-7.

Table 5.4—7 Equipment Required for Mine Site Construction

Equipment Description	Units at Peak
Bulldozers (Cat D8, D7 and D6)	4
Excavators (Cat 365, 345, and 330)	4
Grader (Cat 14)	1
Loaders (Cat 980, and 930)	2
Packer (Cat CS563)	2
Water/Sand/Gravel Trucks	1
Articulated Haul Trucks (Cat 740)	8
Fuel/Lube Trucks	1
Mechanic/Welder Truck	2
Winch Tractor and Trailer	1

Other non-major equipment requirements for the all-season road construction may include crew buses, flat deck trucks, light towers, generators and sub-contractor equipment.

5.4.4.3 List of Quantities

Major materials and quantities for the construction of the mine site are shown in Table 5.4-8.

Table 5.4—8 Mine Site Construction Quantities

Item Description	Quantity
Site Clearing	20 ha
Site Road and Pad Base Material	165,000 m^3
Site Road and Pad Surfacing Material	30,000 m^3
Geo-Grid	266,000 m^2
HDPE Liner	3,800 m^2
Site Ditches	7,900 m (linear)
Culverts	800 m (linear)

5.4.5 Construction of the Underground Mine

The construction of the underground mine and ancillary facilities will include the following main steps:

- Development of a mine portal
- Construction of twin ramps
- Mining/excavation of the development areas for the processing facility and other underground infrastructure
- Mining/excavation of the aggregate stopes
- Development of the ore production levels

The first phase in construction of the underground mine will involve the development of a portal and twin ramps. The overburden at the portal location generally consists of silt and clay with minor layers of sand and gravel, overlain by a thin layer of organic soil. The portal area will be sealed to prevent groundwater inflow on all sides by driving sheet-piling down to the bedrock level and grouting.

This enclosed area will be dewatered, with the water pumped to a collection pond before release to the peat bog. The portal will be excavated through overburden to bedrock, with the walls of the excavation sloped to a stable configuration. The rock mass quality at the portal location is variable. Lower rock quality was primarily observed within the relatively weathered and fractured rock that was encountered near surface. The rock mass quality was observed to generally increase with depth. The dominant joint orientation is sub-horizontal, although several steep joint orientations can be expected. Hydraulic conductivities estimated during baseline studies were shown to be typical of fractured crystalline rock masses and range from 10^{-8} to 10^{-5} m/s with an average of 10^{-6} m/s. Hydraulic conductivity also generally decreases with depth and appears to correspond to the increase in rock mass quality with depth (KP, 2013b).

The initial surface ramps will be driven as 6 m x 6 m headings using two boom jumbos. Blasting will be a typical round with perimeter holes drilled in tight spacing to minimize damage to the excavation, reduce potential ground support and increase advance rates. The blasted rock will be hauled to surface to be used for aggregate, if appropriate. Because the development will be in competent rock, it is anticipated that the dominant ground support system will be shotcrete with selective use of bolts and mesh. Bolt spacing and mesh weave will be adjusted to the ground conditions. Investigations are planned to determine whether the rock in the upper portion of the ramp must be grouted to seal out water. The excavations during the construction phase are shown on Figure 5.4-6. It is anticipated that construction of the portal will take six months and ramp development from surface to the 175 m level (where the processing facility will be established) will take approximately 13 months.

Construction Progress, Year 1 Q4

Construction Progress, Year 2 Q4

Construction Progress, Year 3 Q4

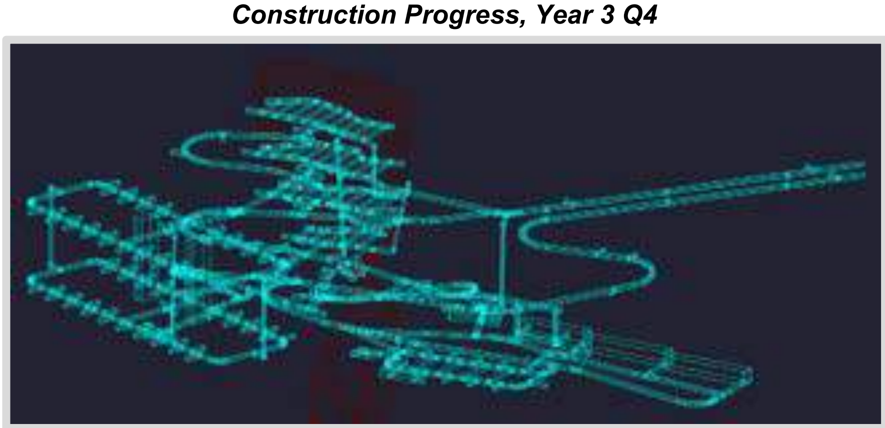


Figure 5.4-6 Underground Development - Construction Phase

When the declines reach the 75 metre depth, excavation of the aggregate stoping areas will begin. The 175 m level will host the primary crusher station, truck dump, detonator magazine and explosives magazine. The production levels will also begin at the 175 m level. The layout of the 175 m level is shown on Figure 5.4-7.

Figure 5.4-7 Layout of the 175 m Level

The mine and mill control, warehouse and maintenance facilities will be located on the 200 m level. The grinding and flotation plant will also be located at this depth. Storage areas for processing reagents will be located above the mill.

The positioning of process facilities will make use of the three dimensional layout options available in an underground location, with parallel operations separated by rock using a 3:1 pillar:opening ratio. Warehouse space will be configured to keep materials close to where they are needed. The final optimization of underground facilities will take place during detailed design.

At this stage, the aggregate stopes will be developed sufficiently to provide aggregate extraction, initial tailings storage, and temporary bulk storage of materials needed for the mill level development.

The construction of the 200 m level concentrator will consist of 870 m of drift, 272 m of 15 x 15 m excavations and 300 m of vertical excavation for bins. Additional work crews will be added during the mill level excavations. These crews will also construct the 200 m level warehouse, shops and facilities, which will consist of 906 m of 5 m by 5 m development and 260 m of 12 m x 12 m excavation for these facilities. This will be followed by the final excavations at the 175 m level for the crushing facility, which will consist of a 906 m of 5 m x 5 m excavation, 50 m of 12 m x 16 m excavation, and 300 m of 17 m x 24 m excavation.

At the end of the construction phase, installation of the processing facility will be completed, excavations to the ore body will have been completed on the 125 m level and the 175 m level, and two aggregate stopes will have been excavated.

5.4.6 Development Rock

Granodiorite rock extracted during the development of the portal, ramp and aggregate stopes will be used as construction aggregate, backfill, road construction and concrete production. The development rock is expected to have negligible ARD/ML potential (Technical Supporting Document 5). Geochemical testing of aggregate material will be ongoing during the construction and operations phases. The geochemistry monitoring plan is outlined the Environmental Management System (Volume 4).

The contrast between the ore body and surrounding granodiorite is quite apparent and there is no anticipated PAG development rock expected from the development of the underground infrastructure during the construction phase. There is potential for PAG development rock to be encountered during the final stages of construction as the access to the ore is developed. This rock will be stored and disposed of underground. An allowance has been made to temporarily store PAG development rock on surface in a lined facility next to the aggregate stockpile area in the unexpected event sufficient storage underground is not yet available.

Treatment of run-off water from any stored PAG development rock underground will utilize dolomite excavated during portal development.

An aggregate crushing and screening plant will be established at surface near the portal to produce and stockpile the various sizes and types of material needed for construction (Figure 5.4-3) of the mine and the all-season road. Surface water drainage from the area will be controlled and routed to a surface water collection pond.

The estimated aggregate volume to be produced during the construction phase is shown in Table 5.4-9. Aggregate production will continue during mine operations.

Table 5.4—9 Aggregate Production during Construction Phase

Construction Phase	Year 1	Year 2	Year 3
Aggregate Production (t)	170,016	643,860	758,664

A concrete batching plant will be installed near the portal and used during construction of the mine and ancillary facilities. Three concrete trucks with 5 m^3 capacity will be used on a year-round basis. As the mine development finishes, this batch plant will be integrated into the backfill plant to be placed at the same location.

5.4.7 Overburden Stockpiling

Overburden stockpiles (including separate mineral soils and organic soils stockpiles) from the development of the portal will be located adjacent to the aggregate stockpiles and surface water drainage will be controlled and routed to the surface water collection pond. The location of the containment areas and surface water collection pond is shown on Figure 5.4-3.

5.4.8 Explosives Manufacture, Storage, Transportation and Use

A qualified explosives contractor will be contracted to establish manufacturing, storage and delivery services for bulk and packaged explosives. During the construction phase, the ammonium nitrate fuel oil (ANFO) blasting agent for the development of the underground mine will be manufactured on-site in a temporary manufacturing and storage facility. The facility will meet NRCan's requirements under the *Explosives Act* (NRCan, 1985). Stick-type explosives, boosters and detonators will be stored in three separate magazines, located away from the explosives plant in accordance to *Ontario Mining Act* requirements. The ANFO production will be less than 1,000 kg/day. Raw materials will be stored away from the plant so the separation requirements from other work areas will be minimized. The explosives magazines will be sized to store a one year supply of material in two locations (50,000 tonnes at each site), bermed and separated by 500 m (distances to be confirmed with NRCan during licensing). Waste materials from the ANFO plant will be collected for shipment to a licensed off-site landfill. The location of the temporary explosives plant is shown on Figure 5.4-3. During operations, the explosives will be prepared off-site and transported to the mine for direct shipment to the underground storage magazines.

ANFO spills will be swept up and disposed in a burning ground, as per explosives regulations. Some ANFO will be spilled during explosives loading operations at the development headings and will be swept up and disposed as at the plant, however some spilt ANFO may dissolve in the water at the heading and will be pumped to the surface collection pond. Testing of the water in the pond and treatment (including oil recovery) will be made before releasing water to the environment.

5.4.9 Fuel Supply, Storage and Distribution

A fuel storage facility (tank farm) will be installed early in the construction phase to meet the diesel fuel requirements for the life of the Project. Temporary double-walled Envirotanks will also be used during the construction period. The fuel storage and distribution facility will be located in the production area (Figure 5.1-2).

The tank farm will consist of three steel fuel storage tanks, each with a capacity of 850,000 L. The tank farm containment will have a capacity of one storage tank plus 10% (i.e. 850,000 L plus 85,000 L). The tank farm containment will be built with a 1.25 m sub grade base, a 0.15 m layer of sand with one layer of geo-grid and one layer of HDPE liner, and topped with 200 mm of crushed aggregate. The HDPE liner will run up the slopes and extend to the top of the berms. The berms will be constructed to a height of 2 m and have a slope of 2H:1V.

Diesel fuel will be delivered to the site by tanker trucks and will be unloaded into the main tank farm. Diesel fuel from the main tank farm will be distributed by site fuel trucks to various consumption points, including the camp facilities, incinerator, and surface and underground vehicles. Each facility will have day tanks, as required. Fuel lines connecting fuel tanks to the power plant will be installed above ground with supports and insulation.

Maximizing the use of electric equipment for the underground operations at the Project will result in a lower overall rate of fuel consumption compared to conventional underground mines utilizing diesel-powered mobile equipment. Pipelines to convey diesel fuel from surface to underground will not be required.

The estimated diesel fuel requirement during the construction phase is outlined in Table 5.4-10.

Table 5.4—10 Construction Phase Diesel Fuel Requirements

Construction Phase			
	Year 1	Year 2	Year 3
Fuel Requirements (litres)	700,000	3,500,000	4,000,000

Minor quantities of gasoline will likely also be required and may be stored in a double-lined Envirotank or in drums within a bermed storage area.

5.4.10 Mine Site Camp Facilities Supporting Construction

The existing exploration camp (Esker Camp) will be used for accommodations and staging during the first two years of the construction phase. The camp will gradually be expanded from approximately 85 person capacity at the start of construction to a peak force of 190 persons early in the second year of construction. This camp will be removed at the end of the construction phase. Camp facilities will also include construction offices, a nursing station, a mine dry, a kitchen, and a dining room. Potable water will be supplied from local groundwater wells currently used at Esker Camp. The operations phase accommodations facility will be moved to site in modules early in the second year of construction and will replace Esker Camp in the second quarter of that year.

Power to the construction camp will be supplied by temporary generators reaching a maximum capacity of 1.5 MW. Mine construction activities will require an additional 3 MW of temporary generators.

5.4.11 Sewage and Solid Waste Management

Sewage will be treated by the rotating biological contactor (RBC) system currently located at Esker camp site for just over the first year of the construction phase. The new accommodation facilities and sewage treatment system will be operational in the second year of construction and will be permitted by an Environmental Compliance Approval (ECA) by the MOE. The discharge location from the sewage treatment plant is shown on Figure 5.1-1.

Solid waste management during the construction, operation and closure phases of the Project will consist of a waste management facility equipped with an incinerator. No landfill will be constructed at the mine site. Materials not suitable for incineration, such as recyclables, including plastic, tin, and glass, will be sorted compacted and stored until they can be shipped out to an off-site licensed landfill facility. Scrap metal will be stored on-site with the recyclables until it can be shipped off site or reused. Wood packaging will be burned on site or transported off-site, as appropriate.

The on-site incinerator will be the primary means of disposing of combustible, non-hazardous domestic waste, and will be installed at the waste management facility in the first year of construction (Figure 5.4-3). The incinerator will be operated and maintained to meet applicable requirements in Guideline A-7 for remote locations in northern Ontario (MOE, 2010). The daily design capacity for the mine site incinerator is 3 tonnes. The MOE recognizes that remote facilities can utilize the convenience of on-site thermal controlled burning because the system components avoid temperatures that are known to promote toxic flue gas formation (MOE, 2010).

5.4.12 Surface Water Management during Construction

During the construction of the all-season road and mine site facilities, surface water will be managed to prevent the degradation of water quality or the damage and destruction of aquatic habitat. The installation of temporary erosion and sediment control features using "Best Management Practices" (BMPs) will be the first step towards controlling sediment and erosion during construction. All temporary sediment and erosion control features will require regular maintenance and will be reclaimed after achieving soil and sediment stabilization. Sediment mobilization and erosion will be managed by:

- Installing sediment controls prior to construction activities
- Limiting the extents of soil disturbance, as much as is practical
- Reducing water velocity across the ground, particularly on exposed surfaces and in areas where water can gather or pool
- Progressively rehabilitating disturbed land and constructing drainage controls to improve the stability of rehabilitated land
- Protecting natural drainages and watercourses by constructing appropriate sediment control devices such as collection and diversion ditches, sediment traps and sediment ponds

A surface water collection pond will be built early in the construction phase to ensure surface water from the mine development area is properly managed. The details and design parameters of the surface water collection pond are discussed in a following Section.

5.4.13 Groundwater Management during Construction

Groundwater is expected to seep into the underground workings during the construction of the portal, ramps, and underground infrastructure. The greatest volume of inflow is expected during the development of the ramps as the fractured bedrock near surface exhibits the highest hydraulic conductivity. Mitigation measures, including grouting of the portal and ramp area, will be employed to minimize groundwater inflow to the underground workings. Fractures or fault zones will be avoided where possible. Grouting will be carried out where they are encountered during the development of the mine.

Mine water from the underground development will be collected in sumps and pumped to the surface water runoff collection pond for monitoring and treatment, if required. Pumping of underground water to the surface is expected to peak at the end of the construction phase when the maximum extent of underground development has occurred and the processing facility is not yet operational. The construction phase water balance is outlined in Section 5.9.5.1.

5.4.14 Trans-load Facility

The trans-load facility will be established during the third and final year of construction. The trans-load facility will be located approximately 5 km east of the community of Savant Lake at a brownfield site alongside the CN mainline, which was formerly a rail siding used by the forestry industry (Figures 5.1-3 and 5.1-4). Construction activities at the trans-load facility will include:

- Upgrading of the forestry access road from Highway 599 to the trans-load facility
- Upgrading the existing rail siding
- Development of a lined surface water collection pond

- Site grading and asphalt paving to direct surface runoff to the collection pond
- Installation of a pre-engineered steel building to contain all transfer equipment, stored concentrate, and to house the rail car loading area
- Installation of an equipment shed for the loader and rail car mover
- Re-establishment of a power line from the existing electrical grid to the site using an existing utility right of way (ROW)
- Installation of on-site backup diesel generation (750 kW)
- Installation of office facilities
- Establishment of septic system for treatment of sewage and greywater
- Installation of a fueling station with secondary containment (10,000 litre tank)
- Wash bay for site equipment with oil-water separator

The current disturbed area at the rail siding is large enough to accommodate the facility and there will be minimal new ground disturbance.

5.4.15 Environmental Discharges during Construction

The discharges to the environment during construction phase will include:

- Water:
    - Mine site surface runoff
    - Groundwater pumped to surface from the development of portal, ramp and underground facilities
    - Surface runoff from road and site construction
    - Treated sewage from construction camps
- Air and Noise:
    - Emissions from temporary generators at mine site and construction camps
    - Incinerator emissions at mine site
    - Emissions from mobile equipment

5.5 MINE OPERATION

5.5.1 Overview

The Eagle's Nest deposit is a high grade nickel-copper-platinum-palladium mineralized pipe up to 60 m across and 200 m length on strike. The ore body is hosted in highly competent granodiorite. Micon International Inc. produced the National Instrument 43-101 compliant Technical Report in October of 2012, noting reserves of 11.1 million tonnes of ore (1.68% nickel, 0.87% copper, 0.89 g/t platinum, 3.09 g/t palladium and 0.18 g/t gold), plus another 9.6 million tonnes of inferred resource, which through additional geological investigation may extend the mine life to 20 years. The ore body currently shows potential for additional resource at depth.

The mine plan involves underground mining techniques with the placement of many facilities underground, including mineral processing and tailings management. The mining of the deposit will be undertaken using bulk stoping techniques with highly automated underground mining techniques including electrical mobile equipment. Similar techniques will be used to extract granodiorite rock for use as aggregate rock to develop roads and other infrastructure. Paste and cemented paste tailings will be used to backfill mined voids. The aggregate stopes will be used for disposal of remaining tailings. Key mine plan parameters are shown in Table 5.5-1.

Table 5.5—1 Key Mine Plan Parameters

Parameter	Value
Mine Life	11 years
Daily Ore Production	2,960 tonnes/day
Daily Concentrate Production	420 tonnes/day
Daily Aggregate Production	1,350 tonnes/day

5.5.2 Mining Technique

The deposit is ideally suited to underground bulk mining using blast hole stoping techniques (due to the geometry, grade, and the host rock strength). The mine will utilize a method referred to as slot/slash or longhole mining, which involves driving drifts transversely across the orebody. Initially, a slot will be created at the contact with the hanging wall using longhole drilling and blasting techniques. Once the slot has been formed, ore will be blasted to the slot and removed via remote mucking for truck haulage to the processing facility. The stope will then be backfilled with cemented tailings, so adjacent stopes can be mined.

Construction of the stopes will occur from the main extraction drift connected to the ramp. The extraction drifts connect to upper and lower sill drifts and the sill drifts will be of sufficient size to accommodate the mining equipment. Once a slot is opened, the remainder of the drilling and blasting will be carried out with conventional in-the-hole equipment and slurry explosives.

The compactness of the Eagle's Nest deposit will allow for short underground travel distances and it is expected that, with good fragmentation, rock handling through main passes to feed the main crushing station will be highly efficient. Readers wishing more information on the mine design are encouraged to review the Technical Report available at Noront's website: www.norontresources.com.

5.5.3 Mining Equipment

The mining method will use the most advanced proven technology available. A main telecommunication/computer networking system will originate from an underground operations centre. The system will connect to mining equipment used in delineation drilling, development, production, backfilling and infrastructure support systems (e.g. ventilation, dewatering, electrical and micro-seismic monitoring, etc.).

The development equipment fleet will consist of jumbo drills, machines for loading of emulsion explosives and primers, load-haul-dump machines, ground support equipment and trucks. Two fleets of equipment will be used in the mine to meet the required development schedule. Ground support, with mechanical bolting and screening, cannot be automated easily but will incorporate spray-on ground support (e.g. shotcrete), as required.

Production mining equipment will consist of a fleet of longhole production drills, emulsion explosives loaders, and haulage trucks. The infrastructure systems, including electric haulage trucking, crushing, bin control and processing will use the same digital control system to operate the equipment in the field. Handheld devices will be supplied that allow some wireless control of the muck handling system.

Tele-remote controlled equipment if adopted may permit unmanned mining to take place in the lower levels of the mine, below overlying cemented backfilled stopes. All equipment connected to the control stations in the operations centre will have on-board computer systems to support manual and tele-remote operation. Each piece of equipment will include positioning and navigation systems as part of the base package.

5.5.4 Explosives Manufacture, Storage, Transportation and Use

During the operations phase of the mine, the explosives for the underground mining will be manufactured off-site and transported to the mine site and stored underground in licensed magazines, meeting Ministry of Labour and NRCan requirements under the *Explosives Act* (NRCan, 1985).

5.5.5 Underground Mine Development

The mining will take place in three phases. The first phase represents the initial construction of the underground mine, which is outlined in Section 5.4.5. The second phase involves the development of the upper zone of the ore body (down to the 175 m levels). The first ore to be mined and processed will be extracted from between the 125 m and 175 m levels. Standard primary-secondary sequencing will allow backfilling of ore stopes with cemented tailings before mining starts in the adjacent stopes. The development of twin declines to the 575 m level will be concurrent with mining in the upper zone. The development and production of the upper zone of the ore body will take place during the first three years of operations.

The orebody pinches out between the 175 m and the 275 m level. The development of the lower zone of the ore body (below the 275 m level) will be initiated from the 575 m level in the third year of production. Development at this level will be concurrent with the extraction of the crown pillar, which is described in Section 5.5.7. Once the crown pillar is extracted, development will continue in the lower zone for the remainder of the mine life. The development of the mine production levels is shown on Figure 5.5-1 and the mine workings at the end of mining are shown on Figure 5.5-2.

5.5.6 Aggregate Stope Mining

Aggregate stopes will be excavated during operations to provide material for infrastructure construction. The long term aggregate stope production rate will average 1,350 tonnes/day. The aggregate stopes will also provide excess tailings storage capacity during regular mining cycles when ore stopes are not available for cemented backfill.

There is a large lateral extent of granodiorite in which to locate the aggregate stopes. They will be accessed from the 175 m level and be located away from the ramp and infrastructure associated with the processing facility. The aggregate stopes will be mined out using the same production practices as the mineralized stopes. The location of the aggregate stopes is shown on Figure 5.5-1.

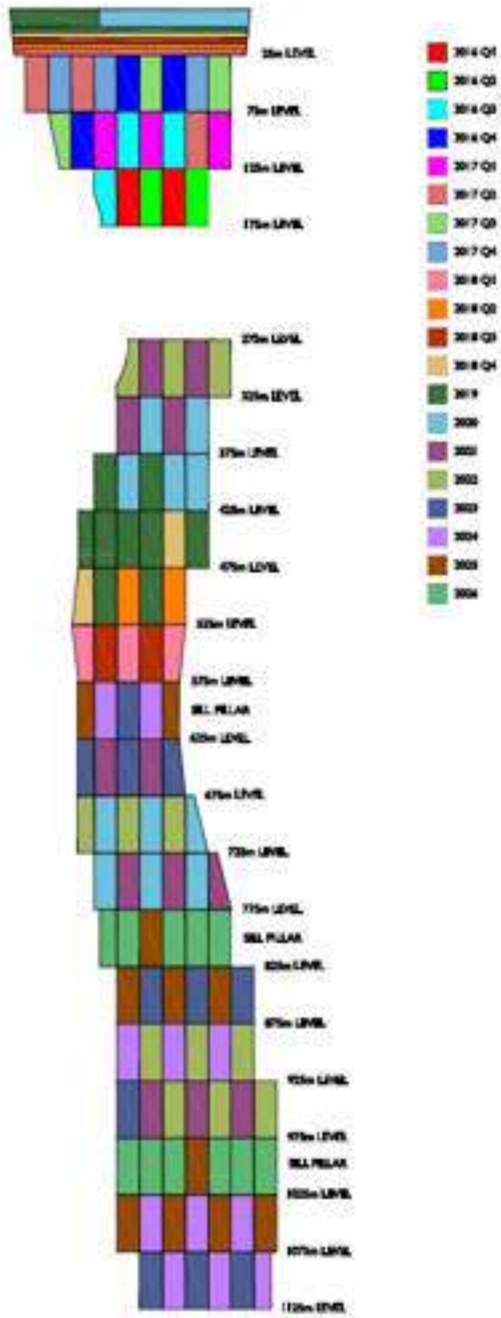


Figure 5.5-1 Mine Life Development Plan

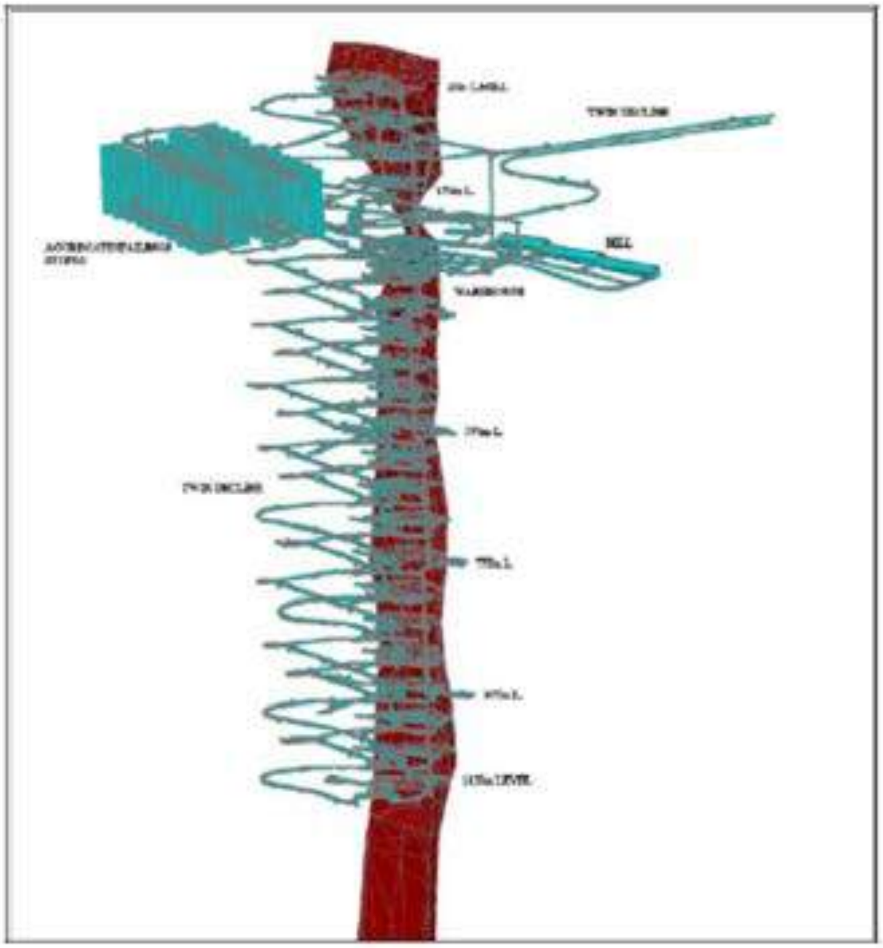


Figure 5.5-2 Mine Workings at End of Production

5.5.7 Extraction of Crown Pillar

The extraction of the crown pillar will begin concurrently with the development of the lower zone of the mine (i.e. in the third year of production) and will be completed over a one year period. On surface, the perimeter of the crown pillar will be excavated and a concrete barrier constructed using cemented aggregate rock from the paste backfill plant. The concrete barrier will extend from surface to bedrock. The upper bedrock horizon is fractured and weathered and more permeable than the rock below. As such, this area of bedrock will be drilled with a ring of holes and injected with cement grout to reduce water ingress to the mine during the extraction of the crown pillar.

Once the concrete barrier is in place, overburden material (peat, clay, sand) inside the perimeter will be extracted and stockpiled for later reclamation. The crown pillar, which extends to a depth of 25 m below the top of the bedrock, will be drilled, blasted, and extracted from below and the ore will be transported to the processing facility via underground tunnels and passes.

Once extracted, the crown pillar will be backfilled up to several metres below the water table using cemented tailings. To eliminate the potential for ARD/ML, the cemented backfilled tailings will be capped with cemented aggregate. The stages in the extraction of the crown pillar are shown on Figure 5.5-3.

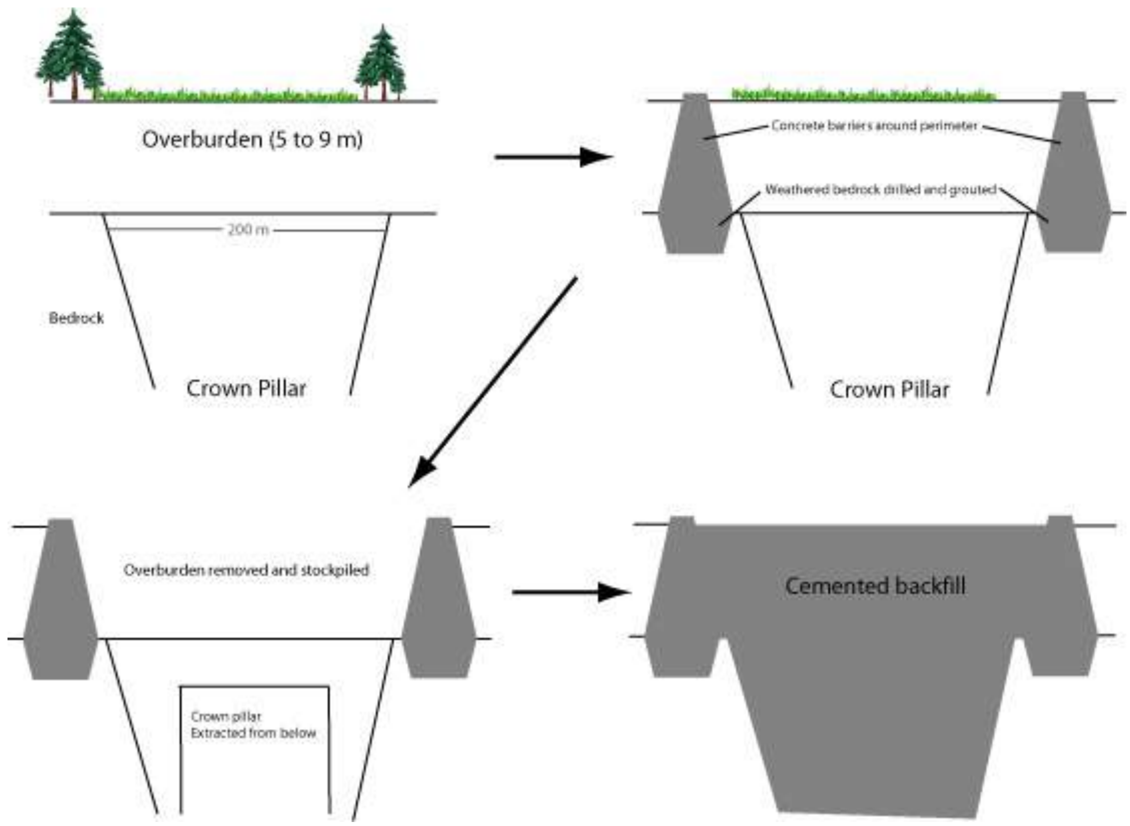


Figure 5.5-3 Extraction of Crown Pillar

5.5.8 Mine Ventilation

Ventilation requirements for the proposed underground operations are based on the Regulations for Mines and Mining Plants in Ontario, standard ventilation engineering practices, and experience in the ventilation of mines at similar depths and production rates.

The ventilation system has been designed at 450,000 cfm, with the mill being ventilated with 50,000 cfm and the warehouse complex with 80,000 cfm. A 56 MMBTUH indirect oil fired mine air heating system and 2 x 350 HP booster fans will be located at the portal and will provided tempered air for the initial development and mining. The system will be equipped with variable frequency drives that will allow a staged increase in the mine air volume requirements. As development and mining progresses, a 4 m diameter fresh air raise will be installed with 2 x 250 HP booster fans on the 125 m level.

The greatest ventilation requirement will be during full scale mine and mill production. Regulations require 100 CFM per diesel motor horsepower, a factor that is increased by 25% to account for system losses. Also included is ventilation for the underground mill. Ventilation requirements for the mill assume that a volume equal to the mill volume needs to be replaced on an hourly basis. Using a 100% utilization factor on the operating mine trucks and load-haul-dump fleet, and a 30% utilization factor on the balance of the underground mine fleet, an estimated total underground ventilation is 750,000 CFM. Noront is examining the use of electrically powered mining equipment to reduce ventilation requirements. Ventilation requirements for the concentrator are also being reviewed. Minimal heating of fresh air will reduce power consumption, while utilizing electric powered haul trucks and LHD units potentially reduces ventilation requirements to 450,000 CFM.

5.6 PROCESSING

5.6.1 Processing Facility Overview

The Eagle's Nest mine will be highly productive for its size due to the uniform shape of the deposit, its suitability to blast hole stoping methods, and the combining of mining processes that shorten normal stope cycle times. A production rate of 2,960 tonnes/day has been selected based on the following properties:

- The compact dimensions of the deposit allows for transverse stoping from a footwall access drift
- The shape of the mineralization facilitates a repetitive design and layout of mine workings from level to level
- The vertical nature of the deposit allows materials handling to be carried out using standard and automated processes that have relatively low labour requirements
- The competence of the host rock and mineralization which will allow conventional ground support methods. It is not anticipated that production will often be interrupted due to unexpected ground control issues.

Ore processing will comprise conventional crushing, grinding, flotation and concentrate dewatering to produce a single concentrate containing typically 10.2% Ni, 5.7 % Cu, 19 g/t Pd, 5 g/t Pt, 1 g/t Au and 13 g/t Ag. The annual production schedule of the processing facility is summarized Table 5.6-1.

Table 5.6—1 Processing Facility Production Schedule

Criterion	Units	Process Average
Operating Time	days	365
Ore to mill	tonnes/year	1,080,000
Concentrate Production	dry tonnes/year	153,000
	dry tonnes/day	420

The main processing facilities will be built underground, including the warehouse and maintenance shops to service equipment. The underground location will reduce the use of concrete foundations to be constructed on surface under challenging soil conditions. This arrangement will also decrease the surface footprint of the Project.

The underground processing facility will consist of:

- Primary, secondary, and tertiary crushing equipment with associated conveyors and screens
- Coarse and fine ore bins
- Grinding mills for massive and net-textured ore
- Flotation circuits
- Reagent storage and preparation tanks
- Slurry preparation and pumping facility
- A 30,000 t capacity cement storage facility

The concentrate and tailings will be pumped to the surface processing facility into thickening tanks for primary dewatering. From there, the tailings will either be pumped to the backfill plant for blending with cement to form cemented paste fill, or filtered and pumped directly to the empty aggregate stopes for storage as paste tailings. A simplified process flow diagram is shown on Figure 5.6-1.

The on-surface processing facility building will be located adjacent to the power plant near the portal area. This building will house surface process equipment for concentrate dewatering, drying/cooling and storage, handling, and load-out. Locating the processing facility building near the power plant will allow a heat recovery system to recover heat from the diesel exhaust for use in concentrate drying.

5.6.2 Crushing

The run-of-mine ore will be delivered to an underground grizzly with 0.6 m by 0.6 m openings positioned over a 400 tonne per hour capacity jaw crusher. Oversize materials will be broken using a hydraulic boom breaker on top of the grizzly. The crushed product will be conveyed to either the 3,000 tonne capacity net-textured crushed storage bin or the 3,000 tonne capacity massive ore storage bin. Net-textured and massive mineralization will be campaigned separately through the crushing facility. The crushing storage areas will be located underground and will have dust collection systems installed.

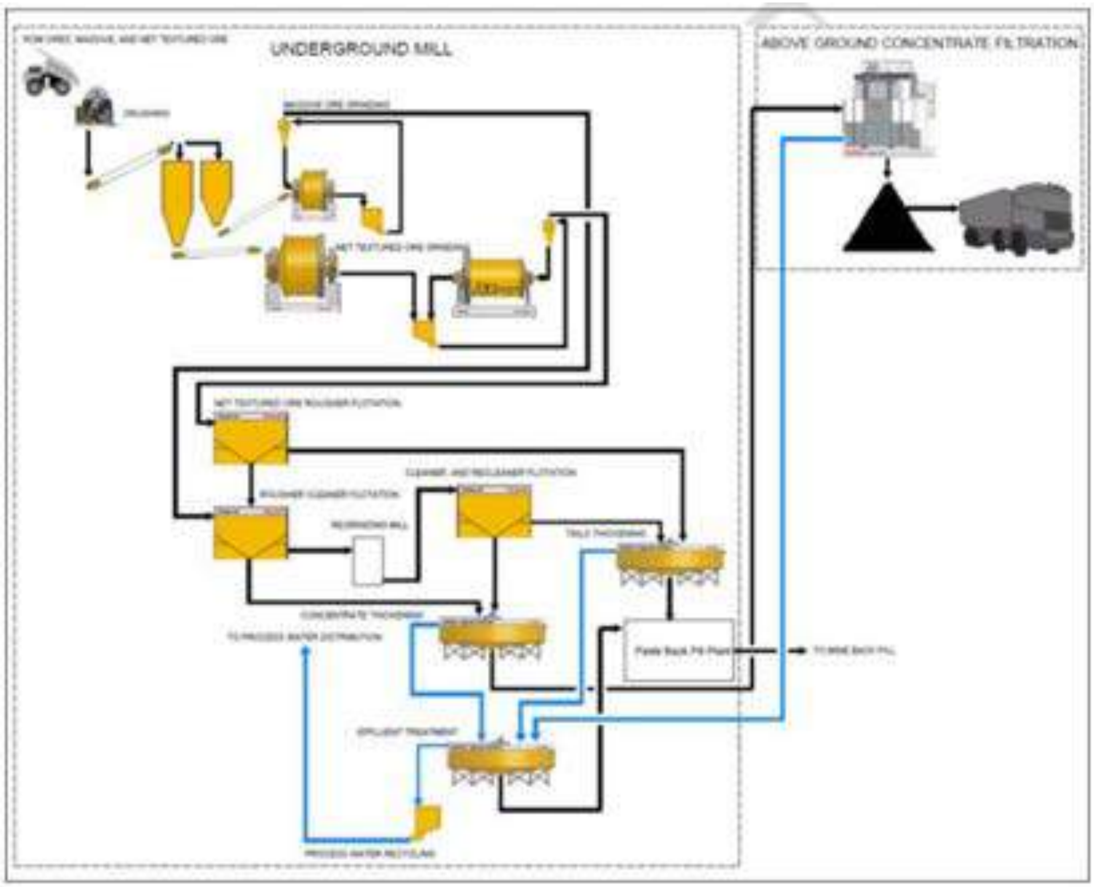


Figure 5.6-1 Process Flow Diagram - Mine Site

5.6.3 Grinding

Underground feeders below the net-textured and massive ore bins will feed the net-textured and massive semi-autogenous grinding (SAG) mill feed belt conveyors, of which both will be equipped with a belt scale. The products from the net-textured SAG mill and the massive ore SAG mill will be screened and oversize material (pebbles) will be conveyed to a pebble crusher. A cone crusher will process pebbles from both grinding circuits and the product will discharge onto the net-textured SAG mill feed conveyor.

The fine discharge from the massive SAG mill will be pumped to a cyclone cluster. The cyclone overflow product, with a target particle size of P_{80} 100 µm, will be forwarded directly to the primary flotation cleaning circuit. The underflow will go back into the SAG mill for further grinding.

The fine product from the net-textured SAG mill will be combined with the secondary ball mill discharge and pumped to another cluster of cyclones. This cyclone overflow with a target particle size of P_{80} 55 µm will feed the rougher flotation circuit and the underflow will feed the ball mill.

On average, the processing facility will mill 420 tonnes/day of massive ore and 2,540 tonnes/day of net-textured material. The net-textured milling circuit will be designed for between 2,250 to 3,000 tonnes/day.

5.6.4 Flotation

The flotation circuit is shown on Figure 5.6-1. The rougher concentrate will be directed to the first cleaning circuit, where it will join the aerated massive ore cyclone overflow stream. The scavenger concentrate will feed the re-grind circuit and the scavenger tailings will be pumped to the tailings thickener.

Prior to the cleaning stage, the massive ore cyclone overflow product will be aerated in two aeration tanks. The concentrate from the cleaner cells will be pumped to the concentrate thickener and the cleaner tailing will feed the re-grind circuit.

The feed of the re-grinding circuit comprises the scavenger concentrate, first cleaner tails, scavenger cleaner concentrate and scavenger re-cleaner tailings. The purpose of the re-grind mill circuit is to produce a product with a target P_{80} of 35 μm.

The overflow of the re-grind circuit cyclones will feed the scavenger cleaner circuit, which will comprise eight scavenger cleaner flotation tank cells. The concentrate from these scavenger cleaner cells will feed a scavenger re-cleaner circuit containing three flotation tank cells. The concentrate from the scavenger re-cleaners will join the cleaner concentrate and be pumped to the concentrate thickener.

The cleaner concentrate and scavenger re-cleaner concentrate will be combined into a single slurry product and pumped to surface through a 0.20 m diameter pipe. The pumps will be positive displacement pumps, and the pipe will discharge on surface into a high rate thickener.

5.6.5 Concentrate Dewatering, Drying and Cooling

The thickener underflow will be stored in two 600 m^3 agitated holding tanks that will ensure that there will be enough storage capacity prior to pumping thickened concentrate to the filters. Any overflow from the concentrate thickener will feed the underground effluent treatment plant.

A filter press in the process plant will be used for concentrate dewatering. Due to the self-heating nature of moist nickel concentrate, drying and cooling will be required to bring it to a stable state for storage and transport. Wet filter cake with a design moisture content of 8 % will be transported from the filter press to the dryer by belt conveyor. A screw conveyor at the dryer inlet will maintain a consistent material feed rate into the dryer.

Hot flue gases recovered from the diesel generation power plant will facilitate the drying process. The drying process will be fully automated and will have the flexibility to mix ambient outdoor air with the flue gas to accommodate changing heat requirements with feed rate and moisture content.

Concentrate will be discharged from the dryer with a design moisture content less than 0.3%. The dry, fluidized material will enter a bag house, where diesel exhaust and water vapor from evaporation will be vented to the exterior atmosphere at a temperature of 120°C. Dry concentrate will be collected in the bag house hopper and fed into the cooler. The cooling operation will use process water to cool the dry concentrate from 120°C to approximately 30°C. Cooling water will be recirculated for cooling and reuse.

5.6.6 Concentrate Handling and Load Out

An air-gravity conveyor at the cooler discharge will transport the cool, dry concentrate to an airlift, which will transport material vertically to gain the necessary elevation to fill the storage bins. An air-gravity conveyor with three discharge points will accept feed from the airlift and automatically discharge 25 tonnes/hour into one of the three overhead 800 tonne capacity storage bins equipped with bin fill level indicators. The system will be totally enclosed, thereby eliminating dust emissions to the surrounding environment. The pneumatic conveying system will be powered by a total of three positive displacement blowers.

A truck load-out system will consist of all equipment downstream of the storage bins. When an empty truck is parked on the truck scale, the operator and/or truck driver will position the loading spout above the truck hopper inlet and initiate a fill sequence. Initiating a fill sequence will start a multiple inlet air-gravity conveyor, which will accept discharge from one of three bins via a pneumatic rotary valve. The conveyor will discharge into one of the loading hoppers. The storage bins will be equipped with bin aerator to assist in fluidizing material while discharging from the bins. The discharge of the loading hopper will be equipped with a truck loading spout that will fill the hopper truck at a rate of 200 tonnes/hour. A 35 tonne truck will be filled in approximately 10 minutes. The automated truck scale will eliminate overfilling and material spillage by automatically reducing and stopping the flow rate at predetermined set points. The loading spout lowers into the truck to reduce dust generation and loss of material.

5.6.7 Tailings Dewatering

Process tailings will be thickened in a high rate thickener located underground. The thickener underflow, with a slurry density of approximately 60% solids by weight, will be pumped to the filter feed holding tanks. A portion of the thickener overflow will feed the effluent treatment plant, while the remainder will be recycled as process water.

The tailings thickener underflow and the underflow of the effluent treatment clarifier will be collected in the filter feed holding tank and fed to the vacuum disc filters (filter area 120 m^2). Filtrate will feed the tailings thickener and the filter cake will be fed to the backfill plant.

5.6.8 Process Effluent Recycle and Treatment

The processing facility will operate at a water deficit and process water will not be returned to the environment. A portion of the concentrate and tailings thickener overflow streams will feed the underground effluent treatment plant for recycling into process water. The treatment facility is designed to process up to 70 m3/h of effluent and will be designed to remove heavy metals and sulphates. The effluent treatment plant sludge will be combined with the process tailings for disposal. The effluent treatment plant package will consist of oxidation, precipitation, solid-liquid separation, reagent preparation and auxiliary systems.

5.6.9 Reagents and Process Consumables

A number of reagents and process consumables will be used in flotation, de-watering and water treatment facility operation:

- Flotation collector (sodium isopropyl xanthate): 55 to 77 tonnes/year
- Flotation frother (methyl isobutyl carbinol): 22 to 28 tonnes/year
- Flotation gangue depressant (carboxyl methyl cellulose): 66 to 1,101 tonnes/year
- Concentrate flocculant: 7 to 8 tonnes/year
- Tailings flocculant: 21 to 25 tonnes/year
- Processing facility, quicklime: 315 to 385 tonnes/year
- Effluent treatment, quicklime: 317 to 631 tonnes/year
- Effluent treatment, ferric sulphate: 0 to 32 tonnes/year
- Effluent treatment, aluminium compound: 158 to 1,182 tonnes/year
- Effluent treatment, hydrochloric acid: 237 to 396 tonnes/year
- Effluent treatment, flocculant: 8 to 12 tonnes/year
- SAG mill - massive ore grinding media: 18 to 44 tonnes/year
- SAG mill - net textured ore grinding media: 378 to 453 tonnes/year
- Ball mill - net textured ore grinding media: 838 to 1,005 tonnes/year
- Regrind mill grinding media: 222 to 266 tonnes/year

Reagent solutions will be stored underground in separate holding tanks and will be added, as required, to the process by metering pumps. Each reagent will have its own preparation system, including a bulk handling system and mixing and holding tanks. The mixing and holding tanks will be equipped with level indicators and instrumentation to ensure that spills do not occur during normal operation. Appropriate ventilation, eye-wash stations, safety showers, fire and safety protection, and Material Safety Data Sheet stations will be provided at the reagent preparation areas.

5.6.10 Process Water Balance

During operations, the underground process facility will require water in the grinding, flotation, and tailings thickening circuits at a rate of 150 m^3/h. The process water requirements will be satisfied from:

- Water in ore (6.5 m^3/h)
- Recycled process water treated in an underground treatment plant (20 m^3/h)
- Recycled water from the concentrate drying circuit and mine drilling activities (61 m^3/h)
- Water reclaimed from un-cemented backfilled tailings seepage (17 m^3/h)
- Maximum estimated inflow to the underground workings (21 m^3/h)
- Freshwater make-up (24 m^3/h)

Water loss from the processing facility will include:

- Water retained in the voids of the cemented and un-cemented backfilled tailings (49 m^3/h)
- Water retained in the concentrate (3 m^3/h).

The freshwater make-up will be supplied from the surface freshwater tank. The process water balance is shown on Figure 5.6-2.

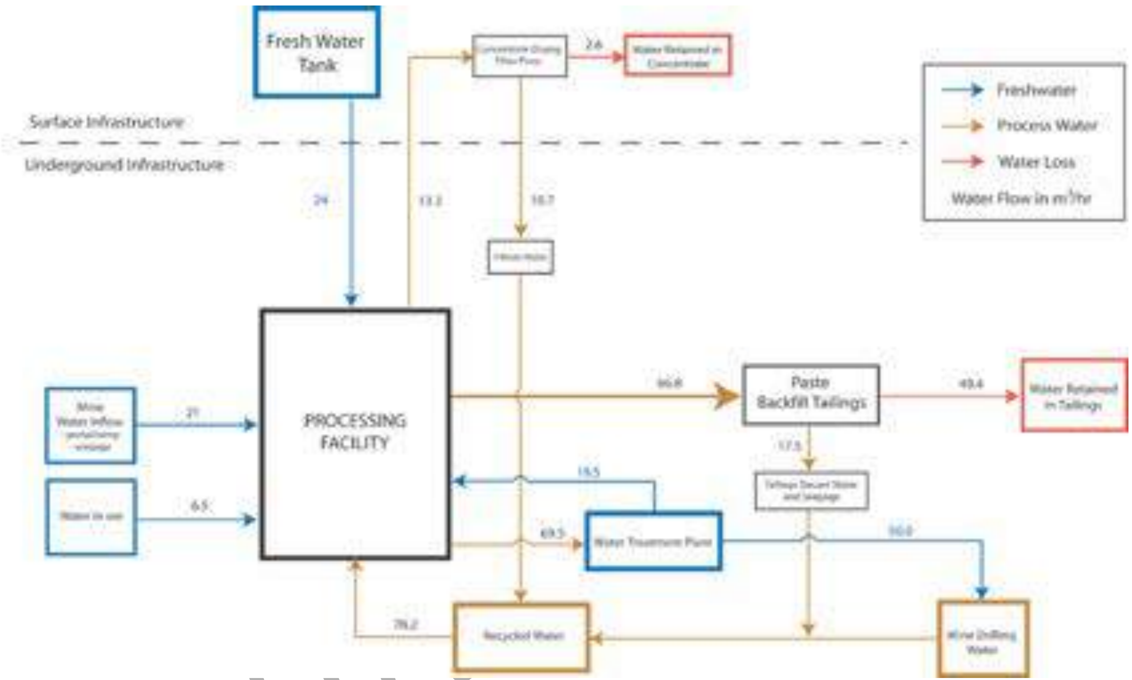


Figure 5.6-2 Process Water Balance

5.7 CONCENTRATE TRANSPORT

5.7.1 Mine Site to the Trans-load Facility

The concentrate will be transported approximately 550 km along the all-season transportation corridor from the mine site to the trans-load facility near Savant Lake. This route includes a new all-season road constructed from the Pickle Lake North Road to the mine site. Traffic from the mine site to the trans-load facility is expected to average 12 trucks-loads per day, each carrying approximately 35 tonnes of concentrate. A fleet of 12 trucks would complete a round trip each day based on multiple drivers and 24 hour operation. The trucks are loaded from the top and will be covered with a solid cap.

Safe operation of the road will be a key focus for Noront. The truck traffic for the shipment of concentrate and for the re-supply of the mine site will coexist with community traffic along the southern section of the road. It is expected that First Nation communities will establish all-season access to this section of the new road. Sharing of the road with and communication of road information to the communities will be important elements of the operation. Details of the operation of the road are outlined in the All-season Road Management Plan (Volume 4).

5.7.2 Trans-load Facility

The trans-load facility will be used to transfer the concentrate from the trucks to rail cars. The design and construction of the trans-load facility is described in Section 5.4.15.

The truck trailers will discharge from the rear or the side of the trailer into an unloading hopper. Screw conveyors will transport the dry concentrate to a bucket elevator at a design throughput of

200 tonnes/hour. Dust collectors will be used throughout the concentrate handling process and any material trapped by the dust collector will re-enter the process flow in a controlled manner through a rotary valve. The bucket elevator will transport material from the screw conveyors and discharge to an elevated 800 tonne storage bin. The storage bin will, in turn, load the hopper rail cars by gravity feed and a dust controlling loading spout system. When an empty rail car is in position on the rail car scale, the operator will position the loading spout and initiate a fill sequence. When a fill sequence is initiated, the storage bin aeration system will start to assist in fluidizing the material discharging from the bins. The rotary valve at the bin discharge will control the flow of material into the loading spout. The system will automatically shut down when the rail car is full to eliminate spillage in the loading area. Following loading, the rail cars (approximate capacity of 75 tonnes/rail car) will be covered. A total of 166 rail cars will be loaded per month (5.5 per day).

Figure 5.7-1 illustrates the process to be used at trans-load facility for truck unloading and rail car loading.

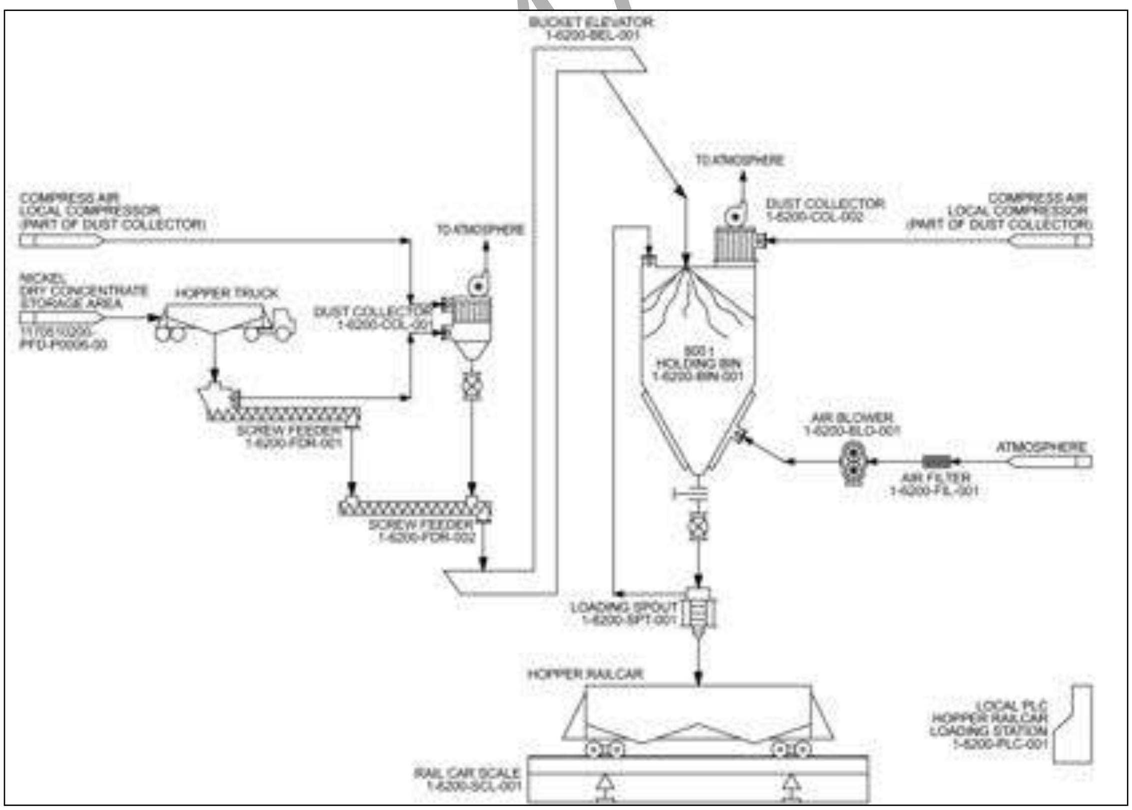


Figure 5.7-1 Process Flow Diagram - Trans-load Facility

An additional 2,500 tonnes of concentrate will be stockpiled in a storage area inside the main building and a loader will be used to move the concentrate to the rail car transfer equipment inside the building when required.

A truck and equipment wash station will be located near the exit of the load-out building. The trucks and loading equipment will be pressure washed as needed to remove any excess dust using minimal water.

The exit area of the building will be paved to capture surface runoff and direct it to the surface water collection pond for monitoring and treatment, if required. Areas outside of the surface water collection area will also be paved to minimize dust, but they will be considered clean and surface runoff will not be collected.

5.8 WASTE MANAGEMENT

5.8.1 Tailings Management

The processing of ore is currently expected to produce 9.5 million tonnes of tailings over the life of the Project. All of the tailings and any PAG waste rock will be stored underground as either paste backfill (PB) or cemented paste backfill (CPB). Integrating tailings (and waste rock) into backfill material is common practice in the mining industry and will reduce or, in this case, eliminate the need for surface tailings disposal. Typical paste backfill mixtures range from 75 to 85% solids by weight and because of the fine grain size, the particles in a paste mixture will not settle out once the mixture is stationary (Zinck and Griffith, 2013).

The CPB will be used to backfill the ore production stopes as CPB's. The backfill will provide the necessary ground support to permit mining of adjacent slopes. The PB will be disposed into the aggregate stopes, since there is no ground support requirement.

5.8.2 Cemented Paste Backfill of Ore Production Stopes

Approximately 65% of the tailings created from the production of ore will be converted to CPB and used to fill the ore production stopes. The ore stope backfilling process will be initiated once mucking is complete in an entire ore stope. The first stage in the disposal process is the creation of a cemented rock plug in the lower mucking horizon. Once the plug is established, rock and paste fill will be mucked into the open stope from the top sill. This will be followed by the remainder of the stopes being filled with CPB. The ore stope backfilling process is outlined on Figure 5.8-1.

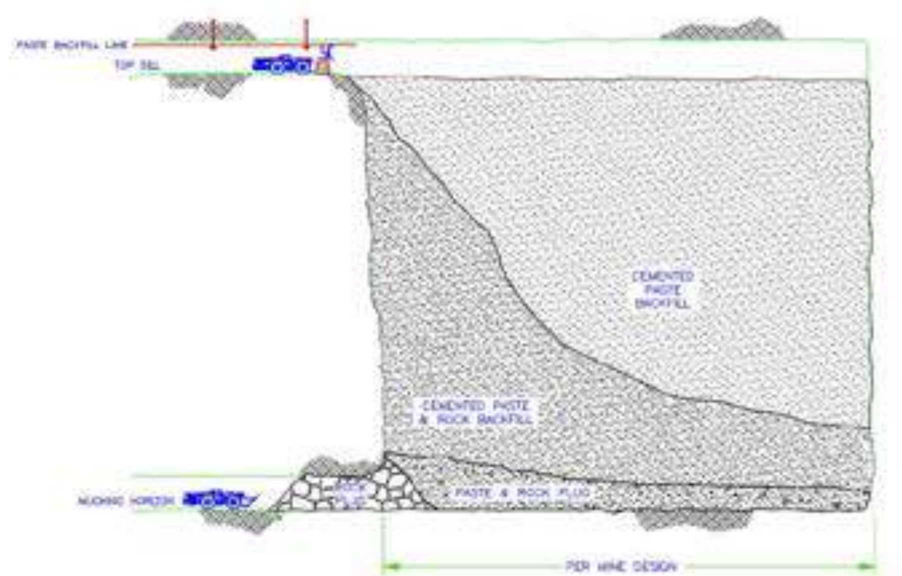


Figure 5.8-1 Ore Production Stope Backfilling Process

The CPB plant will be installed at the processing facility level of the mine and will consist of a tailings thickener system, tailings filters, mixing plant with binder and paste pumping, and an underground distribution system. The thickener will be located adjacent to the final flotation tailings pump box so that the tailings in the thickener underflow are pumped to the backfill plant. This will allow for maximum gravity distribution of CPB to the mining stopes. Approximately 90% of all ore stopes will be filled by gravity, while stopes slightly below the paste backfill plant, and those above, will require paste pumps.

The CPB will consist of 35 m^3/h of water and 36 m^3/h of solids. Approximately 3.8% by weight of cement mixture will be required to generate the CPB. The proper disposal of tailings as CPB will encapsulate the tailings and significantly reduce water and oxygen (air) movement, and essentially seal the tailings from the environment. This will effectively reduce the ARD potential of the CPB. In addition, the cement will act as a neutralizing agent, which will also limit any acid generating or metal leaching concerns during the operation of the mine (MEND, 2006).

5.8.3 Paste Backfill of Aggregate Stopes

The PB will be disposed into the aggregate stopes located between the 75 and 175 m levels. Each stope will have a total volume of 62,500 m^3, generate 168,750 t of aggregate, and store 115,625 t of tailings. A total of 30 stopes of this size will be needed for the PB tailings. Access to each aggregate stope will be through the top and bottom sills. Large engineered concrete bulkheads (keyed plugs) will be placed at the base of each aggregate stope. This will avoid the risk of liquefaction of the un-cemented paste. The overall layout of the aggregate stopes will include large rock pillars on all sides in order to isolate each stope. The deposition of tailings to the aggregate stopes is shown conceptually on Figure 5.8-2.

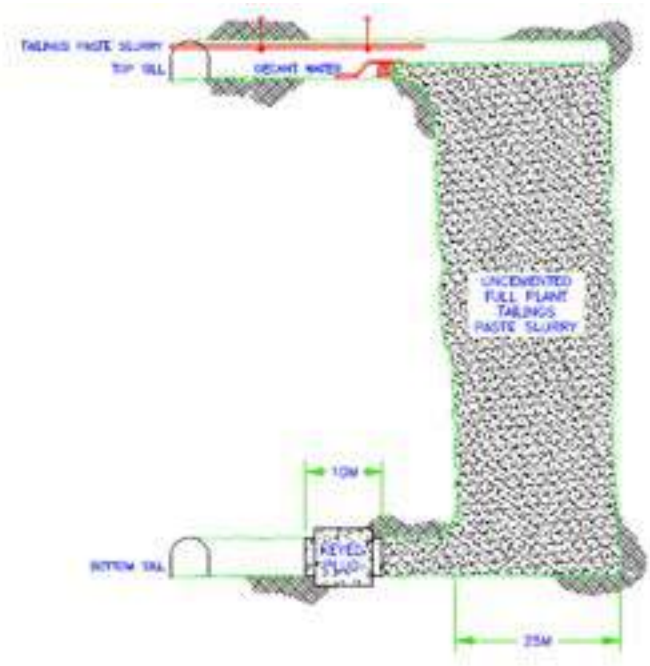


Figure 5.8-2 Aggregate Stope Backfilling Process

Paste backfilling will reduce sulphide oxidation and subsequent ARD as the paste backfill will be saturated. However, seepage from the tailings will be collected, treated if necessary, and reclaimed for process water use.

5.8.4 Tailings Disposal Schedule

The tailings production schedule and aggregate stope requirements are outlined in Table 5.8-1.

Table 5.8—1 Aggregate Stoping, Backfilling and Tailings Disposal Schedule

Description	Unit	Mine Life Total	Operations Phase Year			
			1	2	10	11
Mine Production Rate	Tonnes	11,131,500	1,095,000	1,095,000	1,095,000	181,500
Mine Production Volume	m^3	3,446,285	339,009	339,009	339,009	56,192
Mill Tailings	Tonnes	9,461,775	930,750	930,750	930,750	154,275
Mining Backfill	Tonnes	6,375,627	627,167	627,167	627,167	103,955
Tailings Disposal	Tonnes	3,086,148	303,583	303,583	303,583	50,320
Mill Tailing Volume	m^3	5,114,473	503,108	503,108	503,108	83,392
Mining Backfill Volume	m^3	3,446,285	339,009	339,009	339,009	56,192
Tailings Disposal	m^3	1,815,381	178,578	178,578	178,578	29,600
Aggregate Stope Tonnes Produced	Tonnes	4,901,529	482,161	482,161	482,161	79,920
Aggregate Stopes Required (62,500 m^3)	-	29.0	2.9	2.9	2.9	0.0

NOTES:
1. ALL VOLUMES AND TONNAGES CONSTANT FROM YEAR 1 TO YEAR 10.

5.8.5 Potential Acid Generating (PAG) Waste Rock Handling

PAG waste rock is defined as rock not suitable for use as aggregate due to ARD/ML concerns. Rock of this nature will be minimal and associated with the development near the ore body. Any PAG waste rock encountered during operations will be disposed of as cemented paste backfill in the ore stopes and will not be stored on surface. An allowance has been made to temporarily store waste rock at surface in a lined facility next to the aggregate stockpile area. This stockpile will be used in the unexpected event that PAG waste rock is generated early in the mine life (before sufficient storage is developed underground). This stockpile will be moved underground when sufficient storage is available.

5.8.6 Solid Waste Management

5.8.6.1 Non-hazardous Wastes

Solid waste products will include domestic waste, such as food scraps, packaging, and refuse. Inert waste such as glass, scrap metal and clean plastics will also be produced.

A waste management facility building will be established at the north end of the mine site property. The facility will sort and handle all solid, non-bulky wastes generated at the mine site, and will consist of an incinerator, compactor and both closed and outdoor storage. The on-site waste management facility will be fenced off to prevent animals (e.g. wolves, foxes, bears, etc.) from accessing potential food sources. An engineered lined landfarm will be located at the mine site within the waste management facility to receive any contaminated snow and/or soil.

The incinerator described in Section 5.4.12 will be used to dispose of non-hazardous combustible waste during the construction, operation and closure phases of the Project.

Details surrounding monitoring of the emissions will be determined through the provincial air emissions approval process. Fly ash will be collected using either a wet or dry scrubbing system. Fly ash and bottom ash will be contained separately in drums, tested using the Toxicity Characteristic Leaching Procedure (TLCP) to determine if the ash is hazardous or non-hazardous (in accordance with O.Reg. 347; amended by O.Reg. 558/00), and disposed of in an appropriately licensed off-site waste disposal facility.

Materials not suitable for incineration (e.g. recyclable plastic, tins, glass, etc.) will be sorted, compacted and stored until they can be shipped for disposal to an off-site licensed waste disposal facility. Scrap metal will also be stored on-site with the recyclables until it can be shipped off site or reused. Wood packaging will be burned on site or transported off site, as appropriate.

5.8.6.2 Hazardous Waste Management

Hazardous waste may include, but not be limited to, biomedical waste, contaminated soils, used petroleum products, and petroleum contaminated containers. These wastes will be handled and stored in sealed containers within lined and bermed areas or in secondary containment within the waste management facility (Figure 5.1-1). These materials will be sent off-site to an appropriate licenced facility. Any contaminated soils will be treated on-site in a bioremediation area.

Used glycol and lubricating oils will be stored in tanks at the waste management facility and sent off-site to a licensed off-site disposal facility. All contaminated liquids will be stored in clearly marked containers and sent to a licensed disposal facility. Empty fuel tanks will be stored within the fuel storage area and returned to the vendor. If the containers are not returnable, they will be cleaned, crushed and stored on-site until they can be shipped off-site.

5.8.6.3 Waste Management Streams

Table 5.8-2 outlines the waste streams and disposal methods.

Table 5.8—2 Waste Management Plan

Waste Stream	Example Materials	Disposal Method
Non- hazardous Combustible	Paper, cardboard, wood packaging, food scraps, clothing	On-site Incineration
Non-hazardous Non-combustible	Scrap metals, plastics, glass, fly/bottom ash	Off-site disposal at a licenced facility
Hazardous Wastes	Batteries, biomedical wastes, used fuel and lubricant containers, paint cans, fly ash	Off-site disposal at a licenced facility
Contaminated Soils	Hydrocarbon contaminated soil or snow	On-site landfarm/bioremediation area

5.8.7 Sewage Treatment

All domestic wastewater generated at the mine site will report to the sewage treatment plant prior to discharge to the environment. Wastewater from the accommodation and surface processing facilities will be pumped to the treatment plant. Wastewater generated from underground facilities will be stored in holding tanks. The tanks will be pumped, when required, and transported to the sewage treatment plant using a sewage truck.

The sewage treatment plant will consist of an appropriately sized package sewage treatment plant, such as a rotating biological contactor (RBC). The package sewage treatment plant will be fed by a pair of alternating duty, constant feed submersible pumps, which will be installed at the bottom of an in-ground concrete surge tank and pump chamber.

The total workforce at the mine site is expected to be between 700 and 800 people during construction and approximately 300 people during operations. Discharge from the sewage treatment plant is expected to be 2 to 4 m^3/h. Discharge of treated sewage will be to a wetland adjacent to the facility. The wetland flows eastward for 600 m into the Muketei River (Figure 5.1-1).

A Class 4 septic system will be installed at the trans-load facility for treatment of sewage, as specified in the Ontario Building Code (OBC). The design sewage volume of the septic system is 0.1 m^3/h.

5.9 WATER MANAGEMENT

5.9.1 Water Management Objectives

The Water Management Plan (Volume 4) describes strategies and provides guidance on the control of water from the project during construction, operations, and after closure. The general objectives of the water management plan are to:

- Utilize during operations all groundwater generated from the underground workings in the processing circuit and in tailings disposal. This arrangement will minimize make-up water requirements and avoid a discharge during the operation phase.

- Meet processing water requirements using make-up water from groundwater wells and surface water collection pond
- Manage surface water to prevent contamination of non-impacted water resources, including the control of erosion to limit sediment runoff
- Divert excess runoff that may interfere with site operations
- Treat sewage effluent prior to discharging to the environment

The water management strategies for the project components are discussed in the following sections.

5.9.2 Fresh Water Requirements

Fresh water will be required for mining operations, ore processing and for domestic use. Fresh water required by the processing plant will be satisfied, to the maximum extent possible by recycled and treated process water, mine inflows, and seepage collected from paste backfill tailings. Additional fresh water required by the processing plant will be satisfied from fresh water tanks on surface.

Fresh water will be pumped to a central wet well from groundwater wells. The final location of the water supply wells has yet to be determined. Freshwater from the central wet well will be pumped to the fresh water storage tank at the portal area to meet process water requirements.

For the underground facilities, the pipework required for fresh water, fire water, and potable water piping will be routed through a single bore hole drilled in the portal area and extended down to the underground mine with three tie-ins for water distribution. Fire water for the underground mill and other underground facilities will be supplied from surface tanks. A separate fire water system, complete with storage tank and fire water pumps, will be provided for surface facilities at a design flow rate of approximately 100 m^3/h. Potable water for the underground mill and other facilities will be supplied from the ground level potable water tank.

5.9.3 Potable Water Treatment System

A water treatment system will be located at the portal area to provide potable water for the facilities near the portal area. Fresh water (at a flow rate of 6 m^3/h) will enter the potable water treatment plant and pass through two pre-treatment filters, two ultrafiltration membranes, two UV disinfection systems, and duplex effluent pumps. The modular unit will be located in a pre-engineered building in the Portal Area and will operate 24 h/day and 365 days/year.

A separate water well and treatment system will service the camp facilities and will be designed for peak camp occupancy, which is expected to range from 700 to 800 people during the construction phase (Section 5.13.3).

5.9.4 Mine Site Surface Water Collection Pond

Site drainage within the mine site infrastructure footprint will be handled with surface grading and open channels/swales. The surface infrastructure areas will be graded to drain runoff towards storm water collection ditches and the ditches will convey runoff to the surface water collection pond. A 0.02 millimeter particle size has been assumed as the design particle size to be captured in the surface water collection pond. Site drainage collection ditches, associated culverts and the pond spillway will be designed for the 1 in 200 year, 24 hour event (rain plus snowmelt). The collection pond will be designed for the 1 in 10 year event (rain plus snowmelt) plus two days of mine dewatering volume.

The water contained in the surface water collection pond will be reused in the processing facility to the extent practicable. Discharge to the environment from the surface water collection pond will be monitored and treated as required. The mine site surface water collection pond and catchment area are shown on Figure 5.1-1.

5.9.5 Mine Site Water Balance

The mine site water balance includes all major components that will require water or discharge water. The water management strategy and water balance will be different during the construction, operations and closure phases.

5.9.5.1 Construction Phase Water Balance

Water inputs at the mine site during the construction phase will include:

- Inflow to the underground workings
- Surface runoff collection
- Freshwater from groundwater supply wells

The inflows to the underground during construction will be from the 0 to 200 m level of the mine and are estimated to peak at 21 m^3/h during the final year of construction. The water will be collected underground and pumped to the surface water collection pond.

Surface runoff will be routed to the surface water collection pond from the facilities and laydown areas. During the construction phase, fresh water will be required for underground mine development and at the cement plant. Water will be recycled from the underground workings for development drilling and other activities whenever possible. Water for the cement plant (estimated to be 5 m^3/h) and mine development water not obtained from underground will be taken from the surface water collection pond.

The estimated surface runoff and volume of water pumped from the underground workings to the surface water collection pond during the construction phase are shown in Table 5.9-1.

Table 5.9—1 Surface Water Collection Pond Discharges during the Construction Phase

	Monthly Discharge (m^3/month)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Surface Runoff	0	0	0	16,587	4,210	5,744	6,317	5,532	5,447	4,120	0	0
Mine Inflow	15,490	13,990	15,490	14,990	15,490	14,990	15,490	15,490	14,990	15,490	14,990	15,490
Reclaim for cement plant	3,720	3,360	3,720	3,600	3,720	3,600	3,720	3,720	3,600	3,720	3,600	3,720
Monthly Discharge	11,770	10,630	11,770	27,977	15,980	17,134	18,087	17,302	16,837	15,890	11,390	11,770

The potable freshwater requirements at the mine site are estimated to be 2 m^3/h based on the following volumes:

- Human consumption - 4.5 L/person/day
- Food preparation and clean-up - 7 L/person/day
- Showering facilities - 95 L/person/day
- Washroom facilities - 60 L/person/day

The freshwater requirements will be supplied by several groundwater wells that will pump to a central wet well. The final location of the wells has not yet been determined.

Water outputs during the construction phase will include:

- Discharge of treated sewage (estimated to be 2 m^3/day)
- Discharge of water from the surface collection pond

The construction phase mine site water balance is shown on Figure 5.9-1.

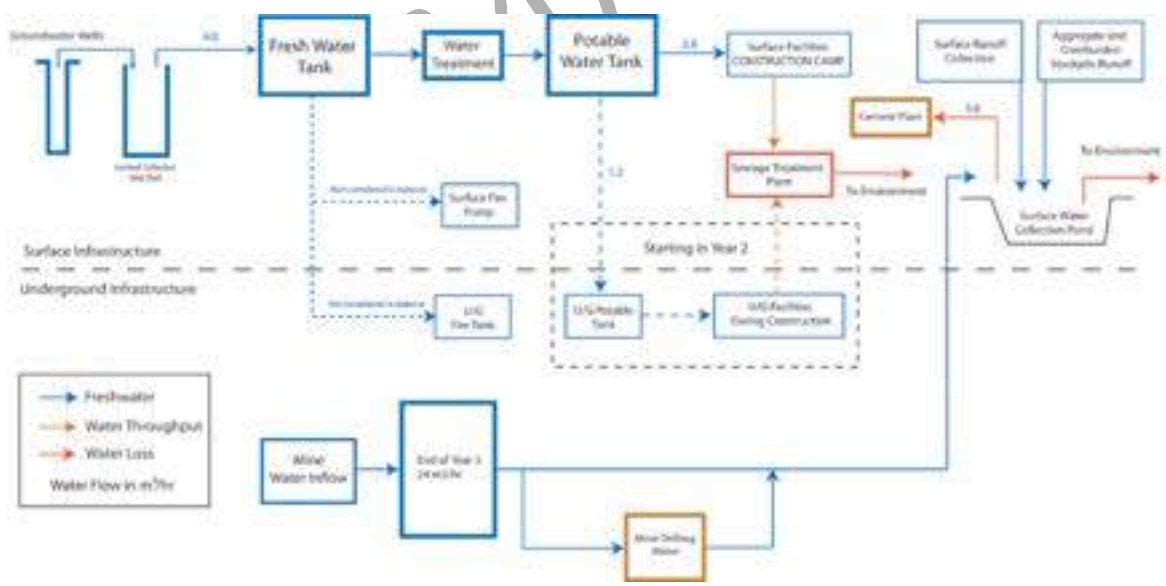


Figure 5.9-1 Construction Phase Mine Site Water Balance

5.9.5.2 Operations Phase Water Balance

During operations, the underground process facility will require approximately 150 m^3/h of water. As outlined in Section 5.5.10, the majority of the water required (104 m^3/h) will be satisfied from water in the ore, water reclaimed from un-cemented tailings, and water recycled from the processing facility. The remaining water required (46 m^3/h), will be obtained from inflows to the underground workings and from the freshwater tank on surface. The estimated groundwater inflows to the underground and freshwater make-up required from the surface tank during the operations phase are shown in Table 5.9-2.

Table 5.9—2 Inflows to Underground Workings during the Operations Phase

Operations Phase	Process Facility Freshwater Requirement (m^3/h)	Mine Inflow (m^3/h)	Freshwater Make-up Required (m^3/h)
Year 1-3	46	21	25
Year 4-11	46	18	28

Surface water runoff will be routed to the surface water collection pond during the operations phase. Only a little surface water runoff will be available during winter. As such, the collection pond is not considered to be a reliable source of water for the processing facility. The monthly discharge from the surface water collection pond to the environment during the operations phase is shown in Table 5.9—3.

Table 5.9—3 Monthly Discharge from Surface Water Collection Pond during the Operations Phase

	Monthly Discharge (m^3/month)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Discharge from Pond	0	0	0	16,587	4,278	5,838	6,419	5,621	5,536	4,187	0	0

Freshwater will be supplied to the surface water tank by a network of groundwater wells that will pump to a central wet well. Additional hydrogeologic investigations will be undertaken to determine the final location of the wells.

Potable water for the camp will be obtained from the surface water tank at a rate of 2 m^3/h, based on a 300 person accommodation facility.

Water outputs during the operations phase will include:

- Discharge of treated sewage from the accommodation facility (2 m^3/h)
- Water retained in the cemented and un-cemented backfill tailings (49 m^3/h)
- Water retained in concentrate(2.6 m^3/h)

The mine site water balance during the operations phase is shown on Figure 5.9-2. The management of surface water is described in additional detail in the Environmental Management Systems (Volume 4).

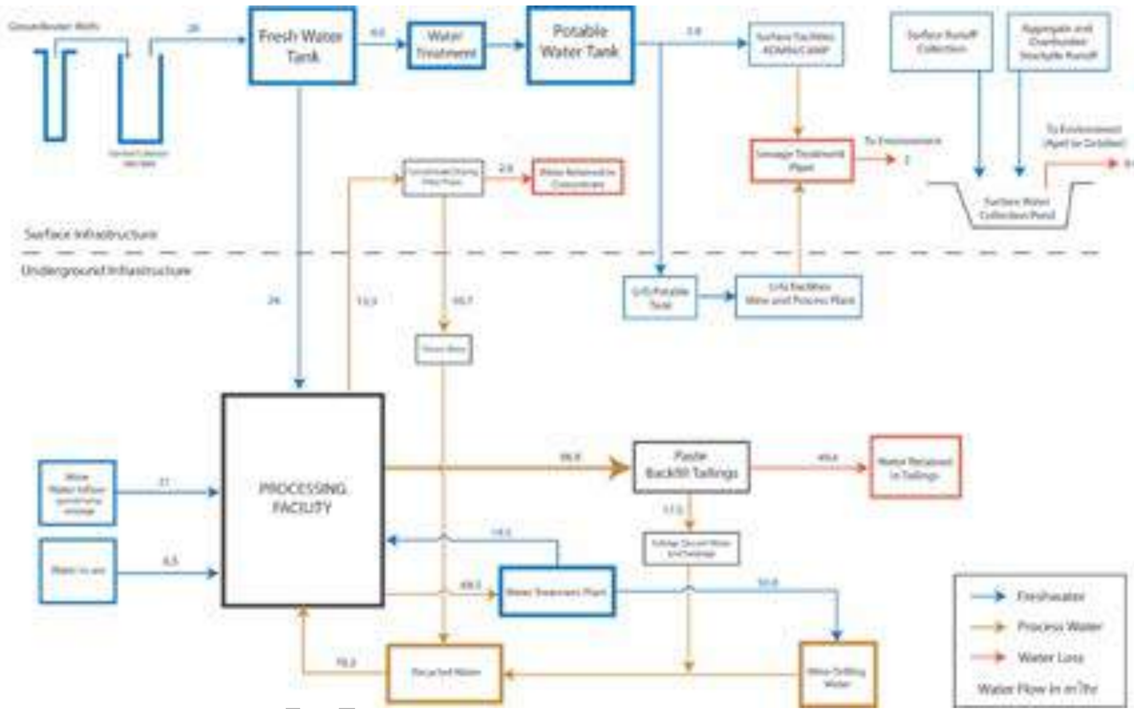


Figure 5.9-2 Operations Phase Site Wide Water Balance

5.9.5.3 Closure Phase Water Balance

During the closure phase, the processing facility will not be in operation and will not require water. Potable water will be required at the accommodation facility. Groundwater inflows will contribute to the passive flooding and closure of the underground workings.

5.9.6 Mine Site Water Monitoring and Treatment

Mine site waste water will be treated to achieve either federal and provincial environmental guidelines or relevant site specific water quality objectives. Discharge limits will be in accordance with Ontario Regulation 560/94, Effluent Monitoring and Effluent Limits - Metal Mining Sector. Sewage effluent water will be treated to meet the Provincial Water Quality Objectives (PWQO) at the point of discharge during all phases of the Project.

5.9.6.1 Water Treatment during the Construction Phase

During the construction phase, surface water and mine inflow water will be collected and discharged from the surface water collection pond (Table 5.9-1). The pond water quality will be monitored at regular intervals for total suspended solids (TSS) and to ensure the discharge water meets the effluents limits outlined in O. Reg. 560/94.

5.9.6.2 Water Treatment during the Operations Phase

During operations, surface water will be collected and discharged from the surface water collection pond (Table 5.9—1). The pond water quality will be monitored at regular intervals for total suspended solids (TSS) and to ensure that the discharge water meets the effluents limits outlined in O. Reg. 560/94. Underground water will be collected and pumped to the underground water treatment plant so that it can be recycled in the processing facility. The average input to the treatment plant will be 70 m^3/h. The plant will have the capacity to treat additional underground waste water should the need arise.

5.9.6.3 Water Treatment during the Closure Phase

The underground workings will be allowed to flood to near surface static groundwater levels at closure. The initial surge of water is expected to contain some oxidation products that will accumulate during operations. This initial surge will likely have a lower pH and higher metal concentrations than baseline conditions. During the initial stage of flooding, groundwater will be sent to a water treatment plant and recirculated back to the underground workings. The closure phase water treatment requirements will be determined through the monitoring of the underground water quality.

Tailings and mine rock oxidation will be inhibited by the flooding of the mine and the underground water quality is expected to stabilize. At this time water treatment will no longer be required.

5.9.7 Trans-load Facility Water Management

Site drainage at the trans-load facility will be managed with surface grading and open channels/swales. The majority of the surface infrastructure area will be considered clean and will be paved and graded to drain water away from the facility. The surface runoff from the exit area of the concentrate loading building and the truck wash bay will be collected and diverted to the surface water collection pond.

Water from the surface water collection pond will be discharged to the environment away from surface waters. As part of the surface water monitoring commitments during operations, the pond water quality will be monitored periodically for total suspended solids (TSS) and to ensure the discharge water meets the effluents limits outlined in O. Reg. 560/94. Treatment will be implemented if it is found that the runoff water has elevated concentrations of metals. The estimated discharge from the runoff collection pond is shown in Table 5.9—4.

Table 5.9—4 Monthly Discharge from Trans-load Facility Surface Water Collection Pond

	Monthly Discharge (m^3/month)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Discharge from Pond	0	0	0	86	21	29	32	28	28	21	0	0

Freshwater use at the trans-load facility will include potable water to be supplied from groundwater wells and water for truck washing and general activities. Domestic sewage will be treated by a Class 4 septic system.

5.10 SUPPORTING MINE INFRASTRUCTURE

5.10.1 Overview

The Project will require the following supporting infrastructure components and site services to support operations at the mine site:

- Power supply and distribution
- Maintenance of access roads
- Camp facilities and Accommodations
- Communications

5.10.2 Power Supply

The mine site currently has no access to utility power, although a power line is being sought. Power for the site will be provided by a dedicated diesel generator power plant designed for a capacity of 22 MW. Eight diesel generator sets will be in continuous operation at the mine site. The power plant will be part of the surface facility at the mine portal location and will house the generators in an N+2 configuration. This arrangement will provide backup capacity accommodate routine maintenance and/or a breakdown. Energy recovered from the diesel exhaust will be used for both the concentrate drying process, as well as for heating buildings located in the production area. The average electrical load during the life of the mine will be as follows:

- Mine: 2,865 kW
- Mill: 9,072 kW
- Surface Facilities: 1,955 kW
- Total: 13,892 kW
- Capacity: 22,000 kW

The trans-load facility will be connected to the existing power grid via a previously used utility corridor. A 750 kW backup power generator will be installed at the site.

5.10.3 Road Maintenance

Maintenance of the all-season road between the Pickle Lake North Road and the mine site will be required during operations. Surfacing crush material will be derived from aggregate sources used during construction of the road and will need to either be produced on a yearly basis or be stockpiled and inventoried for several years of road maintenance. Approximately 30 km of re-surfacing per year will be necessary. This will require an aggregate supply of approximately 30,000 m^3. A surfacing crew will operate for one or two months duration in the summer.

5.10.4 Camp Facilities and Accommodation

A single “Services Building Complex” for multiple uses will be installed. This building will include the administration and engineering offices, a small warehouse for surface supplies, mine dry, nursing station, assay and environmental laboratory, surface maintenance shops, recreational facilities, health and safety and training rooms.

The accommodation building is designed to hold approximately 350 beds. This camp size includes an allowance for transitional occupancy during turn-around and for inoperable occupancy. The accommodation building will be attached to the services building complex.

5.10.5 Communications

Fibre-optic lines will be placed along the all-season road corridor to the mine site in order to provide high capacity data connection to global networks. Surface and underground operations will be linked with high speed data connections, to provide voice, data and video communications in support of the overall tele-remote control of equipment and processes. All vehicles and underground personnel will have communications capabilities.

5.11 ENVIRONMENTAL DISCHARGES DURING OPERATIONS

The discharges to the environment during operations phase will include:

- **Water:**
  - Mine site surface runoff
  - Trans-load facility surface runoff and truck wash water
  - Treated waste water from mine site and accommodation facilities
  - Treated waste water from trans-load facility
- **Air:**
  - Emissions from generators at mine site
  - Incinerator emissions at mine site
  - Emissions from mobile equipment
  - Fugitive dust from aggregate stockpiling at mine site
  - Concentrate dust during transport and loading

5.12 CLOSURE AND RECLAMATION

5.12.1 General

Closure and reclamation of the Project will take place at the end of the operations phase. The closure phase of the Project is overviewed in the following sections and provided in detail in the Closure and Reclamation Plan (Volume 4). The Mine Closure and Reclamation Plan addresses how the facilities associated with the mining operations, local and access roads will be reclaimed.

Following the successful completion of the federal and provincial environmental assessment processes, an updated stand-alone closure plan will be formally submitted to the Ontario Ministry of Northern Development and Mines (MNDM) in accordance with Ontario Regulation (O.Reg.) 240/00.

Mine closure under O.Reg. 240/00, requires the identification of progressive reclamation activities and end of mine life reclamation activities. Progressive reclamation refers to those activities that can be undertaken while the mine is in operation. Progressive rehabilitation reduces the end of mine life liabilities. O.Reg. 240/00 also requires the contemplation of three closure scenarios: 1) temporary suspension, 2) state of inactivity, and 3) final closure. These scenarios are described in the Mine Closure and Reclamation Plan.

5.12.2 Closure Objectives

The primary objective of mine closure is to decommission the Project infrastructure and return the Project sites to a physically and chemically stable condition that is close to pre-development conditions as reasonably possible. The closed site also needs to be compatible with the surrounding land uses.

Consultation and the incorporation of local community needs and wishes is an important element of mine closure under O.Reg. 240/00. Consultation on mine closure with nearby First Nation communities and other stakeholders will be carried out during the environmental assessment, during the preparation of the Mine Closure Plan, and throughout the life of the Project. It is expected that the local First Nation communities and others (e.g. other mining and exploration companies, etc.) may have an interest in participating in the mine closure process for the Project or in using some of the infrastructure for their own purposes.

5.12.3 Overview of Closure Activities

Final mine closure activities at the Project sites will involve the following:

- Decommissioning of surface buildings and infrastructure
- Decommissioning of underground equipment and infrastructure
- Removal of fixed and mobile equipment and any salvageable materials
- Removal of remaining hazardous wastes to a licenced off-site facility
- Removal of remaining non-hazardous wastes to a licenced off-site facility or to the underground for disposal
- Reclamation of disturbed ground surfaces, including:
  - The testing and removal of any contaminated soils to a licenced facility
  - Breaking up concrete foundations
  - Re-contouring the disturbed areas to mimic the surrounding areas
  - Scarification of compacted areas
  - Placement of soil over disturbed areas
  - Revegetating the disturbed areas with local plant species
- Flooding of the underground workings to the near surface static groundwater level passively or actively using either on-site groundwater wells or surface water sources
- Preventing access to the underground workings by means of an engineered barricade in the portal that will be certified in accordance to O.Reg 240/00
- Backfilling and/or capping the mined out crown pillar in accordance to O. Reg. 240/00
- Decommissioning of local site roads
- It is anticipated that the all-season access road will be the responsibility of other users or local communities at closure. Therefore it is not likely the road will be decommissioned. However, if this is not the case, the road will be decommissioned. Decommissioning of the road would include removal of bridge and culvert crossings, re-establishment of natural drainage patterns, and scarification and vegetation of the road surface.
- Monitoring the site for chemical and physical stability during the active closure and post closure periods

The active closure phase involves the decommissioning of surface and underground infrastructure and facilities, as well as all land reclamation activities. The active closure phase is expected to last approximately 2 years and will be followed by approximately 5 years of post-closure monitoring to ensure that the closure objectives have been fulfilled.

The accommodation facilities will be downsized at closure to meet the requirements of the closure phase work force. At the end of the two year active closure phase, the camp facilities will either be completely decommissioned or further downsized to support post closure maintenance and monitoring activities.

5.12.4 Environmental Discharges during the Closure Phase

During the closure phase, environmental discharges will be limited to the treatment and discharge of sewage from camp facilities, and air and noise emissions associated with the operation of heavy equipment. These discharges will be similar to the operation phases (but lower in volume or magnitude).

5.12.5 On-going Monitoring Requirements

Monitoring will be undertaken during the construction, operation, closure and post-closure phases. During the active closure phase, monitoring will include supervision or inspection of decommissioning works, environmental monitoring during in-water works in fish bearing waters (i.e., during culvert or bridge removals), and tracking of the appropriate execution of closure activities (including the disposal of wastes). Water quality sampling will be undertaken at regular intervals in the vicinity of closure activities.

Monitoring during closure will continue until the closure objectives have been met. Post-closure monitoring programs are expected to include:

- Monitoring of the filling of the underground workings, including groundwater quality and final water elevation
- Monitoring of the physical stability of earthworks and the success of revegetation efforts

There will be no stockpiles at surface following the active closure phase. The installation of an engineered barricade at the entrance portal will ensure that access to the underground is not possible. As such, the closed out site will present few concerns with regards to ongoing physical stability and public safety. While achieving closure objectives is the endpoint of the ongoing post-closure monitoring, a post-closure monitoring phase will be implemented for approximately 5 years. The duration of the post-closure monitoring phase will be further refined in the final Mine Closure Plan and will be determined in consultation with the government, First Nation communities and Project stakeholders.

5.13 WORKFORCE AND HUMAN RESOURCES

5.13.1 General

Noront is committed to developing a Project that provides sustainable benefits to the people of the region. The success of Noront depends upon the combined capabilities of its employees, technology, resources, and customers. Human Resources management activities are guided by the following commitments to the workplace and to the people. Noront will:

- Strive to achieve a workplace for its employees and contractors that is free from occupational injury and illness
- Respect human rights, and the traditional culture, values and customs of Aboriginal people
- Report, manage and learn from injuries, illnesses and high potential incidents to foster a workplace culture focused on safety and the prevention of incidents
- Foster and maintain a positive culture of shared responsibility, based on participation, behaviour and awareness

Noront's commitments and employment policies with respect to its workforce are described in the Human Resource Management Plan (Volume 4).

The Company is currently working in cooperation with communities and stakeholders in the region to establish education and training programs that will provide opportunities for local residents to be employed by the Project and to equip them with skills that will sustain them beyond the life of the Project.

5.13.2 Workforce Requirements

Workforce requirements have been estimated for both the construction and operation phases of the Project. Personnel requirements during the closure and post-closure phase are a subset of the operational requirements and are not discussed separately.

5.13.3 Construction Phase Workforce Requirements

The construction workforce ranges in size over the three year construction period from about 200 to 700 persons (Table 5.13—1), when shift rotations are counted. The estimated site workforce includes the workers on and off shift at each of the Project sites. The estimates are approximate and expected to vary seasonally and between each year.

Table 5.13—1 Construction Workforce Estimate

Description	Mine Site	Transportation Corridor	Trans-load Facility	Total
Construction Personnel	38		5	43
Sub-contractor Personnel	450	250	37	737
Total	488	250	42	**780**

The work week at all facilities will be 12-hour days, 7 days per week. The planned scheduled work rotation for most contractors during the construction phase will be for example, 3 weeks on with 1 week off or 4 weeks in with 2 weeks off, depending on contractor labour agreements.

Successful completion of the construction phase is dependent on the quality and commitment of the workforce. The accommodation camps will offer comfortable quarters and recreational and entertainment facilities to promote a safe, healthy, and inviting worker environment. These facilities will encourage workers to remain within the accommodation boundaries during leisure time. The capacity and number of accommodation camps during construction are shown in Table 5.13—2.

Table 5.13—2 Construction Camp Capacities

Km 0 Camp	Km 50 Camp	Km 200 Camp	Mine Site
50	50	50	**400**

The above numbers are based on peak camp capacities as the construction workforce will vary over the three year construction phase and shift rotations mean roughly one third of the workforce is off shift at any time. As such, the camp capacity numbers presented in Table 5.13—2 do not necessarily correspond directly with the construction workforce totals presented in Table 5.13—1.

Employee transportation to the Project site during the construction phase will be provided by Noront. Flights will operate between the First Nation community points of hire, via small aircraft operated by northern air carriers on a charter basis, either directly to the mine site or via a central community. Regular scheduled flights from Thunder Bay to the mine site are planned, landing at the airstrip to be constructed and operated by a First Nation joint venture.

Crew changes at the road construction camps will be via helicopter or truck (during winter).

5.13.4 Operation Phase Workforce Requirements

The total estimated workforce during the operation phase is 300 to 400 people, including both on-site and off-site personnel, and inclusive of both Noront and contract personnel. This estimate does not include staffing required for any ongoing exploration work throughout the operations phase. Most on-site staff will work on a scheduled rotation of 2 weeks working at site and 2 weeks off. The projected distribution of the workforce by skill level is provided in Table 5.13—3. Approximate total payroll numbers will be double those in the table to account for the staff rotations, with the exception of the corporate workforce. These estimates reflect direct employment required for operations.

Table 5.13—3 Estimated Operation Phase Workforce by Skill Level

	Management	University	College	Superintendents	Fore-persons	Trades	Equipment Operators	Clerical	Semi/Unskilled	Total
Corporate Total	7	4	2					4		17
Mine Site	3	27	24	4	13	89	111	2	34	307
Transportation Corridor	1	1	4		4	4	38	1	4	57
Trans-load Facility	1			1			4			6
Totals	12	32	30	5	17	93	153	7	38	387

5.13.5 Closure and Reclamation Phase Workforce Requirements

During the closure phase, a small part of the operation phase workforce will be retained to carry out reclamation activities at project development areas. The size and composition of the closure and reclamation workforce will be determined during the operation phase, at least two years prior to the planned commencement of closure and reclamation activities.

Section 6

Biophysical Effects

Knight Piésold
CONSULTING
www.knightpiesold.com

TABLE OF CONTENTS

PAGE

TABLES

FIGURES

6 – BIOPHYSICAL EFFECTS

6.1 AIR QUALITY

6.1.1 Introduction

Air quality is an important environmental factor in protecting biota and human health values. Project activities will result in release of air emissions to the local area. The changes in ambient air quality due to Project activities were evaluated against National and Provincial objectives and standards to determine potential effects to human health and the biophysical environment.

The air quality assessment involved the following steps:

- Providing an overview of regional ambient air quality concentrations
- Summarizing applicable regulations and guidelines
- Defining a regional study area (RSA)
- Scoping Project-related emission sources that could cause potential air quality effects
- Estimating the emissions inventory associated with the Project
- Reviewing potential effects and mitigation options
- Performing dispersion modelling in order to estimate the potential residual effect on air quality
- Predicting ambient air quality concentrations and dustfall deposition rates to determine the change during mine operations
- Comparing results with applicable criteria in the Project area

6.1.2 Rationale for VEC Selection

Project-related air emissions will result in increases to ambient air quality concentrations of air contaminants. Air emissions from the Project will include emissions from mining operations and the combustion of fuel for power generation and equipment use. Furthermore, dust and particulate matter from the production of aggregate and from road use will affect air quality at the mine site. Air emissions from industrial projects in Ontario are regulated, and may also cause indirect effects to human health, water quality, vegetation and wildlife (Table 6.1-1).

Table 6.1-1 Air Quality VEC Selection Rationale

VEC	KEY INDICATOR(S)	RATIONALE FOR VEC SELECTION OR EXCLUSION
Ambient Air Quality	SO_2, NO_2, CO, dustfall, TSP, PM_{10}, $PM_{2.5}$	Ambient air quality is a concern for human health and ecological environment such as vegetation, water quality and wildlife. Regulatory concern; key indicator parameters have been selected to help define the chance attribution of the Project activities

Ambient air quality is a broad term. It is therefore important to select measurable parameters to assess the potential effects of the Project on the receiving environment. The effects on air quality were evaluated based on changes in air contaminants as key indicators, including:

- Sulfur dioxide (SO_2)
- Nitrogen dioxide (NO2)
- Carbon monoxide (CO)
- Dustfall
- Total suspended particulates (TSP)
- Particulate matter less than 10 microns (PM10)
- Particulate matter less than 2.5 microns (PM2.5)

The selected air contaminants include those typically associated with mining operations and anticipated Project activities and for which criteria have been established to be protective of various receptors including human health and ecological environment. The measurable parameters are compared to the applicable ambient air quality objectives/standards.

6.1.3 Applicable Guidance

The applicable provincial and national ambient air quality criteria used in the assessment are summarized in Table 6.1-2.

The Ontario Ministry of the Environment recently updated its provincial ambient air quality criteria (MOE, 2012b). Ambient air quality criteria (AAQCs) identify various averaging times (e.g., 24 hour, 8 hour and 1 hour) appropriate for the effect that they are intended to protect against. The effects considered may be human health, particulate, odour, vegetation, soiling, visibility, corrosion or effects on vegetation and animals. AAQCs are set with different averaging times (e.g., 24 hour, 1 hour and 10 minutes) appropriate for the effect that they are intended to protect against. The effects considered may be human health, particulate, odour, vegetation, soiling, visibility, corrosion or effects on vegetation and animals.

National ambient air quality objectives (NAAQO) framework is defined under the *Canadian Environmental Protection Act* in 1999. The reference level and objectives are based on the development of an extensive scientific assessment. The assessment document and air quality objectives are currently being subject to peer reviews and stakeholder consultations, and as such the original AQOs have not yet been formally revised to a new two-level system (EC, 2010). Until 1999, the three-tiered system of NAAQOs was replaced to reflect current understanding of the continuum of health and environmental effects caused by air pollution; however, objectives are still given in the following three categories (Health Canada, 2005):

- *Maximum desirable level* is the long term goal for air quality and provides a basis for an anti-degradation policy for the unpolluted parts of the country, and for continuing development of control technology
- *Maximum Acceptable Level* is intended to provide adequate protection against effects on soil, water, vegetation, materials, visibility, personal comfort and well-being
- *Maximum tolerable Level* denotes time-based concentrations of air contaminants beyond which, due to diminishing margin of safety, appropriate action is required without delay to protect the health of the general public

Table 6.1-2 Ambient Air Quality Guidelines and Objectives

Air Contaminant	Averaging Period	Provincial	National		
		Ontario Ambient Air Quality Criteria (µg/m^3)	Canada Ambient Air Quality Objectives (µg/m^3)		
			Maximum Desirable	Maximum Acceptable	Maximum Tolerable
SO_2	Annual	55	30	60	-
	24-Hour	275	150	300	-
	1-hour	690	450	900	-
NO_2	Annual	-	60	100	-
	24-Hour	200	-	-	-
	1-hour	400	-	400	-
PM_{10}	Annual	-	-	-	-
	24-hour	50	-	-	-
$PM_{2.5}$	Annual	-	-	-	-
	24-hour	30	-	-	-
Dustfall	Annual	4.6 g/m^2	-	-	-
	30 day	7 g/m^2	-	-	-
CO	8-Hour	15,700	6000	15000	-
	1-hour	36,200	15000	35000	-

NOTES:

1. $PM_{2.5}$ is based on the 24-hour 98th percentile ambient measurement annually, averaged over three consecutive years.

6.1.4 Assessment Boundaries

Spatial boundaries for air quality were established based on where there is a reasonable expectation of an effect of the Project on ambient air quality. Ambient air quality at the mine site area is subject to work place safety standards rather than ambient air quality objectives; therefore the mine site area is excluded from the spatial boundaries for the effects assessment on air quality. For the assessment of potential effects of the Project on air quality, two study areas are defined: the local study area (LSA) and the regional study area (RSA). These spatial boundaries are identified in Technical Supporting Document 2.

The LSA for the effects assessment on air quality is the 10 km wide band surrounding the mine site where the contribution of the mining activities on ambient air quality will likely occur. The selected size of the LSA is based on experience from similar small industrial developments. The RSA for the effects assessment on air quality extends to 20 km from the centre of the Project boundary. The 40 x 40 km RSA covers the area where concentrations of compounds are anticipated to be quantifiable but lower than Provincial criteria or National objectives.

The receptors (potential air quality effects to workers) inside the mine site boundary were excluded from the assessment (MOE, 2009) because air quality at the mine site is subject to work place safety standards rather than ambient air quality objectives. Additionally, access to the Project mine site area is restricted to the general public and there are no permanent or temporary residential settlements in the region.

The temporal boundaries for the assessment are defined based on the timing and duration of Project activities that could induce effects to air quality. Effects will be identified with reference to activities occurring in one or more of the Project phases:

- Construction (3 years)
- Operation (11 years)
- Closure (2 years)
- Post-closure (a minimum of 5 years)

The current expected Project life is 16 years, inclusive of the construction, operation, and closure phases. Unlike effects on other VECs, effects on air quality are generally highly reversible once the emission source is removed.

Air emissions from mining are mainly associated with the releases of air contaminants from blasting, crushing, loading/unloading, hauling, material transfer, stockpiles and equipment use. These activities are relatively intense and frequent during construction, operation and closure phases of the mine life. The majority of construction activities will take place underground such as drilling, blasting, process component installations. Moreover, majority of surface construction activities will consist of mechanical installations, local and short-term road upgrades and surface grading rather than stripping, drilling and regular blasting therefore construction phase was considered as minor on ambient air quality and not considered in modelling assessment.

6.1.5 Potential Effects and Mitigation Measures

Table 6.1-3 identifies the potential interactions of different project components and activities with air quality. This process serves to inventory the interactions so that reoccurring effects can be identified to focus the assessment on the main issues of concern to air quality.

Table 6.1-3 Project Components and Mechanism of Interaction Summary for Air Quality

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Mine Site			
Ground Preparation (e.g., cut, fill, grub, etc.)	C	Yes	Particulate matter and gas pollutant emissions
Construction of surface infrastructure	C	Yes	Particulate matter and gas pollutant emissions
Underground mine development, including de-watering	C	No	No interaction with air quality because activity is not an emission source

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Underground mine operation	O	No	No interaction with air quality because equipment use electric and dust is mitigated by design
Underground ore processing and concentrate loading	O	No	No interaction with air quality in underground activity, concentrate will be handled in containers
Tailings production and underground disposal	O	No	No interaction with air quality in underground activity
Mining of crown pillar	O	Yes	Particulate matter and gas pollutant emissions
Aggregate production	C, O	Yes	Particulate matter and gas pollutant emissions
Aggregate and topsoil stockpiles	C, O	Yes	Particulate matter and gas pollutant emissions
Construction of site roads	C	Yes	Particulate matter and gas pollutant emissions
Accommodation facility operation	C, O	No	No interaction with air quality because it doesn`t include air emissions. Heating will be electric so no boilers at camp
Power plant operation	C, O	Yes	Particulate matter and gas pollutant emissions
Fuel Storage and distribution	C, O	Yes	Volatile gas pollutant emissions
Equipment and vehicle use	C, O, CL	Yes	Particulate matter and gas pollutant emissions
Explosives use, handling and storage	C, O	Yes	Particulate matter and gas pollutant emissions
Groundwater use for potable water and underground processing	C, O	No	No interaction with air quality because it doesn`t include air emissions
Surface water management (non-contact water)	C, O, CL	No	No interaction with air quality because it doesn`t include air emissions.
Waste management: solid and sewage waste facilities	C, O, CL	Yes	Particulate matter and gas pollutant emissions (incinerator)
Hazardous materials handling and storage	C, O, CL	No	No interaction with air quality because it doesn`t include air emissions
Closure of underground workings	CL	Yes	Particulate matter and gas pollutant emissions
Closure of surface facilities, including portal	CL	Yes	Particulate matter and gas pollutant emissions
Scarification and reclamation	CL	Yes	Particulate matter and gas pollutant emissions
Training Programs	C, O	No	No interaction with air quality because it doesn`t include air emissions
Mine Staffing	C, O, CL	No	No interaction with air quality because it doesn`t include air emissions.

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Procurement of goods and services	C, O, CL	No	No interaction with air quality because it doesn`t include air emissions
Transportation Corridor			
Ground preparation for road (e.g. cut, fill, grub, etc.)	C	Yes	Particulate matter and gas pollutant emissions
Aggregate and borrow site development	C, O	Yes	Particulate matter and gas pollutant emissions
Road construction (includes culvert, bridge installation)	C	Yes	Particulate matter and gas pollutant emissions
Road maintenance	O	Yes	Particulate matter and gas pollutant emissions
Equipment and vehicle use	C, O	Yes	Particulate matter and gas pollutant emissions
Waste management	C	Yes	Particulate matter and gas pollutant emissions (incinerator)
Water management (non-contact water)	C, O	No	No interaction with air quality because it doesn`t include air emissions
Explosives use, handling and storage	C	Yes	Generation of particulate matter
Fuel Storage and distribution	C	Yes	Gas pollutant emissions
Construction camps	C	Yes	Particulate matter and gas pollutant emissions
Hazardous materials handling and storage	C, O	No	No interaction with air quality because it doesn`t include air emissions
Employment	C, O	No	No interaction with air quality because it doesn`t include air emissions
Procurement of goods and services	C, O	No	No interaction with air quality because it doesn`t include air emissions
Trans-load Facility			
Ground preparation and site construction	C	Yes	Particulate matter and gas pollutant emissions
Construction of rail siding	C	Yes	Particulate matter and gas pollutant emissions
Construction of buildings and loading facility	C	Yes	Particulate matter and gas pollutant emissions
Upgrading site access roads	C	Yes	Particulate matter and gas pollutant emissions
Installation of transmission line within existing right of way	C	Yes	Particulate matter and gas pollutant emissions
Waste management: solid and sewage waste facilities	C, O	Yes	Particulate matter and gas pollutant emissions (incinerator)

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Water management (including surface water collection pond)	C, O	No	No interaction with air quality
Water supply well	C, O	No	No interaction with air quality because it doesn`t include air emissions
Fuel Storage and distribution	C, O	Yes	Volatile gas pollutant emissions
Equipment and vehicle use	C, O	Yes	Particulate matter and gas pollutant emissions
Hazardous materials handling and storage	C, O	No	No interaction with air quality
Operation of concentrate loading facility	O	Yes	Particulate matter and gas pollutant emissions
Re-grading, ditching, and placement of asphalt	C	Yes	Particulate matter and gas pollutant emissions
Equipment and vehicle use	C O CL	Yes	Particulate matter and gas pollutant emissions
Procurement of goods and services	C, O	No	No interaction with air quality because it doesn`t include air emissions
Closure of facility	CL	Yes	Particulate matter and gas pollutant emissions

NOTES:

1. C – CONSTRUCTION, O – OPERATION, CL – CLOSURE

The potential effects of Project on air quality can be summarized according to the types of air contaminants that will be emitted by the Project (Table 6.1-4).

Table 6.1-4 Potential Effects on Air Quality

AIR CONTAMINANT(S)	KEY INDICATOR(S)	POTENTIAL INDIRECT EFFECTS / RECEPTORS	DIRECTION
Suspended particulate matter emissions	PM_{10}, $PM_{2.5}$	Human health, wildlife	Adverse
Gas pollutant emissions	SO_2, NO_2, CO	Human health, wildlife, vegetation	Adverse
Dustfall deposition	Dustfall, TSP	Vegetation, surface water quality	Adverse

Effects were evaluated by generating an inventory of sources of the potential air contaminants by project phase. The inventory of sources was entered into an air dispersion model, which incorporates factors that affect the fate and transport of contaminants in the atmosphere such as meteorological conditions, site configuration, emission release characteristics and the surrounding topography. The air emission inventory, methodology of modelling and results are presented in Technical Supporting Document 2. The potential effects and proposed mitigation measures for each of the air contaminant groupings in Table 6.1-4 are discussed further below.

The detailed tables presented in this section indicating each major Project component's interaction with changes in ambient air quality during the construction, operation and decommissioning phases. Since the construction within each area would require equipment that emits pollutants, most of the Project areas, including Mine Site, road upgrades, and off-site transportation, are expected to have an interaction with changes in ambient air quality. However, the duration is short and mine disturbance area is small therefore effects during the construction phase were considered minor or negligible. Similarly, decommissioning will require less amount of power, equipment and activity compare to operation phase therefore the effects on ambient air quality were considered as negligible.

The EIS guidelines requested an assessment of VOCs, ammonia and diesel particulate matter. VOC is a broad term for all organic compounds which have high vapor pressure in ambient temperatures including methane, benzene, toluene, xylenes, etc. The major source of volatile organic carbons (VOCs) with the Project is fuel, and most of the fuel consumed by the Project at the mine site is by power generators, since underground vehicles will be powered by electricity and the fuel requirements of the haul trucks will only partially be met by onsite fuel storage. VOCs from diesel engine emissions are minimal because VOC emissions primarily result from incomplete combustion or fugitive vapour from storage. Diesel fuel has a very high boiling point and does not evaporate at normal temperatures. The Project supplies major power from diesel generators which have controlled internal combustion mechanisms therefore VOC release is minimal.

Ammonia emissions at mine sites typically originate from blasting and heap leaching in metal mining. The Project does not include a heap leach facility. Furthermore, blasting for a small capacity (2,960 t/d) does not require substantial ANFO consumption to generate significant amount of ammonium emissions.

Diesel particulate matter was estimated by using the methods described in air emission estimations and included in the modelling study to predict the dispersion of the contaminant along with other particulate matter sources such as fugitive sources.

6.1.5.1 Suspended Particulate Matter

Potential Effects

Suspended particles with larger particle sizes may cause a nuisance, while particles with smaller diameters can potentially cause respiratory illness and lung disease on humans. The key indicators of suspended particulate are $PM_{2.5}$ and PM_{10}. The primary effects of particulate matter on vegetation are reduced growth and productivity due to interference with photosynthesis and phytotoxic impacts as a result of blocking stomata.

The primary sources of PM generated by the Project include: diesel fuel combustion, the waste incinerator, and fugitive dust from roads and disturbed areas. The handling of ore and concentrate is a potential source of PM but these releases will be mitigated as described below.

Mine Site Construction and Operation – Construction activities and the use of site roads at the mine site will generate dust. Concentrate storage and transfer to haul trucks will also occur at the mine site, but these activities will take place inside buildings equipped with dust collection systems.

Road Construction and Operation – The all-season road will receive heavy use as part of its construction including the extraction of aggregate, crushing and placement of fill in the roadbed. During the operations phase of the Project, the road will be used to transport fuel, concentrate, supplies, equipment, and the workforce. Projected traffic volumes include approximately 20 round-trip concentrate haul truck-loads per day (based on multiple drivers and 24-hour operation). Other vehicular traffic on the road will add an estimated 3 to 6 vehicles per day. Concentrate haulage trailers will be side or rear dump style, so losses from belly-dump closure will be eliminated. Trailers will be covered with hard caps to prevent the release of concentrate dust during road travel.

Trans-load Facility – Because the trans-load facility is located on a brownfield site, limited new ground disturbance will be required during construction. The footprint of the development area at the trans-load facility will be covered in coarse gravel during the site re-development, which will minimize dust emissions considerably. During operations, the trans-load facility will be used to transfer concentrate from the hopper trucks to stockpiles within the load-out building. The concentrate will be reclaimed from the stockpiles and delivered in an enclosed transfer system to the rail cars, which utilizes a retractable fill chute that extends into the rail car to reduce dusting. Dust collection systems will be provided at all concentrate handling points. Thus, there is minimal potential for airborne dust and emissions from vehicle traffic and ore handling at the trans-load facility.

Proposed Mitigation Measures

As discussed above, all stockpiling, crushing and processing of the ore will occur underground and concentrate drying, loading and transfer operations will occur indoors or in enclosed transfer equipment equipped with dust collection systems. The trucks hauling concentrate from the mine site to the trans-load facility will be equipped with sealed caps to restrict the release of concentrate from the trucks.

Major suspended particulate matter sources were estimated as fugitive sources from unpaved roads and diesel generators. Other control methods to minimize fugitive dust emissions are listed below:

- Applying dust suppressants on roads
- Enforcing traffic speed limits on roads (Road Management Plan – Volume 4, Section 13)
- Equipping concentrate haul trucks with hard caps on trailers
- Using end dump or side dump trailers to haul concentrate (instead of belly dump trailers)
- Progressively vegetating any disturbed areas at the mine site that will not be disturbed in the future

In addition to the above, travel distances on surface at the mine site are short, which reduces fugitive dust from unpaved roads. Climate normals indicate 168 days of measurable precipitation which also reduces eliminates generation of fugitive dust.

6.1.5.2 Gaseous Pollutants

Potential Effects

Emissions of SO_2, NOx, and CO are primarily produced from fuel combustion, especially at high temperatures, and could potentially affect the respiratory system and cause headaches and dizziness. The primary sources were diesel generators; surface diesel equipment, incinerator and ANFO use for explosives detonations. The detailed emission estimations are in Technical

Supporting Document 2. The adverse effects on humans and wildlife include respiratory systems. Gas pollutants have effects on soil, vegetation and water bodies. Adverse effects on human and ecological environment are assessed in relevant sections such as human health assessment, wildlife and vegetation.

Power demand and regular vehicle use during construction and closure phases are relatively lower than operations. The main construction and closure activities involve mechanical installations/dismantling such as process equipment, and power requirements are much lower than during operations. As such, diesel generators are not significant air emission sources during the construction and closure phases.

Proposed Mitigation Measures

Most mining operations use diesel powered equipment, but the Project will use electrical equipment for underground operations. Using electrical equipment reduces gas pollutants substantially in underground operations. Additionally, blasting results in particulate matter emissions but this will not contribute to ambient air because blasting will take place underground and ventilation design mitigates particulate matter in air.

Surface equipment and vehicles will be maintained on a regular basis to ensure their efficiency. The factory recommended maintenance programs provide the best practices which enables optimum engine operation including fuel combustion. This preventive mitigation is widely used and cost effective solution to minimize air emissions and to provide optimum fuel consumption.

Multiple generators will be used at site to supply power at site. The power generators will be maintained regularly to ensure optimum operation conditions. Environment Canada adopted a regulation to use ultra-low sulphur diesel in Canada which dramatically reduces sulphur dioxide emission to atmosphere (EC, 2002).

Gaseous pollutants can be decreased by conserving energy and using fuel efficiently. In order to maintain these basic principles, the mitigations measure would be:

- Minimize diesel vehicle and machinery emissions by turning vehicles and equipment off when not in use
- Use residual heat from diesel generators in the power plant to dry concentrate
- Operate equipment at optimum rated loads and minimize number of trips where applicable
- Follow maintenance procedures recommended by manufacturers
- Impose no idling policy where applicable

Refuse waste will be incinerated at site with a dual chamber incinerator which provides sufficient temperature and duration for safe burning. The capacity of incinerator will be sufficient to accommodate domestic waste from the camp and non-hazardous wastes from mining activities such as cardboard boxes and scrap wood. Dual chamber incinerators are widely used in remote locations in Canada where off-site disposal is costly and generates transportation related emissions to the environment. Although, MOE does not promote the use of incinerators, it is recognized that such remote facilities can utilize the convenience of on-site thermal controlled burning (MOE, 2010a) because the system components avoid temperature range that is known to promote toxic flue gas formation.

The daily design capacity was estimated less than 3 tonnes and the incinerator unit will be operated and maintained to meet requirements in Guideline A-7 (MOE, 2010a) and Canada-Wide standards for dioxins and furans (CCME, 2001). These standards limit in-stack air emissions for air contaminants such as particulate matter, dioxins, furans and metals. Guideline A-7 is not intended to provide operational standards for incinerators but intended to guide operations to meet environmental standards.

6.1.5.3 Dustfall

Potential Effects

Dustfall is settling particulate matter which is generated from the same sources as suspended particulate matter. The primary source is unpaved roads or erosion for mining activities.

Dustfall deposition may affect vegetation growth and at high levels of deposition, and depending on the chemical characteristics of the dustfall, may also affect soil quality, water quality, wildlife and human health.

Proposed Mitigation Measures

The mitigation measures for managing dustfall from ore, concentrate and fugitive sources are the same as those identified to mitigate emissions of suspended particulate matter (Section 6.1.5.1).

6.1.6 Air Quality Modelling Methodology

A refined model, AERMOD, was selected as the modelling system for the reasons listed below:

- Anticipated transport distances are less than 50 km due to size of the Project
- Air emission sources in the mine site is complex (single or multiple point, area, line, volume sources) with multiple buildings contributing downwash
- Particulate matter depositions due to fugitive dust emissions
- Constant or time-varying emissions, and
- Concentration estimates for all terrain locations required

AERMOD is a widely used regulatory air dispersion program which is a steady-state Gaussian plume model. The output provides maximum or ranked concentrations at a selected receptor point over the study area. The selection of AERMOD is consistent with the requirements of Air Dispersion Modelling Guideline for Ontario (MOE, 2009).

Selecting emission rates to quantify air contaminants depends on the purpose of the modelling application. For this Project, worst-case air emissions were used to estimate air emissions during operations, expecting that this will adequately represent conditions during the construction phase. The following were used to quantify air emissions for the Project:

- Approved/proposed emission limits (incinerator at waste management facility)
- Manufacturer specifications (diesel generators for plant and underground mining activities)
- Published emission factors such as USEPA AP-42 emission factors (off-road vehicles, blasting, erosion, unpaved roads, transfer points etc.)

Models were developed for the mine site (for all air contaminants of interest) and for the transportation corridor (particulate matter and dustfall only). Potential residual Project-related (after mitigation) effects on ambient air quality in the study area were assessed by using quantitative methods as follows:

- Estimation of the air emissions during operation phase originating from Project components and activities
- Prediction of Project-related gas pollutants and particulate matter concentrations and deposition through the atmosphere, using quantified dispersion modeling (AERMOD)
- Addition of the predicted incremental concentrations to baseline levels to determine ambient air quality concentrations during operation phase
- Comparison of the resulting predicted concentrations and dustfall rates with Canadian and Ontario ambient air quality criteria to determine if residual air quality effects may occur

The outputs of the model were post processed to generate concentration and deposition isopleths for better comparison on maps. Technical Supporting Document 2 provides the emissions inventories used in the modelling, a detailed description of the modelling methodology, and figures showing the resultant isopleths for the air contaminants modelled at each Project location.

6.1.7 Mine Site Air Quality Modelling Results

There is no Project fence line or property boundary at the mine site, as the site will not be fenced and the mineral claim boundaries are large and do not adequately represent a property boundary. However, receptors must be placed along the plant boundary to demonstrate compliance at the nearest reportable geographical locations to the sources. In these instances, the MOE (2009) directs proponents to predict air quality concentrations at a distance of 200 m from the nearest Project infrastructure or mine activity. A reference point, termed the “Property Boundary Measurement Point”, has been identified approximately 200 m to the east of the main mine site area. The model results reveal that the maximum concentrations would occur at this reference point during operations.

The maximum concentrations of air contaminants predicted at the mine site Property Boundary Measurement Point are compared to the applicable AAQCs in Table 6.1-5.

Results are presented on the isopleth maps in Appendix B of Technical Supporting Document 2. Concentrations of all air contaminants modelled are well within the applicable AAQC at the property boundary measurement point, which demonstrates that the Project will comply with Ontario’s regulatory requirements and guidelines (O. Reg. 419/05).

Table 6.1-5 Maximum Predicted Air Quality Concentrations at the Mine Site

Compound	Averaging Period	Predicted Concentration (µg/m³)	AAQC Limit (µg/m³)	% of Limit
SO_2	1 hr	58.9	690	9
	24 hr	8.8	275	3
	Annual	1.2	55	2
NO_2	1 hr	91.3	400	23
	24 hr	43.2	200	22
CO	1 hr	247.7	36,200	1
	8 hr	166.1	15,700	1
TSP	24-hr	20.1	120	17
	Annual	15.7	60	26
PM_{10}	24 hr	12.9	50	26
$PM_{2.5}$	24 hr	6.1	30	20
Dustfall	30 day	0.34 [1]	7 g/m²	5

[1] Project Incremental Deposition

6.1.8 Transportation Corridor Air Quality Modelling Results

Suspended particulate matter, total particulate matter and dustfall were modelled along a representative section of road to predict the fugitive dust likely to be generated by the road. The results of this modelling are presented in Appendix B of Technical Supporting Document 2.

The maximum concentrations of air contaminants predicted along the all-season road are compared to the applicable AAQCs in Table 6.1-6.

Table 6.1-6 Maximum Predicted Particulate Matter Concentrations Along the Road

Compound	Averaging Period	Predicted Concentration (µg/m³)	AAQC Limit (µg/m³)	% of Limit
TSP	24-hr	63.9	120	53.3
PM_{10}	24 hr	22.4	50	44.8
$PM_{2.5}$	24 hr	5.8	30	19.3
Dustfall	30 day	2.05 [1]	7 g/m²	29.3

[1] Project Incremental Deposition

Concentrations of all air contaminants modelled are well within the applicable AAQC along the all-season road, which demonstrates that the Project will comply with Ontario's regulatory requirements and guidelines (O. Reg. 419/05).

6.1.9 Trans-load Facility Residual Effects

The level of activity and quantity of air emissions at the trans-load facility is a sub-set of what will occur at the mine site. Using the mine site air quality modelling results as a proxy and considering the various mitigation measures to be implemented (asphalt surfacing, containment of dust, etc.), the residual effects are expected to be minor.

6.1.10 Potential Residual Effect and Determination of Significance

The assessment criteria for effects to air quality are presented in Table 6.1-7.

Table 6.1-7 Determining Significance of Residual Effects for Air Quality

Criteria	Rating	Definitions
Magnitude	Low	Predicted effects on air quality are within the natural baseline variability
	Medium	Predicted effects on air quality are not within the natural baseline variability but do not exceed any applicable regulatory ambient air quality criteria
	High	Predicted effects on ambient air quality are not within the natural baseline variability and exceed any applicable regulatory thresholds
Geographical Extent	Localized	Effect limited to the LSA
	Widespread	Effect extends to the RSA
Duration	Short Term	Effect lasts <2 years
	Medium Term	Life of Project (11 years)
	Long Term	Beyond the life of the Project, or permanent
Frequency	Infrequent	Effect occurs rarely (i.e. monthly to yearly)
	Frequent	Effect occurs intermittently or continuously (i.e. weekly or daily)
Reversibility	Reversible	Effect is reversed after the activity ceases
	Irreversible	Effect will not be reversed after the activity ceases, or the effect is permanent
Context	Low	Low resilience to imposed stresses, or will not easily adapt to the effect.
	High	High resilience to imposed stresses, or will easily adapt to the effect.
Probability of occurrence	Low	Low likelihood that the predicted residual effect will occur.
	Moderate	Moderate likelihood that the predicted residual effect will occur. (Unknown)
	High	High likelihood that the predicted residual effect will occur.

Table 6.1-8 presents the ratings assigned for the various assessment criteria and the conclusions regarding the potential significance of residual effects to air quality.

As the predicted air quality concentrations will be above natural baseline variability but within applicable AAQC under worst-case conditions, a medium magnitude rating is applied in all instances. The geographic extent of these effects is localized and confined to the LSAs; the effects will occur for the duration of the project (medium term); the effects will frequently occur; and the effects are fully reversible. The Project areas have no nearby receivers and therefore have a high resilience to imposed stresses. The probability of the effects occurring is high.

Table 6.1-8 Residual Effects on Air Quality and their Significance

Residual Effect	Area	Predicted Degree of Effect After Mitigation Measures								Significance of Residual Effect
		Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Ambient air quality effects and dust deposition	M	Adverse	Medium	Local	Long-term	Infrequent	Reversible	Low resilience	Moderate	Not significant
	TC	Adverse	Medium	Local	Long-term	Infrequent	Reversible	Low resilience	Moderate	Not significant
	TLF	Adverse	Medium	Local	Long-term	Infrequent	Reversible	Low resilience	Moderate	Not significant

6.1.11 Conclusions

Ambient air quality concentrations and dust deposition rates were predicted by using the AERMOD air quality dispersion model for the entire study area. The model was run for a 5 year period to estimate maximum periodical and annual average concentrations during the operation phase of the Project.

The predicted results were compared with ambient air quality standards applicable in Canada and Ontario. The comparisons indicate that there are no exceedances in the study area and concentrations are well below the criteria. The residual effects on ambient air quality is expected to be not significant. The highest concentrations were predicted to be on the project boundary to the nearest point to the proposed power generators. The details for baseline ambient air concentrations, air emission estimations, modelling, predicted results and methodology are contained in Technical Supporting Document 2.

6.2 CLIMATE

6.2.1 Introduction

Increases in greenhouse gases (GHGs) cause a resultant increase in the heat retained within the Earth's atmosphere, causing changes in the global climate. These changes could lead to alterations in local glacial cover, hydrologic regime and vegetative and wildlife communities. The significance of the proposed Project`s potential effects on climate change is assesses by estimating the GHG contributions of Project activities to the atmosphere.

The effect on climate change from a single emitter cannot be quantified by estimating the Project's incremental contribution to atmospheric GHGs. As such, the significance of the proposed Project's potential effects on climate is assessed by comparing projected Project emissions to national, provincial and mining industry statistics.

6.2.2 Rationale for VEC Selection

Project-related GHG emissions will result in increases to global GHG emissions. Emissions from the Project include combustion of fuel for power generation and equipment use including off-road vehicles and transportation corridor traffic. Climate change is a VEC because of the increasing public concerns of climate change potential due to GHG emissions and reporting requirements by Government (Table 6.2-1).

Table 6.2-1 Climate VEC Selection Rationale

VEC	Key Indicator(s)	Rationale for VEC Selection or Exclusion
Climate Change	Greenhouse Gasses	GHG increases may result in climate change which is a regulatory concern. Reporting is required but there is no limit for industries to comply with

6.2.3 Applicable Guidance

Current regulations do not require compliance with limits or design changes but there are annual reporting requirements that may apply to the Project.

The Government of Canada recognizes climate change as a global issue requiring a global solution. Canada inscribed in the Copenhagen Accord its 2020 economy-wide target of a 17 % reduction in GHGs from 2005 levels. This target was announced on January 29, 2010.

Canada announced its withdrawal from the Kyoto Protocol at the United Nations Climate Change Conference in 2011. This decision did not change Canada's emissions reduction target by 2020. Canadian Government is developing guidelines and regulations on a sector-by-sector basis.

In 2009, Ontario introduced a regulation requiring large emitters to report their greenhouse gas emissions. The Ontario Ministry of the Environment (MOE) collected data in 2010 and 2011, and required 2011 data to be verified by a third party.

Ontario Regulation 452/09 (O. Reg. 452/09) under the *Ontario Environmental Protection Act* requires large emitters to report their GHG emissions to the MOE. This information will be essential for informing the key design elements of a GHG reduction program. The purpose of the regulation is to provide MOE with better data about the Province's emissions levels, while supporting the implementation of a cap-and-trade program in Ontario. This program will be combined with North American trading systems in the future. O. Reg. 452/09 requires reporting of GHG data by listed facilities emitting 25,000 tonnes of carbon dioxide equivalent (CO_2e) or more per year. Although gold mining is not included in the list, it requires reporting because of the power generation plant and annual emissions in excess of 25,000 tonnes during the operation phase.

6.2.4 Assessment Boundaries

The Project's potential effects on the climate will occur through the release of GHGs, which may contribute to global climate change. The climate effects assessment is limited to the effect the proposed Project would have on atmospheric GHG levels and spatial boundaries are not applicable. As such, potential climate effects assessed in this section are considered to have a trans-boundary geographic extent.

6.2.5 Temporal Boundaries

The temporal boundaries for the assessment are defined based on the timing and duration of the Project activities that could induce effects on climate change. The purpose of a temporal boundary is to identify when an effect may occur in relation to specific Project phases and activities. Effects will be identified with reference to activities occurring in one or more of the Project phases:

- Construction (3 years)
- Operation (11 years)
- Closure (2 years)
- Post-closure (a minimum of 5 years)

The current expected Project life is 16 years, inclusive of the construction, operation, and closure phases.

6.2.6 Potential Effects and Mitigation Measures

Table 6.2-2 identifies the potential interactions of different project components and activities with GHG contributions. This process serves to inventory the interactions so that reoccurring effects can be identified to focus the assessment on the main issue of concern in regard to GHG emissions, fuel consumption.

Table 6.2-2 Project Components and Mechanism of Interaction Summary for GHG Release

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Mine Site			
Ground Preparation (e.g., cut, fill, grub, etc.)	C	Yes	• Fuel combustion due to equipment use
Construction of surface infrastructure	C	Yes	• Fuel combustion due to equipment use
Underground mine development, including de-watering	C	No	• No equipment use required
Underground mine operation	O	No	• Electrical equipment will be used
Underground ore processing and concentrate loading	O	No	• Electrical equipment will be used
Tailings production and underground disposal	O	No	• Electrical equipment will be used
Mining of crown pillar	O	Yes	• Fuel combustion due to equipment use
Aggregate production	C, O	Yes	• Fuel combustion due to equipment use
Aggregate and topsoil stockpiles	C, O	Yes	• Fuel combustion due to equipment use
Construction of site roads	C	Yes	• Fuel combustion due to equipment use
Accommodation facility operation	C, O	No	• Electrical equipment will be used
Power plant operation	C, O	Yes	• Fuel combustion
Fuel Storage and distribution	C, O	Yes	• Fugitive VOCs during transfer and storage
Equipment and vehicle use	C, O, CL	Yes	• Fuel combustion
Explosives use, handling and storage	C, O	Yes	• Fuel use for explosive detonation
Groundwater use for potable water and underground processing	C, O	No	• Electrical equipment will be used
Surface water management (non-contact water)	C, O, CL	No	• Electrical equipment will be used
Waste management: solid and sewage waste facilities	C, O, CL	Yes	• Fuel combustion and other emissions during incineration
Hazardous materials handling and storage	C, O, CL	Yes	• Fugitive VOCs during transfer and storage
Closure of underground workings	CL	Yes	• Fuel combustion due to equipment use
Closure of surface facilities, including portal	CL	Yes	• Fuel combustion due to equipment use
Scarification and reclamation	CL	Yes	• Fuel combustion due to equipment use
Training Programs	C, O	No	• No equipment use required
Mine Staffing	C, O, CL	No	• No equipment use required except for administrational electric
Procurement of goods and services	C, O, CL	No	• No equipment use required except for administrational electric

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Transportation Corridor			
Ground preparation for road (e.g. cut, fill, grub, etc.)	C	Yes	• Fuel combustion due to equipment use
Aggregate and borrow site development	C, O	Yes	• Fuel combustion due to equipment use
Road construction (includes culvert, bridge installation)	C	Yes	• Fuel combustion due to equipment use and explosive detonation
Road maintenance	O	Yes	• Fuel combustion due to equipment use
Equipment and vehicle use	C, O	Yes	• Fuel combustion for operation
Waste management	C	Yes	• Fuel combustion and other emissions during incineration
Water management (non-contact water)	C, O	No	• Electrical equipment will be used
Explosives use, handling and storage	C	Yes	• Fuel use for explosive detonation, fuel consumption for drilling and transfers
Fuel Storage and distribution	C	Yes	• Fugitive VOCs during transfer and storage
Construction camps	C	Yes	• Heating
Hazardous materials handling and storage	C, O	Yes	• Fugitive VOCs during transfer and storage
Employment	C, O	No	• No equipment use required
Procurement of goods and services	C, O	No	• No equipment use required except for administrational electric
Trans-load Facility			
Ground preparation and site construction	C	Yes	• Fuel combustion due to equipment use
Construction of rail siding	C	Yes	• Fuel combustion due to equipment use
Construction of buildings and loading facility	C	Yes	• Fuel combustion due to equipment use
Upgrading site access roads	C	Yes	• Fuel combustion due to equipment use
Installation of transmission line	C	Yes	• Fuel combustion due to equipment use
Waste management: solid and sewage waste facilities	C, O	Yes	• Fuel combustion due to equipment use
Water management (including surface water collection pond)	C, O	No	• Electrical equipment will be used
Water supply well	C, O	No	• Electrical equipment will be used
Fuel Storage and distribution	C, O	Yes	• Fugitive VOCs during transfer and storage
Equipment and vehicle use	C, O	Yes	• Fuel combustion due to equipment use
Hazardous materials handling and storage	C, O	No	• Fugitive VOCs during transfer and storage
Operation of concentrate loading facility	O	Yes	• Fuel combustion due to equipment use
Re-grading, ditching, and placement of asphalt	C	Yes	• Fuel combustion due to equipment use
Equipment and vehicle use	C O CL	Yes	• Fuel combustion due to equipment use
Procurement of goods	C, O	No	• No equipment use required
Closure of facility	CL	Yes	• Fuel combustion due to equipment use

NOTES:

2. C – CONSTRUCTION, O – OPERATION, CL – CLOSURE.

The potential effects of Project on climate change via GHG release can be summarized according to the types of air contaminants that will be emitted by the Project (Table 6.2-3).

Table 6.2-3 Potential Effects on Climate

Contaminant	Key Indicator	Potential Indirect Effects / Receptors	Direction
Greenhouse Gases	CO_2, CH_4, N_2O, others	Climate Change	Adverse

Annual GHG emissions during the Project were calculated at a high level because detailed breakdowns of fuel consumption are not available at this stage of planning the Project. The calculations were completed by multiplying the activity level (e.g., the total annual consumption of diesel fuel) by an emission factor. The following is the basic methodology that was used to estimate the annual GHG emissions in carbon dioxide equivalent (CO_2e) for diesel consumption:

'Total Emissions (tons CO_2e) = Activity Level (diesel consumption in litres) x Emission Factor (t CO_2e/L diesel)'

GHG estimates incorporate the GHG emissions of carbon monoxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) and are presented in units of CO_2 equivalent. The equivalent estimates are calculated by multiplying the emission rate of each substance by its global warming potential relative to CO_2.

GHG emission factors used to calculate construction and operation phase emissions shown in this section were taken from Version 2.0 of the Climate Registry's General Reporting Protocol (Climate Registry, 2013). Each GHG has a different Global Warming Potential (GWP). GWPs are unitless coefficients used to compare the abilities of different GHGs to trap heat relative to that of CO_2. GWPs of the primary anthropogenic GHGs are CO_2 = 1 CO_2e, CH_4 = 21 CO_2e, and N_2O = 310 CO_2e, where 1 CO_2e is the equivalent of one unit of CO_2. In this assessment, emission factors with aggregated have been used and results were shown in CO_2 equivalent.

6.2.7 Greenhouse Gas Estimations

The consumption rate method was applied as described in Environment Canada`s guideline for metal mines (EC, 2004). Environment Canada does not classify mining as a separate sector however it is included in the Mining, Oil & Gas industry category. The data from this sector was used for comparison. The Project`s emission projections were compared with the latest data available (2011) established by Environment Canada (EC, 2013f). Since the majority of equipment will use electricity, the equipment emissions are shifted to power generation units. As such, most emissions will be released from the power plant.

Table 6.2-4 Estimated GHG Releases (CO_2 Equivalents)

Project Phase	Estimated Total Emissions (kt CO_{2eq})	Annual Average Emissions (kt CO_{2eq})	Canada Total in 2011 (kt CO_{2eq})	Ontario Total in 2011 (kt CO_{2eq})	Sector Total in 2011 (kt CO_{2eq})
Construction (mine site)	254	85	702,000	170,600	36,400
Operations (mine site)	1,444	131			
Operations (transportation)	124	11			
Project Total	1,822	not calculated			

NOTES:
1. KT – KILOTONNES.
2. MINING IS INCLUDED IN MINING, OIL AND GAS SECTOR FOR GHG REPORTING.

The Project will generate a total of 1,822 kt CO_2e over the life of the Project. This is very minor in relation to the annual totals for the industry, for Ontario and for Canada.

Noront will implement mitigation strategies during the Project to maintain a small contribution to GHG levels and implement continuous improvement as opportunities are identified. As a member of the Mining Association of Canada, Noront commits to meeting the requirements of the Towards Sustainable Mining (TSM) Initiative. An element of the TSM is energy use and GHG emissions management. There are three performance indicators established under TSM's energy use and GHG emissions management protocol, and Noront intends to work toward an "A" scoring in each of the performance indicators as summarized below:

Energy Use and Greenhouse Gas Emissions Management Systems

Comprehensive energy use and GHG emissions management system established that includes these additional elements:

- Facility or business unit have identified and annually reviewed what energy and emissions sources are material according to their established criteria
- Clear accountability for energy use and GHG emissions management assigned to operational managers
- Energy data is reviewed regularly and integrated into operator actions for energy intensive processes
- Actions and process controls related to energy use and GHG emissions are included in management systems for material sources
- General energy and GHG awareness training is provided to personnel with additional training for key personnel

Energy Use and Greenhouse Gas Emissions Reporting Systems

Comprehensive energy use and GHG emissions reporting system established that includes:

- Energy use and GHG emissions performance results are reported regularly at a facility level to management to inform decision making
- Annual public reporting of energy[1] use and GHG emissions

- Where offsets are used by the facility or business unit to meet commitments, public reporting includes:
  - The amount of offsets as a percentage of total emissions generated at the facility and/or at the business unit level
  - The source and nature of the accreditation of offsets

Energy and Greenhouse Gas Emissions Performance Targets

- Energy and GHG emissions performance targets for the facility and/or business unit are met in the reporting year
- In establishing objectives and targets, the facility or business unit has considered significant energy uses identified in their energy management system as well as its financial, operational and business conditions, legal requirements, technological options, the views of potentially affected parties and opportunities to improve energy performance

6.2.8 Potential Residual Effect and Determination of Significance

A residual effect is any measurable or demonstrable effect on the environment after mitigation. Determining the effect of a single industry on climate change is not possible because GHGs effect climate change on a global scale. The effects of the Project were estimated by comparing the contribution of the Project emissions with National, Provincial and Sector GHGs. The contribution of the Project was considered negligible in comparison with National, Provincial and Sector GHGs. Therefore the Project will not have significant effect on climate change from Project GHG emissions. The assessment criteria are defined in Table 6.2-5 and the ratings are presented in Table 6.2-6.

Table 6.2-5 Determining Significance of Residual Effects for Climate

CRITERIA	RATING	DEFINITIONS
Magnitude	Low	Predicted effects on air quality are within the natural baseline variability
	Medium	Predicted effects on air quality are not within the natural baseline variability but do not exceed any applicable regulatory ambient air quality criteria
	High	Predicted effects on ambient air quality are not within the natural baseline variability and exceed any applicable regulatory thresholds
Geographical Extent	Localized	Effect limited to the LSA
	Widespread	Effect extends to the RSA
Duration	Short Term	Effect lasts < 2 years (Construction phase)
	Long Term	Effect lasts into the Operations, Closure, and Post-Closure phase
	Permanent	Effect continues beyond Post-Closure phase into the foreseeable future
Frequency	Infrequent	Effect occurs rarely (i.e. monthly to yearly)
	Frequent	Effect occurs intermittently or continuously (i.e. weekly or daily)
Reversibility	Reversible	Effect is reversed after the activity ceases
	Irreversible	Effect will not be reversed after the activity ceases, or the effect is permanent
Context	Low resilience	Low resilience to imposed stresses, or will not easily adapt to the effect.
	High resilience	High resilience to imposed stresses, or will easily adapt to the effect.
Probability of occurrence	Low	Low likelihood that the predicted residual effect will occur.
	Moderate	Moderate likelihood that the predicted residual effect will occur. (Unknown)
	High	High likelihood that the predicted residual effect will occur.

Table 6.2-6 Significance of Residual Effects on Climate from GHG Emissions

Residual Effect	Predicted Degree of Effect After Mitigation Measures								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Project GHG emissions affecting climate change	Adverse	Low	Widespread	Long Term	Frequent	Reversible	Low Resilience	High	Not significant

6.2.9 Conclusions

Emissions resulting from the Project activities will contribute to the global GHG inventory. Total direct annual GHG emissions from the proposed Project during the construction phase are estimated to be 85 kt of CO_2-eq per year (averaged over 3 years). The operations phase are estimated to be 131 kt of CO_2-eq per year (averaged over 11 years) which is 0.02 % and 0.08 % of Canada's and Ontario's total annual GHG emissions, respectively.

The mining industry is not classified as a separate industry sector in GHG reports established by Environment Canada. Mining is a part of the Mining, Oil & Gas sector. The Project emissions were estimated to be 0.35 % of this sector considering reported 2011 emissions.

The comparison shows that contribution of the Project`s GHG emissions is low compared to reported industrial, Provincial and overall National emissions. The adverse residual effect identified in the assessment was determined to be not significant.

6.3 NOISE

6.3.1 Introduction

Noise emissions from the Project have the potential to affect the acoustic environment by increasing ambient noise levels. Sound will be emitted from heavy equipment such as mine vehicle traffic, mine equipment, aggregate crushers, haul trucks, the process facility and generators. The changes in ambient noise levels due to Project activities were evaluated against Provincial objectives and standards to determine potential effects to human health and the biophysical environment.

The assessment of noise is summarized in Technical Supporting Document 3 and included the following steps:

- Providing an overview of ambient sound levels
- Summarizing applicable regulations and guidelines
- Defining regional and local study areas
- Scoping Project-related noise sources that could cause potential effects
- Estimating the noise emissions inventory associated with the Project
- Reviewing potential effects and mitigation options
- Performing noise modelling in order to estimate the potential residual effect on the acoustic environment
- Comparing results with applicable criteria in the Project area

6.3.2 Rationale for VEC Selection

Noise is generally defined as unwanted sound and it is characterized in terms of the pressure of the sound wave. Human perception of sound pressure is non-linear: A ten-fold increase in sound pressure is perceived as a doubling of the noise level by the average person. Noise level is measured in decibels (dB) above a standard reference levels. Project-related activities will increase noise levels in project area and noise is of intrinsic importance to human health and the biophysical environment. As such, noise was identified as a VEC (Table 6.3-1).

Table 6.3-1 Noise VEC Selection Rationale

VEC	KEY INDICATOR(S)	RATIONALE FOR VEC SELECTION OR EXCLUSION
Ambient Noise Levels	Noise levels around the project activities	Noise levels are concern for human health and the biophysical environment which may result in a sensory disturbance. Regulatory concern ; key indicator noise levels have been selected to define the limits

Human sound detection ability is frequency dependent and the sound pressure is commonly weighted by frequency to model human perception. Weighted noise levels are given in units of "dBA." A change in noise level of 3 dBA is barely noticeable, while a 10 dBA change is perceived as a doubling of the noise level. Typical noise levels are as follows:

- 0 dBA: the threshold of human hearing
- 10 dBA: rustling leaves

- 20 to 40 dBA: very calm room
- 40 to 60 dBA: normal conversation
- 60 to 80 dBA: passenger car at 10 m
- 80 to 90 dBA: major road at 10 m
- 100 dBA: jackhammer at 1 m
- 110 to 130 dBA: jet takeoff at 100 m
- 130 dBA: human pain threshold

6.3.3 Applicable Guidance

Ontario Environmental Protection Act (EPA; Ontario, 1990a) regulates the ambient noise in rural and urban areas in Ontario to provide protection for environment near human activities. The basic criterion for noise protection is that any audible noise you can hear from human activities should be no louder than the combination of normal background (ambient) noises such as wind, rain etc.

In order to achieve requirements of the EPA, Ontario Ministry of Environment (MOE) established 3 guidelines to regulate noise levels. These are:

- Sound Level Limits for Stationary Sources in Class 3 Areas (Rural) (NPC-232)
- Sound Level Limits for Stationary Sources in Class 1 & 2 Areas (Urban) (NPC-205)
- Sound Levels Due to Road Traffic (NPC-206)

The guidelines aim to apply the sound level limits and criteria to provide appropriate design, buffering and separation of major facilities and sensitive land uses to prevent adverse effects on receptors.

MOE identifies 3 classes of acoustical environments as follows:

- "Class 1 Area" means an area with an acoustical environment typical of a major population centre, where the background noise is dominated by the urban hum
- "Class 2 Area" means an area with an acoustical environment that has qualities representative of both Class 1 and Class 3 Areas, and in which a low ambient sound level, normally occurring only between 23:00 and 07:00 hours in Class 1 Areas, will typically be realized as early as 19:00 hours. Other characteristics which may indicate the presence of a Class 2 Area include:
    - Absence of urban hum between 19:00 and 23:00 hours
    - Evening background sound levels defined by natural environment and infrequent human activity
    - No clearly audible sound from stationary sources other than from those under impact assessment
- "Class 3 Area" means a rural area with an acoustical environment that is dominated by natural sounds, having little or no road traffic, such as the following:
    - A small community with a population of less than 1,000
    - An agricultural area
    - A rural recreational area such as a cottage or a resort area
    - A wilderness area

Under this classification system, the Project is considered a Class 3 area, because the mine site area is undisturbed and in a wilderness area; therefore NPC-232 guidelines are the most relevant established noise criteria for the Project. The Project load-out facilities are located near small towns therefore they are also Class 3-Rural.

In addition, the MOE has published a draft environmental noise guideline (NPC-300) for consultation purposes in 2010. The draft guideline will replace these 3 existing guidelines (NPC-232, NPC 205, NPC-206) in the future. The new guideline suggests the same requirements for the areas where the Project is located therefore the classification (Class 3–Rural) done for Eagle's Nest is also consistent with the proposed new guideline.

The guidelines set the allowable limits for ambient noise levels, which are applicable for receptors. In other words, allowable limits are receptor based and they require comparison of sound levels where receptors are located. For Class 3 areas, the minimum limits are summarized in Table 6.3.2.

Table 6.3-2 Minimum Values for One Hour L_{eq} or L_{LM} by Time of Day

Time of Day	One Hour L_{eq} (dBA) or L_{LM} (dBAI)
07:00 – 19:00	45
19:00 – 23:00	40
23:00 – 07:00	40

The applicable MOE guideline (NPC-232) limits are receptor-based, which requires comparison of predicted or monitored sound levels at the location of a sensitive receptor against the applicable criteria, rather than at a specified area or Project boundary. There are no receptors in the vicinity of the Project boundary therefore the MOE's criteria were used for reference only.

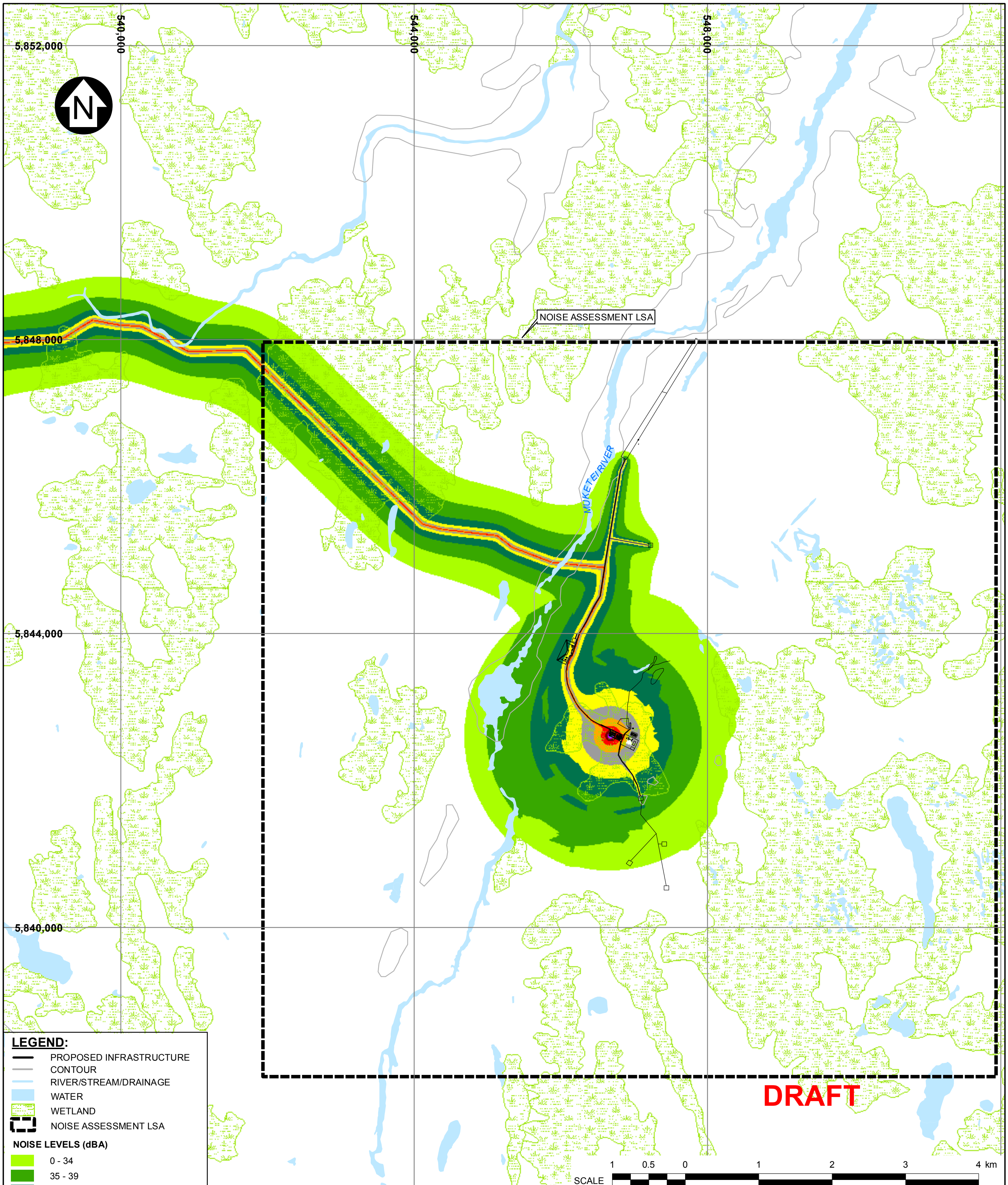
6.3.4 Assessment Boundaries

Project related noise could affect the area around the mine site and the access road corridor and trans-load facilities. Spatial boundaries for noise assessment are limited to the geographic areas for which there is a reasonable expectation of an effect of the Project on existing noise levels. Noise levels in the mine site boundary and facilities are subject to work place safety standards rather than environment noise limits therefore the workers' place in mine site area is excluded from the spatial boundaries for noise effects assessment.

For the assessment of potential effects of the Project, two study areas are defined: the local study area (LSA) and the regional study area (RSA). The RSA was defined as a 30 x 30 km rectangular area surrounding the mine site, where contributions of mining activities, including a portion of access road, will likely occur. The LSA was defined as 10 x 10 km rectangle around the main facilities (Figure 6.3-1).

Savant Lake load-out facility was also considered as a potential noise source and was included in the assessment in order to calculate noise attenuation around the facility. An LSA of 5 x 5 km (Figure 6.3-2) was used to estimate noise levels during operations at the trans-load facility. The load-out facility does not include substantial machinery or equipment use but there will be Project related activities such as traffic and transfer of concentrate from trucks to trains which may increase noise levels at this location.

The temporal boundary for the assessment was defined based on the duration of the Project activities that could increase noise levels. The duration and intensity of anticipated noise sources suggested that operation phase will have potential to increase the environmental noise therefore it is included in the effects assessment. Noise emissions associated with construction are much shorter duration than operations and are therefore not included in the effects assessment. Noise emissions during decommissioning phase are lower and shorter as well. As a result, environmental noise levels were anticipated to increase primarily during operations relative to other stages of the Project.



NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 20 METRES.
4. MINE SITE INFRASTRUCTURE INFORMATION PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

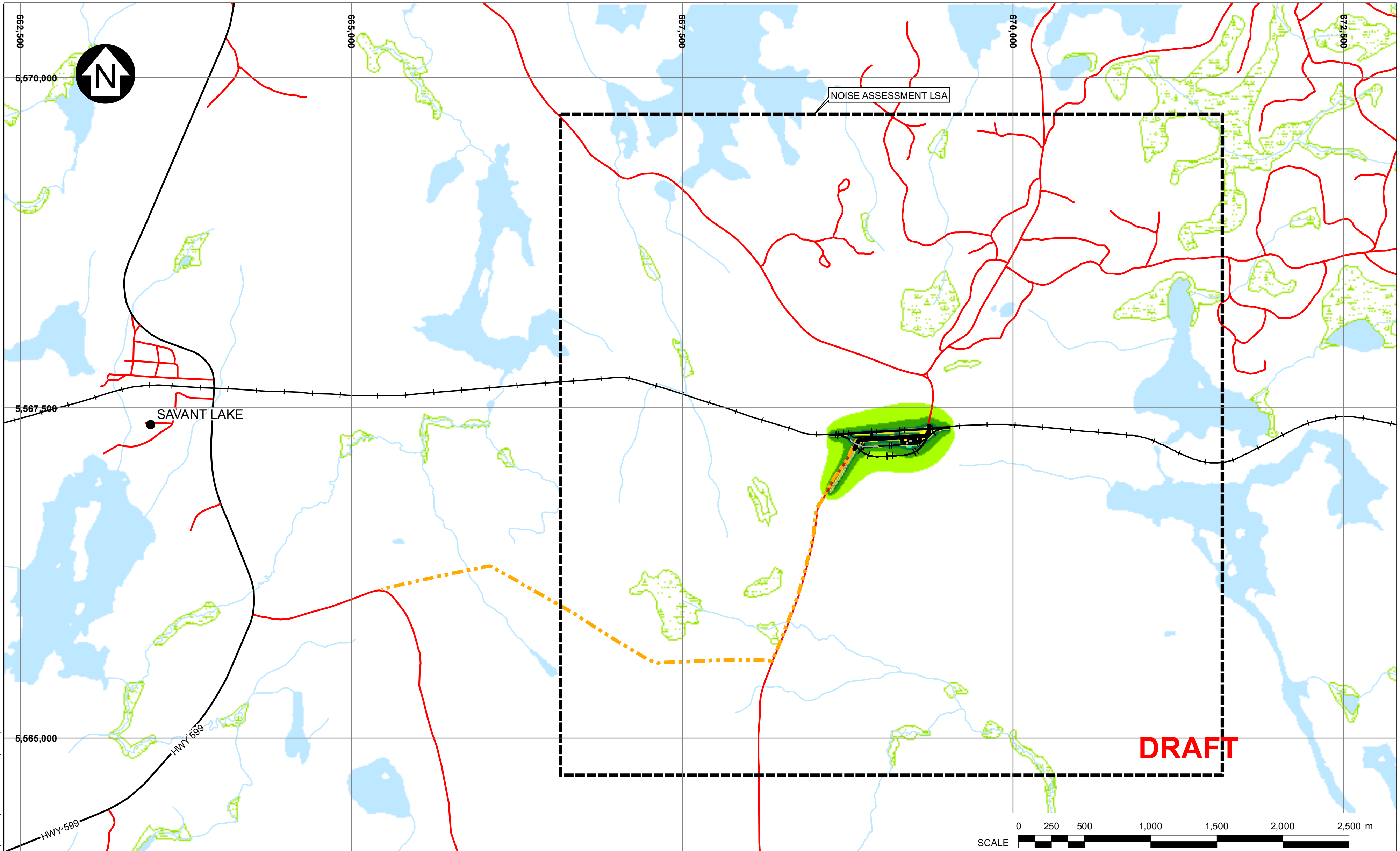
OPERATION PHASE MINE SITE NOISE ASSESSMENT LOCAL STUDY AREA

Knight Piésold CONSULTING

P/A NO.	REF NO.	
NB102-390/1	34	
FIGURE 6.3-1		REV A

A	20DEC'13	ISSUED WITH REPORT	TO	AS	SRA	RAM
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

SAVED: I:\1102\00390\01\A\GIS\Figs\A710_rA.mxd; Dec 20, 2013 1:24 PM; asimpson



LEGEND:

- COMMUNITY
- EXISTING ALL-SEASON ROAD
- RAILWAY
- PROPOSED HYDRO CORRIDOR
- PROPOSED INFRASTRUCTURE
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- NOISE ASSESSMENT LSA

NOISE LEVELS (dBA)

- 0 - 34
- 35 - 39
- 40 - 44
- 45 - 49
- 50 - 54
- 55 - 59
- 60 - 64
- 65 - 69
- 70 - 74
- 75 - 79
- 80 - 84
- 85 - 91

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N.
3. INFRASTRUCTURE IS BASED ON INFORMATION PROVIDED BY TETRA TECH (APRIL 19, 2012).

A	20DEC'13	ISSUED WITH REPORT	ALR	SWK	SRA	RAM
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

OPERATION PHASE TRANS-LOAD FACILITY NOISE ASSESSMENT LOCAL STUDY AREA

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF NO. 34

FIGURE 6.3-2

REV A

SAVED: I:\1102\00390\01\A\GIS\Figs\A711_rA.mxd; Dec 20, 2013 11:54 AM; asimpson

6.3.5 Potential Effects and Mitigation Measures

An interactions table was completed for the effects assessment to determine the Project components and activities that could have a potential interaction with noise. This process serves to focus the assessment on the main issues that may have the potential for effects. Effects described in this section are related to environmental noise effects only and potential effects on wildlife and human health with respective guidelines are included in relevant sections.

The potential effects of the Eagle's Nest for all phases of the Project are summarised in Table 6.3-3. Potential effects on noise are in Table 6.3-4.

Table 6.3-3 Potential Interactions between the Project and Noise

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Mine Site			
Ground Preparation (e.g., cut, fill, grub, etc.)	C	Yes	Noise emission from equipment
Construction of surface infrastructure	C	Yes	Noise emission from equipment
Underground mine development, including de-watering	C	Yes	Noise emission from portal and ramp development
Underground mine operation	O	No	No interaction
Underground ore processing and concentrate loading	O	No	No interaction
Tailings production and underground disposal	O	No	No interaction
Mining of crown pillar	O	Yes	Noise emission from surface preparation and crown pillar extraction
Aggregate production	C, O	Yes	Noise emission from crushing, loading and hauling
Aggregate and topsoil stockpiles	C, O, CL	Yes	Noise emission from equipment
Construction of site roads	C	Yes	Noise emission from equipment
Accommodation facility operation	C, O, CL	Yes	Noise emission from operational activities
Power plant operation	C, O	Yes	Noise emission from generators
Fuel Storage and distribution	C, O	Yes	Noise emission from distribution equipment
Equipment and vehicle use	C, O, CL	Yes	Noise emission from equipment and vehicle use
Explosives use, handling and storage	C, O	Yes	Noise emission from blasting at/near surface and handling
Groundwater use for potable water and underground processing	C, O	No	No interaction
Surface water management (non-contact water)	C, O, CL	No	No interaction
Waste management: solid and sewage waste facilities	C, O, CL	Yes	Noise emission from equipment

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Hazardous materials handling and storage	C, O, CL	Yes	Noise emission from hauling and handling
Closure of underground workings	CL	Yes	Noise emission from plugging portal and crown pillar
Closure of surface facilities, including portal	CL	Yes	Noise emission from equipment
Scarification and reclamation	CL	Yes	Noise emission from equipment
Training Programs	C, O	No	No interaction
Mine Staffing	C, O, CL	No	No interaction
Procurement of goods and services	C, O, CL	No	No interaction
Transportation Corridor			
Ground preparation for road (e.g. cut, fill, grub, etc.)	C	Yes	Noise emission from equipment
Aggregate and borrow site development	C, O, CL	Yes	Noise emission from equipment, blasting and excavation
Road construction (includes culvert, bridge installation)	C	Yes	Noise emission from equipment
Road maintenance	O	Yes	Noise emission from equipment and vehicles
Equipment and vehicle use	C, O	Yes	Noise emission from equipment and vehicles
Waste management	C	No	No interaction
Water management (non-contact water)	C, O	No	No interaction
Explosives use, handling and storage	C	Yes	Noise emission from blasting and handling
Fuel Storage and distribution	C, CL	Yes	Noise emission from distribution equipment
Construction camps	C, O, CL	Yes	Noise emission from operational activities
Hazardous materials handling and storage	C, O, CL	Yes	Noise emission from vehicles
Employment	C, O, CL	No	No interaction
Procurement of goods and services	C, O, CL	No	No interaction
Trans-load Facility			
Ground preparation and site construction	C	Yes	Noise emission from equipment
Construction of rail siding	C	Yes	Noise emission from equipment
Construction of buildings and loading facility	C	Yes	Noise emission from equipment
Upgrading site access road	C	Yes	Noise emission from equipment
Installation of transmission line within existing right of way	C	Yes	Noise emission from equipment
Waste management: solid and sewage waste facilities	C, O	Yes	Noise emission from equipment
Water management (including surface water collection pond)	C, O, CL	Yes	Noise emission from equipment

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Water supply well	C, O	No	Noise emission from installation of well
Fuel Storage and distribution	C, O, CL	Yes	Noise emission from distribution
Equipment and vehicle use	C, O, CL	Yes	Noise emission from equipment and vehicles
Hazardous materials handling and storage	C, O	No	No interaction
Operation of concentrate loading facility	O	Yes	Noise emission from equipment
Procurement of goods and services	C, O	No	No interaction
Closure of facility	CL	Yes	Noise emission from equipment

NOTES:

1. C – CONSTRUCTION, O – OPERATION, CL – CLOSURE.

Table 6.3-4 Potential Effects on Noise

Mechanism of Interaction	Key Indicator(s)	Project Phase	Potential Effect	Direction
Regular mining activities such as equipment use, power generation	Noise levels in the LSA	C, O, CL	Increased noise levels within LSA	Adverse
Traffic including hauling and transportation	Noise levels in the LSA	C, O, CL	Increased noise levels within LSA	Adverse

6.3.5.1 Increased Noise Levels

Potential Effects

Noise will be associated with construction of the Project however it will be short term and will not occur regularly at the same location. Limited blasting is expected for site construction and road upgrades. The Project will generate noise during operations from daily heavy equipment use (e.g., surface mine equipment, haul trucks, plant operation, pumps, diesel generators and underground ventilation fans). Ambient sound levels will increase from the current baseline conditions.

Blasting will take place underground and most process equipment such as the crusher and mill will be located in underground facilities.

Noise modelling methodology and results are summarized in Technical Supporting Document 3. Noise levels from Project activities were modelled based on:

- Estimation of intensity, duration, duty cycle and location of the noise sources during operation phase originating from Project components and activities
- Prediction of Project-related maximum noise levels by using models using International Standards Organization’s 9613-2:1996 (ISO, 1996) for mine site and traffic
- Comparison of the resulting predicted noise levels to applicable Ontario noise limits

The results indicated that the Project noise will be mostly contained within the mine site and trans-load LSAs. Increased noise levels in Project LSAs are forecasted to be within rural limits (Class 3).

Proposed Mitigation Measures

The proposed mitigation measures that will be undertaken to reduce the potential effects on noise are outlined below:

- Project related noise will be reduced by adhering to best management practices. Staff training will be undertaken to improve awareness amongst personnel who actively work on transportation roads and load-out facilities.
- Noisy equipment will be located inside buildings or sheds where practical
- Buildings that provide acoustic shielding will be used to locate noisy equipment and to carry out noisy activities where existing buildings will block noise transmission to noise sensitive neighbours
- Noise transmission to neighbouring areas will be considered in locating and orienting stationary equipment
- A no idling policy can be imposed for mobile equipment and trucks

Operational procedures to mitigate noise emission will include:

- Equipment will be operated with well-designed covers, hoods, shields, etc., in place and latched shut
- Speed limits will be imposed on all Project roads
- Equipment will be maintained periodically by following factory recommendations
- Training will be provided to site workers in noise reduction methods and proper machine use
- Equipment will be inspected for wear or other maintenance issues if noise levels increase noticeably

6.3.6 Potential Residual Effect and Determination of Significance

The assessment criteria for effects of noise on the environment are presented in Table 6.3-5.

Table 6.3-5 Determining Significance of Residual Effects of Noise

Criteria	Rating	Definitions
Magnitude	Low	Predicted effects of noise are within the natural baseline variability
	Medium	Predicted effects of noise are not within the natural baseline variability but do not exceed any applicable regulatory thresholds
	High	Predicted effects of noise are not within the natural baseline variability and exceed any applicable regulatory thresholds
Geographical Extent	Local	Within the LSA as defined for noise
	Regional	Within the RSA as defined for noise
Duration	Short Term	Up to 3 years (e.g., the construction phase)
	Medium Term	Life of Project (operations and closure phases)
	Long Term	Beyond the life of the Project, or permanent
Frequency	Infrequent	Occurs occasionally

Criteria	Rating	Definitions
	Frequent	Occurs often or continuously
Reversibility	Reversible	Pre-Project conditions will return following the cessation of the potential residual effect
	Irreversible	Pre-Project conditions will not return following the cessation of the potential residual effect
Context	Low resilience	The VEC has low resilience to imposed stresses, or will not easily adapt to the effect
	High resilience	The VEC has a high resilience to imposed stresses, or will easily adapt to the effect
Likelihood	Low	Low probability that the predicted effect will occur
	High	High probability that the predicted effect will occur
Significance	Not Significant	Defined by VEC discipline
	Significant	Defined by VEC discipline

Table 6.3-6 presents the ratings assigned for the various assessment criteria and the conclusions regarding the potential significance of residual effects of increased noise.

Table 6.3-6 Significance of Residual Effects on Noise

Residual Effect	Predicted Degree of Effect After Mitigation Measures								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Increased noise levels from regular activities such as equipment use, power generation	Adverse	Med	Localized	Med Term	Frequent	Reversible	High resilience	High	Not significant

The predicted noise emissions will be above the natural baseline variability but within the applicable MOE limits. The geographic extent of these effects will be localized and confined to the LSAs. The effects will occur for the duration of the Project (medium term), will occur frequently, and are fully reversible. The Project areas have no nearby receivers and therefore have a high resilience to imposed stresses. The probability of the effects occurring is high.

6.3.7 Conclusions

An acoustical model was completed referencing ISO 9613-2:1996 (ISO, 1996) Standards for predicting mining equipment noise levels and RLS 90 (RLS 1996) Standards for predicting transportation noise levels. The results of the noise modeling indicate that Project noise will be contained within the mine site area. The noise levels beyond site boundary are below applicable criteria (Technical Supporting Document 3).

Health Canada's and the MOE's approach to noise assessment is a receptor-based evaluation by using internationally recognized standards for acoustics rather than setting noise thresholds and standards. Since there are no human settlements in the Project study areas, the receptor-based comparison could not be performed however, the predicted results, representing worst case, were generated for certain time periods during the day and compared with limits provided in MOE guidelines. The effects on noise on Wildlife are assessed in Section 6.8.

6.4 SURFACE WATER

6.4.1 Introduction

The Project will interact with surface water within the Project's immediate area of influence. Effects to surface water quality will mainly occur at the mine site and effects to quantity will mainly occur along the transportation corridor.

6.4.2 Rationale for VEC Selection

Water quality was selected as a VEC in order to assess the potential effects of the proposed Project on the health of aquatic ecosystems. Water quality forms one of the vital links between the abiotic and biotic environments, and is the foundation for supporting and maintaining healthy ecological processes for a rich and varied community of users (e.g., fish, wildlife, humans). The surface water VECs are quality and quantity as outlined in Table 6.4-1.

Table 6.4-1 Surface Water VEC Selection Rationale

VEC	Key Indicator(s)	Rationale for VEC Selection
Surface Water Quantity	Surface water level and flow	Interaction potential with receiver surface water quality
Surface Water Quality	Metals, pH, nutrients	Interaction potential with receiver surface water quality

6.4.3 Applicable Guidance

Protection measures for surface water quality within Canada and within Ontario are included in the following environmental guidelines and regulations:

- Metal Mining Effluent Regulations (MMERs; Canada, 2002)
- Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQG-PAL; CCME, 1999)
- Provincial Water Quality Objectives (PWQO; MOEE, 1994)

Fisheries and Oceans Canada (DFO) have published best management practices to protect fish and fish habitat, which is directly related to protecting water quality.

The proposed all-season road connecting the mine site to the existing provincial infrastructure will cross many streams and wetlands. The Ontario Ministry of Natural Resources (MNR) published the *Environmental Guidelines for Access Roads and Water Crossings* (1990) that provides guidance and recommended '*Good Practices*' for road development (MNR, 1990). These practices will be used to mitigate hydrological effects and maintain connectivity of the wetlands on either side of the proposed road alignment.

6.4.4 Assessment Boundaries

The selection of the surface water study areas was based on drainage patterns in the area of the mine site, the transportation corridor, and the trans-load facility. The spatial boundaries for the effects assessment were determined for each VEC based on the following considerations:

- The anticipated zone of influence of project effects
- Traditional and local knowledge
- Current and proposed land use by Aboriginal groups
- Ecological, socio-economic and cultural considerations

6.4.4.1 Regional Study Area (RSA)

The RSA was selected to examine the potential of the Project to contribute to cumulative impacts on the regional surface water quality and quantity and include:

- Drainage patterns in the Attawapiskat, Winisk, and Ekwan watersheds (Figure 3.5-1)
- Spatial extent of potential impacts from the Project and all other development projects in these watersheds

6.4.4.2 Local Study Area (LSA)

The surface water LSA was identified for the Project and includes the mine site, the transportation corridor, and the trans-load facility. These areas were selected based on the Project footprint and local drainage patterns of rivers and other water bodies.

- **Mine Site LSA** – Encompasses a portion of the Muketei River, as well as the streams and water bodies in the area (Figure 3.5-2).
- **Transportation Corridor LSA** – Includes an area immediately upstream of the corridor, and extends downstream to include large river systems (Figure 3.5-3).
- **Trans-load Facility LSA** – The trans-load facility is within the Upper Albany River watershed, close to the English River watershed divide. Two small water bodies with surface areas less than 0.06 ha are located on the eastern edge of this property, with no apparent surface connectivity to surrounding watercourses.

6.4.4.3 Temporal Boundaries

The temporal boundaries for the assessment are defined based on the timing and duration of Project activities that could induce effects to vegetation. Effects will be identified with reference to activities occurring in one or more of the Project phases:

- Construction (3 years)
- Operation (11 years)
- Closure (2 years)
- Post-closure (a minimum of 5 years)

The current expected Project life is 16 years, inclusive of the construction, operation, and closure phases.

6.4.5 Potential Effects and Mitigation Measures

The Project has the potential to affect surface water quality and quantity at the mine site and along the transportation corridor. No interaction with surface water will occur at the trans-load facility and as such, there will be no potential effects to surface water at that location.

Potential interactions with surface water quality and quantity are grouped into the following categories for discussion:

- Alteration of flows and levels
- Alteration of water quality from discharge of treated effluent to the environment
- Alteration of water quality from dust deposition
- Alteration of water quality from erosion and sedimentation

The interactions with surface water quality and quantity were assessed by Project component and phase and are shown in Table 6.4-2. Descriptions of the potential Project effects were compiled within this framework and are shown in Table 6.4-3.

Table 6.4-2 Potential Interactions between the Project and Surface Water

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Mine Site			
Ground Preparation (e.g., cut, fill, grub, etc.)	C	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Construction of surface infrastructure	C	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Underground mine development, including de-watering	C	Y	• Discharge from surface water collection pond
Underground mine operation	O	N	• No interaction
Underground ore processing and concentrate loading	O	N	• No interaction
Tailings production and underground disposal	O	N	• No interaction
Mining of crown pillar	O	Y	• Potential for erosion and sedimentation
Aggregate production	C, O	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Aggregate and topsoil stockpiles	C, O	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Construction of site roads	C	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Accommodation facility operation	C, O	N	• No interaction
Power plant operation	C, O	N	• No interaction
Fuel Storage and distribution	C, O	Y	• Fuel spills (assessed under accidents and malfunctions)
Equipment and vehicle use	C, O, CL	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Explosives use, handling and storage	C	Y	• Dust emissions during portal development in construction phase
Groundwater use for potable water and underground processing	C, O	N	• No interaction
Surface water management (non-contact water)	C, O, CL	Y	• Road runoff, increased erosion and sedimentation
Waste management: solid and sewage waste facilities	C, O, CL	Y	• Discharge from wastewater treatment plant

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Hazardous materials handling and storage	C, O, CL	Y	• Spills from hazardous wastes (assessed under accidents and malfunctions)
Closure of underground workings	CL	N	• No interaction
Closure of surface facilities, including portal	CL	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Scarification and reclamation	CL	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Training Programs	C, O	N	• No interaction
Mine Staffing	C, O, CL	N	• No interaction
Procurement of goods and services	C, O, CL	N	• No interaction
Transportation Corridor			
Ground preparation for road (e.g. cut, fill, grub, etc.)	C	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Aggregate and borrow site development	C, O	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Road construction (includes culvert, bridge installation)	C	Y	• Dust emissions • Road runoff, increased erosion and sedimentation • In-stream construction
Road maintenance	O	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Equipment and vehicle use	C, O	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Waste management	C	Y	• Spills from hazardous wastes, fuels and lubricants (assessed under accidents and malfunctions)
Water management (non-contact water)	C, O	Y	• Road runoff, increased erosion and sedimentation
Explosives use, handling and storage	C	Y	• Dust emissions
Fuel Storage and distribution	C	Y	• Fuel spills (assessed under accidents and malfunctions)
Construction camps	C	N	• No interaction
Hazardous materials handling and storage	C, O	Y	• Spills from hazardous wastes (assessed under accidents and malfunctions)
Employment	C, O	N	• No interaction
Procurement of goods and services	C, O	N	• No interaction
Decommissioning of road	CL	Y	• Dust emissions • Road runoff, increased erosion and sedimentation

NOTE:
3. C – CONSTRUCTION, O – OPERATION, CL – CLOSURE

Table 6.4-3 General Effects on Surface Water

Mechanism of Interaction	Key Indicator(s)	Project Phase	Potential Effect	Direction
Effluent Discharge	Surface water quality	C, O	Degradation of water quality and potential effects to aquatic biota	Adverse
Dust deposition	Surface water quality	C, O	Degradation of water quality and potential effects to aquatic biota	Adverse
Increased Erosion and Sedimentation	Surface water quality	C, O	Degradation of water quality and potential effects to aquatic biota	Adverse
Construction of roads and infrastructure at the mine site	Surface water level and flow	C, O	Alteration of flows and water levels	Adverse
Construction of the all-season road	Surface water level and flow	C, O, CL	Alteration of flows and water levels	Adverse

NOTE:
1. C – CONSTRUCTION, O – OPERATION, CL – CLOSURE

Table 6.4-4 General Mitigation Measures for Potential Effects on Surface Water

Mechanism of Interaction	Mitigation Measures
Effluent Discharge	• Effluent discharges (treated sewage effluent and mine water from the surface water collection pond) will satisfy the Ontario Ministry of the Environment (MOE) Environmental Compliance Authorization (ECA) that define ecologically protective chemical and biological water quality objectives for effluent discharge into surface waters. Mine water will meet discharge limits as outlined in the Metal Mining Effluent Regulations (Canada, 2002). • Spills are accidental, unplanned events that are not part of the Project and are addressed in Section 8.3 (Accidents and Malfunctions)
Dust deposition	• Enforced traffic speed limits and use of granular material for topping or dust suppressants on Project roads will reduce dust generation. These activities are discussed in the Road Management Plan (Volume 4). • Enclosing concentrate handling facilities • Dust collection systems • Use of dust suppressants on roads • Additional mitigation measures including measures to reduce and manage concentrate dust emissions are discussed in the Air Quality Management Plan (Volume 4)
Increased Erosion and Sedimentation	• Implement sediment and erosion control measures as identified in the Sediment and Erosion Control Plan (Volume 4). • Weekly inspection and maintenance of Project roads to ensure erosion and sediment control features are installed and functioning properly. These inspections are outlined in the Road Management Plan (Volume 4). • A culvert inspection program is included in the Road Management Plan

Mechanism of Interaction	Mitigation Measures
	(Volume 4) to ensure culvert capacity is adequate and hydraulic connectivity through the road bed is maintained. These provisions will help prevent road washouts and the associated downstream sedimentation. • Surface water run-off and mine de-watering flows will be managed using the Water Management Plan (Volume 4). Implementation of this plan will help minimize erosion and sedimentation that can degrade surface water quality. • The Closure and Reclamation Plan (Volume 4) discusses rehabilitation measures for the decommissioning and closure of the Project infrastructure that addresses physical stability of various Project components
Construction of roads and infrastructure at the mine site and along the all-season road	• Use of Good Practices, as outlined in the Ontario Ministry of Natural Resources (MNR) *Environmental Guidelines for Access Roads and Water Crossings* (1990) • Use of Best Management Practices (BMPs) as per the Ontario Ministry of Transportation (MTO) Environmental Guide for Erosion and Sediment Control during Construction of Highway Projects (2007)

The specific Project-related instances of the general effects are described below.

6.4.5.1 Changes in Water Quality due to Effluent Discharge

Potential Effects

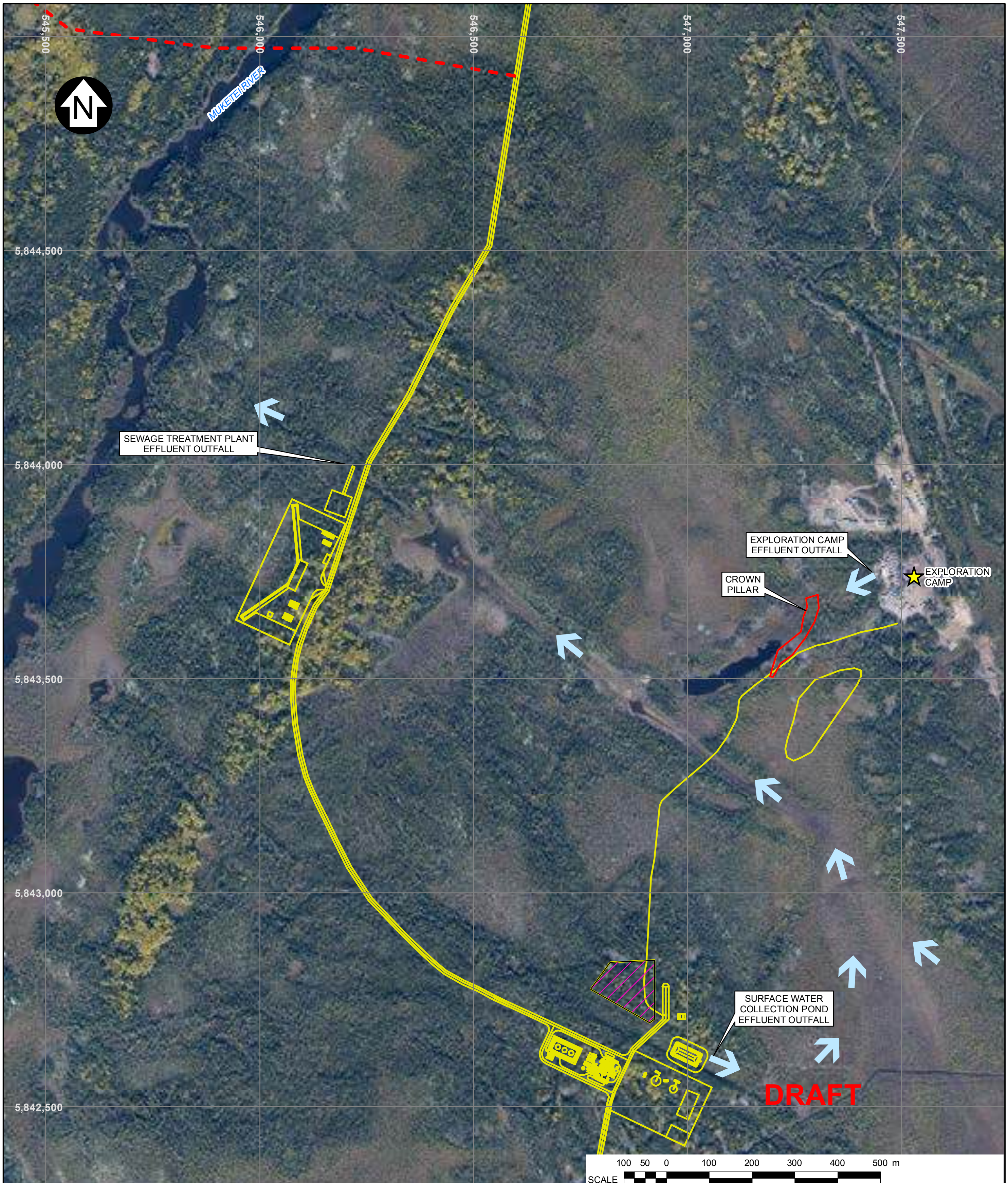
The following effluents will be discharged to the environment at the mine site as shown on Figure 6.4-1:

- Treated sewage effluent from the existing exploration camp (Construction Phase Year 1 and 2 only)
- Treated sewage effluent from the main mine camp (Construction Phase Year 3 and Operation Phase)
- Surface water collection pond (Construction and Operation Phases)

The terms and conditions of the current Certificate of Approval (C of A) for Municipal and Private Sewage Works (MOE, 2011) permits the release of treated effluent from the existing exploration camp at the following capacities:

Table 6.4-5 2011 Certificate of Approval Discharge Capacities

Esker Camp Sewage Treatment Plant (Rated Capacity)	
Average Daily Flow	16.5 cubic metres/day
Peak Flow Rate	41.25 cubic metres/day



LEGEND:

- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- PROPOSED INFRASTRUCTURE
- CROWN PILLAR
- LAYDOWN AREA
- FLOW DIRECTION

NOTES:

1. IMAGE PROVIDED BY SNC-LAVALIN GROUP INC. (2010).
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 2.5 METRES.
4. INFRASTRUCTURE INFORMATION AND PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

MINE SITE DEVELOPMENT AREA EFFLUENT OUTFALL LOCATIONS

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 6.4-1 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	DKK	AS	SRA	RAM

SAVED: I:\102\00390\01\A\GIS\Figs\A654_rA.mxd; Dec 20, 2013 10:28 PM; asimpson

The mine site surface water collection pond will receive the inputs of groundwater pumped to surface from the development of the portal, ramp and underground facilities, as well as mine site surface runoff during the construction phase. Pumping of underground water to the surface water collection pond is expected to peak at the end of the construction phase when the maximum extent of underground development has occurred. The quality of the groundwater pumped to the collection pond is expected to have low concentrations of metals, as the non-acid generating granodiorite that will be excavated for the portal and ramp development is inert (Technical Supporting Document 7).

Should treatment of the mine dewatering effluent be required, the treated effluent will be discharged to a wetland, which may increase the base flow of the watercourse downstream (Figure 6.4-1). During operations, the processing facility will utilize the groundwater inflow and dewatering of the underground to surface will no longer be required. Specific details regarding the management of groundwater inflow into the underground infrastructure are discussed in Section 6.5.

The estimated monthly discharge from the surface water collection pond during the construction phase is shown in Table 6.4-6. The monthly discharge from the surface water collection pond during the operations is shown in Table 6.4- 7. The discharge during the construction phase may increase the flow in the receiving environment and potentially have an effect on water quality. Potential effects to water quality during construction of the road and mine site infrastructure may include increased total suspended solids (TSS), elevated metals concentrations, and changes in pH.

Table 6.4-6 Surface Water Collection Pond Discharges during the Construction Phase

Source	Monthly Discharge (m^3/month)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Surface Runoff	0	0	0	16,587	4,210	5,744	6,317	5,532	5,447	4,120	0	0
Mine Inflow	15,490	13,990	15,490	14,990	15,490	14,990	15,490	15,490	14,990	15,490	14,990	15,490
Reclaim for mine	3,720	3,360	3,720	3,600	3,720	3,600	3,720	3,720	3,600	3,720	3,600	3,720
Monthly Discharge	**11,770**	**10,630**	**11,770**	**27,977**	**15,980**	**17,134**	**18,087**	**17,302**	**16,837**	**15,890**	**11,390**	**11,770**

Table 6.4-7 Monthly Discharge from the Mine Site Surface Water Collection Pond during the Operations Phase

Source	Monthly Discharge (m^3/month)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Discharge from Pond	0	0	0	16,587	4,278	5,838	6,419	5,621	5,536	4,187	0	0

The sewage treatment plant for the accommodations facility is scheduled to begin operation during the second year of construction. A rotating biological contactor (RBC) or similar treatment plant will be used and treated effluent will be discharged to the environment, eventually reporting to the wetland system next to the accommodation complex. The wetland flows approximately 600 m into the Muketei River (Figure 6.4-1). Treatment standards will be consistent with the discharge standards specified in Noront`s current C of A for the existing RBC unit at the exploration camp.

Proposed Mitigation Measures

Domestic and industrial effluent will be treated as required before being released into the receiving environment to mitigate adverse effects related to water quality. The treated sewage effluents from the exploration camp and main camp sewage treatment systems will be discharged at the criteria specified in the current C of A in order to mitigate chemical and biological environmental effects (Table 6.4-8).

Table 6.4-8 Sewage Effluent Discharge Criteria

Effluent Parameter	Maximum Concentration (mg/L)
Carbonaceous Biochemical Oxygen Demand ($CBOD_5$)	25.0
Total Suspended Solids	25.0
Total Ammonia	2.0
Total Phosphorus	1.0
Escherichia coli	200 organisms / 100 mL
pH	Between 6.5 and 9.5 pH

The water discharged from the surface water collection pond is expected to meet the Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQG-PAL) (CCME, 1999) criteria without treatment.

Water quality within the surface water collection pond will be monitored and treated as necessary to achieve the Metal Mining Effluent Regulations (MMERs) discharge limits set out in Schedule 4 (Canada, 2002), which the mine will be required to meet during the construction operations phases.

As such, the effect of the discharge from the surface water collection pond on water quality with mitigation measures is expected to be of low magnitude and not result in a residual effect.

6.4.5.2 Changes in Water Quality due to Dust Deposition

Potential Effects

The construction and use of the all-season access road, aggregate sites, mine site roads, camp facilities, laydown areas, and the portal area will require clearing, grubbing, grading and culvert installation. Airborne dust and emissions from vehicle traffic will be generated and potentially deposited in the surrounding landscape, including local watercourses. The predicted total suspended particulate (TSP) emissions, evaluated under worst case emissions and meteorological conditions, are presented in the air quality modelling results (Technical Supporting Document 2). Although the TSP emissions are expected to be minimal, a slight increase in surface water TSS may occur. Increased TSS has the potential to affect fish and fish habitat and is discussed in greater detail in Section 6.6.

Proposed Mitigation Measures

Mitigation measures for reducing fugitive dust and other air contaminants that may arise from construction/ground disturbance activities, concentrate handling, vehicle use on the mine site roads aggregate sites, and all-season access road are discussed in Section 6.1 and summarized in Table 6.4-4. As the emissions after mitigation are expected to be negligible, no residual effect on water quality from dust deposition is expected.

6.4.5.3 Changes in Water Quality due to Increased Erosion and Sedimentation

Potential Effects

Construction and use of the all-season road, mine site roads, pads, camp facilities, laydown areas and the portal area will require clearing, grubbing, and grading which will expose soils and potentially result in increased erosion and runoff of sediment. In-stream construction activities such as culvert and bridge installations have the potential to generate sediment in watercourses. Development of the approximate 24 potential aggregate sites will involve some blasting, clearing and grubbing. The areas of the borrow areas are estimated to be between 22 ha and 350 ha and are offset from the road alignment by an average distance of approximately 500 m.

These activities may result in soil erosion and potential sedimentation of nearby watercourses. The effect of these activities is discussed as it relates to fish and aquatic organism health in Section 6.6.

During the operations phase, there is the potential for runoff from the road surface to pollute nearby watercourses, especially during periods of heavy rainfall. Potential effects of erosion and sedimentation during the closure phase are similar to the construction phase as equipment will be used to reclaim disturbed areas.

Proposed Mitigation Measures

Best management practices will be employed during the construction, operation and closure phases to limit the extent of soil disturbance as much as possible and utilize regularly maintained, temporary sediment and erosion control features. Noront`s approach to mitigating the potential effects of erosion and sedimentation, and detailed mitigation measures are described in the Sediment and Erosion Control Plan (Volume 4, Section 9). The effects of erosion and sedimentation on water quality are expected to be negligible after mitigation is applied and no residual effect will occur.

6.4.5.4 Alteration of Flows and Water Levels – Mine Site

Potential Effects

The construction and operation phases of the Project will potentially affect surface water flow and levels at the mine site. The primary mechanisms of interaction are:

- The diversion and collection of surface water at the processing facility during construction and operations and discharge to the adjacent wetland
- Underground mine dewatering to the surface water collection pond during the construction phase and discharge to the adjacent wetland
- The discharge of treated effluent from the sewage treatment plant
- The construction of site roads through wetland areas

Water from the surface water collection pond will be discharged to a wetland. During the construction phase, there will be an increase in flow through the wetland during all months of the year. During the operations phase, the flow to the wetlands is expected to be similar to baseline conditions surface runoff will be the only discharge from the surface water collection pond.

The discharge of treated effluent from the exploration camp (Year 1 and 2) and the accommodation facility sewage treatment plant (Year 3 to Closure) will be discharged to the environment at the outfall locations shown on Figure 6.4-1. The current C of A specifies treatment plant discharge flow rate should not exceed 41.25 m^3/day (Table 6.4-5). This flow rate is not expected to affect the water levels or flows of the receiving environment since the end-of-pipe discharge is into a bog that will attenuate the flow and minimize the potential effects.

Construction of site roads through wetland areas can dam on the upstream side of the road, limiting connectivity of local wetlands and altering water levels and flow. Water levels may increase on the upstream sides of the road and decrease on the downstream side. This may result in changes to the functionality of the wetlands.

Proposed Mitigation Measures

The surface water collection pond will discharge to a treed fen wetland which will naturally attenuate the flow and water levels. Fen wetlands are characterized by lateral surface flow and are typically connected to mineral soil water. The increase in flow will be conveyed through the fen and changes in water level are not expected. The flow through the fen will increase above baseline levels during winter but little effect is anticipated as several small water courses in the area do not completely freeze in winter. During operations, little effect on flow and level is anticipated as the majority of the surface runoff collected in the pond would naturally report to this wetland.

Road construction on site will follow the MNR and DFO practices identified in Table 6.4-4 to mitigate effects to local hydrology through design and construction practices. Culverts will be installed to maintain connectivity of water in wetland areas.

Noront`s approach to mitigating the potential effects of surface water flow and level at the mine site are summarized in Table 6.4-4.

6.4.5.5 Alteration of Flows and Water Levels – Transportation Corridor

Potential Effects

The construction of the all-season road will potentially effect surface water flow and levels along the transportation corridor. The primary mechanisms of interaction are:

- The construction of the all-season road through wetland areas
- Development of aggregate sources (borrows and quarries)

The western two-thirds of the proposed all-season road are located within the headwaters of the upper Attawapiskat watershed and the Winisk watershed. These watersheds are characterized by mineral wetlands such as fens and swamps. The Ontario FNLC database lists coniferous swamp is the most common wetland type along the road alignment (Table 6.4-9). There is pronounced internal water movement through swamps and the hydrologic regimes are typically complex. Swamp drainage is typically well connected by streams, ponds, rivers and lakes. Fen wetlands are characterized by lateral surface flow and are typically connected to mineral soil water (Riley, 2011).

Table 6.4-9 Linear Distance of Each FNLC Type

FNLC Category	Distance along all-season road (km)	Percent of total road distance (%)
Coniferous Swamp	29	10
Open Bog	17	6.0
Open Fen	1.8	0.64
Sparse Treed Fen	12	4.3
Thicket Swamp	2.1	0.74
Treed Bog	23	8.2
Treed Peatland	16	5.7
TOTAL	101	36

The Ekwan watershed and lower Attawapiskat watershed near the mine site are characterized by organic wetlands such as bogs and peatlands. Bogs and peatlands have limited surface flow, most notably during the spring melt and very slow water percolation laterally through peats. Variable permeability of the different peat types can also impedes lateral flow.

Road construction through wetlands can have damming effects on the upstream side of the road that restricts flow and can change habitat. Road construction in the upper Attawapiskat and Winisk watershed wetlands is expected to have an effect on the wetlands if connectivity is not maintained. The open fen and treed fen habitat are the most sensitive environments to water level fluctuations.

The bogs and peatlands in the Ekwan and lower Attawapiskat watersheds are expected to be less impacted by the road as they have less natural hydrologic connectivity.

Proposed Mitigation

Mitigation measures for reducing the impact of the road construction on wetlands were derived from MNR, 1990 and include the following practices:

- Construction and use of the road will not exceed the load-carrying capacity of the road material
- Where logistically possible, deep swamps will be avoided due to the risk of failure and the potential cost of repair
- Crossing locations will be selected where there is a well-developed root mat supporting tree growth
- Construction of swamp treatments will occur in the winter and will be conducted when logistically and economically feasible. Winter construction has several advantages including:
    - Allows for shear balding of stumps
    - Allows for heavier construction equipment without getting bogged down or disturbing the root mat
    - Construction can also proceed beyond the swamp without having to wait for the treatment to be completed
- If possible, fill depths over the swamp will be limited to 1.3 metres (four feet) or less

- The root mat under the roadway will be protected from equipment damage. This may be done by diverting through traffic to the edge of the right-of-way, close cutting or shear blading stumps instead of grubbing and using special wide-pad equipment.
- Ditching will not be done unless necessary as per mitigation by design
- Frequent cross culverts will be installed at regular intervals to ensure that surface water is equalized on both sides of the road. Culverts will be located where organic deposit thickness is least where possible. If culverts must be placed on top of deep organic material, installation will be done late in the road construction as logistically and economically feasible to allow for some settlement of bedding material.

Noront`s approach to mitigating the effects of surface water flow and level alterations along the proposed all-season road are include the best practices listed in Table 6.4-4.

6.4.6 Potential Residual Effect and Determination of Significance

The relative significance of residual effects was evaluated based on a suite of standardized assessment criteria including: magnitude, geographical extent, duration, frequency, reversibility, context, and probability of occurrence, as defined for surface water. The assessment methodology is described in Section 2, and the assessment criteria modified to evaluate effects on surface water are presented in Table 6.4-10.

Using the assessment criteria in Table 6.4-10, ratings were assigned to each individual residual effect identified and compiled in Table 6.4-11. All adverse residual effects identified in the assessment were determined to be not significant due to the low or medium magnitude and limited geographical extent of the effects.

Table 6.4-10 Determining Significance of Residual Effects for Surface Water

Criteria	Rating	Definitions
Magnitude	Low	Predicted effects on surface water quality, level and flows are within the natural baseline variability or do not exceed any applicable regulatory thresholds
	Medium	Predicted effects on surface water quality, level and flows are not within the natural baseline variability and exceed applicable regulatory thresholds
	High	Predicted effects on surface water quality, level and flows exceed applicable regulatory thresholds
Geographical Extent	Localized	Effect limited to the LSA
	Widespread	Effect extends to the RSA
Duration	Short Term	Effect lasts <2 years
	Medium Term	Life of Project (11 years)
	Long Term	Beyond the life of the Project, or permanent
Frequency	Infrequent	Effect occurs rarely (i.e. monthly to yearly)
	Frequent	Effect occurs intermittently or continuously (i.e. weekly or daily)
Reversibility	Reversible	Effect is reversed after the activity ceases
	Irreversible	Effect will not be reversed after the activity ceases, or the effect is permanent
Context	Low resilience	Low resilience to imposed stresses, or will not easily adapt to the effect.
	High resilience	High resilience to imposed stresses, or will easily adapt to the effect.
Probability of occurrence	Low	Low likelihood that the predicted residual effect will occur.
	Moderate	Moderate likelihood that the predicted residual effect will occur.
	High	High likelihood that the predicted residual effect will occur.

Table 6.4-11 Significance of Residual Effects for Surface Water

Residual Effect	Project Phase	Predicted Degree of Effect After Mitigation Measures								Significance of Residual Effect
		Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Construction of roads and infrastructure at the mine site	CL	Adverse	Medium	Local	Long Term	Frequent	Irreversible	High	High	Not Significant
Construction of the all-season road	C, O, CL	Adverse	Medium	Local	Long Term	Frequent	Irreversible	High	High	Not Significant

NOTE:
1. C – CONSTRUCTION, O – OPERATION, CL – CLOSURE

6.5 GROUNDWATER

6.5.1 Introduction

Groundwater at the mine site is present in the bedrock and in overburden material. The Project's main interaction with groundwater is at the mine site associated with dewatering of the underground mine.

Similarly, there will be limited interactions with groundwater along the transportation corridor associated with quarries.

The following provides an assessment of potential Project effects on groundwater quantity (level and flow) and quality.

6.5.2 Rationale for VEC Selection

Groundwater was selected as a VEC as it is considered an important resource in Ontario and has the potential to interact with surface water and fish habitat. The key indicators selected to assess groundwater are outlined in Table 6.5-1.

Table 6.5-1 Groundwater VEC Selection and Rationale

VEC	Key Indicator(s)	Rationale for VEC Selection
Groundwater Quantity	Groundwater level and flow	Interaction potential with surface water environment due to dewatering
Groundwater Quality	Dissolved metals, pH, conductivity	Interaction potential with surface water quality

6.5.3 Assessment Boundaries

The assessment boundaries for groundwater are based on the delineation of the physical extent and duration of the Project.

6.5.3.1 Local Study Area

The LSA is the zone where there is reasonable potential for immediate interaction between the Project and the groundwater VECs. Interaction with the groundwater is expected to occur primarily at the mine site due to the underground mining activities and at quarries along the transportation corridor.

For the assessment of potential effects on groundwater, an LSA was defined for the mine site and transportation corridor quarries as follows:

- **Mine Site LSA** - The mine site LSA is defined as the general area around the mine site. The boundary of the study area takes into consideration, the project footprint, the underground mine layout, the local topography, drainage patterns, and baseline groundwater flow conditions (Technical Supporting Document 6). The mine site LSA extends to the eastern bank of the

Muketei River, a radius of approximately 1.5 km surrounding the mine site infrastructure (Figure 6.5-1).
- **Transportation Corridor LSA** - The transportation corridor LSA for the assessment of groundwater effects includes the footprint of each of the potential quarry locations (Figure 6.5-2).

6.5.3.2 Regional Study Area

No RSA was defined to examine the potential effects from the development of the Project on groundwater as measurable effects will not extend beyond the LSAs described above.

6.5.3.3 Temporal Boundaries

The temporal boundaries for the assessment are defined based on the timing and duration of Project activities that could induce effects to groundwater. Effects will be identified with reference to activities occurring in one or more of the Project phases:

- Construction (3 years)
- Operation (11 years)
- Closure (2 years)
- Post-closure (a minimum of 5 years)

The current expected Project life is 16 years, inclusive of the construction, operation and closure phases.

6.5.4 Potential Interactions and Effects

Project components and activities that are identified as potentially interacting with groundwater VECs are assessed for each Project component and are shown in Table 6.5-2.

Table 6.5-2 Potential Interactions between the Project and Groundwater

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Mine Site			
Ground Preparation (e.g., cut, fill, grub, etc.)	C	No	No interaction with groundwater
Construction of surface infrastructure	C	No	No interaction with groundwater
Underground mine development, including de-watering	C	Yes	Groundwater will be pumped from the underground during the development of the mine
Underground mine operation	O	Yes	Groundwater inflows to the mine will be used in the processing facility. Water will be lost to the tailings during the generation of paste backfill.
Underground ore processing and concentrate loading	O	Yes	Groundwater will be used in the processing facility
Tailings production and underground disposal	O, CL	Yes	Groundwater will interact with tailings disposed of underground
Mining of crown pillar	O	Yes	The mining of the crown pillar will interact with groundwater

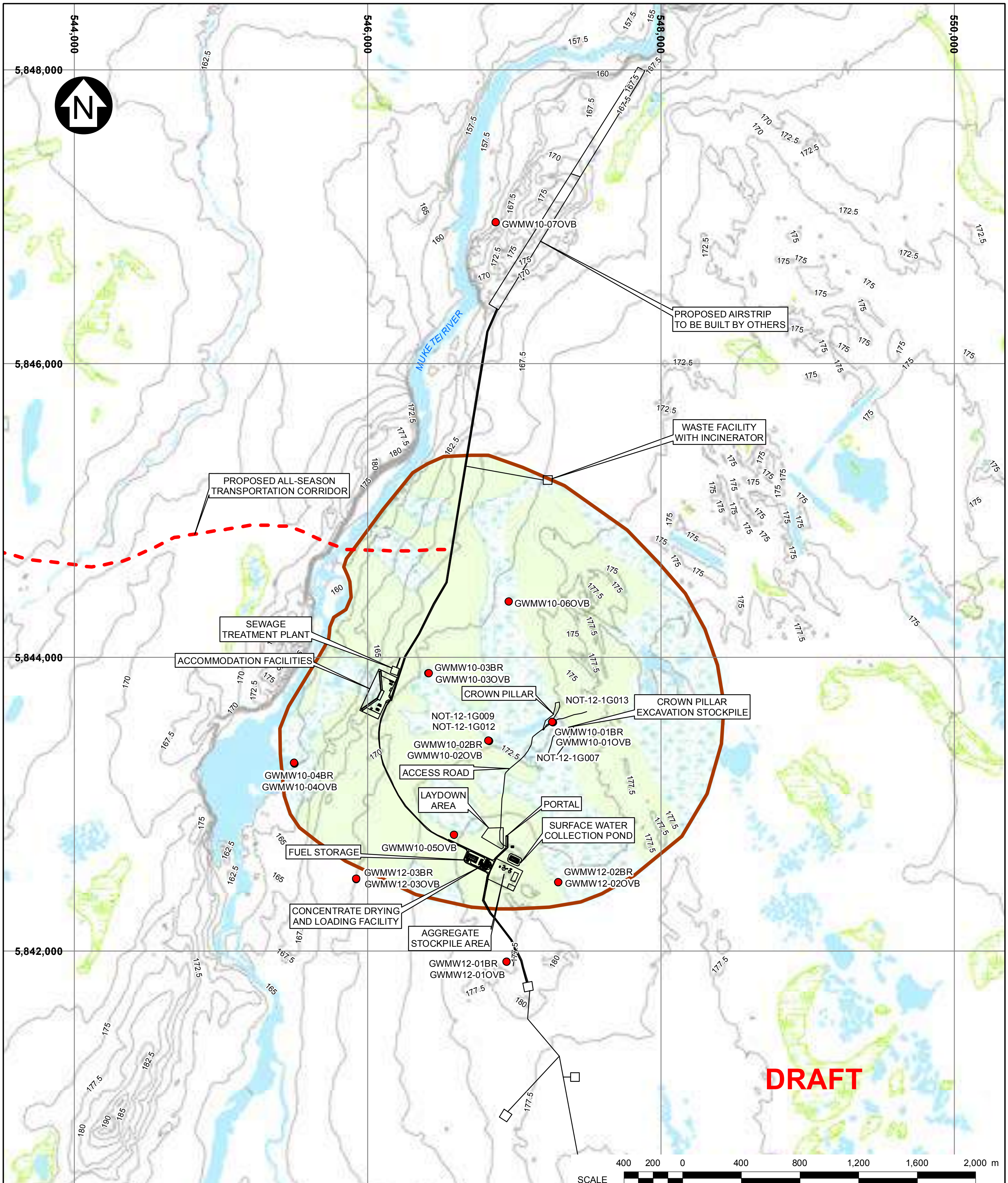
Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Aggregate production	C, O	Yes	The mining of aggregate stopes will result in groundwater inflows to the underground mine
Aggregate and topsoil stockpiles	C, O	No	No interaction with groundwater
Construction of site roads	C	No	No interaction with groundwater
Accommodation facility operation	C, O	No	No interaction with groundwater
Power plant operation	C, O	No	No interaction with groundwater
Fuel Storage and distribution	C, O	Yes	Potential spills of fuels affecting groundwater quality (assessed in Section 8.3, accidents and malfunctions)
Equipment and vehicle use	C, O, CL	No	No interaction with groundwater
Explosives use, handling and storage	C, O	Yes	Potential effect on groundwater quality through the use of explosives underground
Groundwater use for potable water and underground processing	C, O	Yes	Groundwater will be used for potable water supply and for underground processing
Surface water management (non-contact water)	C, O, CL	No	No interaction with groundwater
Waste management: solid and sewage waste facilities	C, O, CL	No	No interaction with groundwater
Hazardous materials handling and storage	C, O, CL	Yes	Potential spills of fuels affecting groundwater quality (assessed in Section 8.3, accidents and malfunctions)
Closure of underground workings	CL	Yes	Groundwater will allowed to flood the underground workings at closure. Potential for effects on water quality.
Closure of surface facilities, including portal	CL	No	No interaction with groundwater
Scarification and reclamation	CL	No	No interaction with groundwater
Training Programs	C, O	No	No interaction with groundwater
Mine Staffing	C, O, CL	No	No interaction with groundwater
Procurement of goods and services	C, O, CL	No	No interaction with groundwater
Transportation Corridor			
Ground preparation for road (e.g. cut, fill, grub, etc.)	C	No	No interaction with groundwater
Aggregate and borrow site development	C, O, CL	Yes	Potential interaction with groundwater at quarry sites. Borrow sites will be developed above the groundwater table and will not have an interaction with groundwater.
Road construction (includes culvert, bridge installation)	C	No	No interaction with groundwater
Road maintenance	O	No	No interaction with groundwater
Equipment and vehicle use	C, O	No	No interaction with groundwater
Waste management	C	No	No interaction with groundwater
Water management (non-contact water)	C, O	No	No interaction with groundwater
Explosives use, handling and storage	C	Yes	Potential for effects to water quality at quarry sites due to the use of explosives
Fuel Storage and distribution	C, O	Yes	Potential spills of fuels affecting groundwater quality (assessed in Section 8.3, accidents and malfunctions)
Construction camps	C	No	No interaction with groundwater
Hazardous materials handling and storage	C, O, CL	Yes	Potential spills of fuels affecting groundwater quality (assessed in Section 8.3, accidents and malfunctions)
Employment	C, O	No	No interaction with groundwater

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Procurement of goods and services	C, O	No	No interaction with groundwater
Decommissioning of road	CL	No	No interaction with groundwater
Trans-load Facility			
Ground preparation and site construction	C	No	No interaction with groundwater
Construction of rail siding	C	No	No interaction with groundwater
Construction of buildings and loading facility	C	No	No interaction with groundwater
Upgrading site access roads	C	No	No interaction with groundwater
Installation of transmission line within existing right of way	C	No	No interaction with groundwater
Waste management: solid and sewage waste facilities	C, O	Yes	Class 4 septic system will be used for sewage treatment
Water management (including surface water collection pond)	C, O	No	No interaction with groundwater
Water supply well	C, O	Yes	Groundwater will be used for potable water supply
Fuel Storage and distribution	C, O	Yes	Potential spills of fuels affecting groundwater quality (assessed in Section 8.3, accidents and malfunctions)
Equipment and vehicle use	C, O	No	No interaction with groundwater
Hazardous materials handling and storage	C, O	Yes	Potential spills of fuels affecting groundwater quality (assessed in Section 8.3, accidents and malfunctions)
Operation of concentrate loading facility	O	No	No interaction with groundwater
Re-grading, ditching, and placement of asphalt	C	No	No interaction with groundwater
Equipment and vehicle use	C	No	No interaction with groundwater
Procurement of goods and services	C O D	No	No interaction with groundwater
Closure of facility	CL	No	No interaction with groundwater

The potential Project effects are summarized in Table 6.5-3.

Table 6.5-3 Potential Effects on Groundwater

Mechanism of Interaction	Key Indicator(s)	Project Phase	Potential Effect	Direction
Development and operation of underground mine and aggregate stopes	Groundwater level and flow	C, O, CL	Reduction in groundwater table elevation, possible impacts to surface water	Adverse
Storage of tailings underground	Groundwater chemistry	O, CL	Possible change in groundwater quality	Adverse
Aggregate extraction at quarries along transportation corridor	Groundwater level and chemistry	C,O,CL	Reduction in groundwater levels and possible change in groundwater quality	Adverse



LEGEND:

- GROUNDWATER MONITORING WELL LOCATION
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- PROPOSED INFRASTRUCTURE
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- OUTER DRAWDOWN INFLUENCE (APPROXIMATE)
- WETLAND (BASED ON AIRPHOTO)
- UPLAND

NOTES:

1. BASE MAP PROVIDED BY SNC LAVALIN INC., 2010.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 2.5 METRES.
4. INFRASTRUCTURE INFORMATION PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.
5. PROPOSED ALL-SEASON TRANSPORATION CORRIDOR PROVIDED BY KIEWIT INFRASTRUCTURE ENGINEERS (NOVEMBER 26, 2013).
6. WETLANDS WITHIN OUTER DRAWDOWN INFLUENCE AREA HAVE BEEN DELINEATED FROM AIRPHOTO, (2010).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	DKK	AS	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

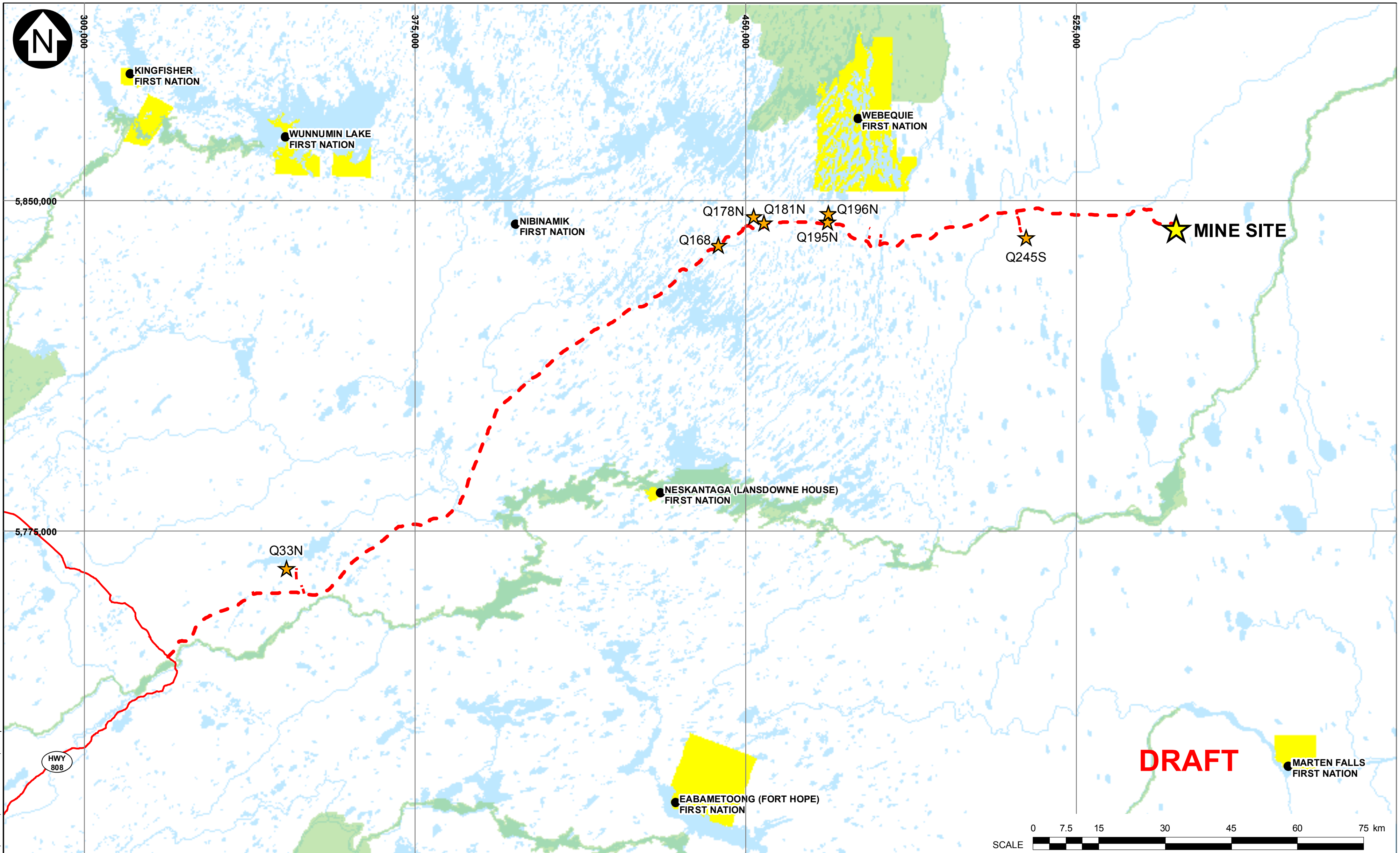
GROUNDWATER DRAWDOWN ZONE OF INFLUENCE

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 6.5-1 REV A

SAVED: I:\102\00390\01\A\GIS\Figs\A655_rA.mxd; Dec 19, 2013 2:01 PM; asimpson



LEGEND:

- MINE SITE
- PROPOSED QUARRY
- COMMUNITY
- EXISTING ALL-SEASON ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- WATER
- PARK
- FIRST NATIONS RESERVE

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORATION CORRIDOR PROVIDED BY KIEWIT INFRASTRUCTURE ENGINEERS (NOVEMBER 26, 2013).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	SRA	AS	RDW	ALR

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

PROPOSED QUARRY LOCATIONS

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF NO. 34

FIGURE 6.5-2

REV A

SAVED: I:\1102\00390\01\A\GIS\Figs\A598_rA.mxd; Dec 17, 2013 10:42 AM; asimpson

Project components and activities will interact with and potentially affect groundwater primarily through:

- Change in groundwater levels and flows caused by underground mine dewatering potentially affecting local surface waters
- Change in groundwater quality post-closure due to underground disposal of paste and cemented paste backfill tailings
- Change in groundwater levels and flows, from development of quarries below the groundwater table along the transportation corridor

Additional minor interactions with groundwater have been considered and determined to be negligible at the mine site. This includes the withdrawal of groundwater for water supply. Because the draw on the water supply wells is minor (approximately 24 m^3/h, or 0.4 L/minute; Section 5.6.10), this Project interaction is expected to have a negligible effect on groundwater conditions and is not considered further in the assessment.

Similarly, there will be limited interaction with groundwater at the trans-load facility. A groundwater well will be installed with a very modest draw to supply only several workers and limited wash water. A class 4 septic system will also be installed to dispose of sewage. These are minor activities with negligible potential to cause effects. Accordingly, these interactions are not assessed further.

6.5.4.1 Lowered Groundwater Levels at the Mine Site

Groundwater, and potentially surface water, will be affected primarily during the dewatering of the mine. The inflows to the underground mine during construction and operations were estimated using both an analytical model and MODFLOW version 2011.1 Pro. The predicted groundwater inflow to the underground workings are predicted to range from a low of 5 L/s to a high of 28 L/s (assumes limited mitigation), depending on the phase of mine. It is estimated that >60 % of the groundwater inflows will be in the upper 200 m of the mine. Dewatering, due to the underground workings, will likely result in a maximum drawdown of 10 m directly above the mine. The drawdown declines to close to 0 m at the Muketei River. The flows in the Muketei River are predicted to be reduced by less than 5 L/s due to this minimal drawdown or < 1 % of measured low flows in the river (Technical Supporting Document 17).

During mine development, groundwater inflows may be higher than estimated. Higher inflows may occur on a short term basis if mine development intersects relatively high permeability features. To date, no geologic units or structures have been intersected during site investigations that are interpreted to potentially produce relatively high long term inflows. Noront intends to drill additional drillholes at the mine to assess this potential. The results of this additional drilling will be evaluated in the future to update the current hydrogeological characterization. Specific to the ramp construction, further investigations will be undertaken in advance of the face to avoid potentially high groundwater inflows. If high inflows are observed during these investigations, the area will be grouted prior to advancing the ramp.

Groundwater will also be affected by the extraction of the crown pillar. The extraction of the crown pillar will begin concurrently with the development of the lower zone of the mine (i.e. in the third year of production) and will be completed over a one year period. On surface, the perimeter of the crown pillar will be excavated and a concrete barrier constructed using cemented aggregate rock from the paste backfill plant. The concrete barrier will extend from surface to bedrock. The upper bedrock horizon is fractured and weathered and more permeable than the rock below. As such, this area of bedrock will be drilled with a ring of holes and injected with cement grout to reduce water ingress to the mine during the extraction of the crown pillar.

The crown pillar will be progressively backfilled with cemented paste tailings. After extraction of the crown pillar is completed it will be filled with cemented aggregate. Details of the crown pillar extraction plans are in Section 5.5.7.

At closure the underground workings will be allowed to flood naturally. The current mine plan estimates that the majority of the void space of the underground mine will eventually be filled with paste backfill. The remaining void space (< 1,400,000 m^3) will be flooded with groundwater. Based on a natural groundwater lower end inflow rate of about 5 L/s at closure, the underground voids will flood in approximately 20 years maximum (Hydrogeology Modelling TSD 17). This will be monitored to confirm the flooding rate and to adjust closure plans as needed. After the water level in the mine reaches the natural static level, seepage inflow will be minimal and the groundwater regime will return to near pre-development conditions.

Drought conditions, if they occur, are anticipated to have a minimal effect on the static groundwater level and likely would only be noticed in the overburden and not the bedrock at the site. This would also be the case throughout the region. Drought may also enhance the effect of groundwater drawdown on the wetlands near the mine to the east because of reduced recharge from precipitation. This may reduce the functionality of the wetlands for a short period, but they are not expected to disappear. Baseline water levels in the wetlands are expected to return following periods of high rainfall and recharge (e.g. during spring freshet, fall rains, etc.) (Hydrogeology Modelling TSD 17).

After the mine floods, the horizontal groundwater gradient between the mine and the Muketei River is very low at < 0.013. Based on a conservative hydraulic conductivity at the mine site of < 1 x 10^{-6} m/s, the groundwater flow velocity is in the range of 0.4 m/yr. Based on this crude groundwater velocity calculation, groundwater is not expected to reach the Muketei River (about 2 km west) from the flooded underground for 1000's of years.

Proposed Mitigation Measures

The design of the Project has included a few mitigation measures to reduce the effect on groundwater levels at the mine. In addition, adaptive management will also be implemented if necessary. The following outlines the mitigation measures:

Crown Pillar Extraction - On surface, the perimeter of the crown pillar will be excavated and a concrete barrier constructed. The concrete barrier will extend from surface to bedrock. The upper bedrock horizon is fractured and weathered and more permeable than the rock below. As such, this area of bedrock will be drilled with a ring of holes and injected with cement grout to reduce water ingress to the mine during the extraction of the crown pillar.

Portal and Ramp Development - The portal area will be sealed to prevent groundwater inflow on all sides by driving sheet-piling down through the overburden to the bedrock. The weathered and more permeable rock near surface will be injected with cement grout to reduce water ingress.

Mitigation measures to reduce water ingress from the ramps will also include injecting cement grout where groundwater inflow is encountered during development in fractures or faults. Fractures or fault zones will be avoided, if possible.

General Underground Workings – Groundwater inflow will be mitigated by grouting faults/fractures that produce significant inflows.

Mined out ore stopes and aggregate stopes will be backfilled with cemented paste backfill and paste backfill through operations. Backfilling these openings will reduce water ingress into the mine. The cemented paste backfill and paste backfill is expected have a low hydraulic conductivity similar to the surrounding rock. In addition, the backfill may help seal fractures, which will reduce water ingress.

6.5.4.2 Post-Closure Groundwater Quality in the Underground Mine

The quality of seepage into the underground mine may be affected by a combination of PAG tailings, PAG waste rock and exposed PAG walls.

All of the tailings and any PAG waste rock will be stored underground as either paste backfill (PB) or cemented paste backfill (CPB). Integrating tailings (and waste rock) into backfill material is common practice in the mining industry and can reduce or, in this case, will eliminate the need for surface tailings disposal.

The CPB will be used to backfill the ore production stopes. The backfill will provide the necessary ground support to permit mining of adjacent slopes. The PB will be disposed into the aggregate stopes, since there is no ground support requirement.

The proper disposal of tailings as CPB will encapsulate the tailings and significantly reduce water and oxygen (air) movement, and essentially seal the tailings from the environment. This will effectively reduce the ARD potential of the CPB. In addition, the cement will act as a neutralizing agent, which will also limit any acid generating or metal leaching concerns during the operation of the mine (MEND, 2006). Backfilling the mined out ore stopes will also seal off any PAG walls.

The PB will be disposed into the granodiorite aggregate stopes. Large, engineered concrete bulkheads (keyed plugs) will be placed at the base of each aggregate stope. This will mitigate the risk of liquefaction of the un-cemented paste. Paste backfilling will reduce sulphide oxidation and subsequent ARD as the paste backfill will be saturated.

The underground workings will act as a sink in the groundwater LSA due to the drawdown caused by an opening below the groundwater table. During operations all water underground will be collected and treated and then used in processing. As such, the underground mine will have zero discharge to the environment during operations and therefore no effect on the groundwater or surface water quality in the area.

As indicated in Section 6.5.4.1, the underground workings will flood naturally over a maximum period of 20 years, or much more rapidly with assisted filling eventually returning to the natural static water level. The natural static groundwater table is lower than the ground surface. In addition, the only openings to the underground (the portal and the crown pillar) will be plugged with concrete or cemented aggregate at closure. As such, the flooded underground workings will not directly discharge to the surface.

The horizontal groundwater gradient between the mine and the Muketei River is very low at < 0.013. Based on a conservative hydraulic conductivity at the mine site of < 1 x 10^{-6} m/s, the groundwater flow velocity is in the range of 0.4 m/yr. Based on this crude groundwater velocity calculation, groundwater is not expected to reach the Muketei River (about 1.5 km west) from the flooded underground for 1000's of years.

Groundwater quality in the flooded underground workings is difficult to predict. However, for the reasons described above, the groundwater is not expected to be of adverse water quality. The groundwater will be treated in the unlikely event that it exceeds the effluent discharge requirements of the Environmental Compliance Approval (ECA) or the MMERs. Should the groundwater quality meet MMERs requirements but not receiving water objectives, this is not expected to be consequential given that:

- There are no other users of groundwater in the area
- Once the underground workings are flooded, the chemistry of the groundwater is unlikely to degrade over time
- The portal to the underground will be sealed
- The static groundwater level is below surface and no groundwater discharge to surface will occur
- Shallow groundwater gradients and the distance to nearby surface waters (the Muketei River) are such that considering attenuation, potentially impaired groundwater within the flooded underground workings is not expected to reach the Muketei River

The effects to groundwater quality following mitigation are therefore expected to be negligible.

Proposed Mitigation Measures

The design of the Project has included a few mitigation measures to ensure that there will be no residual effects on the groundwater quality leaving the underground mine. In addition, adaptive management will also be implemented if necessary. The following outlines the mitigation measures:

Tailings and Waste Rock Disposal - The proper disposal of tailings and waste rock as CPB will encapsulate the tailings and significantly reduce water and oxygen (air) movement, and essentially seal the tailings from the environment. This will effectively reduce the ARD potential of the CPB. In addition, the cement will act as a neutralizing agent, which will also limit any acid generating or metal leaching concerns during the operation of the mine (MEND, 2006). Backfilling the mined out ore stopes will also seal off any PAG walls.

The PB will be disposed into the granodiorite aggregate stopes. Large, engineered concrete bulkheads (keyed plugs) will be placed at the base of each aggregate stope. This will avoid the risk of liquefaction of the un-cemented paste. Paste backfilling will reduce sulphide oxidation and subsequent ARD as the paste backfill will be saturated. However, seepage from the tailings will be collected, treated if necessary, and reclaimed for process water use during operations

Plugging of Portal and Crown Pillar Openings - After no further access is required underground the portal will be sealed with concrete. The crown pillar will have been plugged with cemented aggregate shortly after the crown pillar was mined out. Plugging the portal and crown pillar will eliminate water from underground directly discharging to the surface. There will be no other openings to surface from the underground workings.

Adaptive Management - Active Flooding of Mine Workings - At closure, to reduce the timeline to naturally flood the underground workings, an adaptive management measure will be considered comprising supplementing the flooding with surface water pumped from the Muketei River. The measured flows in the river at freshet range between 10 to 30 m3/s and last for 3 to 5 weeks/year (Technical Supporting Document 1). Using only a portion of these flows would have minimal effect to the river. This would hasten the recovery of the groundwater table to pre-development levels. This would be considered if monitoring of the underground seepage suggested that water quality may be adverse. Active flooding of the underground will fill the underground with fresh water, and will reduce the potential reaction time (oxidation time) of the walls and wastes within the underground (discussed in Section 6.5.4.2).

6.5.4.3 Lowered Groundwater Levels at Quarries

Quarries will be developed along the transportation corridor to provide aggregate for road construction. The quarries will be developed to a maximum depth of 6 m below the groundwater table only if the Project demands for aggregate require it. The quarries will remain above the groundwater table if there is no need for the rock.

The excavation depth of 6 m below the groundwater table was chosen as it allows the equipment to remove the rock without dewatering. No equipment or personnel will be required to enter the quarries below the groundwater table. The quarries will also be designed so that they will become "kettle" like ponds with no direct outflow to the surface environment. Sediment created from excavation within the quarries will settle to the bottom of the ponds within each quarry. Blasting residue, expected to be minor, will also be contained within the quarry. The quarries will have minimal to nil effect on groundwater.

The quarries will each be permitted/licenced under the *Aggregate Resources Act* through the MNR prior to development. The lip/edge of each quarry will all be setback a minimum of 50 m from water bodies.

6.5.5 Potential Residual Effects and Determination of Significance

The change in groundwater level at the mine is considered to be a residual effect that cannot be completely mitigated until after mine closure. Underground mine water quality will not have a residual effect during operations or at closure due to mitigation measures that will be implemented for the Project.

The change in groundwater level at the quarries will also not have a residual effect. The groundwater table at the quarries will be allowed to recover to static level and no discharge of the water will occur during operations or at closure.

The relative significance of the change in groundwater level at the mine was evaluated based on standardized assessment criteria including: magnitude, geographical extent, duration, frequency, reversibility, context, and probability of occurrence, as defined for groundwater (*CEAA* 1992; amended in 2010) (Table 6.5-4).

Table 6.5-4 Significance of Change in Groundwater Level

Criteria	Rating	Definitions
Magnitude	Low	Predicted effects on groundwater are within the natural baseline variability
	Medium	Predicted effects on groundwater are not within the natural baseline variability but do not exceed any applicable regulatory thresholds; or affect surface water flows but within natural baseline variability
	High	Predicted effects on groundwater are not within the natural baseline variability and exceed any applicable regulatory thresholds, or affect surface flows greater than natural baseline variability
Geographical Extent	Local	Within the LSA as defined for groundwater
	Regional	Within RSA as defined for groundwater
Duration	Short Term	Up to 3 years (e.g., the construction phase)
	Medium Term	Life of Project (operations and closure phases)
	Long Term	Beyond the life of the Project, or permanent
Frequency	Infrequent	Occurs occasionally
	Frequent	Occurs often or continuously
Reversibility	Reversible	Pre-Project conditions will return following the cessation of the potential residual effect
	Irreversible	Pre-Project conditions will not return following the cessation of the potential residual effect
Context	Low resilience	The VEC has low resilience to imposed stresses, or will not easily adapt to the effect
	High resilience	The VEC has a high resilience to imposed stresses, or will easily adapt to the effect
Likelihood	Low	Low probability that the predicted effect will occur
	High	High probability that the predicted effect will occur
Significance	Not Significant	Defined by VEC discipline
	Significant	Defined by VEC discipline

Ratings were assigned to the residual effect of changes in groundwater level and are outlined in Table 6.5-5.

Table 6.5-5 Significance of Residual Effects on Groundwater

Residual Effect	Predicted Degree of Effect After Mitigation Measures								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Change in groundwater level at mine affecting surface water	Adverse	Med	Localized	Med Term	Frequent	Reversible	High resilience	High	Not significant

The residual effect from the change in groundwater level will be confined to the mine site LSA. The residual effect is summarized in Table 6.5-6.

Table 6.5-6 Summary of Residual Effects after Mitigation Measures for Groundwater

Potential Residual Effects	Direction	Significance	Level of Confidence
Change in groundwater level at mine site affecting surface water	Adverse	Not significant	High

6.6 AQUATIC RESOURCES

6.6.1 Introduction

The Project will interact with aquatic resources within the Project's immediate area of influence. Effects to fish and fish habitat will mainly occur at watercourse crossings along the transportation corridor and to a lesser degree at the mine site.

6.6.2 Rationale for VEC Selection

Fish and fish habitat is protected under the federal *Fisheries Act* and fish are an important resource to local communities. Fish have ecological, cultural, recreational and commercial value as they support various fisheries, and play a fundamental role in the functionality of the entire aquatic ecosystem. Primary and secondary producers such as periphyton and benthic invertebrates are key components of the aquatic food web foundation. They provide food sources for higher trophic levels (e.g., fish and birds) and are useful as indicators of overall aquatic health, due to their relatively long-lived and sedentary life histories.

Lake Sturgeon (*Acipenser fulvescens*) inhabiting the Hudson Bay-James Bay area are currently identified as a species of special concern. One of the management priorities identified by Committee on the Status of Endangered Wildlife in Canada (COSEWIC) is to ensure that future effects to Lake Sturgeon habitats do not result in sub-population declines.

Given the above, the aquatic resources VECs are fish, fish habitat, and Lake Sturgeon as outlined in Table 6.6-1.

Table 6.6-1 Fish and Aquatic Resources VEC Selection Rationale

VEC	Key Indicator(s)	Rationale for VEC Selection or Exclusion
Fish and fish habitat	Habitat alteration; distribution and abundance of key indicator species of aboriginal and recreational importance: Northern Pike, Walleye, and Whitefish	Regulatory concern (*Fisheries Act*); key indicator species (e.g., Walleye) have been identified which are regularly harvested by local communities
Lake Sturgeon	Habitat alteration; distribution and abundance	Biodiversity concern; Hudson Bay-James Bay population classified as species of 'special concern' and the species is regularly harvested by local communities

6.6.3 Applicable Guidance

The protection of fish and fish habitat in Canada is built into the environmental legislation of the *Fisheries Act* (1985), which is administered by the Federal Department of Fisheries and Oceans Canada (DFO). This legislation requires that project activities do not affect the overall productive capacity of fish habitat through the prohibition against causing serious harm to fish that are a part of or support a commercial, recreational or Aboriginal fishery.

The Fisheries Protection Policy Statement (DFO, 2013) outlines DFO's objectives in administering the *Fisheries Act*, and emphasizes the long-term goal of a net gain in productive capacity of fish habitats in order to achieve the underlying principle of "No Net Loss" (DFO, 2013). This program centres on managing the effects to fish resulting from habitat degradation or loss, alterations to fish passage and flow.

6.6.4 Assessment Boundaries and Baseline Conditions

The starting point for defining the spatial boundaries of the effects assessment on fish and fish habitat was the delineation of the physical extent of the Project's activities, including the mine site, transportation corridor, and trans-load facility.

6.6.4.1 Aquatic Resources Regional Study Area

An RSA was selected to examine the potential of the Project to contribute to cumulative effects on the aquatic resources of the larger landscape, including:

- The Attawapiskat, Winisk, and Ekwan watersheds
- Spatial extent of potential effects from the Project and all other development projects in these watersheds
- A review of existing information regarding fish species composition, distribution, relative abundance, and migrations in the region

Figure 6.6-1 presents the aquatic resources RSA used to assess fish, fish habitat and Lake Sturgeon.

6.6.4.2 Aquatic Resources Local Study Areas

Aquatic resource LSAs were identified for each of the Project components: mine site, transportation corridor, and trans-load facility. The boundaries were selected based on the Project footprint and local drainage patterns of the near-by rivers and water bodies.

- **Mine Site LSA** - Encompasses a portion of the Muketei River, as well as the streams and water bodies in the area (Figure 6.6-2)
- **Transportation Corridor LSA** - Includes an area immediately upstream of the corridor, and extends downstream far enough to include large river systems or water bodies with high connectivity to aquatic overwintering habitat (Figure 6.6-3 and Figure 6.6-4)
- **Trans-load Facility LSA** – The trans-load facility is within the Upper Albany River watershed, close to the English River watershed divide. Two small water bodies with surface areas less than 0.06 ha are located on the eastern edge of this property, with no apparent surface connectivity to surrounding watercourses. The aquatic resources LSA at the trans-load facility is limited to these two ponds due to the small size and limited connectivity of the water bodies.

The fish-bearing waters near the mine site were assessed during the baseline aquatic assessments. These ponds and streams contain small-bodied fish species (i.e., cyprinids) and are disconnected from large water bodies that contain fish that are part of or support a commercial, recreational or Aboriginal fishery. The most commonly found species were Finescale Dace (*Phoxinus neogaeus*) and Brook Stickleback (*Culea inconstans*).

The baseline aquatic assessments conducted on 39 streams along the proposed all-season road alignment captured Lake Sturgeon in the Muketei River, near the mine site (Figure 6.6-2). The Pineimuta River is the only other watercourse likely to have Lake Sturgeon near to the proposed all-season road (Figure 6.6-3). This assumption is based on the size of the surveyed streams along the road alignment and their connectivity to known Lake Sturgeon populations (e.g., Otoskwin-Attawapiskat River).

The fish species most commonly found in the surveyed streams less than 3 m wide were small-bodied forage fish species (i.e., cyprinids) or juvenile fish utilizing the stream as rearing habitat. Large-bodied fish such as Northern Pike (*Esox lucius*), Walleye (*Sander vitreus*), White Sucker (*Catostomus commersonii*) and Shorthead Redhorse (*Moxostoma macrolepidotum*) were found in the larger surveyed streams (i.e., greater than 3 m wide). No fish were captured in five of the 39 streams. These capture results may be attributed to multiple variables including water quality, seasonal movements of resident fish, collection gear and/or connectivity to other fish-bearing waters.

The fish community survey data collected during the baseline assessment is provided in the Baseline Aquatic Environment Report (Technical Supporting Document 8). The five fish species most commonly found in the surveyed streams are as follows:

- White Sucker (46 % of streams)
- Brook Stickleback (41 % of streams)
- Pearl Dace (*Margariscus margarita*; 41 % of streams)
- Northern Pike (31 % of streams)
- Finescale Dace (31 % of streams)

Other fish species that are not in the above list, but are typically considered part of a recreational, commercial or Aboriginal fishery, include Brook Trout (*Salvelinus fontinalis*) and Lake Whitefish (*Coregonus clupeaformis*). There were no Brook Trout captured during the baseline studies and Lake Whitefish were only captured in the Muketei River near the mine site.

LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- OTHER MINE PROJECT
- COMMUNITY
- EXISTING ALL-SEASON ROAD
- MAJOR WATERSHED DIVIDE
- ATLANTIC OCEAN - HUDSON BAY DRAINAGE DIVIDE
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- PROVINCIAL BORDER
- ATTAWAPISKAT RIVER
- REGIONAL STUDY AREA
- WATERSHED FLOW DIRECTION

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (NOV 26, 2013).
4. MAJOR WATERSHED DATA PROVIDED BY: NATURAL RESOURCES CANADA.
5. BASE MAP IMAGERY PROVIDED BY ESRI GIS ONLINE (http://www.arcgis.com)

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	DKK	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

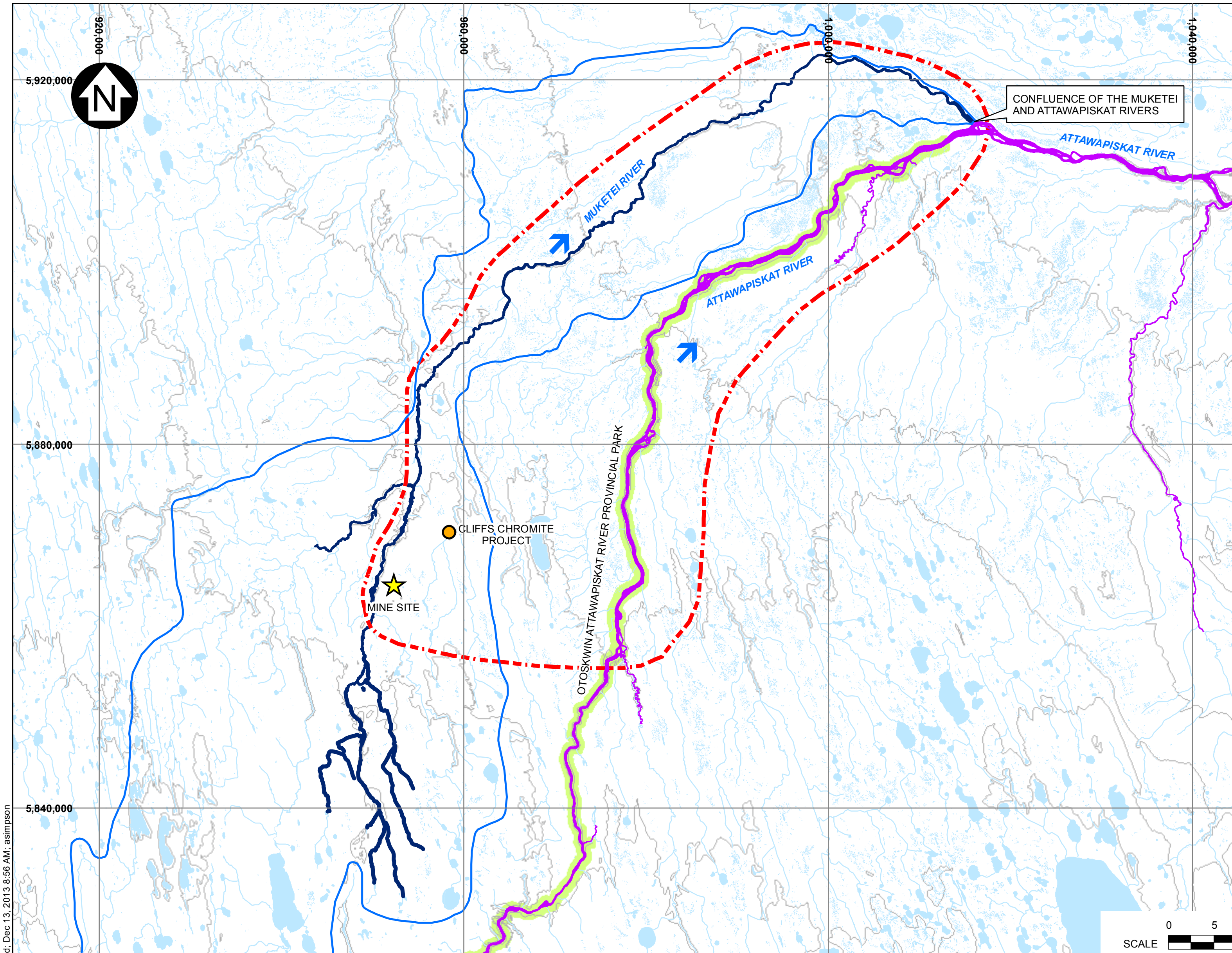
AQUATIC RESOURCES REGIONAL STUDY AREA

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 6.6-1 | REV A

SAVED: I:\1102\00390\01\A\GIS\Figs\A556_rA.mxd; Dec 13, 2013 9:26 AM; spenfold



LEGEND:

- MINE SITE
- CLIFFS CHROMITE PROJECT
- ATTAWAPISKAT RIVER (MAIN CHANNELS)
- MUKETEI RIVER (MAIN CHANNELS)
- MUKETEI RIVER SUBWATERSHED
- RIVER/STREAM/DRAINAGE
- WATER
- PROVINCIAL PARK
- AQUATIC RESOURCES LOCAL STUDY AREA
- FLOW DIRECTION

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N.
3. CLIFFS CHROMITE PROJECT LOCATION IS THE OPEN PIT FROM THE CONCEPTUAL MINE SITE LAYOUT (AUGUST 2012).

SAVED: I:\1102\00390\01\A\GIS\Figs\A583_rA.mxd; Dec 13, 2013 8:56 AM; asimpson

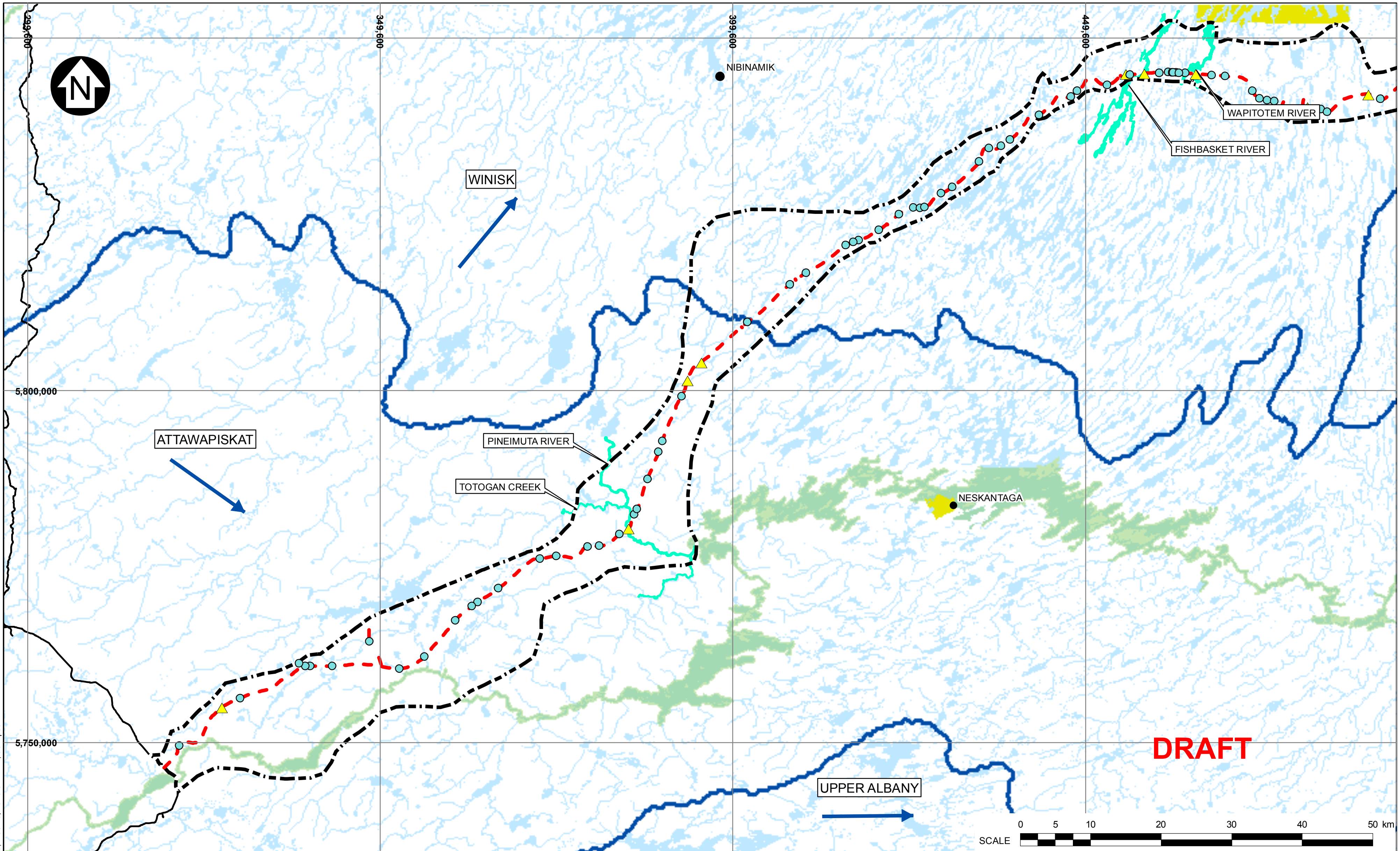
A	20DEC'13	ISSUED WITH REPORT	RAC	SWK	SRA	RAM
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

NO

E

SUBR
MINE SITE

Knight P
CON



LEGEND:

- COMMUNITY
- WATERSHED FLOW DIRECTION
- PICKLE LAKE NORTH ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- RIVER/STREAM/DRAINAGE
- WATER
- MAJOR WATERSHED DIVIDE
- MAJOR WATERCOURSE
- FIRST NATIONS RESERVE
- OTOSKWIN-ATTAWAPISKAT RIVER PROVINCIAL PARK - WATERWAY
- TRANSPORTATION CORRIDOR LOCAL STUDY AREA
- MAJOR WATERSHED DIVIDE
- PROPOSED CULVERT CROSSING
- PROPOSED BRIDGE CROSSING

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (NOV 26, 2013).
4. MAJOR WATERSHED DATA PROVIDED BY: NATURAL RESOURCES CANADA.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	DKK	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

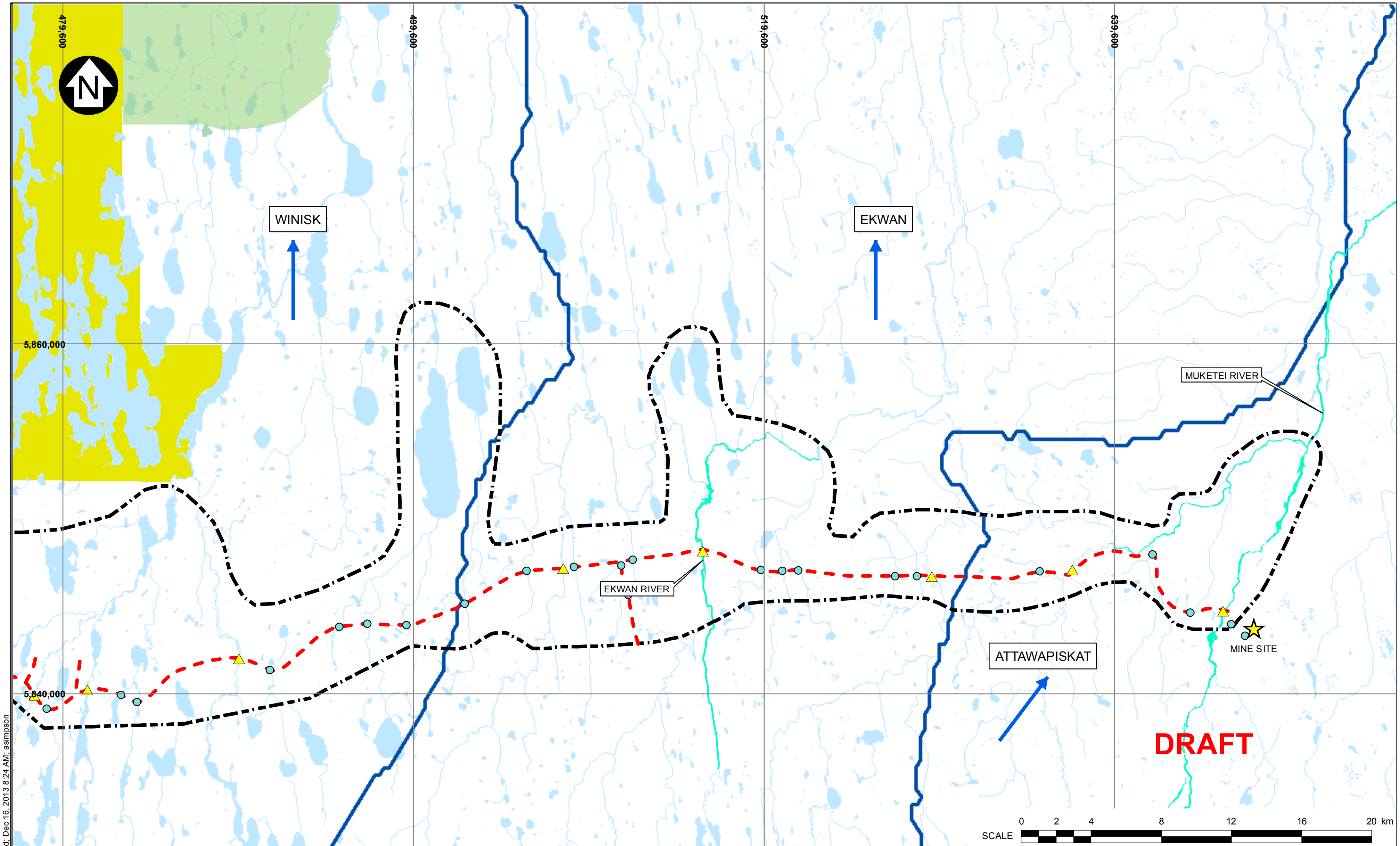
TRANSPORTATION CORRIDOR AQUATIC RESOURCES LOCAL STUDY AREA (1 OF 2)

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 6.6-3 | REV A

SAVED: I:\102\00390\01\A\GIS\Figs\A557_rA.mxd; Dec 16, 2013 8:22 AM; asimpson



LEGEND:

- MINE SITE
- WATERSHED FLOW DIRECTION
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- RIVER/STREAM/DRAINAGE
- WATER
- MAJOR WATERSHED DIVIDE
- MAJOR WATERCOURSE
- TRANSPORTATION CORRIDOR LOCAL STUDY AREA
- FIRST NATIONS RESERVE
- PROVINCIAL PARK
- MAJOR WATERSHED BOUNDARY
- PROPOSED CULVERT CROSSING
- PROPOSED BRIDGE CROSSING

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (NOV 26, 2013).
4. MAJOR WATERSHED DATA PROVIDED BY: NATURAL RESOURCES CANADA.

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

TRANSPORTATION CORRIDOR AQUATIC RESOURCES LOCAL STUDY AREA (2 OF 2)

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 6.6-4 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	DKK	SWK	SRA	RAM

SAVED: I:\102\00390\01\A\GIS\Figs\A560_rA.mxd; Dec 16, 2013 8:24 AM; asimpson

6.6.4.3 Temporal Boundaries

The temporal boundaries for the assessment are defined based on the timing and duration of the Project activities that could induce effects on the aquatic resources. Long-term effects can be detected in some of the fish species and aquatic resources in the Project area, as they are long-lived. As such, the purpose of a temporal boundary is to identify when an effect may occur in relation to specific Project phases and activities. Effects will be identified with reference to activities occurring in one or more of the Project phases:

- Construction (3 years)
- Operation (11 years)
- Closure (2 years)
- Post-closure (a minimum of 5 years)

The current expected Project life is 16 years, inclusive of the construction, operation, and closure phases.

6.6.5 Potential Effects and Mitigation Measures

6.6.5.1 General

The surface footprint of the mine site will be minimized given that most mine infrastructure will be located underground (e.g., mine facilities, ore processing, workshops, maintenance facilities and explosives storage, etc.). Construction of the surface infrastructure, including: roads, pads, a surface water collection pond, accommodation facilities and fuel storage area will be primarily located in upland areas, away from fish habitat. The transportation corridor will interact with fish and fish habitat at stream crossing locations along the route.

Potential interactions and effects are grouped into three categories and sub-divided for discussion:

- Fish Habitat Loss
  - Habitat loss at water crossings
  - Increased erosion and sedimentation during ground disturbance activities
  - Increased erosion and sedimentation during in-stream activities
- Sub-lethal Effects to Fish
  - Increased erosion and sedimentation during ground disturbance activities
  - Increased erosion and sedimentation during in-stream activities
  - Dust deposition from construction, operation and closure activities
  - Discharge of effluent into environment
  - Effects of in-stream activities on fish and fish health
- Lethal Effects to Fish
  - Increased angling access
  - Effects of in-stream activities on fish and fish health

These mechanisms can also cause stress that can reduce fish fitness (i.e., growth, reproduction and recruitment), induce behavioural changes (e.g. habitat avoidance) and can incur sub-lethal effects to periphyton, benthic invertebrates and aquatic organism health.

For the purposes of this assessment, mitigation measures included any action, project design feature, or management practice that will reduce or eliminate effects to fish and fish habitat within the Project LSA.

The interactions with fish and fish habitat (inclusive of Lake Sturgeon) were assessed by each Project component and phase (Table 6.6-2). A description of the potential Project effects were compiled within this framework in Table 6.6-3. The general mitigation measures related to these effects are provided in Table 6.6-4.

Table 6.6-2 Interaction Summary for Fish and Fish Habitat

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Mine Site			
Ground Preparation (e.g., cut, fill, grub, etc.)	C	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Construction of surface infrastructure	C	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Underground mine development, including de-watering	C	Y	• Discharge from surface water collection pond
Underground mine operation	O	N	• No pathways for interaction with fish and fish habitat
Underground ore processing and concentrate loading	O	N	• No pathways for interaction with fish and fish habitat
Tailings production and underground disposal	O	N	• No pathways for interaction with fish and fish habitat
Mining of crown pillar	O	Y	• Surface access to crown pillar near EP-4 water body potentially causing change in productive capacity
Aggregate production	C, O	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Aggregate and topsoil stockpiles	C, O	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Construction of site roads	C	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Accommodation facility operation	C, O	N	• No pathways for interaction with fish and fish habitat
Power plant operation	C, O	N	• No pathways for interaction with fish and fish habitat
Fuel Storage and distribution	C, O	Y	• Fuel spills
Equipment and vehicle use	C, O, CL	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Explosives use, handling and storage	C	Y	• Dust emissions during portal development in construction phase
Groundwater use for potable water and underground processing	C, O	N	• No pathways for interaction with fish and fish habitat
Surface water management (non-contact water)	C, O, CL	Y	• Road runoff, increased erosion and sedimentation
Waste management: solid and sewage waste facilities	C, O, CL	Y	• Discharge from wastewater treatment plant
Hazardous materials handling and storage	C, O, CL	Y	• Spills from hazardous wastes (assessed under accidents and malfunctions)

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Closure of underground workings	CL	N	• No pathways for interaction with fish and fish habitat
Closure of surface facilities, including portal	CL	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Scarification and reclamation	CL	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Training Programs	C, O	N	• No pathways for interaction with fish and fish habitat
Mine Staffing	C, O, CL	Y	• Increased angling access/fish harvest
Procurement of goods and services	C, O, CL	N	• No pathways for interaction with fish and fish habitat
Transportation Corridor			
Ground preparation for road (e.g. cut, fill, grub, etc.)	C	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Aggregate and borrow site development	C, O	Y	• Dust emissions • Road runoff, increased erosion and sedimentation • Shockwaves, vibrations and blasting residues
Road construction (includes culvert, bridge installation)	C	Y	• Dust emissions • Road runoff, increased erosion and sedimentation • In-stream construction • Riparian habitat removal • Increased angling access/fish harvest
Road maintenance	O	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Equipment and vehicle use	C, O	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Waste management	C	Y	• Spills from hazardous wastes, fuels and lubricants
Water management (non-contact water)	C, O	Y	• Road runoff, increased erosion and sedimentation
Explosives use, handling and storage	C	Y	• Dust emissions
Fuel Storage and distribution	C	Y	• Fuel spills (assessed under accidents and malfunctions)
Construction camps	C	N	• No pathways for interaction with fish and fish habitat
Hazardous materials handling and storage	C, O	Y	• Spills from hazardous wastes (assessed under accidents and malfunctions)
Employment	C, O	Y	• Increased angling access/fish harvest
Procurement of goods and services	C, O	N	• No pathways for interaction with fish and fish habitat
Decommissioning of road	CL	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Trans-load Facility			
Ground preparation and site construction	C	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Construction of rail siding	C	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Construction of buildings and loading facility	C	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Upgrading site access roads	C	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Installation of transmission line within existing right of way	C	N	• No pathways for interaction with fish and fish habitat

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Waste management: solid and sewage waste facilities	C, O	N	• No pathways for interaction with fish and fish habitat
Water management (including surface water collection pond)	C, O	Y	• Discharge from surface water collection pond
Water supply well	C, O	N	• No pathways for interaction with fish and fish habitat
Fuel Storage and distribution	C, O	N	• No pathways for interaction with fish and fish habitat
Equipment and vehicle use	C, O	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Hazardous materials handling and storage	C, O	Y	• Spills from hazardous wastes (assessed under accidents and malfunctions)
Operation of concentrate loading facility	O	N	• No pathways for interaction with fish and fish habitat
Re-grading, ditching, and placement of asphalt	C	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Equipment and vehicle use	C O D	Y	• Dust emissions • Road runoff, increased erosion and sedimentation
Procurement of goods and services	C, O	N	• No pathways for interaction with fish and fish habitat
Closure of facility	CL	N	• No pathways for interaction with fish and fish habitat

NOTES:
4. C – CONSTRUCTION, O – OPERATION, CL – CLOSURE.

Table 6.6-3 General Effects on Fish and Fish Habitat

Mechanism of Interaction	Potential Effect
Dust emissions	Dust emissions can occur due to ground disturbance, vehicle traffic and aggregate production associated with the Project construction, operation and closure phases. Deposition of dust in fish habitat has the potential to increase total suspended solids (TSS), degrade water quality, infill substrate, cause avoidance behaviour, reduce feeding and, growth, and effect health of resident fish.
Water quality changes due to effluent into environment	Effluent will enter fish habitat from the surface water collection pond (during the construction phase) and the wastewater treatment plant outfalls. This can increase the base flow of receivers, promote erosion and sedimentation of substrate, and even destabilize stream banks. These effects can also increase TSS, degrade water quality (i.e., nutrient loading), cause avoidance behaviour, reduce feeding, reduce growth, and effect the health of resident fish.
Increased erosion and sedimentation	Typical ground preparation and construction activities, along with aggregate use and non-point source surface water have the potential to cause increased erosion. This erosion and the related accumulation of material in depositional areas can result in a destruction of fish habitat (e.g., infilling of substrate and loss of benthic invertebrate communities).
Change in habitat productive capacity	Productive capacity (PC) is the maximum natural capability of habitat to produce healthy fish or to support aquatic organisms. PC can be affected by habitat alterations such as riparian habitat removal and limiting connectivity between watercourses. Both of these alterations can reduce the quality of the fish habitat components.

Mechanism of Interaction	Potential Effect
In-stream construction activities	Construction activities can alter/remove in-stream cover, increase TSS and potential cause direct loss of fish by machinery and equipment. In addition, in-stream activities may also require flow diversions that can increase in-stream erosion (i.e., scour), increase downstream sedimentation and cause direct fish loss due to stranding or mechanical entrainment against water intakes.
Increased angling access	Increased fish harvesting may occur due to the improved accessibility of watercourses along the transportation corridor. The fish communities along this route may be negatively affected due to reduced populations caused by a new predator species (i.e., humans). This activity is induced by the Project, but not directly related to the Project construction or operations and is, therefore, discussed in the cumulative effects assessment (Volume 3).

Table 6.6-4 General Mitigation Measures for Potential Effects on Fish and Fish Habitat

Mechanism of Interaction	Mitigation Measures
Dust emissions	• Enforced traffic speed limits and use of granular material for topping or dust suppressants on Project roads will reduce dust generation. These activities are discussed in the Road Management Plan (Volume 4). • Additional mitigation measures including measures to reduce and manage concentrate dust emissions are discussed in the Air Quality Management Plan (Volume 4)
Effluent into environment	• Effluent discharges (treated sewage effluent and mine water from the surface water collection pond) will satisfy the Ontario Ministry of the Environment (MOE) Environmental Compliance Authorization (ECA) that define ecologically protective chemical and biological water quality objectives for effluent discharge into fish habitat. Mine water will be non-acutely toxic and meet discharge limits as outlined in the Metal Mining Effluent Regulations (Canada, 2002). • Final discharge points and outfall pipes will be designed to minimize in-stream disturbance and any potential negative physical effects to fish habitat • Spills are accidental, unplanned events that are not part of the Project and are addressed in Section 8.3 (Accidents and Malfunctions)
Increased erosion and sedimentation	• Implement sediment and erosion control measures as identified in the Sediment and Erosion Control Plan (Volume 4). • Utilize appropriate water crossing design and treatment methods as determined by general siting variables. The goal would be to avoid critical and/or highly sensitive habitat, maintain fish passage and avoid or minimize channel re-alignment (MTO, 2009) • Weekly inspection and maintenance of Project roads to ensure erosion and sediment control features are installed and functioning properly. These inspections are outlined in the Road Management Plan (Volume 4). • A culvert inspection program is included in the Road Management Plan (Volume 4) to ensure culvert capacity is adequate and hydraulic connectivity through the road bed is maintained. These provisions will help prevent road washouts and the associated downstream sedimentation.

Mechanism of Interaction	Mitigation Measures
	• Surface water run-off and mine de-watering flows will be managed using the Water Management Plan (Volume 4). Implementation of this plan will help minimize erosion and sedimentation of fish habitat in the receiving watercourses. • The Closure and Reclamation Plan (Volume 4) discusses rehabilitation measures for the decommissioning and closure of the Project infrastructure that addresses physical stability of various Project components • Use of Best Management Practices (BMPs) as per the Ontario Ministry of Transportation (MTO) Environmental Guide for Erosion and Sediment Control during Construction of Highway Projects (2007) • Use of Good Practices as outlined in the Ontario Ministry of Natural Resources (MNR) Environmental Guidelines for Access Roads and Water Crossings (1990)
Change in habitat productive capacity	• Minimize riparian zone alteration. Stabilize and re-vegetate disturbed areas to prevent material from entering water. • Utilize stream crossing design (e.g., full span structures) to minimize in-stream work and alteration to habitat that contributes to fish productivity (e.g., riparian)
In-stream construction activities	• Adhere to the Fish Habitat Compensation Plan that will be developed using crossing-specific details and standard best practices as outlined in the following bullets • Use of Good Practices, as outlined in the Ontario Ministry of Natural Resources (MNR) *Environmental Guidelines for Access Roads and Water Crossings* (1990) • Utilize MNR in-water work timing window guidelines to avoid sensitive (i.e., spawning) periods for the fish species that are present (MNR, 2013) • Small water crossings using half-culverts (e.g., Enviro-Span®) will be installed where feasible to avoid in-stream contact and reduce effects to fish and fish habitat • Small to medium-sized water crossings (e.g., culverts) will be installed during the winter months to the extent possible to reduce effects to fish and fish habitat • Install large crossing structures during low-flow summer conditions and outside of seasonal fish migration and spawning periods • Maintain fish passage (including minimum flows and depths) • Install and maintain fish screens, guards and netting across any water intakes withdrawing water. These provisions will reduce the likelihood of fish impingement and entrainment (DFO, 1995). • Minimize duration of in-stream activities (i.e., machinery in water) as much as possible • Complete fish salvages as required, prior to in-stream activities
Increased angling access	• This effect is considered in the cumulative effects assessment (Volume 3) • A strict no-fishing policy will be enforced for all Project staff throughout the transportation corridor and at the mine site • Noront will discuss the implications of the new road access on increased angling with the MNR. The MNR has the responsibility for managing fisheries resources in Ontario

The specific Project-related instances of the general effects are described below.

6.6.5.2 Dust Deposition

Potential Effects

Construction and the use of the all-season access road, mine site roads, pads, camp facilities, laydown areas and the portal area will require clearing, grubbing, grading and culvert installation. Airborne dust and emissions from vehicle traffic will be generated and deposited in the surrounding landscape including local watercourses. The predicted total suspended particulate (TSP) emissions, evaluated under worst case emissions and meteorological conditions, is presented in the air quality modelling results (Technical Supporting Document 2). Deposited TSP may result in a slight increase in TSS, which may affect fish and fish habitat at the different Project areas.

- **Mine Site Construction and Operation** – Construction activities and the use of site roads at the mine site will generate dust. Concentrate storage and transfer to haul trucks will also occur at the mine site, but these activities will take place inside buildings.
- **Road Construction and Operation** – The all-season road will receive heavy use as part of its construction. During the operations phase of the Project, the road will be used to transport fuel, concentrate, supplies, equipment, and the workforce. Projected traffic volumes include approximately 20 round-trip concentrate haul truck-loads per day (based on multiple drivers and 24 hour operation). Other vehicular traffic on the road will add an estimated 3 to 6 vehicles per hour/day. Concentrate haulage trailers will be side or rear dump style, so losses from belly-dump closure will be eliminated. Trailers will be covered to prevent lost of concentrate dust during road travel.
- **Trans-load Facility** – Because the trans-load facility is located on a brownfield site, limited new ground disturbance will be required during construction.

  During operations, the trans-load facility will be used to transfer concentrate from the hopper trucks to stockpiles within the load-out building. The concentrate will be reclaimed from the stockpiles and delivered in an enclosed transfer system to the rail cars, which utilizes a retractable fill chute that extends into the railcar to reduce dusting. Dust collection systems will be provided at all concentrate handling points. The footprint of the trans-load facility will be covered in asphalt, in part to reduce dust emissions. Thus, there is minimal potential for airborne dust and emissions from vehicle traffic and ore handling at the trans-load facility. A detailed account of the effects from dust and emissions on water quality is provided in the air quality effects in Section 6.2. The closest fish habitat in the ponds are isolated from the trans-load facility site by a forested buffer.

  A truck and equipment wash station will be located near the exit of the trans-load facility load-out building. The hopper trucks and loading equipment will be pressure washed, as is needed, to remove any excess dust using minimal water. The wash water will be directed to a surface water collection pond prior to land discharge into the environment. No discharge to the nearby ponds is expected.

  Construction and operation of the trans-load facility is expected to have negligible effect on fish and fish habitat (i.e., the ponds).

Proposed Mitigation Measures

Mitigation techniques for reducing fugitive dust and other air contaminants that may arise from construction/ground disturbance activities, concentrate handling, vehicle use on the mine site roads and all-season access road include:

- Enclosing concentrate handling facilities
- Enforced traffic speed limits on roads
- Use of dust suppressants on roads
- Dust collection systems

Fugitive concentrate dust at the mine site and the trans-load facility will be managed by carrying out truck loading and unloading indoors and by equipping the concentrate handling equipment with dust collectors. At the trans-load facility, any material trapped by the dust collector will re-enter the process flow in a controlled manner by a rotary valve. The bucket elevator will transport material from the screw conveyors and discharge to an elevated 800 tonne storage bin. The storage bin will load the hopper rail cars by gravity feed and a dust controlling loading spout system. The above dust management techniques will mitigate the potential of fugitive concentrate dust escaping into the environment during the handling process.

The exit area of the trans-load facility building will also be paved to capture surface runoff and direct it to the surface water collection pond for monitoring and treatment, if required. Areas outside of the surface water collection area will also be paved to minimize dust. Due to the permeable soils in this area (sand), it is unlikely that surface water runoff will travel beyond the erosion control features and into fish habitat.

6.6.5.3 Water Quality Changes due to Effluent Discharges

The following effluents will be discharged to the environment at the mine site:

- Treated sewage effluent from the main construction/operation camp
- Treated sewage effluent from the existing exploration camp
- Mine water originating from the underground workings (construction phase only), discharged from the surface water collection pond

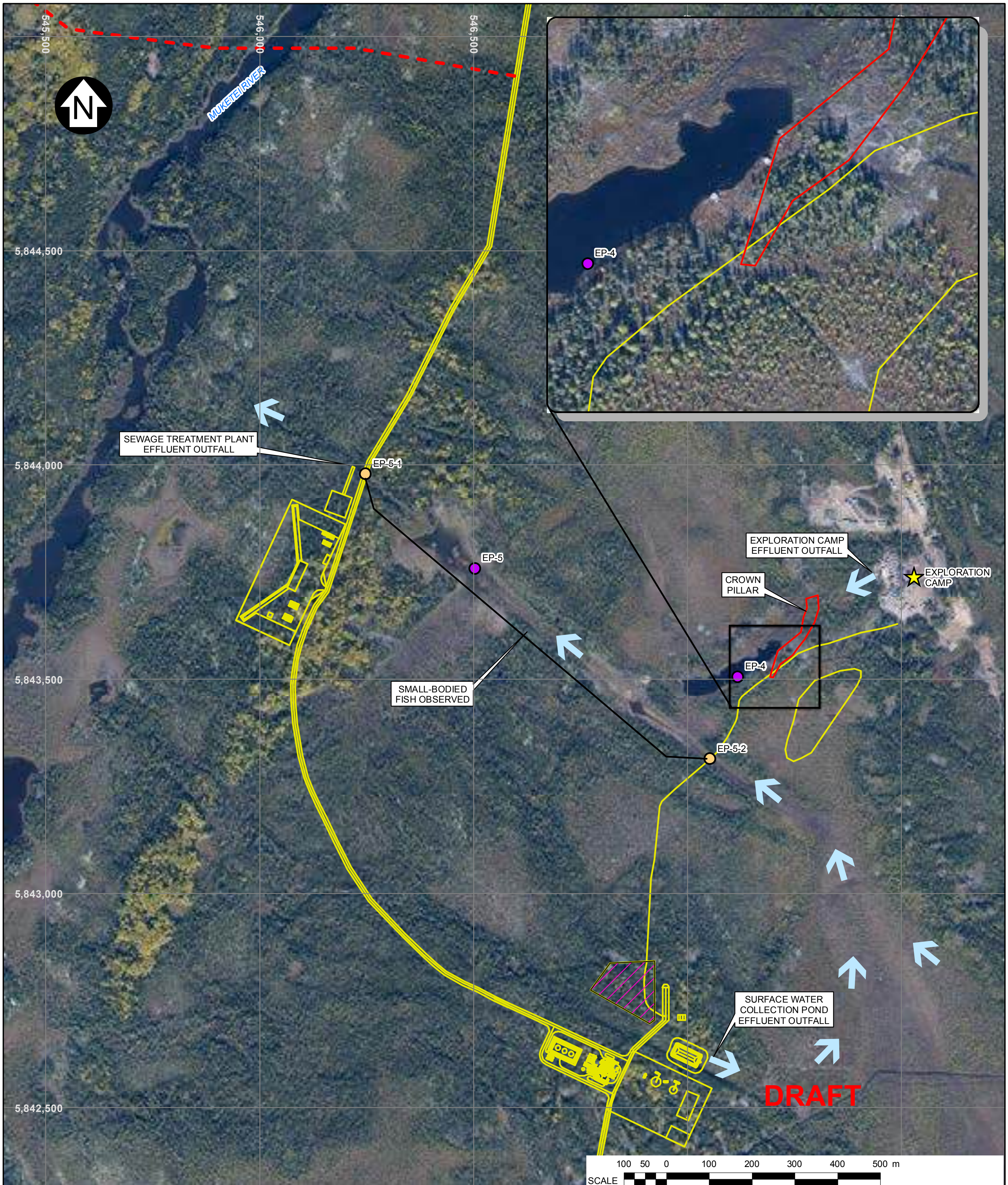
The location of these discharges relative to fish habitat is shown on Figure 6.6-5. As indicated in the water quality effects assessment in Section 6.4, sewage discharges will be in compliance with the specified limits of the current Certificate of Approval (C of A). Mine effluent will also be released, and eventually report to EP-5. The mine effluent is expected to meet CCME criteria for the protection of freshwater aquatic life within EP-5 (where fish are known to be present). Alternatively, treatment will be provided to achieve the required result.

6.6.5.4 Habitat Loss and Alteration at Water Crossings

Potential Effects

The Project will involve the installation of bridges and culverts within watercourses at the mine site and along the transportation corridor that, are known to support fish. Installation of culverts, bridge piers or bridge abutments within the watercourses will result in a loss of fish habitat. Fish habitat alteration may also occur during in-water construction, if appropriate mitigation measures are not implemented.

- **Mine Site** – Two watercourse crossings will be required on mine site roads, both crossing the EP-5 drainage to the Muketei River (see crossings EP-5-1 and EP-5-2 on Figure 6.6-5). Upstream of the proposed crossing locations, the wetland habitat is primarily a broad wetland without defined channels or ponds. Near to crossing EP-5-2, a narrow channel (< 3.0 m) begins that continues downstream towards the Muketei River. The baseline aquatic studies for this area confirmed that small-bodied fish (e.g., cyprinids) were present. Downstream of EP-5-2, beaver dams have created a number of ponds (e.g., EP-5) with limited connectivity to upstream or downstream habitat during periods of low flow. The stream reaches between EP-5 and the stream confluence with the Muketei River appear to have subterranean connectivity as well as undefined surface drainages where no stream channel exists. There is limited connectivity between the Muketei River and the drainage stream of EP-5. As such, the fish community in the upper reaches of this stream do not likely contribute to the downstream forage base of the Muketei River.



LEGEND:

- AQUATIC ASSESSMENT LOCATION
- PROPOSED WATER CROSSING
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- PROPOSED INFRASTRUCTURE
- CROWN PILLAR
- LAYDOWN AREA
- FLOW DIRECTION

NOTES:

1. IMAGE PROVIDED BY SNC-LAVALIN GROUP INC. (2010).
2. COORDINATE GRID IS IN METRES.
   COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. INFRASTRUCTURE INFORMATION AND PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

MINE SITE DEVELOPMENT AREA
WATER CROSSINGS

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 6.6-5 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	DKK	AS	SRA	RAM

SAVED: I:\102\00390\01\A\GIS\Figs\A511_rA.mxd; Dec 20, 2013 8:45 AM; asimpson

Other crossings of non-fish bearing, wetland habitat may also be required at various locations along the mine site roads. These crossing locations will be determined by in-situ conditions.

Approximate dimensions of the anticipated crossings were used to estimate in-stream and riparian habitat loss (Table 6.6-5 and Table 6.6-6).

Table 6.6-5 Estimated In-stream Fish Habitat Loss – Mine Site

Watercourse	Affected Stream Length (m)	Affected Stream Area (m^2)
Upstream drainage of EP-5	30	660
Downstream outlet of EP-5	30	30

NOTES:
1. MEASUREMENTS TO ESTIMATE HABITAT LOSS TAKEN FROM HIGH RESOLUTION ORTHOGRAPHIC IMAGERY.

Table 6.6-6 Estimated Riparian Habitat Loss – Mine Site

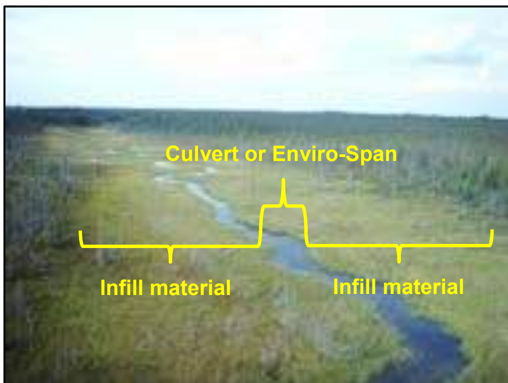
Watercourse	Affected Stream Length (m)	Affected Stream Area (m^2)
Upstream drainage of EP-5	60	300
Downstream outlet of EP-5	60	120

NOTES:
1. MEASUREMENTS TO ESTIMATE HABITAT LOSS TAKEN FROM HIGH RESOLUTION ORTHOGRAPHIC IMAGERY

- **Transportation Corridor** – Approximately 91 watercourse crossings are located along the alignment of the proposed all-season road (Figure 6.6-3 and Figure 6.6-4). Crossing structures will include culverts, Enviro-Span (open arch culverts) or full span bridges for the 91 water crossing locations identified during baseline investigations. The aerial surveys conducted in 2013 estimated the bankfull stream widths for the proposed all-season road ranged from less than 1 m to approximately 75 m. A summary of the watercourse crossing widths and the crossing structures likely to be used is provided in Table 6.6-7, with detailed crossing information proved in Technical Supporting Document 16. The general road construction techniques and environmental considerations will be adapted based on the type of terrain encountered (See Section 5.4 for a summary of road development). The type of crossing structure will be determined by the in-situ watercourse conditions (e.g., bankfull width, substrate/base, local hydrology, etc.). Some streams located along alignment of the proposed all-season road have broad wetted widths, with shallow floodplains and narrow drainage channels. In these instances, a full span bridge may not be a viable alternative and some infilling of the floodplain may occur (Figure 6.6-6). Full span bridges will be installed where stream crossings have suitable bank foundation conditions (i.e., bedrock) and the bankfull width satisfies design requirements (Figure 6.6-6).

In-stream fish habitat losses will be incurred due to infilling at many of the stream crossings requiring culverts. Further habitat losses may be incurred at larger bridge crossing locations where bank stabilization and centre piers are required to span the water body.

The access road follows a realignment of the existing winter road that currently services the First Nation communities of Eabametoong, Neskantaga, Nibiamik, and Webequie. Development of the existing winter road applied log infill for many crossings. These barriers to fish mobility will be removed as part of the realignment work.



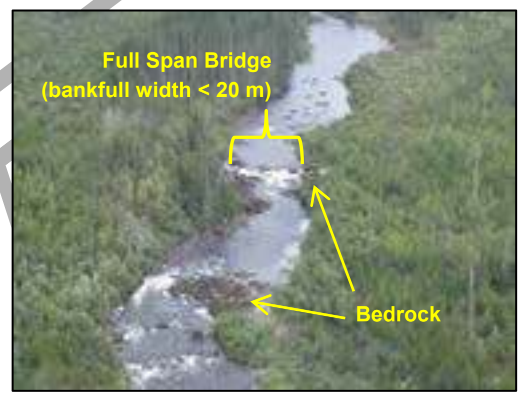


Figure 6.6-6 Broad floodplain crossing (left) and a narrow bedrock crossing (Right)

In addition to habitat loss, temporary stream habitat alteration may occur during the installation of watercourse crossing structures. Potential effects may include:

- Increases in localized sedimentation
- Temporary reduction in fish access
- Removal of in-stream cover
- removal of riparian habitat
- Construction of in-stream works at bridge crossing locations

It is highly probable that some fish-bearing aquatic habitat will be lost due to bridge and culvert installations. Details on the amount of infill or the size of in-stream footprints will be provided when detailed road design work is available and detailed quantification of effected habitat is possible. At wide crossing locations full-span bridges will be the preferred crossing option where this strategy is logistically and economically viable. Full-span bridges will aim to avoid stream bank or streambed alteration that could affect primary productivity or fish populations (e.g., limit recruitment, rearing habitat or affect free passage). It is possible that the placement of riprap or other supporting abutment material at bridge locations may alter or remove undercut banks and other forms of overhanging cover utilized by fish and other aquatic organisms. Watercourse crossings involving full span bridges will require riprap to be placed flush with the stream bank to avoid alterations to channel flow or flow volume.

Approximately 75 % of the watercourse crossings constructed along the road alignment will be in the form of single, double, or oversized culverts. Sizing for the culverts will be based on the type of water course encountered. As discussed above, many of the larger culvert structures in watercourses within floodplains that have wide bankfull widths will require infilling of the wetland and potential alteration of in-stream habitat.

Table 6.6-7 Number and Type of Watercourse Crossing along Transportation Corridor

Watercourse Crossing Type	Number of Watercourse Crossings	Range of Wetted Widths (m)	Range of Bankfull Span or Culvert Length (m)
Culverts (including double and oversize culverts)	68	<1-30	<1-30
Enviro-Span (open arch culvert)	8	1-25	1-25
Small Full-Span Bridges	13	2-30	9-20
Large Full-Span Bridges	2	10-50	20-75
Total Number or Size Range	**91**	**< 1-50**	**<1-75**

NOTES:

1. BASED ON DATA COLLECTED BY KIEWIT AND KP, OCTOBER 2013.
2. APPROXIMATELY FIVE ADDITIONAL CULVERT CROSSINGS MAY BE REQUIRED FOR ACCESS ROUTES TO AGGREGATE SOURCES.

Proposed Mitigation

The Project development will have some loss of fish habitat. As such, a Conceptual Fish Habitat Compensation Plan (Conceptual FHCP) has been developed (Volume 4, Section 10). Once the road alignment and site-specific details of the each water crossing have been confirmed, the habitat loss will be quantified for the development of a detailed draft FHCP as part of a *Fisheries Act* Authorization. This will include identification of any areas confirmed to be (or supporting) a recreational, commercial or Aboriginal fishery, which has already led to a rerouting of the proposed access road over part of the route south of Webequie. A summary of the mitigation measure is provided in Table 6.6-4, with additional mitigation measures discussed below.

Avoidance of stream bank or bed alteration to protect fish and fish habitat will be done wherever logistically and economically feasible. It is assumed that some crossings will require in-stream placement of material, however the final FHCP will address these activities within the DFO regulatory framework.

Bridge installation on fish-bearing watercourses will avoid any stream bed alteration. Riprap or other sources of supporting material will be installed below bridges to minimize the risk of slope failure.

Where required, temporary ice bridges will be used to provide far shore access for construction equipment. Temporary crossing structures will comply with measures outlined by DFO and local regulatory guidelines to avoid causing harm to fish and fish habitat. Ice bridges will be removed prior to spring break-up to prevent unnatural ice jamming and flooding.

The expected effects to downstream habitat (e.g., temporary increased turbidity and sedimentation during construction) are minimal, since the ditching and/or crossings will be installed using best practices. These practices include appropriate design for in-situ conditions to minimize in-stream alteration and to accommodate fish passage to upstream habitat.

6.6.5.5 Increased Erosion and Sedimentation

Potential Effects

Construction and use of the all-season road, mine site roads, pads, camp facilities, laydown areas and the portal area will require clearing, grubbing and grading. All of these activities will expose soils and potentially result in erosion and runoff of sediment. In-stream construction activities, such as culvert and bridge installations, also have the potential to generate sediment in watercourses. Developing approximately 24 potential aggregate sites will also involve some blasting, clearing and grubbing. The borrow areas are estimated to be between 22 ha and 350 ha and are offset from the road alignment by an average distance of approximately 500 m.

If not adequately mitigated, the surface disturbance associated with these activities may result in soil erosion and potential sedimentation of nearby watercourses. Sedimentation may hinder fish passage, cause avoidance or have negative effects on nearby fish and aquatic organism health. Elevated turbidity can raise water temperatures and reduce feeding and growth rates (Robertson et al., 2006 and Kerr, 1995). If not properly mitigated increased erosion and siltation may homogenize streambed material, reduce downstream water depths at water crossings, and alter habitat quality for periphyton and benthic invertebrate communities. Spills and other malfunctions that may affect the aquatic environment are discussed further in Section 8.3.

The potential effects of erosion and sedimentation during construction will be reduced during the operation phase. During operations, there is the potential for road runoff (sedimentation, road salts) from vehicle traffic to pollute nearby watercourses and yield sub-lethal effects to fish, periphyton, benthic invertebrates and other aquatic biota.

Project-related potential effects of erosion and sedimentation during the closure phase are similar to the construction phase, but the effects will be restricted to the mine site since the all-season road is expected to remain.

Proposed Mitigation Measures

Best management practices during the Project construction, operation and closure phases will, as much as possible, limit the extent of soil disturbance and utilize regularly maintained, temporary sediment and erosion control features. Reducing water velocity across the ground, particularly on exposed surfaces and in areas where water can gather or pool, will be accomplished by lining erodible soils with rough surfaces (e.g., vegetation and brush). The low relief of the mine site means that there will be few shallow slopes for water to runoff. Table 6.6-4 outlines Noront`s approach to mitigating the effects of erosion and sedimentation. Detailed measures are described in the Sediment and Erosion Control Plan (Volume 4, Section 9).

6.6.5.6 Alteration of Fish Habitat due to In-stream Construction Activities

Potential Effects

In-stream construction activities at stream crossing will produce excess noise, tremors, temporary flow alterations, erosion and/or sedimentation. These effects may hinder fish passage, cause habitat avoidance or have negative effects on nearby fish and aquatic organism health. Increases in TSS and turbidity can cause temporary avoidance of previously suitable habitat or have negative consequences for fish and aquatic organism health, such as immune suppression, reduced feeding, and lower reproductive fitness.

Activities such as habitat degradation (i.e., riparian vegetation removal within transportation corridor right-of-way) have the potential to cause indirect fish mortality by reducing fish health or habitat productive capacity over time. Other more sedentary aquatic organisms, including incubating fish eggs and benthic invertebrates may experience lethal effects due to habitat loss or degradation.

The use of any heavy machinery required for construction within the stream channel at water crossing locations has the potential to trample and alter fish and fish habitat. Temporary de-watering, infilling, and localized increases in erosion and sedimentation during construction activities may be lethal to incubating fish eggs or benthic invertebrates.

The use of explosives will be required for the construction of transportation corridor roads and associated infrastructure including rock quarries and aggregate borrow sources. Some quarries and blasting sites will be near fish-bearing watercourses and there will be the potential for explosive shockwaves or blast residues to increase fish stress or cause habitat avoidance. While DFO guidelines provide detonation setbacks for avoiding lethal effects to fish and developing embryos at spawning sites, similar guidelines for sub-lethal effects are not available (Wright and Hopky, 1998). Effects from explosives use at sites along the transportation corridor are expected to be negligible as explosives use is not planned at watercourse crossings and setback distances from quarried and borrow areas will be greater than those outlined in Wright and Hopky (1998).

The potential for blasting residues to leach into nearby watersheds is discussed in Section 6.4. Quarries will not be free draining and no discharge is expected.

The predicted sub-lethal effects (e.g., reduced growth, reproduction and general health, etc.) associated with the construction of different components of the Project transportation corridor (outlined above) are relatively minor in comparison to the overall quantity of available habitat in the Attawapiskat (Pineimuta, Muketei and Attawapiskat rivers), Winisk (Fishbasket and Wapitotem rivers), and Ekwan River systems. Thus, long-term effects on the health of aquatic biota populations are anticipated to be negligible.

Proposed Mitigation Measures

Various mitigation measures will be utilized to minimize effects to fish and fish habitat during the construction, operation and closure phases of the Project. These include utilizing full span structures where possible and following available best management practices. Detailed mitigation techniques are provided in the documents referenced in Table 6.6-4.

In addition to the above mitigation measure, once the road alignment and site-specific details of the each water crossing have been confirmed, the habitat loss will be quantified to generate a detailed no-net-loss fish and fish habitat compensation plan as part of a *Fisheries Act* Authorization. This will include identification of any areas confirmed to be (or supporting) a recreational, commercial or Aboriginal fishery.

6.6.5.7 Riparian Habitat Alteration and Loss at the Crown Pillar

The surface around the crown pillar will be excavated during Year 3 of the mine operations phase. The crown pillar is located close to EP-4 pond (Figure 6.6-5). EP-4 is a small body of water, approximately 0.9 ha with a maximum depth of 1 m as discussed in the aquatic environment baseline report (Technical Supporting Document 8). Before mining can begin, a concrete barrier will be constructed around the circumference of the crown pillar using cemented aggregate rock from the paste backfill plant. The concrete barrier will extend from surface into the bedrock to eliminate water inflows and allow mining to take place from underground. Additional detail on mining of the crown pillar is provided in Section 5.

Unmitigated, the modification of riparian habitat at this location may result in elevated levels of TSS and turbidity in the EP-4 pond. Other potential effects from riparian habitat loss include a reduced quantity of shoreline cover, and lowered nutrient and food inputs into the water body.

Coffer dams and/or sheet piling will be used to isolate the work area from the aquatic environment and limit disturbance associated with these construction activities. Care will be taken to avoid releasing coffer dam fill materials into EP-4, and all bags and materials will be removed after crown pillar excavation and extraction is completed. All water pumped from contained work areas within the crown pillar coffer dams will be discharged on an upland site to allow sediment removal before it re-enters any watercourse.

Baseline studies detected Finescale Dace and Brook Stickleback in pond EP-04. These fish species are not anticipated to affected by the excavation of the crown pillar nor are they a part of or supporting a commercial, recreational or Aboriginal fishery. As such, a *Fisheries Act* authorization is not anticipated for this activity.

6.6.6 Potential Residual Effects and Determination of Significance

The relative significance of residual effects on fish and fish habitat was evaluated based on a suite of standardized assessment criteria including: magnitude, geographical extent, duration, frequency, reversibility, context, and probability of occurrence. The assessment methodology is described in Section 2 and the modified assessment criteria used to evaluate the effects on fish and fish habitat are presented in Table 6.6-8.

Using the assessment criteria in Table 6.6-8, ratings were assigned to each individual residual effect identified and compiled in Table 6.6-9 (Habitat Loss and Alteration) and Table 6.6-10 (Sub-Lethal effects). All adverse residual effects identified in the assessment were determined to be not significant due to a low or medium magnitude and a limited geographical extent.

Table 6.6-8 Determining Significance of Residual Effects for Fish and Fish Habitat

Criteria	Rating	Definitions
Magnitude	Low	Predicted effects on fish and aquatic organisms are within the natural baseline variability or do not exceed any applicable regulatory thresholds (e.g., potential 'serious harm to fish' is compensated for under the Fish Habitat Compensation Plan)
	Medium	Predicted effects on fish and aquatic organisms are not within the natural baseline variability and exceed applicable regulatory thresholds for species that are not part of or support a commercial, recreational or Aboriginal fishery (e.g., isolated small-bodied fish communities not utilized for baitfish harvest)
	High	Predicted effects on fish and aquatic organisms exceed applicable regulatory thresholds for aquatic species of conservation concern or the aquatic organisms that are a part of or support a commercial, recreational or Aboriginal fishery (e.g., upstream baitfish communities connected to and in support of downstream sport fish populations)
Geographical Extent	Localized	Effect limited to the LSA
	Widespread	Effect extends to the RSA
Duration	Short Term	Effect lasts <2 years
	Medium Term	Life of Project (11 years)
	Long Term	Beyond the life of the Project, or permanent
Frequency	Infrequent	Effect occurs rarely (i.e. monthly to yearly)
	Frequent	Effect occurs intermittently or continuously (i.e. weekly or daily)
Reversibility	Reversible	Effect is reversed after the activity ceases
	Irreversible	Effect will not be reversed after the activity ceases, or the effect is permanent
Context	Low resilience	Low resilience to imposed stresses, or will not easily adapt to the effect.
	High resilience	High resilience to imposed stresses, or will easily adapt to the effect.
Probability of occurrence	Low	Low likelihood that the predicted residual effect will occur.
	Moderate	Moderate likelihood that the predicted residual effect will occur. (Unknown)
	High	High likelihood that the predicted residual effect will occur.

Table 6.6-9 Significance of Residual Effects for Fish and Fish Habitat due to Habitat Loss and Alteration

Residual Effect	Area	Predicted Degree of Effect After Mitigation Measures								Significance of Residual Effect
		Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Construction Phase										
Increased dust emissions, erosion and sedimentation	TC	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High Resilience	High	Not Significant
In-stream construction activities	TC, MS	Adverse	Medium	Localized	Short Term	Infrequent	Reversible	High Resilience	High	Not Significant
Change in habitat productivity	TC	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High Resilience	Moderate	Not Significant
Operation Phase										
Riparian habitat loss and alteration at crown pillar	MS	Adverse	Low	Localized	Long Term	Frequent	Irreversible	High Resilience	Low	Not Significant

Table 6.6-10 Significance of Residual Effects for Fish and Fish Habitat due to Sub-Lethal Effects

Residual Effect	Area	Predicted Degree of Effect After Mitigation Measures								Significance of Residual Effect
		Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Construction and Decommissioning Phases										
Increased dust emissions, erosion and sedimentation	TC	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High Resilience	High	Not Significant

In Canada, the principal tools for the management of fisheries and fish habitat are the *Fisheries Act* and its associated habitat management policies. Compensation for loss of fish habitat is defined by the DFO habitat management program as 'replacement of natural habitat, increase in productivity of existing habitat, or maintenance of fish production by artificial means' (DFO 1986). The loss of fish habitat due to in-water structures (e.g., bridge piers) is likely to occur, however the FHCP is intended to mitigate Project effects associated with fish habitat losses. The main goal of the FHCP is to offset the loss of 'productive capacity' described in the 'no net loss' guiding principle outlined in the DFO Policy for the Management of Fish Habitat in Canada. As such, no significant residual effects will be produced by the construction, operation or decommissioning Project activities.

6.6.7 Discussion of Significance

No significant habitat loss and alteration, lethal effects or sub-lethal effects on fish and aquatic organisms are predicted to occur due to the Project (Table 6.6-9 and Table 6.6-10). This is in accordance with the *Fisheries Act* legislation, which is designed to protect the overall productive capacity of fish habitat through the prohibition against causing serious harm to fish that are a part of or support a commercial, recreational or Aboriginal fishery.

All residual effects were considered not significant due to the low to medium magnitude and localized geographical extent of the anticipated effects.

The assessment of significance is contingent on the complete implementation of mitigation and fish compensation measures. The level of confidence applied to the residual effects for habitat loss, sub-lethal and lethal effects to fish and fish habitat were either rated as moderate or high. These ratings indicate that the mechanisms of interaction are clearly understood and that there is a relatively low degree of uncertainty in the significance predictions.

A moderate level of confidence was applied to those residual effects involving the loss of riparian habitat, loss of fish bearing habitat, changes to habitat productivity and potential fish harvesting rates. These effects are dependent on mitigation strategies that have been implemented for similar projects. The interaction between these effects and fish and fish habitat in the Project area is only partially understood and will require some context related information gathering during Project development. A high level of confidence was applied to potential effects associated with in-stream construction works, dust liberation, and erosion and sedimentation. The mechanisms of interaction between the potential effects of the Project to fish and fish habitat are well understood and there is a low degree of uncertainty in the predictions.

Further to the overall discussion of significance, it is anticipated that Lake Sturgeon populations will not be affected by the Project development. Lake Sturgeon were captured in the Muketei River during the baseline aquatic studies, and there is a high likelihood that they are present in the Pineimuta River. The Muketei and Pineimuta river crossings will likely be positioned at narrow sections of these rivers to minimize crossing structure length. These locations will minimize the extent of any in-stream habitat loss or alteration. Upon completion of the site-specific crossing designs, the FHCP will consider any changes to habitat utilized by Lake Sturgeon throughout their life stages.

6.6.8 Follow-up Program

Crossing sites along the transportation corridor will require more detailed assessments before any potential habitat losses can be quantified and a detailed no-net-loss Fish Habitat Compensation Plan can be developed as part of a *Fisheries Act* Authorization. These field and desktop based assessments will be focused on verifying the type of road crossing structure required at each watercourse along the transportation corridor and the potential for habitat losses and/or alterations that may occur during these installations.

6.7 VEGETATION

6.7.1 Introduction

The Project lies within the Ontario Shield Ecozone which is comprised of coniferous and mixed forests, wetlands, and the highest percentage of burned areas in Ontario (MNR, 2009). The proposed Project will interact with vegetation primarily due to ground disturbances during the construction phase. This section provides an assessment of potential Project effects on upland habitats, harvested plants, rare community types and rare plant species. It also includes proposed mitigation to reduce Project effects on vegetation.

6.7.2 Rationale for VEC Selection

Vegetation communities provide habitat to wildlife and rare vegetation species or communities are a biodiversity concern. The key indicators selected to assess vegetation are outlined in Table 6.7-1.

Table 6.7-1 Vegetation VEC Selection and Rationale

VEC	Key Indicator(s)	Rationale for VEC Selection
Upland Ecosystems	Loss or alteration of upland ecosystems	Biodiversity concern; upland habitats support diverse plant species as well as provide important habitat to wildlife
Wetland Ecosystems	Loss or alteration of wetland ecosystems	Regulatory concern; agencies have expressed concern about potential Project impacts to wetlands
Rare Plant Species	Loss of rare plant species	Biodiversity concern; Land clearing activities to develop mine infrastructure may impact rare plant species

6.7.3 Assessment Boundaries

The assessment boundaries for vegetation are based on the delineation of the physical extent of the Project's activities, including the mine site, transportation corridor, and trans-load facility. Spatial boundaries for the effects assessment were determined based on the anticipated zone of influence of Project effects.

6.7.3.1 Regional Study Area

The RSA was selected to examine the potential direct and indirect effects from the development of the Project. However, for vegetation, effects are not expected to extend beyond the LSA.

6.7.3.2 Local Study Area

The LSA is the zone where there is reasonable potential for direct effects between Project components and the vegetation VECs. The LSA is defined by the Project footprint including the mine site, transportation corridor and trans-load facility. A buffer of 1 km from Project infrastructure was selected to encompass the maximum predicted spatial extent of the combined direct and indirect effects. The LSA is intended to capture effects that extend beyond the Project footprint, such as the deposition of dust. The mine site and transportation corridor LSAs are approximately 1,900 ha and 77,750 ha respectively. Within the LSAs, the Project footprint areas include:

- **Mine Site PDA** - Encompasses the footprint of the mine site infrastructure (portal, laydown and stockpile areas, surface processing facilities, diesel generators, fuel storage area, accommodation facility, site roads, waste management facility etc.). The total land area occupied by the mine site PDA is approximately 33 ha.
- **Transportation Corridor PDA** - Encompasses the footprint of the road corridor right-of-way (30 m width), borrow sources, quarries and associated spur roads. The total land area occupied by the transportation corridor PDA is approximately 7,300 ha.
- **Trans-load Facility PDA** - Includes the footprint of the trans-load facility infrastructure. The total land area occupied by the trans-load facility PDA is approximately 1.0 ha.

6.7.3.3 Temporal Boundaries

The temporal boundaries for the assessment are defined based on the timing and duration of Project activities that could induce effects to vegetation. Effects will be identified with reference to activities occurring in one or more of the Project phases:

- Construction (3 years)
- Operation (11 years)
- Closure (2 years)
- Post-closure (a minimum of 5 years)

The current expected Project life is 16 years, inclusive of the construction, operation, and closure phases.

6.7.4 Potential Interactions and Effects

Project components and activities that are identified as potentially interacting with vegetation VECs are assessed for each Project component and are shown in Table 6.7-2. Project components and activities will interact with and potentially affect vegetation VECs primarily through:

- Physical loss or alteration of vegetation by land clearing within the Project footprint (construction phase)
- Potential introduction of invasive plant species (construction, operations and closure phases)
- Dust deposition and emissions (construction and operations phase)

In addition, effects to vegetation could occur due to unplanned events such as spills of fuel or concentrate. This is assessed as an accidental and malfunction in Section 8.3.

Table 6.7-2 Potential Interactions between the Project and Vegetation

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Mine Site			
Ground Preparation (e.g., cut, fill, grub, etc.)	C	Yes	Clearing vegetation within mine site PDA
Construction of surface infrastructure	C	Yes	Generation of dust, potential for introduction of invasive species
Underground mine development, including de-watering	C	No	No interaction with vegetation
Underground mine operation	O	No	No interaction with vegetation
Underground ore processing and concentrate loading	O	No	No interaction with vegetation
Tailings production and underground disposal	O	No	No interaction with vegetation
Mining of crown pillar	O	Yes	Clearing vegetation within mine site PDA
Aggregate production	C, O	Yes	Generation of dust
Aggregate and topsoil stockpiles	C, O	Yes	Generation of dust
Construction of site roads	C	Yes	Generation of dust
Accommodation facility operation	C, O	No	No interaction with vegetation
Power plant operation	C, O	No	No interaction with vegetation
Fuel Storage and distribution	C, O	Yes	Potential spills of fuels and lubricants
Equipment and vehicle use	C, O, CL	Yes	Generation of dust
Explosives use, handling and storage	C, O	No	No interaction with vegetation
Groundwater use for potable water and underground processing	C, O	No	No interaction with vegetation
Surface water management (non-contact water)	C, O, CL	No	No interaction with vegetation
Waste management: solid and sewage waste facilities	C, O, CL	No	No interaction with vegetation
Hazardous materials handling and storage	C, O, CL	Yes	Potential spills of hazardous wastes
Closure of underground workings	CL	No	No interaction with vegetation
Closure of surface facilities, including portal	CL	Yes	Beneficial effect of vegetation recovery; potential for introduction of invasive species
Scarification and reclamation	CL	Yes	Beneficial effect of vegetation recovery; potential for introduction of invasive species
Training Programs	C, O	No	No interaction with vegetation
Mine Staffing	C, O, CL	No	No interaction with vegetation
Procurement of goods and services	C, O, CL	No	No interaction with vegetation

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Transportation Corridor			
Ground preparation for road (e.g. cut, fill, grub, etc.)	C	Yes	Clearing vegetation within transportation corridor PDA
Aggregate and borrow site development	C, O	Yes	Clearing vegetation within mine site PDA, dust generation
Road construction (includes culvert, bridge installation)	C	Yes	Generation of dust, potential for introduction of invasive species
Road maintenance	O	Yes	Generation of dust, potential for introduction of invasive species
Equipment and vehicle use	C, O	Yes	Generation of dust, potential for introduction of invasive species
Waste management	C	Yes	Potential spills of wastes
Water management (non-contact water)	C, O	No	No interaction with vegetation
Explosives use, handling and storage	C	Yes	Generation of dust
Fuel Storage and distribution	C	Yes	Potential spills of fuels and lubricants
Construction camps	C	No	No interaction with vegetation
Hazardous materials handling and storage	C, O	Yes	Potential spills of hazardous wastes
Employment	C, O	No	No interaction with vegetation
Procurement of goods and services	C, O	No	No interaction with vegetation
Trans-load Facility			
Ground preparation and site construction	C	No	No clearing of vegetation required within trans-load facility PDA
Construction of rail siding	C	No	No clearing of vegetation required
Construction of buildings and loading facility	C	Yes	Generation of dust
Upgrading site access roads	C	Yes	Limited clear of vegetation required in upland ecosystems, no interaction with wetland ecosystems. Generation of dust
Installation of transmission line within existing right of way	C	Yes	Limited clear of vegetation required in upland ecosystems. No interaction with wetland ecosystems
Waste management: solid and sewage waste facilities	C, O	Yes	Potential spills of wastes
Water management (including surface water collection pond)	C, O	No	No interaction with vegetation
Water supply well	C, O	No	No interaction with vegetation
Fuel Storage and distribution	C, O	Yes	Potential spills of fuels and lubricants
Equipment and vehicle use	C, O	Yes	Generation of dust
Hazardous materials handling and storage	C, O	Yes	Potential spills of hazardous wastes
Operation of concentrate loading facility	O	No	No interaction with vegetation
Re-grading, ditching, and placement of asphalt	C	No	No interaction with vegetation
Equipment and vehicle use	C O CL	Yes	Generation of dust
Procurement of goods and services	C, O	No	No interaction with vegetation
Closure of facility	CL	Yes	Beneficial effect of vegetation recovery; potential for introduction of invasive species

NOTES:

1. C - CONSTRUCTION PHASE; O - OPERATIONS PHASE; CL - CLOSURE PHASE.

Following consideration of the interactions identified in Table 6.7-2, the assessment focuses on the potential Project effects to vegetation identified in Table 6.7-3.

Table 6.7-3 Potential Effects on Vegetation

Mechanism of Interaction	Key Indicator(s)	Project Phase (C, O, CL)	Potential Effect	Direction
Physical loss or alteration of vegetation communities/species	Vegetation abundance	C, O	Physical loss or alteration	Adverse
Dust deposition affecting vegetation health	Vegetation health, presence of invasive species	C	Deposition of dust, introduction of invasive species, accidental spills	Adverse
Maintenance of roads, equipment and vehicle use	Vegetation health, presence of invasive species	C, O, CL	Deposition of dust, introduction of invasive species, accidental spills	Adverse
Reclamation and closure	Vegetation health and abundance	C, O, CL	Vegetation reclamation	Beneficial

6.7.4.1 Physical Loss or Alteration of Vegetation - Upland Ecosystems

Potential Effects

Vegetation in upland ecosystems will be removed or altered during the construction phase due to clearing associated with the mine site and transportation corridor PDAs. The removal of vegetation can result in the fragmentation of forest communities which can result in the isolation of plant populations as the developed spaces act as barriers to plant distribution (Harper et al., 2005). In addition, new openings created by site clearing for construction may attract light demanding species and may be avoided by other species, potentially changing species composition.

The direct loss of vegetation in upland ecosystems within the mine site PDA and LSA was computed using the Far North Land Cover (FNLC) database and is shown in Table 6.7-4.

Table 6.7-4 Loss of Upland Ecosystems

FNLC Category	Area Within Mine Site LSA (ha)	Percent of Mine Site LSA (%)	Area Within Mine Site PDA (ha)	Percent of Mine Site LSA Lost (%)
Coniferous Treed	2.0	0.10	0	**0**
Deciduous Treed	4.5	0.23	0	**0**
Disturbance - Non and Sparse Woody	48.4	2.5	0.96	**2.0**
Mixed Treed	93.9	4.9	0.88	**0.9**
Sparse Treed	421.0	22	13.5	**3.2**
TOTAL	570	30	15.3	**2.7**

The area of upland ecosystems lost at the mine site will be approximately 15 ha, which equals approximately 2.7 % of the upland habitats in the mine site LSA.

The direct loss of vegetation in upland ecosystems within the transportation corridor right of way and for quarry and borrow sites was computed using the FNLC database and is shown in Table 6.7-5 and Table 6.7-6.

Table 6.7-5 Loss of Upland Ecosystems in All-season Road Right-of-Way

FNLC Category	Area Within Transportation Corridor LSA (ha)	Percent of Transportation Corridor LSA (%)	Area Within All-Season Road PDA (ha)	Percent Lost in LSA (%)
Coniferous Treed	20,643	27	281	1.4
Deciduous Treed	2,477	3.2	42	1.7
Disturbance - Non and Sparse Woody	993	1.3	6.2	0.62
Disturbance -Treed and/or Shrub	9,618	12	100	1.0
Mixed Treed	2,887	3.7	34	1.2
Sparse Treed	5,281	6.8	55	1.0
TOTAL	41,899	54	518	0.7

Table 6.7-6 Loss of Upland Ecosystems in Borrow and Quarry Sites

FNLC Category	Area Within Transportation Corridor LSA (ha)	Percent of Transportation Corridor LSA (%)	Area Within All-Season Road PDA (ha)	Percent of Upland Habitat Lost in LSA (%)
Coniferous Treed	20,643	27	2754	13
Deciduous Treed	2,477	3.2	264	11
Disturbance - Non and Sparse Woody	993	1.3	72	7.2
Disturbance -Treed and/or Shrub	9,618	12	875	9.1
Mixed Treed	2,887	3.7	395	14
Sparse Treed	5,281	6.8	479	9.0
TOTAL	41,899	54	4,839	11

The area of upland ecosystems lost during the clearing of the 30 m right-of-way for the all season road will be approximately 518 ha, which equals approximately 0.7 % of the upland habitats in the transportation corridor LSA. The area of upland ecosystems lost during the clearing of the quarry and borrow sites will be approximately 4,839 ha, which equals approximately 11 % of the upland habitats in the transportation corridor LSA.

No direct loss of vegetation will occur during the construction of the trans-load facility as the infrastructure will be placed within an already disturbed site. The transmission line to the trans-load facility will be constructed along a previously disturbed corridor and minimal clearing of vegetation will be required. The access road to the trans-load facility will be upgraded, however, minimal clearing of vegetation will be required.

Indirect changes to vegetation in upland ecosystems are possible, but this loss would be limited to a few cases and will not occur at a large scale. Indirect changes to upland habitats that could occur as a result of the Project include changes to surface drainage, erosion, and snow accumulation patterns.

Proposed Mitigation Measures

The design and layout of the infrastructure was developed to avoid ecologically sensitive areas and minimize the amount of vegetation removal required. Disturbance to the vegetation communities will be generally limited to the areas necessary for the development of the mine site and the transportation corridor. Standard construction best practices will be used during the site preparation and construction phase to reduce the potential negative interactions with the environment. Progressive reclamation of disturbed lands will be executed, where appropriate. When clearing occurs, overburden and topsoil will be stockpiled and subsequently used as a source for rehabilitation/restoration of vegetative species.

The majority of vegetation removal in upland ecosystems will occur during the development of borrow and quarry sites. At the end of the construction phase, borrow sites will be rehabilitated to minimize the duration of the disturbance. Some of the quarry sites will be used through operations for road maintenance. At closure, all developed areas will be rehabilitated as outlined in the Conceptual Closure and Rehabilitation Plan (Volume 4, Section 6).

A number of measures will be used to reduce the effect of the installation of the transmission line and upgrading of site roads to the trans-load facility, to including:

- Not grading or stripping within the corridor
- Stabilizing of disturbed soil to assist in the regrowth of vegetation and to control erosion
- Hand-clearing of vegetation where appropriate to minimize soil disturbance

6.7.4.2 Physical Loss or Alteration of Vegetation - Wetland Ecosystems

Potential Effects

The Project will interact with wetland ecosystems during the development of the mine site and transportation corridor. The primary effect will be the physical loss of wetland ecosystems due to site clearing. In addition, road construction has the potential to have an indirect effect on a variety of ecosystem attributes, including biodiversity on adjacent wetlands up to 1 or 2 km from the road. Although such indirect effects are more linked to increases in road density in already developed areas and can take several years to decades to be measureable (Findlay and Bourdages, 2000).

The direct loss of vegetation in wetland ecosystems within the mine site PDA and LSA was computed using the FNLC database and is shown in Table 6.7-7.

Table 6.7-7 Quantifiable Loss of Wetlands at the Mine Site

FNLC Category	Area Within Mine Site LSA (ha)	Percent of Mine Site LSA (%)	Area Within Mine Site PDA (ha)	Percent of Wetland in Mine Site LSA Lost (%)
Clear Open Water	77	4.0	0	
Coniferous Swamp	8.3	0.43	0	**0**
Open Bog	115	5.9	0	**0**
Sparse Treed Fen	473	24	7.46	**1.6**
Thicket Swamp	21	1.1	0	
Treed Bog	260	13	1.62	**0.62**
Treed Peatland	408	21	8.68	**2.1**
TOTAL	1,362	70	18	**1.3**

The area of wetland ecosystems lost at the mine site will be approximately 18 ha, which equals approximately 1.3 % of the wetland habitats in the mine site LSA.

The direct loss of vegetation in wetland ecosystems within the transportation corridor right of way and for quarry and borrow sites was computed using the FNLC database and is shown in Table 6.7-8 and Table 6.7-9.

Table 6.7-8 Quantifiable Loss of Wetlands along the All-season Road Right-of-Way

FNLC Category	Area Within Transportation Corridor LSA (ha)	Percent of Transportation Corridor LSA (%)	Area Within All-Season Road PDA (ha)	Percent of Wetland in Transportation Corridor LSA Lost (%)
Clear Open Water	6,240	8.0	22	0.35
Coniferous Swamp	7,187	9.2	86	1.2
Open Bog	6,124	7.9	52	0.85
Open Fen	590	0.76	5.5	0.93
Sparse Treed Fen	3,900	5.0	37	0.95
Thicket Swamp	874	1.1	6.5	0.74
Treed Bog	6,056	7.8	70	1.2
Treed Peatland	4,707	6.0	48	1.0
TOTAL	35,678	46	327	**0.9**

Table 6.7-9 Quantifiable Loss of Wetlands at Borrow and Quarry Sites

FNLC Category	Area Within Transportation Corridor LSA (ha)	Percent of Transportation Corridor LSA (%)	Area Within Borrow and Quarry PDA (ha)	Percent of Upland Habitat Lost in LSA (%)
Clear Open Water	6,240	8.0	0	**0**
Coniferous Swamp	7,187	9.2	333	**4.6**
Open Bog	6,124	7.9	202	**3.3**
Open Fen	590	0.76	9.8	**1.7**
Sparse Treed Fen	3,900	5.0	187	**4.8**
Thicket Swamp	874	1.1	27	**3.1**
Treed Bog	6,056	7.8	276	**4.5**
Treed Peatland	4,707	6.0	340	**7.2**
TOTAL	35,678	46	1,375	**3.8**

The area of wetland ecosystems lost during the clearing of the 30 m right-of-way for the all season road will be approximately 327 ha, which equals approximately 0.9 % of the upland habitats in the transportation corridor LSA. The area of upland ecosystems lost during the clearing of the quarry and borrow sites will be approximately 1,375 ha, which equals approximately 3.8 % of the upland habitats in the transportation corridor LSA.

There will be no physical loss or alteration to wetland ecosystems during the construction or operation of the trans-load facility.

Proposed Mitigation Measures

The design and layout of the infrastructure was developed to avoid ecologically sensitive wetland areas and minimize the environmental effects and because construction of infrastructure in wetland ecosystems is more technically challenging. Disturbance to wetland ecosystems will be limited to the areas necessary for the development of the mine site and the transportation corridor. The transportation corridor alignment was chosen to avoid wetland ecosystems as much as possible.

The majority of physical loss to wetlands will occur during the development of borrow and quarry sites. However, the wetland area lost at borrows and quarry sites was estimated using the FNLC data. The borrow sites were selected based on field observation and are all generally located in upland ecosystems. As such, it is possible the FNLC data overestimate the area of wetlands to be lost during the development of the borrow and quarry sites.

At the end of the construction phase, borrow sites in wetland ecosystems will be rehabilitated to minimize the duration of the disturbance. Some of the quarry sites will be used through operations for road maintenance. At closure, all developed areas will be rehabilitated as outlined in the Conceptual Closure and Rehabilitation Plan (Volume 4, Section 6).

6.7.4.3 Physical Loss or Alteration of Vegetation - Rare Plant Species

Potential Effects

No rare plant species were identified during baseline studies, however, rare plants may be destroyed and rare plant habitat may be removed during construction. The potential loss of rare plants will occur within the PDAs. As such, the potential loss of rare plants will be limited in extent. Indirect changes to rare plants species and vegetation health are possible, but this loss would be limited to a few cases and are not expected to occur at a large scale.

Proposed Mitigation Measures

The potential loss of rare plants will be minimized by minimizing the extent of the Project footprint as much as possible. It is assumed that the loss of rare plant species will be minimal to negligible as none were identified during baseline studies.

6.7.4.4 Dust Deposition

Potential Effects

The emission and deposition of Dust (TSP) will occur during construction, operation and decommissioning phases of the Project. Dust will be transported downwind and deposited according to local atmospheric conditions and particle size. The effects of dust on vegetation will depend on the type of dust, the deposition load and the type of exposure. For example, dust can physically inhibit plant function and/or plants can uptake metals in dust either directly through tissue or via roots in the soil. The direct effects of dust on vegetation included decreased chlorophyll and photosynthesis (Spatt and Miller, 1981) and blocking or covering the stomata, resulting in physical inhibition to function (Walker and Everett, 1987). This can result in reduced growth and a decrease in the overall health of the plant.

The predicted total suspended particulate (TSP) emissions were evaluated under worse case emissions and meteorological conditions and are presented in the air quality modelling results (Technical Supporting Document 2).

- **Mine Site Construction and Operations** - Construction activities and use of site roads at the mine site will generate dust. Concentrate storage and transfer to haul trucks will inside of buildings at the mine site and not expected to generate any significant dust emissions.
- **Road Construction and Operation** - The all-season road will receive heavy use during the construction phase. During the operations phase of the Project, the road will be used to transport fuel, concentrate, supplies, equipment, and workforces with projected traffic volumes of 12 round-trip truck-loads per day (based on multiple drivers and 24 hour operation).
- **Trans-load Facility** - The trans-load facility will be located on a brownfield site and limited new ground disturbance will be required during construction.

During operations, the trans-load facility will be used to transfer concentrate from the trucks to storage bins within the load-out building. The concentrate will be delivered in an enclosed transfer system to the rail cars. Dust collection systems will be provided at all concentrate handling points. The footprint of the trans-load facility will be covered with asphalt in order to reduce dust emissions. Thus, there is minimal potential for airborne dust and emissions from vehicle traffic and ore handling at the trans-load facility. A detailed account of the effects from dust and emissions is provided in the assessment of air quality effects in Section 6.1.

Proposed Mitigation Measures

Mitigation techniques for reducing fugitive dust and other air contaminants that may arise from construction/ground disturbance activities, concentrate handling, vehicle use on the mine site roads and all-season access road include:

- Enclosing concentrate handling facilities
- Enforced traffic speed limits on roads
- Use of dust suppressants on roads
- Dust collection systems

Fugitive concentrate dust at both the mine site trans-load facility will be managed by carrying out truck loading and unloading indoors and equipping concentrate handling equipment with dust collectors. At the trans-load facility, any material trapped by the dust collector will re-enter the process flow in a controlled manner by a rotary valve. The bucket elevator will transport material from the screw conveyors and discharge to an elevated 800 tonne storage bin. The storage bin will in turn load the hopper rail cars by gravity feed and a dust controlling loading spout system. The above dust management techniques will mitigate the potential of fugitive concentrate dust escaping into the environment during the handling process.

6.7.4.5 Introduction of Invasive Plant Species

Invasive plant species are species whose rapid establishment and spread can adversely affect ecosystems, habitats and/or other species (Haber, 1997). A total of 441 invasive species (inclusive of aquatic and terrestrial species) have been identified in Ontario, more than any other province in Canada (MNR, 2012). Ontario has been and will continue to be susceptible to invasive species arriving and surviving due to:

- The favourable environmental conditions
- The nature of Ontario`s industrial, urbanized and globally mobile and high population density society
- The large quantities of imports
- The proximity of Ontario to a major international shipping channel, the Great Lakes - St. Lawrence Seaway and multiple land and water entry points on Ontario's borders
- The degraded habitat and ecosystems in many of Ontario's ecological regions

The construction and operation of the Project has the potential to introduce non-native plant species and disrupt native plant communities. The disturbance associated with construction activities can create the type of habitat preferred by invasive plant species (Mack et al., 2000). In addition, the development and use of the transportation corridor can also lead to the introduction and invasion of non-native plant species. The main contributor to the introduction of invasive and noxious weeds is human transport (Mack et al. 2000). For example, vehicles and machinery can serve as dispersal mechanisms for plant seeds and/or vegetative parts that can get lodged in tires, the undercarriage, or dirt on the surface of the vehicle. Non-native invasive plant species, or weeds, can alter nutrient cycling, competition, and the energy budget of an ecosystem. This can lead to a decrease in native plant community structure and species diversity (Jager et al. 2009), and lower native species survival and abundance (Mack et al. 2000).

Proposed Mitigation Measures

Preventing the initial establishment of invasive plants is the most effective method for control (Polster, 2005). To mitigate the transport and introduction of non-native plant species into native plant communities, the following mitigation measures will be implemented by the Project:

- Construction equipment will be cleaned prior to using the equipment on the road or at the mine site to remove soils from other work sites
- Local soil and rock material will be used as fill
- Allowing terrestrial habitats to re-vegetate naturally, unless it is determined during progressive rehabilitation that re-seeding with native species is preferable and can be accomplished without introducing invasive, non-native plant species
- Establishing a program for invasive plant detection, control, and removal as part of Noront`s proposed facility-level biodiversity management plan (Volume 4, Section 11).

Noront believes this is a subject that will require further discussion and guidance from the MNR as part of the province`s invasive species strategy (MNR, 2012). Noront is committed to monitoring for invasive species as part of its future biodiversity management plan and communicating its findings with the MNR.

6.7.5 Potential Residual Effect and Determination of Significance

The physical loss or alteration to vegetation and the deposition of dust are considered to be residual effects that cannot be completely mitigated. The relative significance of the residual effect was evaluated based on standardized assessment criteria including: magnitude, geographical extent, duration, frequency, reversibility, context, and probability of occurrence, as defined for upland ecosystems, wetland ecosystems and rare plant species (*CEA Agency* 1992; amended in 2010) (Table 6.7-10).

Table 6.7-10 Criteria for Assessment the Significance of Residual Effects on Vegetation

Criteria	Rating	Definitions
Magnitude	Low	Predicted effects on upland ecosystems, wetland ecosystems and rare plant species are within the natural baseline variability
	Medium	Predicted effects on upland ecosystems, wetland ecosystems and rare plant species not within the natural baseline variability but do not exceed any applicable regulatory thresholds
	High	Predicted effects on upland ecosystems, wetland ecosystems and rare plant species are not within the natural baseline variability and exceed any applicable regulatory thresholds
Geographical Extent	Local	Within the LSA as defined for upland ecosystems, wetland ecosystems and rare plant species
	Regional	Within RSA as defined for upland ecosystems, wetland ecosystems and rare plant species
Duration	Short Term	Up to 3 years (e.g., the construction phase)
	Medium Term	Life of Project (11 years)
	Long Term	Beyond the life of the Project, or permanent

Criteria	Rating	Definitions
Frequency	Infrequent	Occurs occasionally
	Frequent	Occurs often or continuously
Reversibility	Reversible	Pre-Project conditions will return following the cessation of the potential residual effect
	Irreversible	Pre-Project conditions will not return following the cessation of the potential residual effect
Context	Low resilience	The VEC has low resilience to imposed stresses, or will not easily adapt to the effect
	High resilience	The VEC has a high resilience to imposed stresses, or will easily adapt to the effect
Likelihood	Low	Low probability that the predicted effect will occur
	High	High probability that the predicted effect will occur
Significance	Not Significant	Defined by VEC discipline
	Significant	Defined by VEC discipline

Ratings were assigned to the residual effect of physical loss and alteration of vegetation and the deposition of dust (Table 6.7-11.)

Table 6.7-11 Significance of Residual Effects on Vegetation

Residual Effect	Predicted Degree of Effect After Mitigation Measures								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Physical loss or alteration of vegetation	Adverse	Med	Localized	Long Term	Infrequent	Reversible	High Resilience	High	Not Significant
Deposition of dust on vegetation	Adverse	Med	Localized	Long Term	Frequent	Reversible	Low Resilience	High	Not Significant

Significance of Physical Loss or Alteration

The residual effect from the physical loss or alteration of vegetation will be confined to the Project footprint within the mine site and transportation corridor PDAs. The Project footprint will require the clearing of a small percentage of the upland and wetland ecosystems in the LSA and represents a negligible percentage of the ecosystems in the RSA.

The removal of vegetation in will occur during the construction phase of the Project. At the end of the construction phase, all of the borrow sites and a majority of the quarry sites will be rehabilitated. The effect will persist through operations at the mine site and in the transportation corridor. At closure, all developed areas will be actively graded, replanted, reseeded, as outlined in the Conceptual Closure and Rehabilitation Plan (Volume 4, Section 6).

The effect of vegetation loss is anticipated to be reversible but the return to pre-Project conditions is expected to extend beyond the life of the Project. Ecosystems in the LSA are considered to have a high resilience as natural disturbances in the Ontario Shield Ecozone from forest fires are part of the natural ecosystem cycles. Through the rehabilitation at closure, the residual effects on upland and wetland ecosystems are considered to be of low significance.

Significance of Dust Deposition

The deposition of dust and emissions on vegetation is considered to be an adverse effect, with low magnitude, is long term in duration and will occur frequently throughout the life of the Project. Because this effect is localized and is reversible once the project is complete, the residual effect is considered to be of low significance. With the implementation of mitigation measures, the residual effects of dust deposition on upland ecosystems, wetland ecosystems, and rare plant species are expected to be not significant.

The residual effect of the Project on vegetation is considered not significant as the effects will be localized. Confidence in this prediction is moderate (Table 6.7-12).

Table 6.7-12 Summary of Residual Effects after Mitigation Measures for Vegetation

Potential Residual Effects	Direction	Significance	Level of Confidence
Physical loss or alteration of vegetation	Adverse	Not significant	Moderate
Deposition of dust on vegetation	Adverse	Not significant	Moderate

6.8 WILDLIFE

6.8.1 Introduction

The proposed Project has the potential to interact with many groups of wildlife including birds, mammals and species at risk. This section provides an assessment of potential Project effects on these groups of wildlife during each phase of the Project. The effects of the Project during construction and operations are considered together, since the removal and alteration of habitat during construction will not be reversed until the closure phase when the site decommissioning commences. Effects during the construction and operation phases are assumed to be similar.

This assessment also includes proposed mitigation to reduce Project effects on wildlife. The assessment focuses on issues related to the listed above that are considered within the Project's area of disturbance and within the larger Local Study Area (LSA).

6.8.2 Regional Setting

The Project lies within the Ontario Shield Ecozone. The mine site is located in the Big Trout Lake Ecoregion (2W-2), the transportation corridor is located in the Big Trout Lake Ecoregion and the Lake Nipigon Ecoregion. The trans-load facility is located in the Lake Nipigon Ecoregion.

In the Big Trout Lake Ecoregion, sparse forest covers approximately 21.4 % of the ecosystem. Coniferous and mixed forests grow on 19.4 % and 8.4 % of the area, respectively, and small pockets of deciduous forest grow along river valleys. More than 30 % of the ecoregion is covered by various types of wetlands, including 12.1 % water and 9.1 % treed bog. Burns occupy 8.1 % of the ecoregion, which is the highest percentage in Ontario (MNR, 2009).

In the Lake Nipigon Ecoregion, the most common landcover type is mixed forest (23.5 %), followed by coniferous forest (23.0 %), water (17.1 %), sparse forest (15.1 %), deciduous forest (9.0 %), and cutovers (5.7 %). Deciduous forest fire cycles range between 70 and 210 years, and fires tend to be variable in intensity. Jack pine forest fire cycles are somewhat shorter, between 50 and 187 years. Growing season moisture deficits compounded by shallow substrates result in an intense fire regime characterized by relatively frequent and large fires (MNR, 2009).

6.8.3 Rationale for VEC Selection

Furbearers and carnivores have ecological, cultural, recreational and commercial value as they provide revenue to local trappers and constitute a fundamental role in terrestrial ecosystem functioning. The key indicators selected to assess harvested furbearers and carnivores are habitat loss or fragmentation, displacement due to human activities and direct losses of wildlife as outlined in Table 6.8-1.

Table 6.8-1 Wildlife VEC Selection Rationale

Candidate VEC	Key Indicator(s)	Rationale for VEC Selection or Exclusion
Bird species of conservation concern (Bird SCC)	Loss of habitat of Canada Warbler, Common Nighthawk, Olive-sided Flycatcher, Rusty Blackbird, Yellow Rail, Short-eared owl, Peregrine Falcon, Barn Swallow, Bald Eagle, Golden Eagle, Black Tern Indicator species include Ovenbird and Tennessee Warbler	Threatened and Endangered species are legally protected under the ESA or SARA. Species at Risk (SAR) are of biodiversity concern. Potential impacts from the project include: loss of available habitat from the potential development area; sensory disturbance from mine related activities; and mortality due to increased collisions with vehicles and other infrastructure
Waterfowl	Loss of high value habitat of waterfowl	Waterfowl are harvested by local communities. Potential impacts from the project include: loss of available habitat from the Project development area; sensory disturbance from mine related activities; and mortality due to increased collisions with vehicles and other infrastructure
Furbearers	Loss of furbearer habitat	Effects of the Project on furbearer species not expected to be measurable. Effects to harvesting discussed under Aboriginal Resource and Land Use
Carnivores	Wolves, Black Bear, Fox: loss of habitat of carnivores; number of encounters with humans	MNR concern, especially surrounding the interactions with nuisance animals
Moose	Loss of high value moose habitat; mortality due to vehicle collisions and harvesting	Aboriginal concern; important species regularly harvested by local communities
Wolverine	Loss of high value wolverine habitat; mortality due to vehicle collisions and harvesting	Biodiversity concern, provincially and federally
Woodland Caribou	Loss of high value caribou habitat; mortality due to vehicle collisions and harvesting	Biodiversity concern; important species regularly harvested by local communities

Bird Species of Conservation Concern

As shown in Table 6.8-1, there are eleven at risk bird species that are likely to occur within the RSA. These species have a potential to be affected by the Project development. The eleven birds SAR include:

- Canada Warbler
- Peregrine Falcon
- Common Nighthawk
- Short-eared Owl
- Olive-sided Flycatcher
- Barn Swallow
- Black Tern
- Yellow Rail
- Bald Eagle
- Golden Eagle
- Rusty Blackbird

Three bird SAR were observed within the mine site LSA: Common Nighthawk, Olive-sided Flycatcher and Rusty Blackbird. Three other bird SAR were observed within the RSA: Bald Eagle, Canada Warbler and Peregrine Falcon.

The Ovenbird and Tennessee Warbler were selected as indicator species to predict and monitor Project related effects to SAR and other local bird species.

Waterfowl

Within the RSA there is a large quantity of suitable habitat for waterfowl. There are countless lakes, ponds, rivers and wetlands that provide suitable feeding and nesting habitat for a variety of waterfowl species. There were 20 waterfowl species observed during the course of the baseline investigations within the RSA. Of these 20 species observed only one species, Canada Goose, was observed at the mine site; however, incidental observations of other waterfowl species were made at the Muketei River. The following is a list of waterfowl species observed within the RSA:

- American Wigeon
- Blue-winged Teal
- Brandt
- Bufflehead
- Canada Goose
- Common Goldeneye
- Common Loon
- Common Merganser
- Lesser Scaup
- Greater Scaup
- Green-winged Teal
- Long-tailed Duck
- Mallard
- Merganser spp.
- Northern Pintail
- Red-breasted Merganser
- Ring-necked Duck
- Snow Goose
- Tundra Swan
- White-winged Scoter

Furbearers

Local furbearers include Beaver (*Castor canadensis*), Muskrat (*Ondatra zibethicus*), Snowshoe Hare (*Lepus americanus*), Fisher (*Martes pennanti*), Marten (*Martes americana*), Lynx (*Lynx canadensis*) and Red Fox (*Vulpes vulpes*). Most furbearers tend to be concentrated along the watercourses, either because they are directly associated with water habitats (e.g., Beaver and Muskrat) or because they prefer forest and forest/shrubland habitats which border the creeks and rivers (e.g., Marten, Lynx, and Red Fox).

Carnivores

The Gray Wolf (*Canis* lupus) and Black Bear (*Ursus americanus*) are the largest carnivores within the RSA and occur at low densities. They live within the RSA during the entire year and likely have active den sites every year. None of the local carnivores are designated as being of conservation concern. It is estimated that few carnivores are harvest each year. Wolf numbers are generally dependant on ungulate abundance (e.g., moose and woodland caribou), so any effects from the Project will likely be not significant compared to the main effect of carnivore response to the predator-prey relationship.

Moose

Moose (*Alces alces*) are the largest ungulate species in Ontario and rely on a mixture of young and mature forests for shelter, and wetland habitats for food (i.e., aquatic plants). Moose populations grow relatively slowly. Although many wildlife species will reproduce rapidly when suitable habitat conditions exist, in some species such as moose, the numbers increase much more gradually. Moose comprise a critical resource to First Nation hunters as a supply of meat and hides. Hunting is also an important cultural pursuit of First Nation peoples.

Wolverine

The Wolverine (*Gulo gulo*) can be found primarily in remote reaches of the Northern boreal forests and subarctic and alpine tundra of the Northern Hemisphere. Wolverines are solitary animals that generally have a low population density and require a very large home range. The Wolverine is a powerful and versatile predator and scavenger. Prey mainly consists of small to large-sized mammals. Wolverine prey species within the RSA include Beavers, Snowshoe Hare, Martens, Foxes, Lynx, Moose and Woodland Caribou. The Wolverine is protected under Ontario's Endangered Species Act and also receives protection under the Ontario Fish and Wildlife Conservation Act.

Woodland Caribou

There are two distinct populations of woodland caribou in Ontario. The forest-dwelling woodland caribou lives in the boreal forest all year. The forest-tundra woodland caribou lives on the tundra during the spring and summer and moves into the boreal forest for the rest of the year. Only the forest-dwelling woodland caribou is listed as a species at risk in Ontario and are the population living within the RSA. Caribou are well-adapted for life in boreal regions. They have thick coats to help them survive cold winters and large rounded hooves that let them dig for food and walk easily on snow and soft ground such as peat lands.

6.8.4 Applicable Guidance

Protection measures for wildlife within Canada and those species residing within Ontario have been built into various environmental legislations including:

- Ontario's *Fish and Wildlife Conservation Act* (1997)
- Canada's *Migratory Birds Convention Act* (1994)
- Ontario's *Endangered Species Act* (2007)
  - Committee on the Status of Species at Risk in Ontario (COSSARO)
- Canada's *Species at Risk Act (SARA)* (2002)

A summary of the applicable guidance listed above for the wildlife species potentially affected by the Project are provided below. Additional information regarding these guidelines and baseline studies can be found in the Technical Supporting Documents.

Fish and Wildlife Conservation Act (FWC Act)

Administered by the Ministry of Natural Resources (MNR), the *Fish and Wildlife Conservation Act (*FWC Act) governs the lawful hunting and trapping of wildlife (mammals, birds, reptiles, and amphibians) and fish in the province of Ontario and, ultimately, facilitates the conservation and protection of wildlife and the environment they inhabit.

The FWC Act outlines the prohibition of hunting or trapping specially protected species and the requirement for provincially issued licenses for the hunting or trapping of specific animals, birds, reptiles and amphibians. Despite the requirements for a licence to hunt or trap, a farmer is permitted on his own land to hunt or trap some game or furbearing mammals, reptiles or game amphibians without a license during "open season" which is from September 1 through June 30 of the following year.

Dealings with animals and their habitats are detailed in the FWC Act. Specific examples include black bears and their dens (forbidden to intentionally damage or destroy), beaver dams (forbidden to destroy unless the dam threatens one's property), nests and eggs (forbidden to destroy, take or possess the nests or eggs with the exception of specific birds – crows, grackles, cowbirds, sparrows, starlings, and red-winged blackbirds). Hunting, trapping or possessing wildlife or possessing hunting or trapping equipment within a provincial park or Crown game preserve is prohibited unless authorized to do so.

The FWC Act also prohibits the obstruction of legal hunting, trapping or fishing. Specifically, a person shall not interfere with lawful hunting, trapping or fishing by,

- Tampering with traps, nets, bait, firearms or any other thing used for hunting, trapping or fishing
- Placing himself or herself in a position, for the purpose of interfering, that hinders or prevents hunting, trapping or fishing
- Engaging in an activity, for the purpose of interfering, that disturbs or is likely to disturb wildlife or fish

The FWC Act details methods and prohibitions that are in place to address safety. Required safety clothing, restrictions on night hunting, prohibitions against carrying loaded hunting firearms, prohibitions against "body-gripping" (i.e., leg hold) traps, poisons and adhesives when hunting, and restrictions on the use of birds of prey, ferrets and, in specific cases, dogs for hunting are some of the areas addressed by the FWC Act.

The FWC Act provides exceptions to hunting license requirements when considering the protection of one's own property from damage caused by certain species of wildlife. The FWC Act permits a property owner to capture, kill or harass wildlife, excluding white-tailed deer (which requires authorization from the MNR) moose, caribou, elk, and endangered species, to protect the person's property, provided the owner has reasonable grounds to believe that the wildlife has damaged or is about to damage their property.

No person shall keep live game wildlife or live specially protected wildlife in captivity except under the authority of a license, with the following exceptions:

- A person who keeps game amphibians or game reptiles in captivity for the purpose of personal consumption
- A person who keeps in captivity for the purpose of personal education a single game reptile, game amphibian, specially protected mammal, specially protected reptile, specially protected amphibian or specially protected invertebrate, unless it is listed on an endangered species list
- A person who keeps game wildlife or specially protected wildlife in captivity for any educational or scientific purpose, or for any other purpose, if the person has the authorization of the Minister

Enforcement of the FWC Act is overseen by conservation officers appointed by the MNR and also, by virtue of their office, any of the following:

- First Nations Constables
- Royal Canadian Mounted Police (RCMP)
- Game Officers appointed under the federal Migratory Birds Convention Act
- Parks Wardens designated under the federal National Parks Act (2000)
- Conservation Officers from neighbouring provincial or state jurisdictions if acting under the direction of an appointed provincial Conservation Officer

Migratory Birds Convention Act

Administered by the Canadian Wildlife Service, the *Migratory Birds Convention Act*, 1994 (MBCA) provides protection to most species of birds in Canada. Those species that are not protected under the MBCA may receive protection under provincial or federal legislation, such as the SARA, ESA or the FWC Act. The MBCA crosses provincial and international boundaries and protects migratory birds in Canada and the United States.

As indicated in the 1995 Protocol the MBCA enforces the commitment made by both countries to ensure:

"…long-term conservation of shared species of migratory birds for their nutritional, social, cultural, spiritual, ecological, economic, and aesthetic values through a more comprehensive international framework that involves working together to cooperatively manage their populations, regulate their take, protect the lands and waters on which they depend..."

The MBCA addresses hunting, as well as other activities related to migratory birds, including:

- Sale, gift or purchase
- Shipment
- Aviculture
- Taxidermy
- Activities involving birds causing damage or danger (e.g., agriculture)
- Activities involving overabundant species
- Activities at airports
- Activities for scientific research purposes
- Collection, possession, sale or trade of eiderdown
- Import of migratory bird species that are not indigenous to Canada

The Regulations ban all activities that are harmful to migratory birds, their eggs or their nests. However, some activities, such as hunting, may be practiced with the appropriate permit. Applicable regulations under the MBCA include:

- Migratory Birds Sanctuary Regulations
- Migratory Birds Regulations
- Migratory Birds Hunting Regulations (summaries)

Enforcement of the MBCA in Ontario is overseen by the following government agencies:

- Canadian Wildlife Services
- Ministry of Natural Resources
- Royal Canadian Mounted Police

Endangered Species Act

The endangered Species Act (ESA), 2007 provides protection to at risk species in Ontario. An independent body created under the ESA, the Committee on the Status of Species at Risk in Ontario (COSSARO), considers whether a plant or animal should be designated as at risk, and its status.

Plants and animals that are added to the Species at Risk in Ontario List as Endangered, Threatened or Extirpated species are automatically protected from being harmed or harassed. Those species listed as Special Concern are not included in this protection, but may be periodically reviewed for changes to their overall population. When species are listed as Endangered or Threatened, habitat that those species depend on either directly or indirectly for reproduction, rearing, hibernation, migration and feeding is automatically protected.

Recovery strategies and management plan are created by the MNR for Species at Risk in Ontario. The purpose of these documents is to restore populations of these species before they disappear. Recovery strategies are created by the MNR for Threatened and Endangered species. Management plans are prepared by the MNR for Special Concern species, unless a recovery strategy or management plan is required to be prepared for the species under the federal Species at Risk Act.

The Ministry of Natural Resources protects at-risk species and their habitat. Conservation Officers play a key role in enforcing the ESA. Under the act, a person may be ordered to stop an activity that could kill, harm, harass or have another prohibited impact on a protected species, or damage or destroy protected habitat. Additionally, a person who damages or destroys protected habitat may be ordered to take measures to rehabilitate the habitat.

Species at Risk Act

The Species at Risk Act, 2002 (SARA) was created to prevent wildlife species in Canada from becoming extirpated or extinct. The act protects species at risk and their critical habitats. SARA also contains provisions that help to ensure that species of special concern do not become endangered or extinct. An independent body created under the authority of SARA, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), is responsible for identifying and assessing species. COSEWIC's recommendations are then provided to the federal Cabinet and it is up to them to determine if that species is listed under the SARA.

Once a species becomes listed under the SARA it is illegal to kill, harass, capture or harm it in any way. Listed species are also afforded critical habitat protection from destruction. Recovery strategies, action plans and management plans are developed for all listed species.

Recovery Strategies, Action Plans and Management Plans are created for listed species. A recovery strategy is produced for each species added to the list. Recovery Plans are detailed plans that outline short-term objectives and long-term goals for protecting and recovering species at risk.

Recovery strategies include the following (DFO, 2013):

- Describe the particular species and its needs
- Identify threats
- Classify the species' critical habitat
- Provide examples of activities that are likely to result in destruction of the critical habitat
- Set goals, objectives and approaches for species recovery
- Identify information gaps that should be addressed
- State when one or more action plans relating to the strategy will be completed

Action plans are created as part of the Act's two-part recovery planning process. The Action plans are used to implement projects and activities to improve species status. They include information on habitat, protection measures and an evaluation of socio-economic costs and benefits.

Management plans are not species specific but rather focus on protecting one or more species that are particularly sensitive to environmental factors and are not yet considered in danger of becoming extinct.

The SARA is enforced by Environment Canada; aquatic species fall under the jurisdiction of Fisheries and Oceans Canada (DFO).

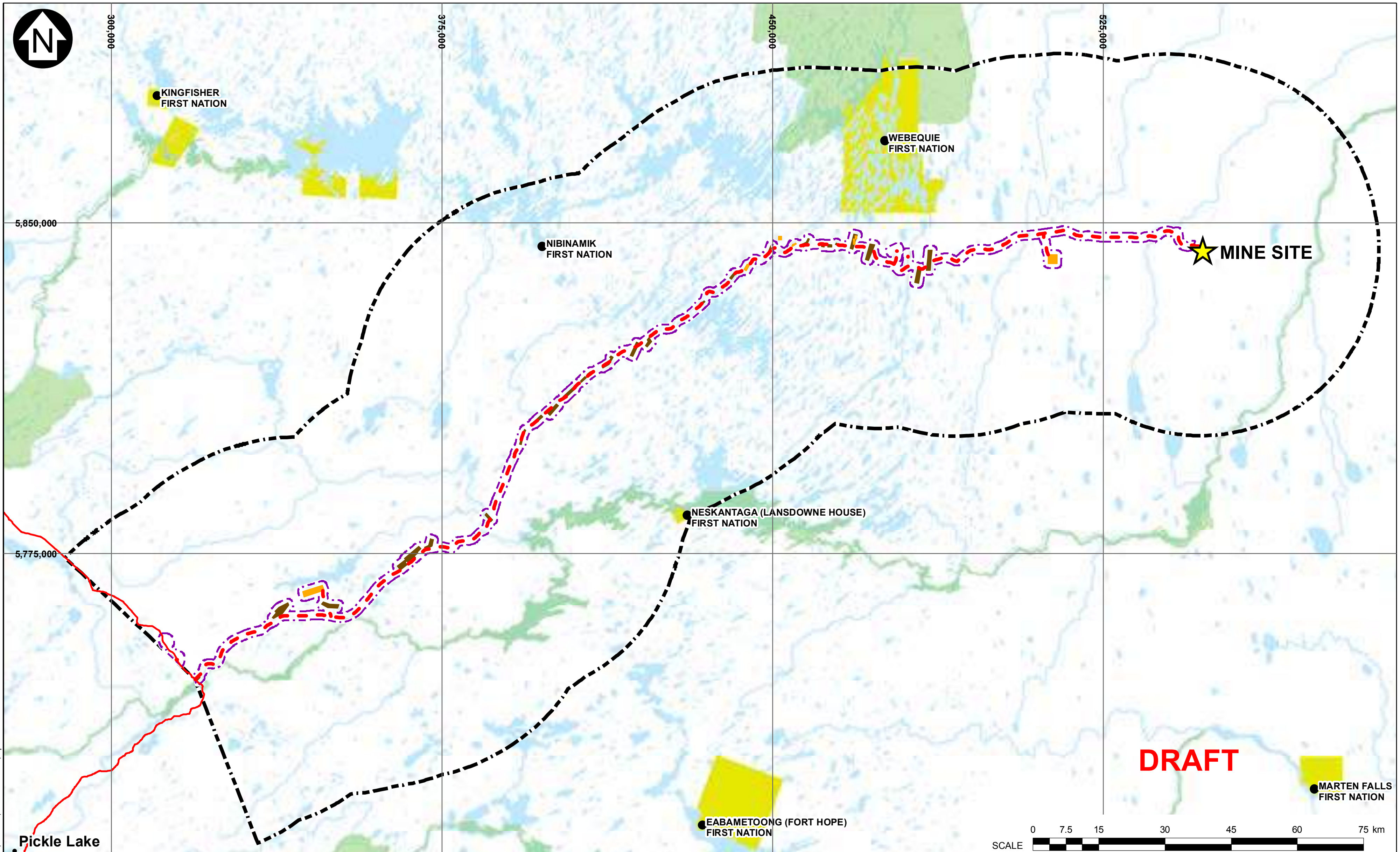
6.8.5 Assessment Boundaries

Regional Study Area for Wildlife

The Project will have the greatest potential impact to wildlife habitat (i.e., vegetation) during the development of the transportation corridor and construction of the mine site infrastructure. The regional study area for the baseline wildlife studies is approximately 2,533,000 ha (25,300 km^2), which was delineated using a 40 km buffer zone on either side of the propose all-season road alignment (Figure 6.8-1). The RSA was chosen based on three primary criteria as follows.

- ***Ecological Representation*** - The RSA area was determined to be representative of the variety of regional forest and wetland types, as well as natural disturbances (mainly fire) that occur in the Project region. Representation was evaluated by comparing the land cover composition of the RSA with the land cover composition of Ecodistricts 2W-2 and 2W 3, which together include more than 95 % of the RSA (Technical Supporting Document 18).

- ***Size*** - Research for the baseline study design confirmed the RSA is more than three times as large as the minimum area required (7,200 km^2) to sustain viable populations of two wide-ranging predators found in the RSA: wolves and black bears (Technical Supporting Document 18). By maintaining habitat for these focal species, the probability of maintaining habitat for other wildlife in the RSA is also high.



SAVED: I:\1102\00390\01\A\GIS\Figs\A579_rA.mxd; Dec 17, 2013 9:13 AM; spenfold

LEGEND:

- MINE SITE
- COMMUNITY
- EXISTING ALL-SEASON ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- RIVER/STREAM/DRAINAGE
- WATER
- PARK
- FIRST NATIONS RESERVE
- PROPOSED BORROW SOURCE
- PROPOSED QUARRY SOURCE
- TRANSPORTATION CORRIDOR REGIONAL STUDY AREA
- TRANSPORTATION CORRIDOR LOCAL STUDY AREA

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY KIEWIT INFRASTRUCTURE ENGINEERS (NOVEMBER 26, 2013).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	DKK	SWK	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

WILDLIFE REGIONAL AND LOCAL STUDY AREAS

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF NO. 34

FIGURE 6.8-1

REV A

- ***Ecological Integrity*** - The RSA has an extremely high level of ecological integrity with more than 95 % undisturbed by human activity. In addition, more than 95 % of the 20 km buffer area adjacent to the RSA has also not been significantly disturbed by human activity. The higher the integrity of the buffer area, the lower the probability is for species extinction within the RSA (Parks and Harcourt, 2002).

Local Study Area for Wildlife

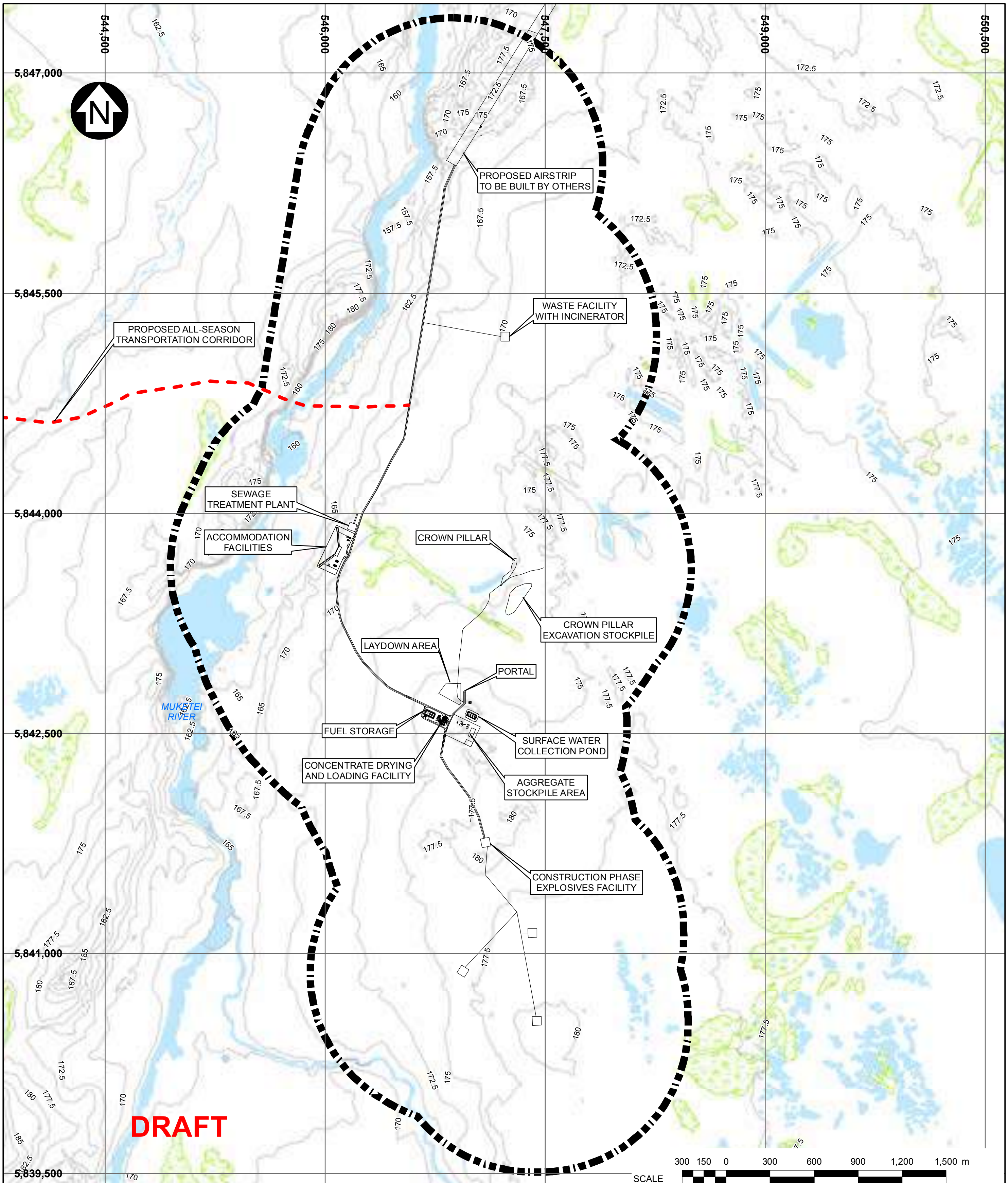
The LSA is the zone where there is reasonable potential for immediate interaction between Project components and the VECs and it is generally the potential development area (PDA), which includes the mine and associated infrastructure, with a buffer of varying distances, depending on the VECs. The baseline studies conducted in support of this effects assessment utilized a 1 km distance from the Project infrastructure as the outer boundary of the LSA (Technical Supporting Document 18). The mine site and transportation corridor LSAs are approximately 1,900 ha and 77,750 ha respectively. Within the LSA, the potential development areas include:

- **Mine Site PDA** - Encompasses the footprint of the mine site infrastructure (portal, laydown and stockpile areas, surface processing facilities, diesel generators, fuel storage area, accommodation facility, site roads, waste management facility etc.). The total land area occupied by the mine site PDA is approximately 33 ha (Figure 6.8-2).
- **Transportation Corridor PDA** - Encompasses the footprint of the road corridor right-of-way (30 m width), borrow sources, quarries and associated spur roads. The total land area occupied by the transportation corridor PDA is approximately 7,300 ha (Figure 6.8-1).
- **Trans-load Facility PDA** - Includes the footprint of the trans-load facility infrastructure. The total land area occupied by the trans-load facility PDA is approximately 1 ha (Figure 6.8-3).
- **Habitat Degradation Buffer** - A degradation buffer was also delineated for the assessment of Project related effects. The buffer is a 6.5 km zone offset from the edge of the PDA within the Project component LSAs. The largest area of degradation is associated with the proposed all-season road.

<u>Temporal Boundaries</u>

The temporal boundaries for the assessment are defined based on the timing and duration of Project activities that could induce effects to wildlife. Some of these species area are long-lived and the purpose of a temporal boundary is to identify when an effect may occur in relation to specific Project phases and activities. The current expected Project life is 16, with effects identified in reference to activities occurring in one or more of the Project phases:

- Construction (3 years)
- Operation (11 years)
- Closure (2 years)
- Post-closure (a minimum of 5 years)



LEGEND:

- MINE SITE
- PROPOSED INFRASTRUCTURE
- CONTOUR
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- MINE SITE LOCAL STUDY AREA

NOTES:

1. BASE MAP PROVIDED BY SNC-LAVALIN GROUP INC. (2010).
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 2.5 METRES.
4. INFRASTRUCTURE INFORMATION PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.
5. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY KIEWIT INFRASTRUCTURE ENGINEERS (NOVEMBER 26, 2013).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

MINE SITE
WILDLIFE LOCAL STUDY AREA

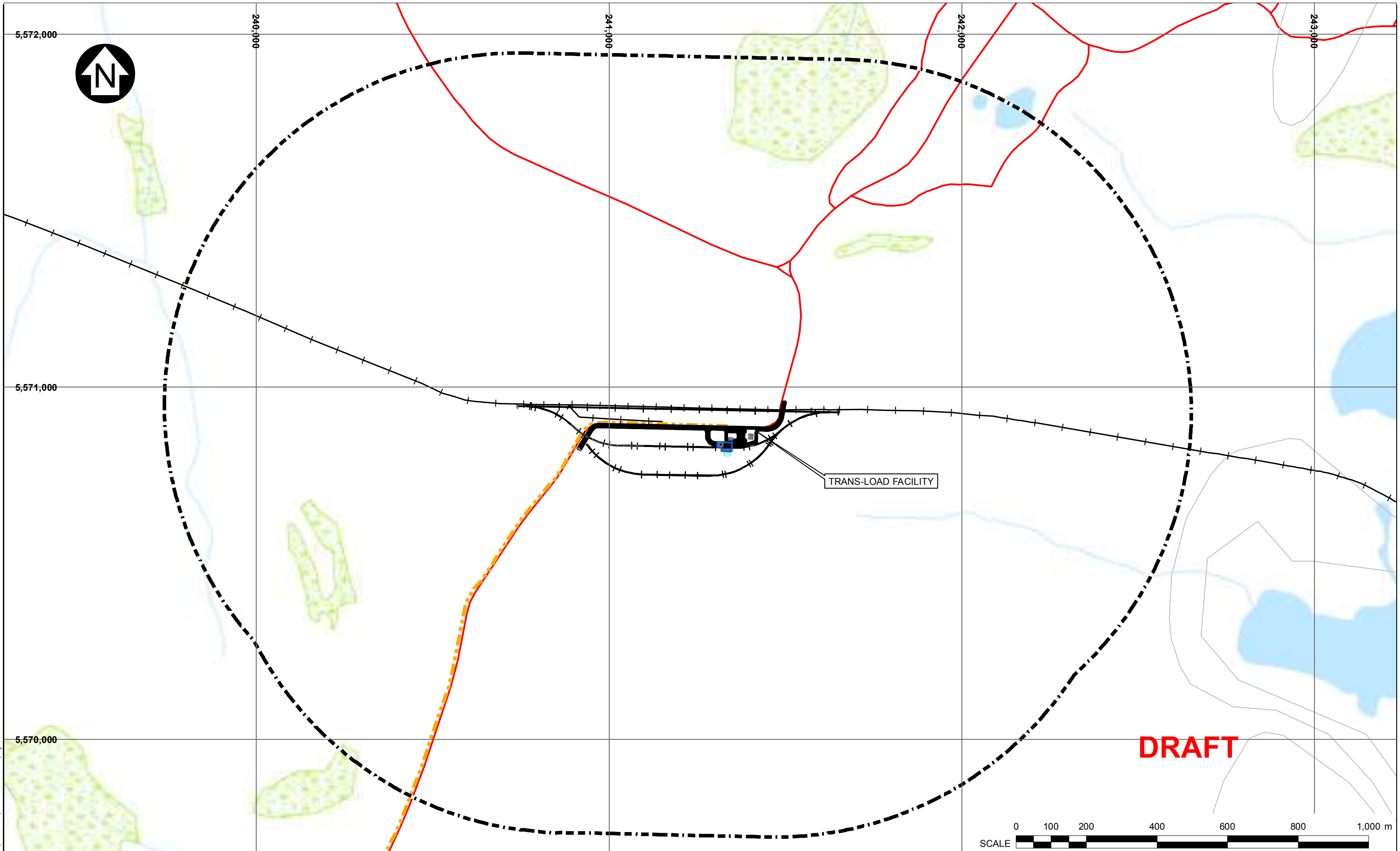
Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 6.8-2 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	DKK	SWK	SRA	RAM

SAVED: I:\102\00390\01\A\GIS\Figs\A581_rA.mxd; Dec 17, 2013 9:04 AM; spenfold



LEGEND:

- EXISTING ALL-SEASON ROAD
- RAILWAY
- PROPOSED HYDRO CORRIDOR
- PROPOSED INFRASTRUCTURE
- CONTOUR
- WETLAND
- SURFACE WATER COLLECTION POND
- TRANS-LOAD FACILITY LOCAL STUDY AREA

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES.
   COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 10 METRES.
4. INFRASTRUCTURE IS BASED ON INFORMATION PROVIDED BY TETRA TECH (APRIL 19, 2012).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

TRANS-LOAD FACILITY
WILDLIFE LOCAL STUDY AREA

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF NO. 34

FIGURE 6.8-3

REV A

A	20DEC'13	ISSUED WITH REPORT	DKK	SWK	SRA	RAM
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

SAVED: I:\1\02\00390\01\A\GIS\Figs\A582_rA.mxd; Dec 17, 2013 8:57 AM; spenfold

6.8.6 Potential Interactions and Effects

The Project includes the development and operation of an underground mine and associated surface infrastructure, an approximately 280 km all-season access road, and a trans-load facility on the existing rail line. The phases of the Project considered in the assessment are construction, operation, and decommissioning. Project components and activities that are identified as potentially interacting with wildlife are assessed for each Project component. When one activity or component is similar in timing, location, and scale, then the component or activity with the largest potential effect in assumed to encompass the other Project components or activities.

Spills of hazardous chemicals at the mine site or along the transportation corridor during construction or operations can affect wildlife and their habitat. Spills are considered to be accidental in nature and will result in unplanned effects. The effect of spills, mitigation measures, and spill response procedures are outlined in Section 8.3.

Potential interactions and impacts were divided into the following categories for discussion:

- **Direct Habitat Loss** - The surface footprint of the mine site will be minimized since most mine infrastructure will be located underground (e.g., mine facilities, workshops and maintenance facilities). Surface infrastructure will include roads, pads, a surface water management pond, accommodation facilities, temporary explosives storage and fuel storage area. These components will primarily be located in upland areas that will be cleared of existing vegetation. The removal of vegetation communities during site clearing for development will eliminate or alter some wildlife habitat.

  Transportation corridor right-of-way (ROW) includes clearing an area approximately 30 m wide to accommodate construction of an all-season road between the Pickle Lake North Road and the Mine Site. In addition to the all-season road, spur roads will be cleared to gain access to borrow and quarry aggregate sites along the route.

  The trans-load facility is a previously disturbed site, adjacent to an active rail line. Project related activities at the trans-load facility are not anticipated to effect local habitat.

- **Indirect Habitat Loss and Degradation** - Habitat can be indirectly lost or degraded due to sensory disturbances that change the amount of suitable habitats, and alter wildlife movement and behaviour (distribution). Examples of sensory disturbances include increased noise levels during construction and operations, as well as visual disturbances from moving vehicles and human intrusion throughout construction and operations. Wildlife may respond to such disturbances by reducing their use of certain areas or altering their movement patterns within an area (e.g., Bayne et al. 2008). Individuals may also respond to sensory disturbances by changing the timing of feeding activities and reducing the amount of time spent feeding. In some situations these behavioural changes can lead to a reduction in fitness (Harrington and Veitch 1992; Habib et al. 2006). Effects can vary and responses appear to be species-specific and seem to depend on the type of disturbance (e.g., visual, noise, smells), the frequency and intensity of the disturbance, and the level of habituation to disturbance (Bayne et al. 2008; Fahrig and Rytwinksi 2009).

  Light, noise and dust created by machinery used for site preparation and construction activities will initially displace some furbearers within the PDA. Noise will likely disturb wildlife more than dust. Some animals have historically been attracted to food waste from the exploration camps in the mine site area, which will likely continue to disrupt their daily activities when close to the accommodation facilities (e.g., Marten, Black Bear and Red Fox).

Similarly, construction camps along the transportation route will likely provide a food attractant to wildlife. The construction and operation of borrow and quarry sites along the route may create an additional source of noise and dust, affecting the daily activities of local wildlife.

The trans-load facility will have intermittent sensory disturbances associated with facility operations, ore hauling trucks and rail traffic. The trans-load facility area is a previously disturbed site, adjacent to an active rail line. Project related activities at the trans-load facility are not anticipated to change the existing amount of disturbance to local wildlife.

In summary, the predicted amount of sensor disturbances near the PDA during construction and operations could alter local wildlife behaviour (Section 6.2). Specific sensory disturbances regarding the assessed groups of wildlife have been discussed below.

- **Mortality** - Interactions between vehicles and wildlife (e.g., birds and mammals) are the most likely cause of wildlife mortality. The construction and operation phases will create traffic in the transportation corridor between the mine site and trans-load facility. Daily trips along this route increase the potential for collisions of vehicles with wildlife. Traffic speed and volume are the primary factors that contribute to road-related wildlife mortality. In addition, roads offer an easy travel route for some animals like moose, especially in the winter (Rost and Bailey, 1979).

  Wildlife mortality may also occur due to the predator road use hypothesis (Moffat, 2012). Wolves use linear features such as roads to quickly navigate their territory while targeting moose habitat near access roads (James & Stuart-Smith, 2000; Kunkel & Pletscher, 2000; Whittington, St. Clair, & Mercer, 2005). The efficiency gained by the wolves using roads in this manner is likely to increase the risk of predation on moose in the Project area.

- **Health** - A Project's effects on wildlife health are typically considered as it relates to potential contamination of forage. Contamination is generally associated with pathways for chemical exposure and uptake by plants as a result of dust and emissions from the Project. The construction, use and closure of the Project infrastructure will likely cause increased dust emissions, however, the roads will be constructed using inert aggregate and are not expected to contribute to chemical contamination. The aesthetic effects of dust settlement on vegetation within the degradation buffer may discourage herbivore browsing. Due to the proportionally small area within the buffer compared to the available habitat in the RSA the Project is not expected to affect wildlife health.

The above mechanisms of integration are listed with their Project component in Table 6.8-2. A description of the potential Project effects was compiled within this framework in Table 6.8-3. The general mitigation measures related to these effects are provided in Table 6.8-4.

Table 6.8-2 Interaction Summary for Wildlife

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Mine Site			
Ground Preparation (e.g., cut, fill, grub, etc.)	C	Yes	• Habitat loss (e.g., nests) • Sensory disturbance
Construction of surface infrastructure	C	Yes	• Sensory disturbance
Underground mine development, including de-watering	C	No	• An interaction is not anticipated since there are no pathways for interaction with wildlife
Underground mine operation	O	No	• An interaction is not anticipated since there are no pathways for interaction with wildlife
Underground ore processing and concentrate loading	O	No	• An interaction is not anticipated since there are no pathways for interaction with wildlife
Tailings production and underground disposal	O	No	• An interaction is not anticipated since there are no pathways for interaction with wildlife
Mining of crown pillar	O	Yes	• Habitat loss (e.g., nests) • Sensory disturbance
Aggregate production	C, O	Yes	• Habitat loss (initial clearing during construction) • Sensory disturbance
Aggregate and topsoil stockpiles	C, O	Yes	• Sensory disturbance
Construction of site roads	C	Yes	• Habitat loss • Sensory disturbance
Accommodation facility operation	C, O	Yes	• Sensory disturbance
Power plant operation	C, O	Yes	• Sensory disturbance
Fuel Storage and distribution	C, O	Yes	• Fuel spills
Equipment and vehicle use	C, O, CL	Yes	• Sensory disturbance • Direct loss (mortalities)
Explosives use, handling and storage	C, O	Yes	• Sensory disturbance during portal development in construction phase
Groundwater use for potable water and underground processing	C, O	No	• An interaction is not anticipated since there are no pathways for interaction with wildlife
Surface water management (non-contact water)	C, O, CL	No	• An interaction is not anticipated since there are no pathways for interaction with wildlife
Waste management: solid and sewage waste facilities	C, O, CL	Yes	• Sensory disturbance (potential attractants)
Hazardous materials handling and storage	C, O, CL	Yes	• Spills from hazardous waste • Direct loss (mortalities)
Closure of underground workings	CL	No	• An interaction is not anticipated since there are no pathways for interaction with wildlife
Closure of surface facilities, including portal	CL	Yes	• Sensory disturbance

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Scarification and reclamation	CL	Yes	• Sensory disturbance
Training Programs	C, O	No	• No pathways for interaction with wildlife
Mine Staffing	C, O, CL	No	• No pathways for interaction with wildlife
Procurement of goods and services	C, O, CL	No	• No pathways for interaction with wildlife
Transportation Corridor			
Ground preparation for road (e.g. cut, fill, grub, etc.)	C	Yes	• Habitat loss • Sensory disturbance
Aggregate: quarry/borrow site development	C, O	Yes	• Habitat loss • Sensory disturbance
Road construction (includes culvert, bridge installation)	C	Yes	• Habitat loss • Sensory disturbance
Road maintenance	O	Yes	• Habitat Loss (Barn swallow nesting in culverts/bridge structures) • Sensory disturbance
Equipment and vehicle use	C, O	Yes	• Sensory disturbance • Direct loss (mortalities)
Waste management	C	No	• No pathways for interaction with wildlife
Water management (non-contact water)	C, O	No	• No pathways for interaction with wildlife
Explosives use, handling and storage	C	Yes	• Sensory disturbance
Fuel Storage and distribution	C	Yes	• Fuel spills
Construction camps	C	Yes	• Sensory disturbance
Hazardous materials handling and storage	C, O	Yes	• Spills from hazardous waste • Direct loss (mortalities)
Employment	C, O	No	• No pathways for interaction with wildlife
Procurement of goods and services	C, O	No	• No pathways for interaction with wildlife
Decommissioning of road	CL	Yes	• Sensory disturbance
Trans-load Facility			
Ground preparation and site construction	C	Yes	• Sensory disturbance
Construction of rail siding	C	Yes	• Sensory disturbance
Construction of buildings and loading facility	C	Yes	• Sensory disturbance
Upgrading site access roads	C	Yes	• Sensory disturbance
Installation of transmission line within existing right of way	C	Yes	• Sensory disturbance
Waste management: solid and sewage waste facilities	C, O	Yes	• Sensory disturbance (potential attractant)
Water management (including surface water collection pond)	C, O	No	• No pathways for interaction with wildlife

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Water supply well	C, O	No	• No pathways for interaction with wildlife
Fuel Storage and distribution	C, O	Yes	• Fuel spills
Equipment and vehicle use	C, O	Yes	• Sensory disturbance (potential attractant) • Direct loss (mortalities)
Hazardous materials handling and storage	C, O	Yes	• Sensory disturbance (potential attractant) • Direct loss (mortalities)
Operation of concentrate loading facility	O	Yes	• Sensory disturbance (potential attractant)
Re-grading, ditching, and placement of asphalt	C	Yes	• Sensory disturbance (potential attractant)
Procurement of goods and services	C, O	No	• No pathways for interaction with wildlife
Closure of facility	CL	No	• No pathways for interaction with wildlife • Habitat Loss (Barn Swallow)

NOTES:

5. C - CONSTRUCTION, O - OPERATION, CL – CLOSURE.

Table 6.8-3 General Effects on Wildlife

Mechanism of Interaction	Description of Potential Effects
Habitat loss, including degradation and fragmentation (i.e., physical alteration)	*Removal of Vegetation for Project Development (Habitat loss and fragmentation)* • The Project components will primarily be located in upland areas where removal of vegetation is a direct loss of habitat and loss of a potential food source for wildlife (e.g., birds, small mammals, ungulates, and beavers) • Fragmentation of vegetation can degrade suitable habitat for species that require large intact areas (e.g., Woodland Caribou and Wolverine) *Dust Emissions (Degradation)* • Dust emissions can occur due to ground disturbance, vehicle traffic and aggregate production associated with the Project construction, operation and closure phases. Deposition of dust onto vegetation can discourage browsing of herbivores (e.g., small mammals and ungulates). *Predator-Prey Relationship (Habitat loss and fragmentation)* • For some predator species (e.g., Wolverine) fragmentation of habitat may inhibit utilization of developed areas, therefore lessening predation pressure on local prey species
Sensory disturbance (e.g., alteration of natural behaviour)	*Noise and Light* • Project related activities such as operations of site facilities and hauling operations on the transportation corridor (e.g., ore trucks, Project materials and supplies) can cause avoidance responses by wildlife. The acoustic environmental effects are discussed in Section 6.2.
Mortality	*Vehicle-wildlife interactions* • Collisions resulting in wildlife mortality may occur while travelling the all-season road with higher likelihood of fatal collisions during low-visibility conditions (e.g., night, fog, heavy precipitation) *Disruption or destruction of active nesting or den sites* • Heavy equipment used for clearing and grubbing activities of the PDA during site preparation may trample and kill young wildlife or destroy unhatched eggs *Waste Management* • For opportunistic species such as Black Bear and Red Fox, unsecured waste can create an attractant that may need to be destroyed to maintain human health and safety *Increased access for harvesting activities* • Increased access may provide additional pressure on the furbearers, waterfowl and other game species found in the Project area *Predator-Prey Relationship* • Construction of an all-season road corridor may be used by predators (e.g., wolves) to improve access to prey (e.g., moose), putting additional stress on those prey populations

Table 6.8-4 General Mitigation Measures for Potential Effects on Wildlife

Potential Effect	Mitigation Measures
Removal of vegetation for development	• The surface footprint of the mine site will be minimized since most mine infrastructure will be located underground (e.g., mine facilities, workshops and maintenance facilities) • The PDA mitigated removal of vegetation through design to avoid ecologically sensitive areas and minimize the amount of vegetation removal (e.g., utilizing existing winter road alignment where possible) • Progressive reclamation of disturbed lands will be conducted where appropriate to minimize habitat loss, degradation or fragmentation • At closure, developed areas will be re-vegetated (e.g., regarded, replanted, reseeded, etc.) using native species and the same variety of plant species that composes the existing habitat when possible (Volume 5)
Dust emissions	• Enforced traffic speed limits and use of dust suppressants on Project roads to reduce dust generation as discussed in the Road Management Plan (Volume 4) • Additional mitigation measures are discussed in the Road Management Plan (Volume 4)
Predator-prey relationship	• Project infrastructure has been designed using existing disturbed areas where possible (e.g., existing winter road alignment) to minimize creation of additional predator corridors
Noise and light	• Lights onsite will be directed to required areas, minimizing the artificial illumination of areas beyond the site • Noise generating facilities (e.g., generator) will be housed to confine noise effects as discussed in Volume 5
Waste management	• Domestic waste will be secured in wildlife-proof containers to minimize opportunities for scavenging • Incinerate all waste foods and human garbage consistent with current industry good management practices to minimize predator attraction to the local area • Staff training to enforce housekeeping requirements throughout the Project areas
Vehicle-wildlife interactions	• Enforced traffic speed limits to help motorists and animals avoid collisions • Develop and implement an education program of wildlife related policies and mitigation to all Project staff (e.g., low visibility conditions and wildlife interactions) • All Project-related transportation activities to give the right-of-way to any wildlife encountered • Communication protocol to alert personnel of wildlife in the local area by relaying sighting information to vehicles and equipment operators and on-site personnel to avoid the area, if possible • Record of all observed wildlife, near-miss collisions and fatal wildlife collisions to identify areas of high wildlife activity and promote awareness of those locations to all staff

Potential Effect	Mitigation Measures
Disruption or destruction of active nest and den sites	• Monitoring of active nest and den sites that may be disturbed by the Project activities • Modify activities to avoid disturbing habitat known to have active nest and den sites until wildlife have finished using the area during early life stages (e.g., kits, chicks, pups)
Increased access for harvesting activities	• Enforced policy banning wildlife harvesting activities (e.g., trapping, hunting) at all Project areas (e.g., mine site, transportation corridor, and trans-load facility)

6.8.6.1 Bird Species of Conservation Concern

Potential Effects - Direct Habitat Loss

Direct habitat loss during the construction phase of the Project related to site preparation activities for the mine site, transportation corridor and trans-load facility will likely have the greatest potential interaction with bird species of conservation concern.

Preferred habitat within the LSA (including the mine site PDA) and the RSA was computed using the FNLC database (Table 6.8-5 and Table 6.8-6, respectively). Clearing of the PDA at the mine site and along the transportation corridor ROW (including the all-season road, spur roads, borrow and quarry sites) will remove or alter areas within the major habitat types preferred by local SAR as shown on Table 6.8-5 and 6.8-6. A 6.5 km buffer area from the PDA, primarily associated with the all-season road and infrastructure within the transportation corridor (e.g., spur roads, borrow and quarry sites) was utilized to quantify the area of degradation within the RSA (Table 6.8-6).

Table 6.8-5 Quantifiable Loss and Degradation of Bird Species of Conservation Concern Habitat at the Mine Site

FNLC Category	Area Within Mine Site LSA (ha)	Percent of Mine Site LSA (%)	Area Within Mine Site PDA (ha)	Percent of Preferred Habitat Lost in Mine Site LSA (%)	Area of Degradation Within Mine Site LSA (ha)
Coniferous Swamp	8.3	0.4	0.0	0.0	0.8
Coniferous Treed	2.1	0.1	0.0	0.0	0.2
Deciduous Treed	4.5	0.2	0.0	0.0	0.5
Disturbance - Non and Sparse Woody	48.4	2.5	1.0	2.0	4.8
Mixed Treed	93.9	4.9	0.9	0.9	9.4
Open Bog	115.4	6.0	0.0	0.0	11.5
Sparse Treed Fen	472.6	24.5	7.5	1.6	47.3
Thicket Swamp	21.2	1.1	0.0	0.0	2.1
Treed Bog	260.1	13.5	1.6	0.6	26.0
Treed Peatland	407.6	21.1	8.7	2.1	40.8
TOTAL	**1434.1**		**19.7**	**7.2**	**143.4**

Table 6.8-6 Quantifiable Loss and Degradation of Bird Species of Conservation Concern Habitat within the RSA

FNLC Category	Area Within RSA (ha)	Percent of RSA (%)	Area Within PDA (ha)	Percent of Preferred Habitat Lost in RSA (%)	Area of Degradation within RSA (ha)
Bedrock	1737.8	0.1	16.0	0.9	1.4
Coniferous Swamp	199282.8	7.9	419.3	0.2	247.3
Coniferous Treed	559656.9	22.1	3034.3	0.5	647.2
Deciduous Treed	76056.5	3.0	306.1	0.4	86.2
Disturbance - Non and Sparse Woody	21836.7	0.9	79.8	0.4	30.5
Disturbance - Treed and/or Shrub	171641.4	6.8	975.0	0.6	315.4
Mixed Treed	105476.0	4.2	429.8	0.4	91.3
Open Bog	305501.0	12.1	254.8	0.1	165.3
Open Fen	26387.9	1.0	15.3	0.1	15.5
Sparse Treed Fen	132609.7	5.2	233.3	0.2	123.1
Thicket Swamp	20671.6	0.8	29.9	0.1	27.9
Treed Bog	215236.2	8.5	347.1	0.2	191.6
Treed Peatland	181856.9	7.2	400.8	0.2	155.9
TOTAL	**2017951.6**		**6541.5**	**4.3**	**2098.5**

An estimate of preferred habitat lost for bird species of conservation concern located within the LSA and RSA is summarized below. The combined total loss of preferred habitat located within the LSA due to physical loss of vegetation is 7.2 %. The estimated amount of habitat degraded within the LSA is approximately 143 ha. Overall there is an estimated combined loss of 4.3 % of preferred habitat within the RSA. The most affected habitats within the RSA, as indicted in table 6.8-6 are bedrock, disturbance - treed and/or shrub, coniferous treed, deciduous treed, mixed treed and disturbance - non and sparse woody. The estimated amount of degraded habit within the RSA is 2,099 ha.

- Bald Eagles require large continuous areas of deciduous or mixed woods next to lakes and rivers. They nest in tall trees, such as pine and poplar, located 50 to 200 m from the shore and require tall dead trees within 400 m of the nest for perching (MNR, 2000). Current Bald Eagle populations are impacted by the continued development of shoreline habitat and pollution (MNR, 2013). Bald Eagle or their nests have not been documented at the mine site; however, there is potential to disturb potential nesting habitat along the transportation corridor. Development within their preferred habitat; coniferous treed, deciduous treed and mixed treed forest types have the potential to affect the Bald Eagle.
- Golden Eagles prefer remote undisturbed areas and arid plateaus that are deeply cut by streams and/or canyons, as well as sparsely treed slopes and rock crags (MNR, 2000). Although Golden Eagles have not been observed within the RSA during breeding bird or migratory studies, they are likely to migrate through the RSA. Golden Eagles are sensitive to disturbance near their nests and may abandon them if harassed. Electrocution on power lines and collisions with wind

turbines is a continuing problem (MNR, 2013). Based on their preferred habitat the probability of the Project interacting with Golden Eagles is low.

- The Short-eared Owl is not known to breed in the RSA. They have a home range of approximately 25 to 125 ha. They require between 75 and 100 ha of contiguous open habitat and are found in grasslands, open areas and/or meadows that are grassy or bushy, marshes, bogs or tundra (MNR, 2000). Major threats to the Short-eared Owl include mowing of agricultural fields and overgrazing by livestock (MNR, 2013). Short-eared Owls have not been observed within the mine site LSA or elsewhere in the RSA. There is expected to be a minimal interaction between Short-eared Owl at the mine site and/or at the trans-load facility. Development within preferred habitat along the transportation corridor could affect the Short-eared Owl, but is unlikely based on knowledge of its current distribution. This species is sensitive to habitat fragmentation.
- The Canada Warbler was detected within the RSA but it was not detected within the mine site LSA. Based on its known distribution the probability of detection in the Ring of Fire region is 10 % versus 68 % in the southern shield region (Cadman et al., 2007). The Canada Warbler requires at least 30 ha of habitat. It is an interior forest species; that prefers dense mixed coniferous or deciduous forests with closed canopy. It can be found in areas with wet bottomlands of cedar or alder; shrubby undergrowth in cool moist mature woodlands; and riparian habitat (MNR, 2000). Declines in the population are likely due to reductions in forests with a well-developed shrub-layer. Direct loss of deciduous or mixed forest with well-developed shrub layers at the mine site, trans-load facility or along the transportation corridor may affect the Canada Warbler. This species is sensitive to habitat fragmentation.
- The Barn Swallow is associated with farmlands and rural areas. They prefer areas with cliffs, caves rock niches, buildings and other man-made structures for nesting. They can also be found in open areas next to a body of water (MNR, 2000). They commonly build their cup-shaped mud nests on human-made structures such as open barns, under bridges and in culverts. They often re-use their nests from year to year. Interactions with barn swallow are more likely to occur at the trans-load facility during construction and operation than at the mine site or along the transportation corridor. Barn swallows may decide to nest on buildings and infrastructure during operations, including the culverts and bridges along the access road. This means that removal of buildings and other infrastructure at closure could affect barn swallow habitat. Maintenance of bridges and culverts could also affect Barn Swallow.
- The Black Tern inhabits wetlands including coastal and inland marshes; large cattail marshes, marshy edges of rivers, lakes and ponds. They are also found in wet open fens and wet meadows. They return to the same areas to nest each year in shallow (0.5 to 1.0 m) deep water and require areas of open water near the nest sites. Their homelands typically over 20 ha. They feed over the adjacent grasslands for insects, fish, crayfish and frogs (MNR, 2000). Black terns have not been observed within the RSA; therefore, interaction with them is expected to be minimal. Development within wetlands along the transportation corridor could potentially affect the Black Tern. Activities at the mine site and trans-load facility are not expected to affect Black Tern or its habitat.
- Common Nighthawk inhabits areas of open ground such as clearings in dense forest, ploughed fields, gravel beached, or barren areas with rocky soils. They are also found in open woodlands and on flat gravel roofs (MNR, 2000). Identified threats within the region include habitat degradation from fire suppression and land use changes in the boreal forest (MNR, 2013).

Common Nighthawk was detected within the mine site LSA and within a variety of habitats within the RSA. Clearing of deciduous, coniferous or mixed forest habitat could affect this species or its habitat.

- The Olive-sided Flycatcher prefers semi-open spruce coniferous forest near open water, such as lakes or rivers. They utilize treed wetlands for nesting and burns with dead trees for perching MNR, 2000). In Ontario, Olive-sided Flycatchers commonly nest in conifers such as White and Black Spruce, Jack Pine and Balsam Fir (MNR, 2013). Evidence suggests that individuals breeding in managed forests may have lower nest success in comparison to those breeding in natural forest stands (MNR, 2013). Olive-sided Flycatchers were observed during the breeding bird surveys at each of the sites surveyed in the RSA, as well as at the mine site. Loss of coniferous treed forest during the construction phase could affect this species.
- The Peregrine Falcon prefers rock cliffs and crags located near water. They can also be found on tall buildings in urban centres. Peregrine Falcons have been observed migrating through the RSA. Based on their preferred habitat conditions, there is a low probability of the Project interacting with Golden Eagle.
- The Rusty Blackbird was observed within the RSA and also within the mine site LSA. The Rusty Blackbird breeds in coniferous dominated wooded streams, swamps and bogs. It was detected at most survey locations during the migration surveys, as well as during the breeding bird surveys. Loss of coniferous treed, treed bog and coniferous swamp during the construction phase could affect this species and it's habitat.
- The Yellow Rail has not been observed in the RSA. They prefer large freshwater or brackish grass and sedge marshes with dense vegetation including bulrushes, horsetails and grasses. Impacts to Yellow rail at the mine site and trans-load facility are not anticipated. Construction activities will be limited within wetland environments along the trans-load facility, but there remains a potential for ground preparation activities to affect Yellow Rail.
- Tennessee Warbler prefers brushy, semi-open habitats. They can be found in grassy opening located within coniferous, deciduous, or mixed woods with dense shrub layers and islands of young deciduous trees. They prefer treed fens and boggy areas, dry pine plantations and beach ridges. Development within deciduous, coniferous and mixed treed areas, as well as fen and bog areas could affect this species and will reduce the amount of available habitat within the PDA for this species.
- Ovenbirds prefer open areas of undisturbed mature deciduous or mixed treed areas with a closed canopy. They like areas with little ground vegetation and lots of debris on the forest floor. They can also be found in forested ravines and well drained riverbanks. They nest in depressions of dead leaves at eth base of trees or fallen logs. They are an area sensitive species requiring over 70 ha of continuous forest. Habitat fragmentation and development within mature deciduous or mixed treed areas could affect this species and will reduce the amount of available habitat within the PDA for this species.

No loss, degradation or fragmentation of preferred habitat for birds of conservation concern is likely to occur during the construction of the trans-load facility as the infrastructure will be placed within an already disturbed site. The transmission line to the trans-load facility will be constructed along a previously disturbed corridor and minimal clearing of vegetation will be required. The access road to the trans-load facility will be upgraded; however, minimal clearing of vegetation will be required.

Potential Effects - Indirect Habitat Loss and Degradation

Indirect habitat loss and degradation to bird SAR will be greatest during the initial construction phase of the Project. Provided that construction activities are located outside of the nesting season sensory disturbances are likely to have a negligible effect on bird SAR. When the birds migrate back to the site they will search for suitable habitat to breed in outside of the PDA. The noise in the Terrestrial Ecology LSA and beyond will be barely detectable above normal background noise. Therefore, the elevated noise is not expected to have a negative effect on the remaining breeding birds in the Terrestrial Ecology LSA.

Potential Effects - Mortality

Bird mortality related to vehicle collisions will not frequently occur. As such, these losses are not anticipated to affect the local bird populations. Raptors and migratory waterfowl have the potential for collision and electrocution from Project power lines. Power line occurrences are likely to be localized around the PDA.

Proposed Mitigation Measures

Appropriate mitigation measures regarding the removal of vegetation, sensory disturbances and mortality within the PDA will be utilized to protect regional bird species of conservation concern and their habitat as discussed in Table 6.8-4.

To minimize any potential for direct or indirect effects on bird SAR, Noront will implement the following mitigation measures:

- Avoid clearing during nesting seasons; however, if clearing cannot be conducted outside of the nesting period, site specific surveys will precede the land clearing activities. Nest searches will be completed in advance clearing activities. If a nest is found appropriate measures will be established to protect the nest.

With the application of these mitigation measures, development related activities are not expected to affect the bird SAR.

6.8.6.2 Waterfowl

Potential Effects - Direct Habitat Loss

Waterfowl (e.g., ducks and geese) are relatively common in the RSA due to the large quantity of available habitat. There are lakes, open water wetlands and pond habitats scattered throughout the RSA. Twenty species of waterfowl were observed during the breeding bird and migratory bird surveys. Canada goose was the only species observed at the mine site during the studies; however, other species of waterfowl have been known to frequent the Muketei River and larger water bodies in the area. The generally preferred open water habitat within the mine site LSA is lacking or small in size. Habitat loss resulting from ground preparation activities at the mine site will be minimal. The majority of site development activities will take place away from open water and wetland habitats at the mine site.

Based on the baseline breeding bird surveys completed, waterfowl use the RSA extensively for staging during migration and/or for breeding. Breeding habitats of the waterfowl that frequent the RSA differ between species. Waterfowl are expected to breed wherever there habitat requirements are met. Aquatic vegetation within wetlands and shoreline habitats provide feeding and nesting areas for waterfowl. Nests are commonly located within 100 m of a water body. Most waterfowl return back to the same area they hatched an in some cases adults return to the same nest sites (Terres, 1982). Direct loss of habitat along the transportation corridor will result from ground preparation activities that take place within wetland and open water habitat, as well as within 100 m of the water body.

No loss, degradation or fragmentation of preferred habitat for waterfowl will occur will occur during the construction of the trans-load facility as the infrastructure will be placed within an already disturbed site. The transmission line to the trans-load facility will be constructed along a previously disturbed corridor and minimal clearing of vegetation will be required. The access road to the trans-load facility will be upgraded; however, minimal clearing of vegetation will be required.

Potential Effects - Indirect Habitat Loss and Degradation

Indirect habitat loss and degradation to waterfowl will be greatest during the initial construction phase of the Project. Provided that construction activities are located outside of the nesting season sensory disturbances are likely to have a negligible effect on waterfowl. When the birds migrate back to the site they will search for suitable habitat to breed in outside of the PDA. The noise in the Terrestrial Ecology LSA and beyond will be barely detectable above normal background noise. Therefore, the elevated noise is not expected to have a negative effect on the remaining waterfowl in the Terrestrial Ecology LSA.

Potential Effect - Mortality

Waterfowl are a valuable resources harvested by the First Nation communities in the area. The creation of an all-season road will provide easier access to a large area, therefore increasing hunting pressure on the migratory and resident waterfowl populations.

Proposed Mitigation Measures

Appropriate mitigation measures regarding the removal of vegetation, sensory disturbances and mortality within the PDA will be utilized to protect regional bird species of conservation concern and their habitat as discussed in Table 6.8-4.

To minimize any potential for direct or indirect effects on bird SAR, Noront will implement the following mitigation measures:

- Avoid clearing during nesting seasons; however, if clearing cannot be conducted outside of the nesting period, site specific surveys will precede the land clearing activities. Nest searches will be completed in advance clearing activities. If a nest is found appropriate measures will be established to protect the nest.

With the application of these mitigation measures, development related activities are not expected to affect waterfowl.

6.8.6.3 Furbearers

Potential Effects - Direct Habitat Loss

The activity likely to have the greatest potential interaction with furbearers is the removal and fragmentation of forest cover and associated vegetation. This will mostly occur during the Project construction phase. Furbearer habitat within the mine site PDA and RSA was computed using the FNLC database (Table 6.8-7).

Habitat loss and degradation associated with the Project has been quantified in relation to the FNLC, which are discussed below as they relate to the areas preferred by local furbearers (Table 6.8-7).

Table 6.8-7 Quantifiable Loss and Degradation of Furbearer Habitat at the Mine Site

FNLC Category	Area Within Mine Site LSA (ha)	Percent of Mine Site LSA (%)	Area Within Mine Site PDA (ha)	Percent of Preferred Forest Lost in Mine Site LSA (%)	Area of Degradation Within Mine Site LSA (ha)
Coniferous Swamp	8.3	0.4	0.0	0.0	0.8
Coniferous Treed	2.1	0.1	0.0	0.0	0.2
Deciduous Treed	4.5	0.2	0.0	0.0	0.5
Disturbance - Non and Sparse Woody	48.4	2.5	1.0	2.0	4.8
Mixed Treed	93.9	4.9	0.9	0.9	9.4
Open Bog	115.4	6.0	0.0	0.0	11.5
Sparse Treed	421.0	21.8	13.5	3.2	42.1
Sparse Treed Fen	472.6	24.5	7.5	1.6	47.3
Treed Bog	260.1	13.5	1.6	0.6	26.0
Treed Peatland	407.6	21.1	8.7	2.1	40.8
TOTAL	**1834**	**95.0**	**33.1**	**10.4**	**183.4**

The preferred areas for the furbearers as described by the MNR in the Significant Wildlife Habitat Technical Guide (2000) have been summarized below:

- Beaver and Muskrat are associated with wetlands, open water and riparian habitat. Development within these areas and adjacent to these areas have the potential to affect local Beaver and Muskrat, specifically the all-season access road construction and water crossing infrastructure (e.g., culverts).
- Marten, Fisher and Lynx are associated with wetlands, riparian areas, thickets, mature forest and forest edges. The Marten and Fisher also rely on cavities in trees and holes in the ground as den sites that may be used year after year. Marten and Fisher also have sensitivity to fragmentation, relying on large areas of suitable habitat for long term population survival. Development within the sparse treed and sparse treed fen has the highest potential to affect Marten and Fisher due to direct habitat loss and fragmentation.
- Red Fox preferentially associate with most habitat types within the PDA except for open water and open bog. Red Fox also rely on cavities in the ground for den sites that may be used year after year. Direct habitat loss due to Project development may affect the local Red Fox, however they are not typically sensitive to habitat fragmentation.
- Snowshoe Hare preferentially associate with forest edges, thickets (i.e., disturbance) and wetlands. Development within the sparse woody disturbance may affect the local Snowshoe Hare.

Furbearer habitat within the RSA was computed using the FNLC database. Clearing the PDA along the transportation corridor ROW (including the all-season road, spur roads and aggregate source areas) will remove or alter areas within the major habitat types preferred by local furbearers as listed in Table 6.8-8. A 6.5 km buffer area from the PDA, primarily associated with the all-season road and infrastructure within the transportation corridor (e.g., spur roads, borrow and quarry sites) was utilized to quantify the area of degradation within the RSA (Table 6.8-8).

Table 6.8-8 Quantifiable Loss and Degradation of Furbearer Habitat within the RSA

FNLC Category	Area Within RSA (ha)	Percent of RSA (%)	Area Within PDA (ha)	Percent of Preferred Habitat Lost in RSA (%)	Area of Degradation within RSA (ha)
Bedrock	1737.8	0.1	16.0	0.9	1.4
Coniferous Swamp	199282.8	7.9	419.3	0.2	247.3
Coniferous Treed	559656.9	22.1	3034.3	0.5	647.2
Deciduous Treed	76056.5	3.0	306.1	0.4	86.2
Disturbance - Non and Sparse Woody	171641.4	6.8	975	0.6	315.4
Disturbance - Treed and/or Shrub	21836.7	0.9	79.8	0.4	30.5
Mixed Treed	105476.0	4.2	429.8	0.4	91.3
Open Bog	305501.0	12.1	254.8	0.1	165.3
Open Fen	26387.9	1.0	15.3	0.1	15.5
Sparse Treed	172435.8	6.8	545.5	0.3	178.8
Sparse Treed Fen	132609.7	5.2	233.3	0.2	123.1
Treed Bog	215236.2	8.5	347.1	0.2	191.6
Treed Peatland	181856.9	7.2	400.8	0.2	155.9
TOTAL	**2169715.7**	**85.8**	**7057.1**	**4.5**	**2249.5**

The most affected habitat preferred by furbearers within the RSA is the mature forest stands and forest edges (e.g., coniferous treed, deciduous treed, mixed treed). These are the highest percentage utilized by furbearers, but do not represent a large portion of removed habitat with from the RSA (< 1.5 %). The area of degraded suitable habitat for the mature forests is highest for coniferous treed areas, but is not likely to have an effect on the furbearers near the PDA. Other potential effects of degradation are discussed in Section 6.8.6.9 (Sensory Disturbance).

No loss, degradation or fragmentation of preferred furbearer habitat will occur during the construction of the trans-load facility as the infrastructure will be placed within an already disturbed site. The transmission line to the trans-load facility will be constructed along a previously disturbed corridor and minimal clearing of vegetation will be required. The access road to the trans-load facility will be upgraded, however, minimal clearing of vegetation will be required.

Potential Effects - Indirect Habitat Loss and Degradation

The most likely indirect habitat loss and degradation for local furbearers will be attractants from domestic waste. This is evident at the existing exploration camps where Martens have been live-trapped and relocated due to persistent scavenging behaviour.

Potential Effect - Mortality

As noted in Table 6.8.-3, domestic waste management has the potential to attract wildlife (e.g., Black Bears). Some individuals can become accustomed to scavenging waste and demonstrate a general lack of fear of humans. When there is an immediate danger to human safety all deterrent options will be investigated (e.g., air horns, cracker shells, non-lethal projectiles). The final course of action to protect Project staff may include destruction of the nuisance animal as per MNR guidelines (Landriault et al., 2000).

Proposed Mitigation Measures

Since the majority of the Project development area will be positioned on available high ground, away from low-lying areas the beaver and muskrat will not likely be affected by direct habitat loss from these activities. Habitat alteration will occur due to changes in stream flow and installation of water crossing structures (e.g., culverts), but will not likely affect Beaver or Muskrat since these animals are readily adaptable and are known to live in human-modified, urbanized environments. Design and construction of the all-season road will include best practices to minimize effects to Beavers and Muskrats such as those suggested by the United States Department of Agriculture Forest Service (Gerich) and the local MNR.

Appropriate mitigation measures regarding the removal of vegetation within the PDA will be utilized to protect regional wildlife habitat as discussed in Table 6.8-4. Dust emissions will be minimized utilizing a variety of mechanisms including mitigation by operation (e.g., speed limits and dust suppressants). Mitigation by design will be used to minimize effects on predator-prey relationships using the existing winter road corridor where possible, instead of creating another predator corridor. Strict waste management practices will also limit attraction of predator/scavenger species and reduce the likelihood of increasing predation on local prey species as noted in Table 6.8-4.

With application of these mitigation measures, the Project is anticipated to have a negligible effect on the furbearers.

6.8.6.4 Carnivores

Potential Effects - Direct Habitat Loss

The activity likely to have the greatest potential interaction with carnivores is associated with the effects of removal and fragmentation of forest cover on their prey species (e.g., Moose and Caribou). This will mostly occur during the Project construction phase. Carnivore habitat within the mine site PDA and RSA was computed using the FNLC database (Table 6.8-9).

MNR Wildlife Management Unit (WMU) 1D, which includes the mine site area, is estimated to support a Black Bear population of 40 to 60 bears for every 100 km^2 (MNR, 2009). Habitat loss and degradation associated with the Project has been quantified in relation to the FNLC, which are discussed below as they relate to the areas preferred by local carnivores (Table 6.8-9).

Table 6.8-9 Quantifiable Loss and Degradation of Carnivore Habitat at the Mine Site

FNLC Category	Area Within Mine Site LSA (ha)	Percent of Mine Site LSA (%)	Area Within Mine Site PDA (ha)	Percent of Preferred Habitat Lost in Mine Site LSA (%)	Area of Degradation Within Mine Site LSA (ha)
Coniferous Swamp	8.3	0.4	0.0	0.0	0.8
Coniferous Treed	2.1	0.1	0.0	0.0	0.2
Deciduous Treed	4.5	0.2	0.0	0.0	0.5
Disturbance - Non and Sparse Woody	48.4	2.5	1.0	2.0	4.8
Mixed Treed	93.9	4.9	0.9	0.9	9.4
Open Bog	115.4	6.0	0.0	0.0	11.5
Sparse Treed	421.0	21.8	13.5	3.2	42.1
Sparse Treed Fen	472.6	24.5	7.5	1.6	47.3
Treed Bog	260.1	13.5	1.6	0.6	26.0
Treed Peatland	407.6	21.1	8.7	2.1	40.8
TOTAL	**1834**	**95.0**	**33.1**	**10.4**	**183.4**

The preferred areas for Black Bear and wolves as described by the MNR in the Significant Wildlife Habitat Technical Guide (2000) have been summarized below:

- Black Bear associate with most habitat types within the PDA except for open water and open bog. Black Bear also rely on cavities in the ground for den sites that may be used year after year. Direct habitat loss due to Project development may affect the local Black Bears, however they are not typically sensitive to habitat fragmentation.
- The Gray Wolf associated with heavily forested areas, and can have a home range of 300 km^2 (MNR, 2000). As with the Black Bear, wolves rely on cavities in the ground for den sites that may be used year after year. Direct habitat loss due to Project development may affect the local wovles, however they are not typically sensitive to habitat fragmentation and as stated above have been known to utilize anthropogenic infrastructure to hunt their territory.

Carnivore habitat within the RSA was computed using the FNLC database. Clearing the PDA along the transportation corridor ROW (including the all-season road, spur roads and aggregate source areas) will remove or alter areas within the major habitat types preferred by local carnivores as listed in Table 6.8-10. A 6.5 km buffer area from the PDA, primarily associated with the all-season road and infrastructure within the transportation corridor (e.g., spur roads, borrow and quarry sites) was utilized to quantify the area of degradation within the RSA (Table 6.8-10).

Table 6.8-10 Quantifiable Loss and Degradation of Carnivore Habitat within the RSA

FNLC Category	Area Within RSA (ha)	Percent of RSA (%)	Area Within PDA (ha)	Percent of Preferred Habitat Lost in RSA (%)	Area of Degradation within RSA (ha)
Bedrock	1737.8	0.1	16.0	0.9	1.4
Coniferous Swamp	199282.8	7.9	419.3	0.2	247.3
Coniferous Treed	559656.9	22.1	3034.3	0.5	647.2
Deciduous Treed	76056.5	3.0	306.1	0.4	86.2
Disturbance- Non and Sparse Woody	171641.4	6.8	975.0	0.9	30.5
Disturbance - Treed and/or Shrub	21836.7	0.9	79.8	0.0	315.4
Mixed Treed	105476.0	4.2	429.8	0.4	91.3
Open Bog	305501.0	12.1	254.8	0.1	165.3
Open Fen	26387.9	1.0	15.3	0.1	15.5
Sparse Treed	172435.8	6.8	545.5	0.3	178.8
Sparse Treed Fen	132609.7	5.2	233.3	0.2	123.1
Treed Bog	215236.2	8.5	347.1	0.2	191.6
Treed Peatland	181856.9	7.2	400.8	0.2	155.9
TOTAL	**2169715.7**	**79.7**	**7057.1**	**4.4**	**2249.5**

The most affected habitat preferred by carnivores within the RSA are the mature forest stands (e.g., coniferous treed, deciduous treed, mixed treed). These are the highest percentage utilized by carnivores, but do not represent a large portion of removed habitat with from the RSA (< 1.5 %). The area of degraded suitable habitat for the mature forests is highest for coniferous treed areas, but is not likely to have an effect on the carnivores near the PDA. Other potential effects of degradation are discussed in Section 6.8.6.9 (Sensory Disturbance).

No loss, degradation or fragmentation of preferred carnivore habitat will occur during the construction of the trans-load facility as the infrastructure will be placed within an already disturbed site. The transmission line to the trans-load facility will be constructed along a previously disturbed corridor and minimal clearing of vegetation will be required. The access road to the trans-load facility will be upgraded, however, minimal clearing of vegetation will be required.

Potential Effects - Indirect Habitat Loss and Degradation

Wolves may exhibit avoidance behaviour until the local animals adjust to the presence of Project infrastructure, which has already occurred to some degree around the existing exploration camps. Wolves have been documented within the exploration camp perimeter, also possibly attracted by odours of food and domestic waste.

Potential Effects - Mortality

Carnivores also have scavenging behaviour that can attract them to road kill. Most animals will remove the carcass from the road to reduce the likelihood of attracting competitors however this behaviour increases the risk of vehicle-wildlife collisions and mortalities.

Proposed Mitigation Measures

Appropriate mitigation measures regarding the removal of vegetation within the PDA will be utilized to protect regional wildlife habitat as discussed in Table 6.8-4. Using the existing winter road corridor where possible, instead of creating another predator corridor mitigates the effects on the predator-prey relationships. Strict waste management practices will also limit attraction of predator/scavenger species and reduce the likelihood of increasing predation on local prey species as noted in Table 6.8-4.

With application of these mitigation measures, the Project is anticipated to have a negligible effect on the carnivores.

6.8.6.5 Moose

Potential Effects – Direct Habitat Loss

Moose tend to be associated with rich riverbank forests, and to a lesser extent with creek margin forests, which provide adequate food and shelter for this species. Moose utilize the denser conifer forests during winter for shelter, and rely on buds and twigs of young trees and shrubs for food. Based on the existing literature, the primary moose habitat within the study area is closely associated with the larger creeks and rivers, and there is a greater representation of coniferous forest, dense deciduous forest and associated shrubs.

MNR Wildlife Management Unit (WMU) 1D, which includes the mine site area, supports a moose population of approximately 2.6 moose for every 100 km^2 based on the most recent MNR survey completed in 2008 (MNR, 2013). Habitat loss and degradation associated with the Project has been quantified in relation to the FNLC, which are discussed below as they relate to the areas preferred by moose (Table 6.8-11).

Table 6.8-11 Quantifiable Loss and Degradation of Moose Habitat at the Mine Site

FNLC Category	Area Within Mine Site LSA (ha)	Percent of Mine Site LSA (%)	Area Within Mine Site PDA (ha)	Percent of Preferred Habitat Lost in Mine Site LSA (%)	Area of Degradation Within Mine Site LSA (ha)
Coniferous Swamp	8.3	0.4	0.0	0.0	0.8
Coniferous Treed	2.1	0.1	0.0	0.0	0.2
Deciduous Treed	4.5	0.2	0.0	0.0	0.5
Mixed Treed	93.9	4.9	0.9	0.9	9.4
Open Bog	115.4	6.0	0.0	0.0	11.5
Sparse Treed	421.0	21.8	13.5	3.2	42.1
Sparse Treed Fen	472.6	24.5	7.5	1.6	47.3
Thicket Swamp	21.2	1.1	0.0	0.0	2.1
Treed Bog	260.1	13.5	1.6	0.6	26.0
Treed Peatland	407.6	21.1	8.7	2.1	40.8
TOTAL	**1806.8**	**93.6**	**32.1**	**8.4**	**180.7**

The preferred areas for moose in the boreal forest region as described by the MNR in the Significant Wildlife Habitat Technical Guide (2000) are semi-open spaces and wetlands for safety and aquatic plants for food. The technical guide also describes seasonal usage of cut-overs and burns during the winter when moose can gather in larger numbers for safety. The removal or fragmentation of treed peatland and sparse treed habitats may have an effect on local moose.

Moose habitat within the RSA was computed using the FNLC database. Clearing the PDA along the transportation corridor ROW (including the all-season road, spur roads and aggregate source areas) will remove or alter areas within the major habitat types preferred by local moose as listed in Table 6.8-12. A 6.5 km buffer area from the PDA, primarily associated with the all-season road and infrastructure within the transportation corridor (e.g., spur roads, borrow and quarry sites) was utilized to quantify the area of degradation within the RSA (Table 6.8-12).

Table 6.8-12 Quantifiable Loss and Degradation of Moose Habitat within the RSA

FNLC Category	Area Within RSA (ha)	Percent of RSA (%)	Area Within PDA (ha)	Percent of Preferred Habitat Lost in RSA (%)	Area of Degradation within RSA (ha)
Bedrock	1737.8	0.1	16.0	0.9	1.4
Coniferous Swamp	199282.8	7.9	419.3	0.2	247.3
Coniferous Treed	559656.9	22.1	3034.3	0.5	647.2
Deciduous Treed	76056.5	3.0	306.1	0.4	86.2
Mixed Treed	105476.0	4.2	429.8	0.4	91.3
Open Bog	305501.0	12.1	254.8	0.1	165.3
Open Fen	26387.9	1.0	15.3	0.1	15.5
Sparse Treed	172435.8	6.8	545.5	0.3	178.8
Sparse Treed Fen	132609.7	5.2	233.3	0.2	123.1
Treed Bog	215236.2	8.5	347.1	0.2	191.6
Treed Peatland	181856.9	7.2	400.8	0.2	155.9
TOTAL	**1976237.6**	**78.1**	**6002.3**	**3.5**	**1903.6**

The most affected habitat preferred by moose within the RSA is the sparse treed and treed peatland habitats. These do not represent a large portion of removed habitat with from the RSA (< 1 %). The area of degraded suitable habitat for these habitats is not likely to have an effect on the moose near the PDA. Other potential effects of degradation are discussed in Section 6.8.6.9 (Sensory Disturbance).

No loss, degradation or fragmentation of preferred moose habitat will occur during the construction of the trans-load facility as the infrastructure will be placed within an already disturbed site. The transmission line to the trans-load facility will be constructed along a previously disturbed corridor and minimal clearing of vegetation will be required. The access road to the trans-load facility will be upgraded, however, minimal clearing of vegetation will be required.

Potential Effects - Indirect Habitat Loss and Degradation

Moose are considered to be relatively tolerant to human disturbances (Salmo Consulting Inc. et al., 2003). Although, moose may be still be affected by the visual and noise disturbances from the infrastructure, vehicle and foot traffic, and aircraft. These short-term disturbances may occur most frequently near the all-season road and during the operation phase near the mine site and trans-load facility.

Potential Effects - Mortality

Moose have been known to associate with disturbed corridors such as roads for ease of movement during winter months. Moose may also be attracted to the presence of deciduous vegetation in roadside ditches during the growing season (Laurian et. al. 2008) as well as the runoff from salted roads in the spring. Therefore, there is an increased risk for vehicle collisions with moose along the transportation corridor.

Proposed Mitigation Measures

Appropriate mitigation measures regarding the removal of vegetation within the PDA will be utilized to protect regional wildlife habitat as discussed in Table 6.8-4. Using the existing winter road corridor where possible, instead of creating another predator corridor mitigates the effects on the predator-prey relationships. With application of these mitigation measures, the Project is anticipated to have a negligible effect on the moose population.

6.8.6.6 Wolverine

This section addresses the potential effects of the Project on direct habitat loss, habitat fragmentation and habitat degradation for Wolverine and provides proposed mitigation measures to eliminate or minimize these potential effects. A 40 km buffer around the transportation corridor and mine site was used as the RSA for Wolverine (Technical Supporting Document 18).

Potential Effects - Direct Habitat Loss

The direct loss of Wolverine habitat in the mine site LSA has been estimated as follows (Table 6.8-13; and Technical Supporting Document 18):

- High quality - 0.05 % of the RSA
- Medium quality - 1.2 % of the RSA
- Low quality - 0.6 % of the RSA

The loss of Wolverine habitat in the Project RSA has been estimated as follows (Table 6.8-14; and Technical Supporting Document 18):

- High quality - 0.02 % of the RSA
- Medium quality - 0.2 % of the RSA
- Low quality - 0.04 % of the RSA

Table 6.8-13 Wolverine Habitat Loss in the Mine Site LSA

Far North Land Cover		Area Within Mine Site LSA (ha)	Percent of Mine Site LSA (%)	Area Within Mine Site PDA (ha)	Percent Lost in PDA Relative to the Mine Site LSA (%)
Suitability	**Category**				
HIGH	Mixed Treed	93.9	5.1	0.9	0.05
	TOTAL HIGH	**93.9**	**5.1**	**0.9**	**0.05**
MEDIUM	Coniferous Swamp	8.3	0.5	0.0	0.0
	Deciduous Treed	4.5	0.2	0.0	0.0
	Coniferous Treed	2.1	0.1	0.0	0.0
	Sparse Treed Fen	472.6	25.8	7.5	0.4
	Sparse Treed	421.0	23.0	13.5	0.7
	Disturbance - Non and Sparse Woody	48.4	2.6	1.0	0.05
TOTAL MEDIUM		**956.9**	**52.2**	**22.0**	**1.2**
LOW	Treed Peatland	407.6	22.2	8.7	0.5
	Treed Bog	260.1	14.2	1.6	0.09
	Open Bog	115.4	6.3	0.0	0.0
TOTAL LOW		**783.1**	**42.7**	**10.3**	**0.6**

Table 6.8-14 Wolverine Habitat Loss within the RSA

Far North Land Cover		Area Within RSA (ha)	Percent of RSA (%)	Area Within Entire PDA (ha)	Percent Lost in PDA Relative to the RSA (%)
Suitability	**Category**				
HIGH	Clear Open Water	339,784.5	13.4	255.4	0.01
	Disturbance - Treed and/or Shrub	21,836.7	0.9	79.8	0.003
	Mixed Treed	105,476.0	4.2	429.8	0.02
TOTAL HIGH		**467,097.2**	**18.5**	**509.6**	**0.02**
MEDIUM	Coniferous Swamp	199,282.8	7.9	419.3	0.02
	Thicket Swamp	20,671.6	0.8	33.2	0.001
	Deciduous Treed	76,056.5	3.0	306.1	0.01
	Open Fen	26,387.9	1.0	15.3	0.0006
	Bedrock	1,737.8	0.1	16.0	0.0006
	Disturbance- Non and Sparse Woody	171,641.4	6.8	975.0	0.04
	Sparse Treed	172,435.8	6.8	545.5	0.02
	Sparse Treed Fen	132,609.7	5.2	233.3	0.009
	Coniferous Treed	559,656.9	22.1	3,034.3	0.1
TOTAL MEDIUM		**1,360,480.4**	**53.8**	**5,578.0**	**0.2**
LOW	Treed Peatland	181,856.9	7.2	400.8	0.02
	Treed Bog	215,236.2	8.5	347.1	0.01
	Open Bog	305,501.0	12.1	254.8	0.01
TOTAL LOW		**702,594.1**	**27.8**	**1,002.7**	**0.04**

The habitat losses in the LSA and the RSA are extremely low. The greatest loss is in the medium quality habitat category in the LSA (1.2 %).

Habitat fragmentation and degradation will occur due to the construction and use of the new winter road that is proposed to connect the existing winter road to the mine site, and from the upgrade of the winter road to an all-season road. It is expected that approximately 20 haul trucks per day will make a return trip from the mine and that other vehicular traffic on the road will add 3 to 6 vehicles per hour/day at maximum. This level of road use is similar to logging roads in northern Ontario.

The influence of logging roads and mine access roads on Wolverine habitat suitability has not yet been determined. However, activities such as recreation, tourism, field research and air traffic have been associated with the displacement of Wolverine from areas of suitable habitat. Due to the conversion of natural habitat to road, and due to the noise, light and dust associated with the use of mine access roads, it is anticipated that Wolverine will avoid suitable habitats adjacent to the road. Further discussion of the effects of road avoidance and sensory disturbances is provided in Section 6.8.6.9.

Data provided by the MNR (2013) was used to compare Wolverine activity at the mine site to Wolverine activity at the east end of the winter road. At the mine site, human activity is intensive including drilling and helicopter traffic, and is continuous during the winter months, compared with the east end of the winter road where there is less human activity consisting of sporadic vehicular traffic during the winter months. To make this comparison, the distances of all Wolverine observations within a 15 km radius of both the mine site and a point on the winter road were determined (Figure 6.8-4 and Figure 6.8-5).

There were five observations at the mine site with a mean distance from the center of the site of 11.6 km, and a minimum distance of 7.7 km. At the east end of the winter road, there were 11 Wolverine observations with a mean distance of 5.6 m from the road, and a minimum distance of 0.9 km from the road. At the mine site where human activity is more intensive, there were less than half as many Wolverine observations. Also at the mine site, the mean distance from the site to the Wolverine observations was 2.1 times greater than the mean distance of the observations to the road.

This cursory analysis of field data indicates that Wolverine in the RSA may be avoiding anthropogenic features with high levels of human activity by as much as two-fold compared with anthropogenic features with low levels of human activity. To account for this avoidance of anthropogenic features that will likely occur due to the Project activities, a 6.5 km buffer was applied to the proposed transportation corridor and mine site and habitat suitability categories within the buffer were quantified (Table 6.8-15).

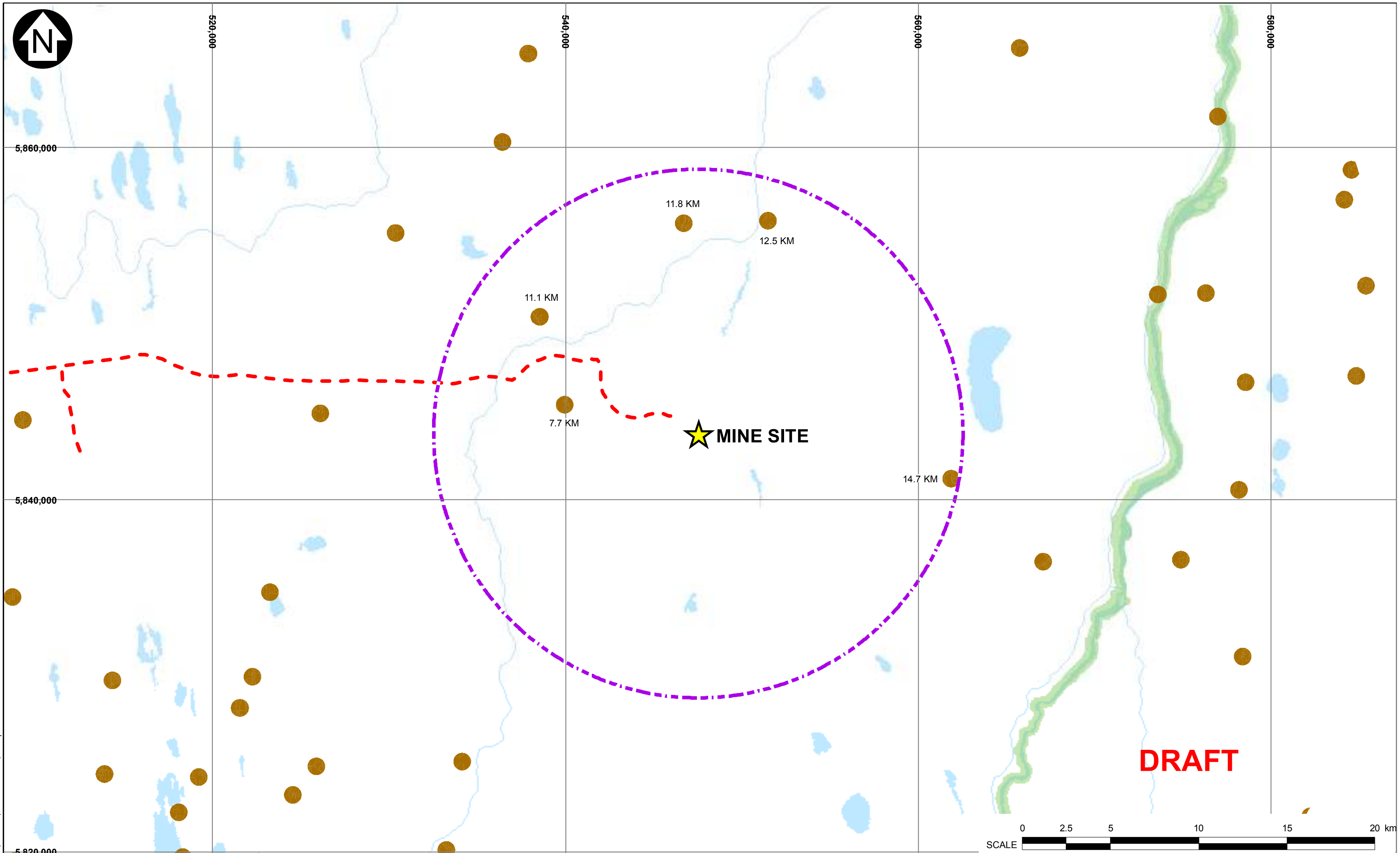
Analysis of the Wolverine habitat suitability within the 6.5 km buffer area provided the amount of each habitat suitability category present in the buffer area as follows (Table 6.8-15; and Technical Supporting Document):

- High quality - 3.7 % of the RSA
- Medium quality - 8.0 % of the RSA
- Low quality - 3.8 % of the RSA

Based on existing knowledge of Wolverine activity in the RSA, it is apparent that they have not been using the 6.5 km buffer around the mine site. However, the current data also indicate that Wolverine have been using the buffer area adjacent to the winter road. With the additional traffic that is anticipated along the winter road due to the Project, it is expected that Wolverine use of the high quality habitat (3.7 % of the RSA) and the medium quality habitat (8.0 % of the RSA) will be reduced. The magnitude of this reduction is difficult to predict but will not likely reach the level of avoidance that seems to be occurring at the mine site. This assessment is based on the expectation that the additional activity along the winter road due to the Project will not reach the level of intensity that has been occurring at the mine site.

Recent work by Carlson and Chetkiewicz (2013), who applied a simulation model to the James Bay Lowlands including the Ring of Fire, concluded that "*simulated mining and hydroelectric development were sufficiently isolated at a regional scale to avoid large impacts to Caribou and Wolverine*."

No loss, degradation or fragmentation of preferred Wolverine habitat is likely to occur during the construction of the trans-load facility as the infrastructure will be placed within an already disturbed site. The transmission line to the trans-load facility will be constructed along a previously disturbed corridor and minimal clearing of vegetation will be required. The access road to the trans-load facility will be upgraded; however, minimal clearing of vegetation will be required.



LEGEND:

- MINE SITE
- COMMUNITY
- WOLVERINE OBSERVATION
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- WATER
- PARK
- FIRST NATIONS RESERVE
- WOLVERINE WITHIN THE RSA
- 15 KM BUFFER ZONE

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009.) ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. WOLVERINE SURVEY LOCATIONS RECEIVED FROM THE OMNR (MAY 15, 2013).
4. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (NOVEMBER 26, 2013).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	PAQ	AS	SRA	RAM

SAVED: I:\102\00390\01\A\GIS\Figs\A619_rA.mxd; Dec 19, 2013 5:16 PM; asimpson

NORONT RESOURCES LTD.

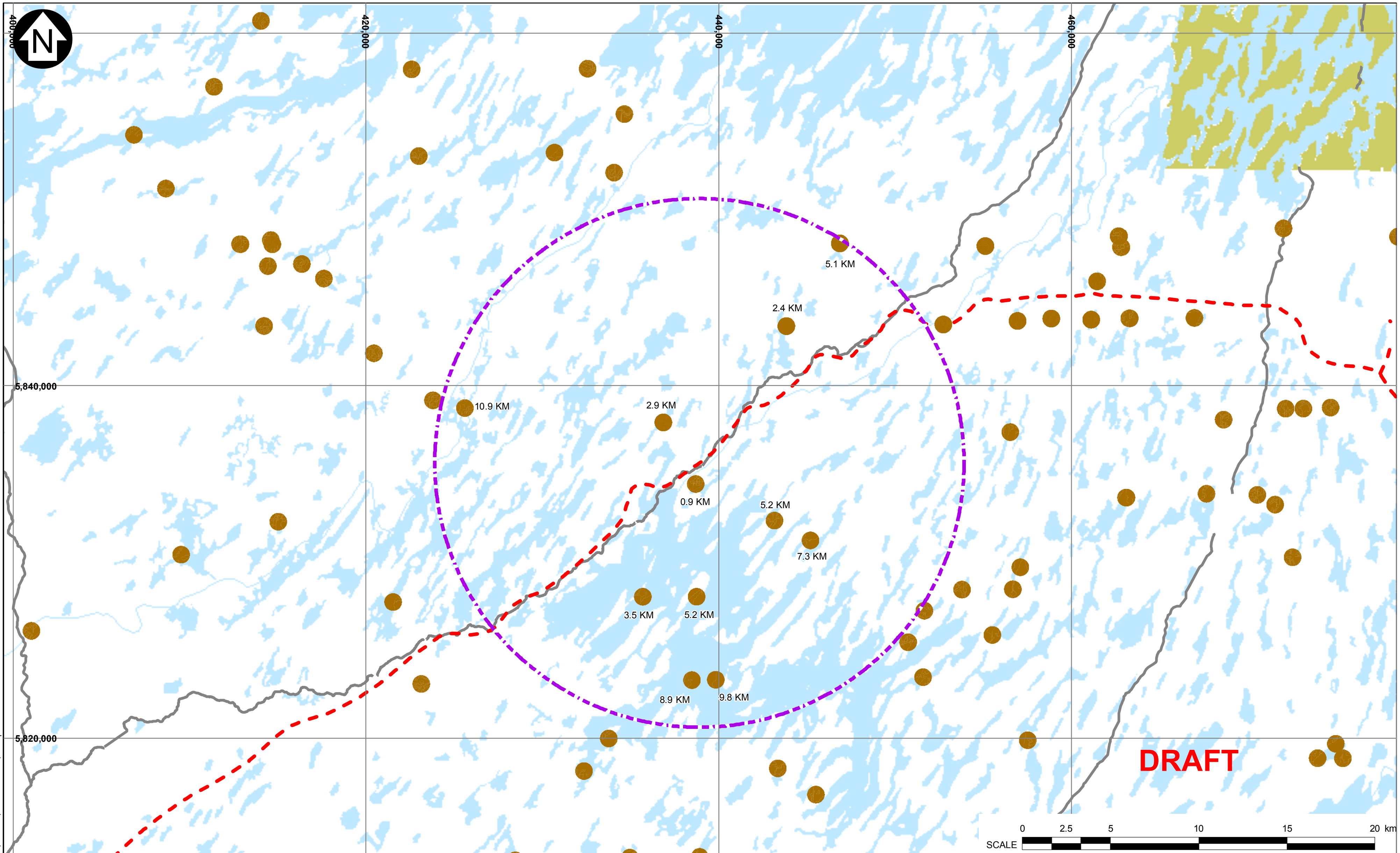
EAGLE'S NEST PROJECT

WOLVERINE WINTER OBSERVATIONS AT THE MINE SITE (15 KM RADIUS)

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 6.8-4 | REV A



SAVED: I:\1102\00390\01\A\GIS\Figs\A618_rA.mxd; Dec 19, 2013 5:17 PM; asimpson

LEGEND:

- MINE SITE
- COMMUNITY
- WOLVERINE OBSERVATION
- RAILWAY
- EXISTING ALL-SEASON ROAD
- WATER
- PARK
- FIRST NATIONS RESERVE
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- WOLVERINE WITHIN THE RSA
- 15 KM BUFFER ZONE

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. WOLVERINE OBSERVATIONS RECEIVED FROM THE OMNR (MAY 15, 2013).
4. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (NOVEMBER 26, 2013).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	PAQ	AS	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

WOLVERINE WINTER OBSERVATIONS AT THE EAST END OF THE WINTER ROAD (15 KM RADIUS)

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF NO. 34

FIGURE 6.8-5

REV A

Table 6.8-15 Wolverine Habitat in the 6.5 km Buffer

Far North Land Cover		Area Within RSA (ha)	Percent of RSA (%)	Area Within 6.5 km Buffer (ha)	Percent of Habitat in the 6.5 km Buffer Relative to the RSA (%)
Suitability	Category				
HIGH	Clear Open Water	339,784.5	13.4	38,602.1	1.5
	Disturbance - Treed and/or Shrub	21,836.7	0.9	41,195.6	1.6
	Mixed Treed	105,476.0	4.2	14,733.7	0.6
TOTAL HIGH		**467,097.2**	**18.5**	**94,531.4**	**3.7**
MEDIUM	Coniferous Swamp	199,282.8	7.9	35,061.2	1.4
	Thicket Swamp	20,671.6	0.8	3,838.5	0.2
	Deciduous Treed	76,056.5	3.0	12,443.5	0.5
	Open Fen	26,387.9	1.0	2,967.5	0.1
	Bedrock	1,737.8	0.1	236.6	0.0
	Disturbance- Non and Sparse Woody	171,641.4	6.8	4,469.7	0.2
	Sparse Treed	172,435.8	6.8	25,802.9	1.0
	Sparse Treed Fen	132,609.7	5.2	20,483.0	0.8
	Coniferous Treed	559,656.9	22.1	96,664.0	3.8
TOTAL MEDIUM		**1,360,480.4**	**53.8**	**201,966.9**	**8.0**
LOW	Treed Peatland	181,856.9	7.2	24,468.4	1.0
	Treed Bog	215,236.2	8.5	32,592.5	1.3
	Open Bog	305,501.0	12.1	38,801.1	1.5
TOTAL LOW		**702,594.1**	**27.8**	**95,862.0**	**3.8**

Potential Effects – Indirect Habitat Loss and Degradation

To ensure their persistence in the broader landscape, Wolverine populations require large habitat areas that are free from human disturbance (OWRT, 2011). They tend to avoid recently logged areas, areas with high road densities and human settlements. The impacts of mineral development of this scale on Wolverine are largely unknown and may range from displacement of individuals due to traffic noise (e.g., from helicopters and haul vehicles) to permanent conversion of habitat due to infrastructure and road networks (OWRT, 2011).

Major highways may ultimately affect gene flow and population persistence of Wolverine (Kyle and Strobeck, 2002), however, the influence of logging roads and mine access roads on Wolverine habitat suitability has not yet been determined (OWRT, 2011). Activities such as recreation, tourism, field research and air traffic have also been associated with the displacement of Wolverine from areas of suitable habitat (Krebs et al., 2007).

In Norway, May et *al.* (2006) found that Wolverine selected undeveloped areas for home range locations and that human development (houses, cabins, settlements, public and private roads) was more important in home range selection than habitat. Also in Norway, the mean distance from 50 natal dens to the nearest public road was 7.5 km and to the nearest private road was 3.1 km (May, 2007). Similarly, in Ontario Dawson et al. (2010) found a denning site that was 7 km from the closest active logging road and 5 km from the nearest human access (a mining trail).

Finally, activities such as recreation, tourism, field research, vehicle traffic and air traffic have also been associated with the displacement of Wolverine from areas of suitable habitat (Krebs et al., 2007).

Potential Effects – Mortality

Road development will result in higher incidences of vehicle collisions with Wolverine, particularly for young dispersing males (Krebs et al., 2004). Increased movements by juvenile males also make them more susceptible than females to trapping (traditional and incidental). Of all anthropogenic causes, incidental trapping of Wolverines has the greatest potential to cause declines in their populations (Ruggiero et al., 2007). Finally, a reduction in the density of Woodland Caribou in the Project area will result in fewer carcasses (wolf kills), which are an important food source for Wolverine in the winter.

Proposed Mitigation Measures

Appropriate mitigation measures regarding the removal of vegetation, sensory disturbances and mortality within the PDA will be utilized to protect Wolverine and their habitat as discussed in Table 6.8-4. With application of these mitigation measures, the Project is anticipated to minimize effects on the Wolverine population.

6.8.6.7 Woodland Caribou

Woodland Caribou will be affected by the Project through the following pathways:

- Direct habitat loss due to the PDA
- Habitat loss and degradation due to dust, noise, light and the presence of humans
- Potential mortality due to vehicle collisions along the road and increased harvesting

Potential Effects - Direct Habitat Loss

The potential effects of the Project on direct habitat loss, habitat fragmentation and habitat degradation for Woodland Caribou and provides proposed mitigation measures to eliminate or minimize these potential effects. With respect to habitat loss, only effects on late winter habitat were considered for the following reasons:

- Woodland Caribou are most vulnerable during late winter due to low energy reserves and severe weather conditions
- The influence of the winter road was not considered in the development of the RSF (resource selection function) models for the other three seasons (Golder Associates, 2012)
- Relative to the RSF models for the other three seasons, the greatest amount of high quality Woodland Caribou habitat adjacent to the transportation corridor is found during late winter

In addition, the RSA used for the late winter habitat RSF model (Golder Associates, 2012) was also used for this effects assessment for Woodland Caribou.

The loss of Woodland Caribou habitat in the RSA due to the PDA has been estimated as follows (Table 6.8-16; and Technical Supporting Document 18):

- High quality - 0.004 % of the RSA
- Medium quality - 0.0 % of the RSA
- Low quality - 0.0004 % of the RSA
- Nil quality - 0.006 % of the RSA

The amount of Woodland Caribou habitat in the 6.5 km degradation buffer (Section 6.8.5) around the transportation corridor and mine site has been estimated as follows (Table 6.8-16; and Technical Supporting Document 18):

- High quality - 0.4 % of the RSA
- Medium quality - 0.005 % of the RSA
- Low quality - 0.00001 % of the RSA
- Nil quality - 0.3 % of the RSA

Table 6.8-16 Suitability Summary of Woodland Caribou Habitat

Habitat Suitability	Amount of Suitable Habitat within RSA Area (ha)	Amount of Suitable Habitat within RSA Area (%)	Amount of Suitable Habitat within the TC PDA (ha)	Amount of Suitable Habitat within the Mine Site PDA (ha)	Amount of Suitable Habitat within the TC 6.5km (ha)	Amount of Suitable Habitat within the Mine Site 6.5km (ha)
NILL	6,039,237	23	1,427.4	0	61,388.6	5,004.9
LOW	6,816,992	27	108.81	0	3.6	0
MEDIUM	6,860,112	27	0	0	1,166.2	0
HIGH	5,861,493	23	953.5	33.1	83,515.4	16,861.9

All of the habitat losses due to the PDA are extremely low as are the amounts of habitat within the 6.5 km buffer (Table 6.8-16). All amounts except high quality (0.4 %) and nil quality (0.3 %) in the buffer are less than or equal to 0.005 %.

Due to the conversion of natural habitat to road, it is anticipated that Woodland Caribou will avoid suitable habitats adjacent to the new all-season road. This is due primarily to higher risk of predation by wolves and through avoidance due to sensory disturbances such as light and noise from road traffic and recreational activities. Avoidance of roads by Woodland Caribou has been documented up to a 30 km distance. Further discussion of the effects of road avoidance and sensory disturbances is provided in section 6.8.6.9 of this volume.

Carlson and Chetkiewicz (2013) applied a simulation model to the James Bay Lowlands, including the Ring of Fire, and concluded that "*simulated mining and hydroelectric development were sufficiently isolated at a regional scale to avoid large impacts to Caribou and Wolverine*."

No loss, degradation or fragmentation of preferred Caribou habitat is likely to occur during the construction of the trans-load facility as the infrastructure will be placed within an already disturbed site. The transmission line to the trans-load facility will be constructed along a previously disturbed corridor and minimal clearing of vegetation will be required. The access road to the trans-load facility will be upgraded; however, minimal clearing of vegetation will be required.

Potential Effects – Indirect Habitat Loss and Degradation

Roads result in a relatively small direct loss of habitat, however they can cause indirect habitat loss through avoidance at distances of 1 km to 30 km (Schindler et al., 2007; Vors et al., 2007; Polfus et al., 2011; Wasser et al., 2011). Vors et *al*. (2007) identified an avoidance threshold of 53 km for railways in northern Ontario. Dyer et al. (2002) found the greatest effect in late winter when Caribou crossed roads six times less frequently than expected. Schindler et al. (2007)

reported that a logging road was being crossed about one third as often as expected from comparisons to randomly generated roads.

Large resorts can affect Caribou to distances of 15 km to 25 km, however trails and cabins also have impacts (Nellemann et al., 2000, 2010). Polfus et al. (2011) reported avoidance of cabins and camps to a distance of 1.5 km. Caribou reaction to recreational snowmobiles has been documented, with fright and escape distances of under 1 km (Mahoney et al., 2001; Reimers et al., 2003). However, intensity of use may be important. In British Columbia, Caribou were displaced from an entire mountain block due to heavy snowmobile traffic, with the implication that "*complete displacement from high quality habitats could force Caribou into inferior habitats*." (Seip et al., 2007)

The literature regarding the effects of mining on Caribou is limited. Weir et al. (2007) detected changes to group structure of Caribou within 6 km of a mine site in Newfoundland during autumn, pre-calving and calving seasons. Caribou responded to the mine year-round, with a 4 km radius of avoidance detected in other seasons. Polfus et al. (2011) detected a zone of influence of 2 km around seasonally operating mines in British Columbia. Boulanger et al. (2012) examined the effects on migratory Caribou of open pit mines in Northwest Territories and found a reduced probability of Caribou occurrence within 14 km of the mine.

Potential Effects - Mortality

Development and use of the transportation corridor will likely increase Woodland Caribou mortality due to vehicle collisions. However, due to their general avoidance of roads, it is highly likely that this source of mortality will be much lower than for other wildlife species. Woodland Caribou that are closer to corridors (roads, trails, seismic lines and pipeline corridors, etc.) are also at higher risk of predation by wolves (James and Stuart-Smith, 2000). Wolves are known to use linear corridors to move through the landscape, where they can attain movement rates three times greater than movement through the surrounding forest (James, 1999).

Proposed Mitigation Measures

Appropriate mitigation measures regarding the removal of vegetation, sensory disturbances and mortality within the PDA will be utilized to protect Woodland Caribou and their habitat as discussed in Table 6.8-4. With application of these mitigation measures, the Project is anticipated to minimize effects on the Woodland Caribou population.

6.8.7 Potential Residual Effect and Determination of Significance

The physical loss, degradation or fragmentation of wildlife habitat (i.e., vegetation), sensory disturbances to wildlife and direct loss of wildlife were considered to be residual effects that cannot be completely mitigated. The relative significance of the residual effect was evaluated based on standardized assessment criteria including: magnitude, geographical extent, duration, frequency, reversibility, context, and probability of occurrence, as defined for upland habitats, rare species, and harvested plants (*CEAA* 1992; amended in 2010) (Table 6.8-17).

Ratings were assigned to the residual effect of the physical loss, degradation or fragmentation of wildlife habitat (i.e., vegetation), sensory disturbances to wildlife and direct loss of wildlife (Table 6.8-18). All adverse residual effects identified in the assessment were determined to be not significant due to a low or medium magnitude and a local geographical extent.

Table 6.8-17 Significance of Residual Effects on Wildlife

Criteria	Rating	Definitions
Magnitude	Low	Predicted effects on wildlife habitat, sensory disturbance and mortality
	Medium	Predicted effects on wildlife habitat, sensory disturbance and mortality not within the natural baseline variability but do not exceed any applicable regulatory thresholds
	High	Predicted effects on wildlife habitat, sensory disturbance and mortality are not within the natural baseline variability and exceed any applicable regulatory thresholds
Geographical Extent	Local	Within the LSA as defined for wildlife habitat, sensory disturbance and mortality
	Regional	Within RSA as defined for wildlife habitat, sensory disturbance and mortality
Duration	Short Term	Up to 3 years (e.g., the construction phase)
	Medium Term	Life of Project (11 years)
	Long Term	Beyond the life of the Project, or permanent
Frequency	Infrequent	Occurs occasionally
	Frequent	Occurs often or continuously
Reversibility	Reversible	Pre-Project conditions will return following the cessation of the potential residual effect
	Irreversible	Pre-Project conditions will not return following the cessation of the potential residual effect
Context	Low resilience	The VEC has low resilience to imposed stresses, or will not easily adapt to the effect
	High resilience	The VEC has a high resilience to imposed stresses, or will easily adapt to the effect
Likelihood	Low	Low probability that the predicted effect will occur
	High	High probability that the predicted effect will occur
Significance	Not Significant	Defined by VEC discipline
	Significant	Defined by VEC discipline

Table 6.8-18 Significance of Residual Effects on Wildlife

Residual Effect	Wildlife Group	Predicted Degree of Effect After Mitigation Measures								Significance of Residual Effect
		Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	
Removal of Vegetation for Project Development	Wolverine	Adverse	Medium	Local	Medium Term	Infrequent	Reversible	Low resilience	High	Not significant
	Caribou	Adverse	Medium	Local	Medium Term	Infrequent	Reversible	Low resilience	High	Not significant
Dust Emissions (Degradation)	Wolverine	Adverse	Medium	Local	Medium Term	Infrequent	Reversible	Low resilience	High	Not significant
	Caribou	Adverse	Medium	Local	Medium Term	Infrequent	Reversible	Low resilience	High	Not significant
Predator-Prey Relationship	Carnivores	Adverse	Medium	Local	Long Term	Infrequent	Irreversible	High resilience	High	Not significant
	Moose	Adverse	Medium	Local	Long Term	Infrequent	Irreversible	High resilience	High	Not significant
	Wolverine	Adverse	Medium	Local	Long Term	Infrequent	Irreversible	Low resilience	High	Not significant
	Caribou	Adverse	Medium	Local	Long Term	Infrequent	Irreversible	Low resilience	High	Not Significant
Noise and Light	Wolverine	Adverse	Medium	Local	Medium Term	Frequent	Reversible	Low resilience	High	Not Significant
	Caribou	Adverse	Medium	Local	Medium Term	Frequent	Reversible	Low resilience	High	Not Significant
Vehicle-wildlife interactions	Carnivores	Adverse	Medium	Local	Medium Term	Infrequent	Reversible	High resilience	High	Not significant
	Moose	Adverse	Medium	Local	Medium Term	Infrequent	Reversible	High resilience	High	Not significant
Increased access for harvesting activities	Waterfowl	Adverse	Medium	Local	Medium Term	Infrequent	Irreversible	High resilience	High	Not significant
	Furbearers	Adverse	Medium	Local	Medium Term	Infrequent	Irreversible	High resilience	High	Not significant
	Moose	Adverse	Medium	Local	Medium Term	Infrequent	Irreversible	High resilience	High	Not significant
	Wolverine	Adverse	Medium	Local	Medium Term	Infrequent	Irreversible	High resilience	High	Not significant
	Caribou	Adverse	Medium	Local	Medium Term	Infrequent	Irreversible	High resilience	High	Not significant

Section 7

Social, Economic and Cultural Effects

Knight Piésold
CONSULTING
www.knightpiesold.com

TABLE OF CONTENTS

PAGE

TABLES

FIGURES

7 – SOCIAL, ECONOMIC, AND CULTURAL EFFECTS

7.1 METHODOLOGY FOR ASSESSING SOCIAL, ECONOMIC AND CULTURAL EFFECTS

This section sets the context of the assessment of Project effects on the social, economic and cultural environments by describing the:

- Spatial and temporal boundaries of the assessment
- Project interactions with the social, economic and cultural environments
- The assessment criteria to be applied to the assessment of significance

Discussions on the potential effects on each VEC are presented in sections 7.2 through 7.10.

7.1.1 Assessment Boundaries

The assessment boundaries for social, economic and cultural environmental effects are based on the delineation of the potential extent of the Project's effects on communities in relatively close proximity to Project activities, including the mine site, transportation corridor, and trans-load facility. Regional and local study areas have been identified for the effects assessment were determined based on the anticipated zone of influence of project effects.

7.1.1.1 Regional Study Area

The RSA is the zone where there is reasonable potential for limited interaction between Project components and the social, economic and cultural environment. The social, economic and cultural environment is dynamic and as such not all VECs identified follow the same RSA. Table 7.1-1 identifies the effect assessment RSA for the respective VECs.

7.1.1.2 Local Study Area

The LSA is the zone where there is reasonable potential for immediate interaction between Project components and the social, economic and cultural environment. The social, economic and cultural environment is dynamic and as such not all VECs identified follow the same LSA. Table 7.1-1 identifies the effect assessment LSA for the respective VECs.

7.1.1.3 Temporal Boundaries

The temporal boundaries for the assessment are defined based on the timing and duration of Project activities that could induce effects to the social, economic and cultural environment. Effects will be identified with reference to activities occurring in one or more of the Project phases:

- Construction (3 years)
- Operation (11 years)
- Closure (2 years)
- Post-closure (a minimum of 5 years)

The current expected Project life is 16 years, inclusive of the construction, operation, and closure phases.

Table 7.1-1 Study Area Boundaries for Social, Economic and Cultural VECs

VEC	RSA	LSA
Community Dynamics	Potential effects are assessed for the Kenora and Thunder Bay districts. A greater emphasis is placed on the City of Thunder Bay as it is anticipated to experience the most effects of the communities in the RSA (Figure 7.1-1).	Potential effects are assessed for the potentially directly affected First Nation communities of Aroland, Attawapiskat, Eabametoong, Marten Falls, Mishkeegogamang, Neskantaga, Nibinamik, Ojibway Nation of Saugeen and Webequie; in addition to the municipalities of Pickle Lake, Ignace and Greenstone. These communities make up the LSA (Figure 7.1-2)
Human Health and Well-being		
Community Infrastructure and Public Services		
Training, Employment and Income		
Local and Regional Economy		
Cultural Resources	No RSA has been identified, as potential effects to cultural resources not expected to extend beyond the LSA.	The LSA is defined by the Project footprint including the mine site, transportation corridor and trans-load facility and a 100 meter buffer along the project footprint.
Aboriginal Resources and Land Use	The RSA is defined as a buffer area 40 km either side of the Project footprint including the mine site, transportation corridor and trans-load facility (Figures 7.1-3 and 7.1-4).	The LSA is defined by the Project footprint including the mine site, transportation corridor and trans-load facility and a 1 km buffer along the project footprint (Figures 7.1-3 and 7.1-4).
Current Use of Crown Lands and Resources for Recreational Purposes		
Navigable Waters		

LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- CONCENTRATE HAUL ROUTE
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- WATER
- RING OF FIRE CLAIM AREA
- SOCIO ECONOMIC RSA
- NWLHIN HEALTH RSA
- LAND AND RESOURCE USE RSA

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N.
3. ACTIVE CLAIM BOUNDARIES BY OTHERS WERE PROVIDED BY THE MINISTRY OF NORTHERN DEVELOPMENT AND MINES (AUGUST 2012).
4. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (NOVEMBER 26, 2013).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

SOCIO-ECONOMIC REGIONAL STUDY AREAS

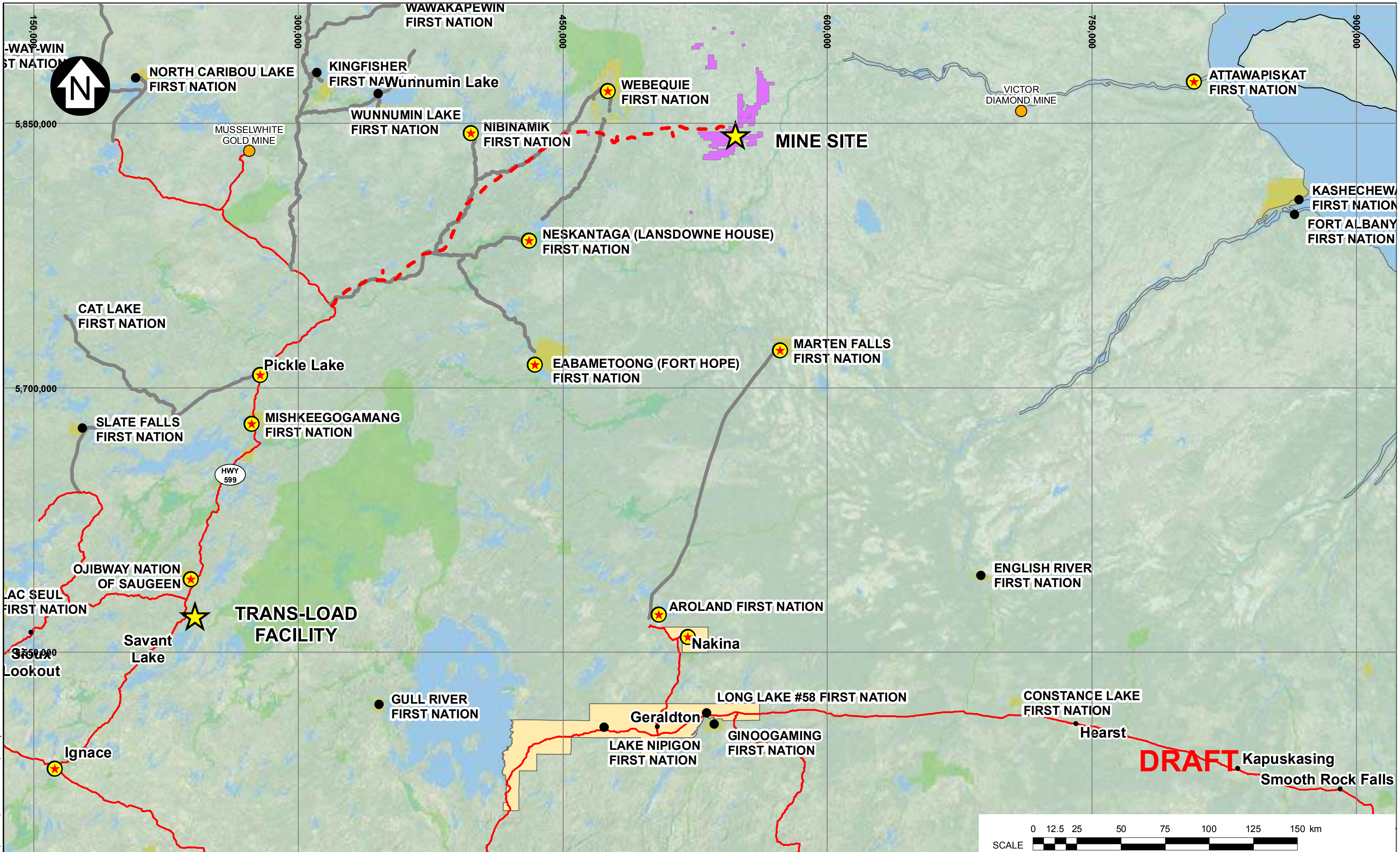
Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 7.1-1 REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	JSP	AS	SRA	RAM

SAVED: I:\1102\00390\01\A\GIS\Figs\A632_rA.mxd; Dec 20, 2013 11:09 AM; spenfold



LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- COMMUNITY
- COMMUNITY LOCATED WITHIN THE LSA
- OPERATING MINE
- MAJOR ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- EXISTING WINTER ROAD
- RAILWAY
- WATER
- FIRST NATIONS RESERVE
- MINERAL CLAIMS HELD BY NORONT
- MINERAL CLAIMS HELD BY OTHERS
- MUNICIPALITY OF GREENSTONE
- PARK

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY NORONT RESOURCES LTD. (NOVEMBER 26, 2013).
4. EXISTING WINTER ROAD NETWORK CREATED FROM DATA PROVIDED BY SNC-LAVALIN GROUP INC. (MARCH 24, 2011) AND DATA FROM THE OMNR LIO DATABASE (2009).
5. ACTIVE NORONT CLAIM BOUNDARIES WERE PROVIDED BY NORONT RESOURCES LTD. (MAY 23, 2013).
6. ACTIVE CLAIM BOUNDARIES BY OTHERS PROVIDED BY MINISTRY OF NORTHERN DEVELOPMENT AND MINES (AUGUST 2012).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	JSP	AS	SRA	RAM

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

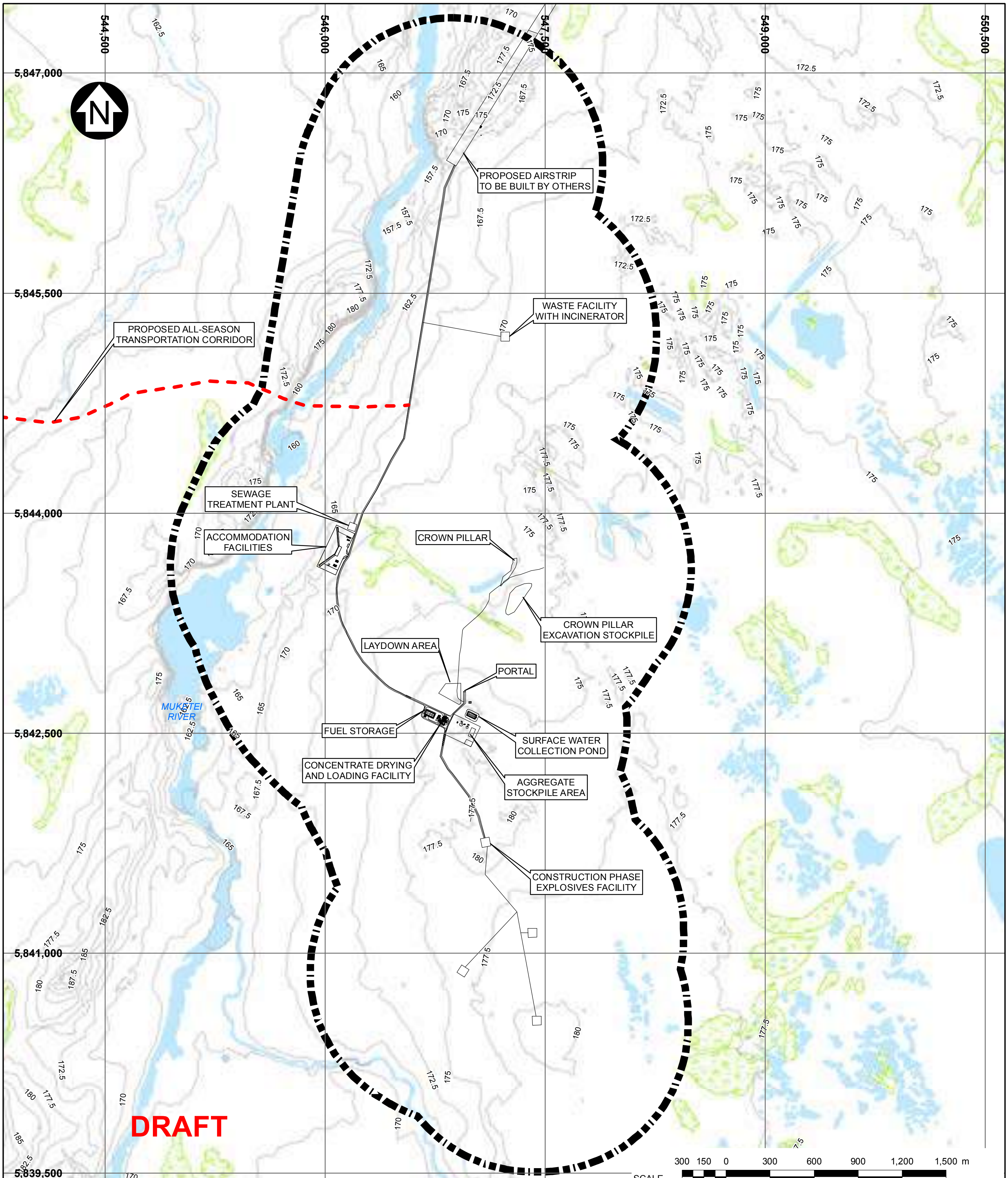
SOCIO-ECONOMIC LOCAL STUDY AREAS

Knight Piésold CONSULTING

P/A NO. NB102-390/1 | REF NO. 34

FIGURE 7.1-2 | REV A

SAVED: I:\102\00390\01\A\GIS\Figs\A630_rA.mxd; Dec 20, 2013 9:03 AM; asimpson



SAVED: I:\1102\00390\01\A\GIS\Figs\A642_rA.mxd; Dec 18, 2013 1:40 PM; spenfold

LEGEND:

- MINE SITE
- PROPOSED INFRASTRUCTURE
- CONTOUR
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- RESOURCE, LAND USE AND NAVIGABLE WATERS LOCAL STUDY AREA

NOTES:

1. BASE MAP PROVIDED BY SNC-LAVALIN GROUP INC. (2010).
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. CONTOUR INTERVAL IS 2.5 METRES.
4. INFRASTRUCTURE INFORMATION PROVIDED BY NORONT RESOURCES LTD. (MAY 30, 2013). LOCATIONS ARE APPROXIMATE.
5. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY KIEWIT INFRASTRUCTURE ENGINEERS (NOVEMBER 26, 2013).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

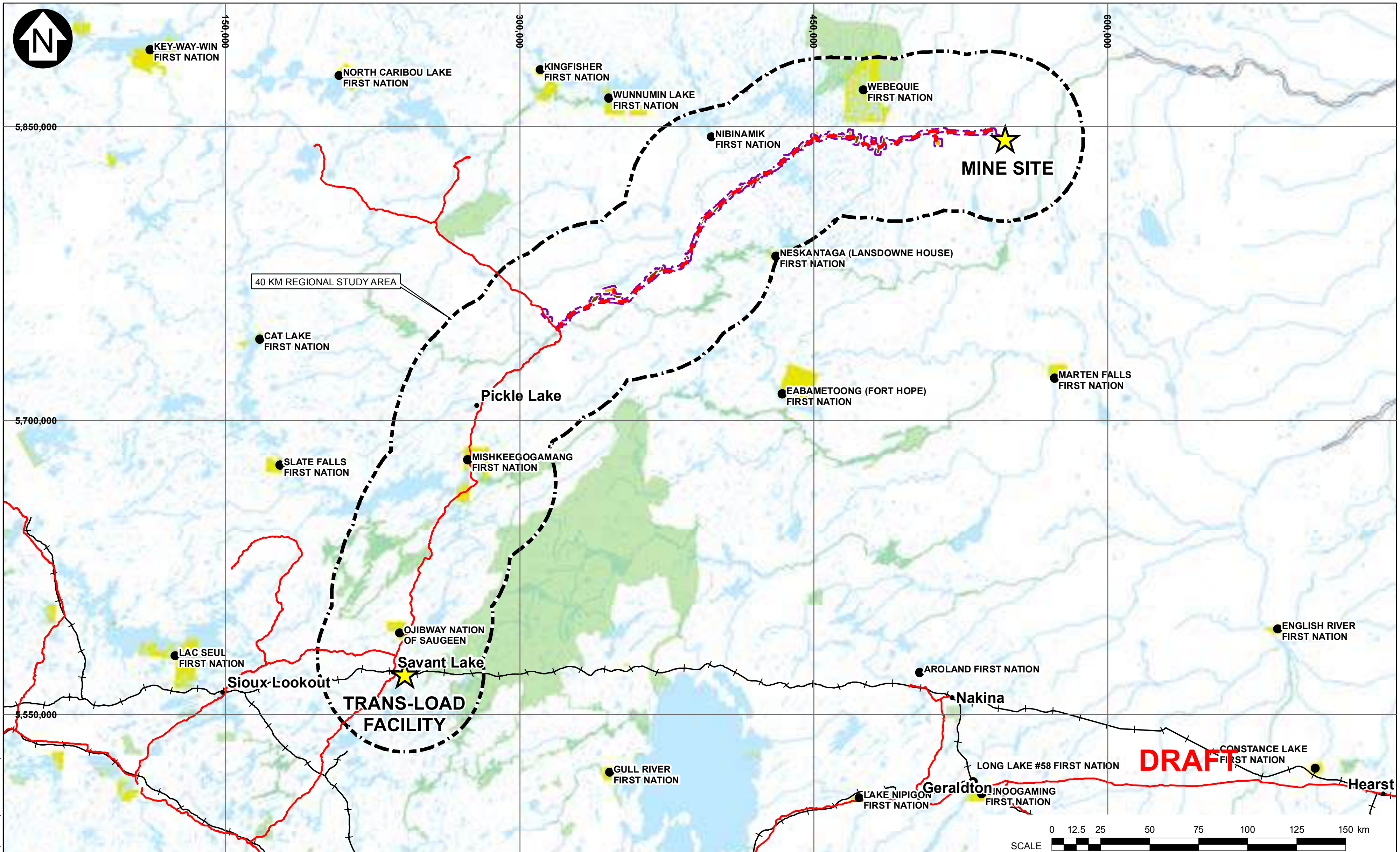
MINE SITE
LOCAL STUDY AREA

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	DKK	SWK	SRA	RAM

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 7.1-3 REV A



LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- COMMUNITY
- EXISTING ALL-SEASON ROAD
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- RIVER/STREAM/DRAINAGE
- WATER
- PARK
- FIRST NATIONS RESERVE
- PROPOSED BORROW SOURCE
- PROPOSED QUARRY SOURCE
- REGIONAL STUDY AREA
- LOCAL STUDY AREA

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 16N.
3. PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR PROVIDED BY KIEWIT INFRASTRUCTURE ENGINEERS (NOVEMBER 26, 2013).

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

LAND AND RESOURCE USE REGIONAL AND LOCAL STUDY AREAS

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 7.1-4 REV A

A	20DEC'13	ISSUED WITH REPORT	DKK	SWK	SRA	RAM
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

SAVED: I:\102\00390\01\A\GIS\Figs\A641_rA.mxd; Dec 18, 2013 4:55 PM; skozmick

7.1.2 Potential Interactions and Effects

The Project includes the development and operation of an underground mine and associated surface infrastructure, an approximately 280 km all-season access road, and a trans-load facility on an existing rail line. The phases of the Project considered in the assessment are construction, operation, and closure. Potential interactions of these Project components and potential effects are identified in Table 7.1-2.

Table 7.1-2 Interaction Summary for Social, Economic and Cultural Environment

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Ground preparation (e.g., cut, fill, grub, etc.)	C	Yes	Potential disturbance of cultural heritage sites; effects to traditional and non-traditional land and resource use
Construction of surface infrastructure	C		
Road construction (includes culvert, bridge installation)	C	Yes	Potential disturbance of cultural heritage sites; effects to traditional and non-traditional land and resource use; navigable waters
Aggregate and borrow development	C, O	Yes	Potential disturbance of cultural heritage sites; effects to traditional and non-traditional land and resource use
Construction camps	C		
Construction of rail siding at TLF	C		
Construction of buildings and loading facility at TLF	C		
Road maintenance	O	Yes	Effects to traditional and non-traditional land and resource use
Equipment and vehicle use	C, O		
Underground mine development	C	No	No interaction
Underground mine operation	O		
Underground ore processing and concentrate loading	O		
Tailings production and underground disposal	O		
Mining of crown pillar	O	Yes	Potential disturbance of cultural heritage sites; effects to traditional and non-traditional land and resource use
Aggregate production	C, O		
Construction of site roads	C		
Accommodation facility operation	C, O		
Power plant operation	C, O		
Fuel storage and distribution	C, O		
Equipment and vehicle use	C, O, CL		
Explosives use, handling and storage	C, O		
Groundwater use	C, O	No	No interaction
Surface water management (non-contact water)	C, O, CL	Yes	Potential effects to land and resource use (drinking water on the land)
Waste management: solid and sewage waste facilities	C, O, CL	No	No interaction
Hazardous materials handling and storage	C, O, CL	Yes	Potential safety concern (addressed in Section 8.3 Accidents and Malfunctions)
Installation of transmission line within existing right of way at TLF	C	No	Effects to traditional and non-traditional land and resource use
Operation of concentrate loading facility	O	No	Effects to traditional and non-traditional land and resource use
Equipment and vehicle use	C, O, CL	No	Effects to traditional and non-traditional land and resource use
Physical mine closure activities	CL	Yes	Effects to traditional and non-traditional land and resource use

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Training programs	C, O	Yes	Education and training; employment and income; health and well-being
Mine staffing	C, O, CL	Yes	Employment and income Health and well-being
Procurement of goods and services	C, O, CL	Yes	Business opportunities; indirect employment; increased income; local and regional economic development
Mine closure	CL	Yes	Potential effects to land and resource use (drinking water on the land); loss of employment and income ; potential decrease in health and well-being

7.1.3 Determination of Significance of Residual Effects

The relative significance of residual effects identified throughout Section 7 are evaluated based on standardized assessment criteria including: magnitude, geographical extent, duration, frequency, reversibility, context and likelihood of occurrence as described in Section 2. The general definitions for each assessment criterion have been modified for evaluating social, economic and cultural effects as described in Table 7.1-3.

Table 7.1-3 Assessment Criteria of Residual Effects to the Social, Economic and Cultural Environments

Criteria	Rating	Definitions
Magnitude	Low	• Within the range of the baseline • Individual level changes may occur
	Medium	• Moderately different from the baseline • Household level changes may occur
	High	• Substantially different from the baseline • Community level changes may occur
Geographical Extent	Local	Effect limited to the LSA
	Regional	Effect limited to the RSA
	Country	Effect felt across the country
Duration	Short Term	Up to 3 years (e.g., the construction phase)
	Medium Term	Life of Project (11 years)
	Long Term	Beyond the life of the Project, or permanent
Frequency	Infrequent	Occurs occasionally
	Frequent	Occurs often or continuously
Reversibility	Reversible	Effect is reversed after the activity ceases
	Irreversible	Effect will not be reversed after the activity ceases, or the effect is permanent
Context	Low resilience	Low resilience to imposed stresses, or will not easily adapt to the effect
	High resilience	High resilience to imposed stresses, or will easily adapt to the effect
Likelihood	Low	Low likelihood that the predicted residual effect will occur
	High	High likelihood that the predicted residual effect will occur

Where further variations from the above table are required to appropriately assess a potential residual effect, the revised assessment criteria will be identified in the appropriate section.

7.2 COMMUNITY DYNAMICS

7.2.1 Introduction

Community dynamics can refer to the demographics of a community, as well as power structures, ethnic or religious divisions, traditional hierarchies, and any stated strategic planning directions of a community. The Project will interact with community dynamics mainly in the First Nation LSA communities owing to their small size and lack of an established wage economy that is integrated with the rest of the region.

7.2.2 Rationale for VEC Selection

The rationale for VEC selection is provided in Table 7.2-1 below.

Table 7.2-1 Community Dynamics VEC Selection and Rationale

VEC	Key Indicators	Rationale
Community Dynamics	Interaction of the Project with various strategic priorities and initiatives (i.e., community land use plans); demographic structure and composition, in and out migration; community level changes as a result of the Project	The Project will interact with smaller communities: changes to the demographics, power structures and community initiatives, will be notable. Community dynamics was identified as a regulatory concern by the Government of Ontario during a scoping meeting on the environmental assessment

7.2.3 Potential Interactions and Effects

The Project is expected to have the following effects that may interact with the community dynamics of the communities in the LSA:

- In-migration and increased mobility within the RSA
- In and out-migration within First Nation communities
- Capacity building within First Nations communities
- Increased competition for skilled workers within smaller communities early in the Project
- Potential interactions with current and planned community initiatives

A discussion regarding these potential effects is provided sections 7.2.4.1 through 7.2.4.5.

In addition to the above potential effects, the Project could alter the power structures or traditional hierarchies in each community. These changes may result in part from increased income by individuals, families or groups within the community. It is recognized that this may occur but these effects are specific to each community and existing power structures are not well understood, so an assessment is not possible.

7.2.3.1 In-Migration and Mobility within the RSA

The Project is anticipated to employ approximately 800 individuals during the construction phase (approximately 450 at the mine site and approximately 350 for the transportation corridor and trans-load facility) and approximately 390 individuals during the operation phase.

Employment opportunities as a result of the Project will not only be limited direct employment. Indirect jobs will be created in industries that either supply good or services to the Project. Induced jobs, those created as a result of employees spending additional income in the overall economy, will also be created. Induced and indirect jobs are estimated to be a factor of 2.5 to one for the Project (MAC, 2012). The creation of these additional jobs has the potential to attract potential employees to the region.

The employment opportunities offered by this Project may result in some individuals moving back into communities in the LSA. The non-Aboriginal communities in the LSA may see a greater increase in population than the remote communities and the RSA. Larger centres such as Thunder Bay and Kenora may see an increase in population due to the development of the Project.

As indicated in the City of Thunder Bay's mining readiness strategy indirect and induced jobs as a result of mining development in northwestern Ontario are anticipated to be approximately 7,000 (Thunder Bay CEDC, 2013). In northwestern Ontario there are approximately 9,800 unemployed residents (both Aboriginal and non-Aboriginal) (Thunder Bay CEDC, 2013). Since the number of total unemployed residents is spread out across a vast region it is anticipated that some individuals may decide to move to centres where employment supporting mining development in the region is available.

Individuals who previously resided in the area may wish to return in order to pursue the improved employment prospects as a result of Project development. With respect to the remote communities individuals that were required to leave the communities for employment may decide to return to the community. This is because employment with the Project affords these individuals the opportunity to live in their home community and still be employed.

With respect to the Eagle's Nest Mine, the number of indirect and induced jobs can largely be sustained by the local unemployed population. As a majority of the support services to the mine will need to be strategically located in easy access to the Project, Noront will target local businesses and local residents to initiate businesses that may service the Project thereby limiting the number of individuals outside of the LSA and Thunder Bay that will potentially relocate in order to seek employment. If some individuals do decide to move in order to pursue indirect and induced job opportunities, they will more likely move to a larger centre such as the city of Thunder Bay. The number of potential job seekers that may relocate is anticipated to be minimal and not significantly affect the overall community dynamics of the city.

Overall the anticipated level of increase in population is expected to be minimal and not result in significant changes to population demographics in the study areas. As such no residual effects with respect in in migration of Project employees are anticipated.

Mitigation Measures

Although the potential influx of Project employees into the LSA communities and Thunder Bay is anticipated to be minimal, mitigation measures have been developed in order to reduce the effect the smaller communities in the LSA may face.

The Project will target most of its employment for the available labour market in the LSA and RSA. It is anticipated that a majority of employees will be from Thunder Bay and the First Nation communities identified in the LSA. Since the majority of potential employees are already within the regions (which would have otherwise seen an increase in population) the increase of the population is predicted to be minimal.

In order to bring employees to the mine site for work, Noront will supply transport from key community locations. Air service will originate in Thunder Bay picking up employees from LSA communities along the route to the mine site. This reduces the need of employees to move to particular centers in order to be eligible for employment with the Project, thereby reducing the population influxes in certain locations.

In order to limit the potential effect of migration of indirect and induced employees as a result of the Project Noront, as indicted above, intends to target local businesses for the supply of services. In addition, Noront has indicated their intention to support the development of First Nation lead business ventures that may provide goods and or services to the Project. This initiative would limit the potential influx of job seekers from outside of the area as it will target local First Nation communities and their members.

7.2.3.2 In and Out-Migration within First Nation Communities

The fly-in/fly-out jobs created by the Project will provide residents in the LSA with a choice related to residency. As a result out-migration of the population from the LSA, particularly the remote First Nation communities, may occur. Local individuals that gain employment from the Project will see an increase in their disposable incomes which may make them more inclined to move to areas where a greater number of services are available. At the level of individuals and families having the option to move to a better serviced area may be experienced as a positive effect. At the community level, the out-migration of individuals may change the community dynamics and may also reduce some strain on community infrastructure such as housing.

Some in-migration may also be experienced as individuals that were required to leave the communities for employment may decide to return to the community. This is because employment with the Project affords these individuals the opportunity to live in their home community and still be employed.

The provision of transportation to the mine site by Noront, from main centres and LSA communities, will enable individuals to pursue relocation if they so desire.

Mitigation Measures

Noront intends to target the local population for employment including First Nation community members residing on-reserve in the LSA. By targeting the local population, there is a reduced need for individuals to leave their communities in order to be eligible for work.

7.2.3.3 Capacity Building within First Nation Communities

The development of the Project is reliant on obtaining an educated and trained workforce. The number of individuals with a desire to enhance their educational attainment and to gain training is expected to exceed the number of jobs available with the Project. This assumption is supported through the results obtained by the needs analysis for training and education opportunities conducted by Confederation College, with the support of Matawa First Nations, WorkBay.Net and Noront. Approximately 2,500 individuals across northwestern Ontario (including 1,000 Matawa First Nations members) expressed their interest in training. The resulting database provides compelling evidence that several thousand individuals seek to participate in today's economy. The number of individuals interested in training and enhancing their education exceeds the number of positions available at the Project during the construction and operation phases (discussion regarding employment effects is presented in section 7.5).

A lack of capacity has been identified as an issue of concern in First Nation communities. This lack of capacity reduces the communities' abilities to effectively deal with various community issues or concerns that may arise, to meaningfully contribute to development projects that may be occurring in their areas and to adequately manage the community. With large numbers of individuals enhancing their education and training, the educational and trained capacity within the LSA and RSA is anticipated to increase. The increase in capacity is anticipated to be more prominent in the smaller communities of the LSA than in larger centres.

Increases in education and trained capacity in the communities will enhance the pool of individuals that can contribute to the successful progress of their communities and to greater level of self-reliance at the individual level and ultimately the community level.

Mitigation Measures

To enhance the benefits of increased education and trained capacity all individuals who wish to pursue additional schooling and training, particularly First Nation community members, will be encouraged to do so. The ROFATA is a program that is intended to help Aboriginal people gain the appropriate training to be eligible for employment with the Project and any future mine developments in the area. Training and education is encouraged in a variety of positions not simply for jobs targeted at the trades or skilled workforce. Positions in the mining industry range from skilled labourers to administrative staff, in addition to the various support services positions such as cooks, manufactures, truck drivers, etc. By encouraging individuals to pursue various avenues of education and training the general capacity at the community level will also increase.

7.2.3.4 Competition for Skilled Workers

As noted in the Socio-economic Baseline TSD 14, education and training rates are lower in the First Nation communities than in the non-Aboriginal LSA communities, the RSA and Ontario overall. This points to an overall need for skilled workers in these communities. Although training and educational enhancement programs are beginning to roll out in the LSA and RSA, a lag in the availability of skilled workers is anticipated.

This lag will result in competition for skilled workers during the early phases of the Project. Skilled workers from the LSA communities are generally already employed either within the community or in other sectors. The prospects of a new job may be attractive to potential employees who may decide to leave their current positions. As a result, communities that rely on the somewhat limited pool of skilled workers can be indirect competition for these employees in the early phases of the Project. This effect can bring strain on the availability, delivery and quality of services in the communities, thereby affecting the overall community dynamic.

Mitigation Measures

In order to minimize the potential adverse effect of competition for skilled workers between the LSA communities and the Project, Noront intends to encourage training early enough to increase the pool of skilled workers available. This is realized through the already developed ROFATA and the promotion of various programs offered to individuals in northwestern Ontario that will help prepare them for the job market in the near future.

7.2.3.5 Current and Planned Community Initiatives

A summary of current and planned community initiatives is provided in the Socio-economic Baseline TSD 14 in sections 8.8 and 9.1. The main community initiatives that will interact with the proposed development of the Project are the Community Based Land Use Plans (CBLUPs) being developed by First Nation communities under the *Far North Act* (2010). All First Nation communities identified in the LSA (with the exception of Ojibway Nation of Saugeen, which falls outside of the area of undertaking for CBLUPs) are required to develop CBLUPs. As of November 2013, no approved CBLUPs have been established within the area of proposed Project development. This has a direct effect on the development of the Project because under Section 12 of the *Far North Act*, opening a mine is prohibited where CBLUPs do not exist.

Other planned First Nation community initiatives which may benefit as a result of the Project are the connectivity and fibre projects planned to enhance technological connectivity in the remote communities. The development of the all-season transportation corridor may enhance the ability of such infrastructure in reaching the remote First Nation communities.

In the non-Aboriginal LSA communities current and planned initiatives that have been identified are specific to municipal infrastructure such as sewage treatment plant upgrades and municipal road upgrades. These initiatives are not anticipated to interact with the proposed Project.

Mitigation Measures

The major interaction the Project will have wit current and planned community initiatives is with the CBLUPs. Noront is dedicated to collecting ATK data to further enhance their understanding of the area proposed for developed as noted in the Aboriginal Traditional Knowledge Study Plan (Volume 4, Section 15). By encouraging and supporting the collection of ATK data Noront will help facilitate the collection of data that can be used to inform the CBLUPs.

7.2.4 Potential Residual Effects and Determination of Significance

The relative significance of residual effects was evaluated based on a suite of standardized criteria including: magnitude, geographical extent, duration, frequency, reversibility, context and likelihood of occurrence. A rating was assigned and compiled in Table 7.2-2 to the residual effect of out-migration.

Table 7.2-2 Significance of Residual Effects on Community Dynamics

Residual Effect	Predicted Degree of Effect After Mitigation Measure								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	
Out-migration	Adverse	Medium	Local	Medium Term	Infrequent	Reversible	High	High	Not Significant
Competition for Skilled Workers	Adverse	Low	Local	Short Term	Infrequent	Reversible	High	High	Not Significant

7.2.5 Discussion of Significance

Out-Migration

The rate of out-migration may be moderated by a return by some individuals and families who have left work outside of their home communities. At the community level, out-migration from the remote LSA communities may present both positive and negative effects, such as severance of close relations (negative effect) and reduced strain on community infrastructure such as housing (positive effect). The effect is assessed to not be high enough to affect community process in a substantial manner.

Some out-migration is anticipated, however, with Noront utilizing local communities as points of hire, the level of out-migration is expected to be of medium magnitude and infrequent. Therefore the residual effect of out migration on community dynamics is assessed to be not significant.

Competition for Skilled Workers

The competition for skilled workers may be moderated by the availability of education enhancement and training programs available in advance of Project construction. This will help develop a larger pool of potential employees. As a result the magnitude for this residual effect is deemed low, the duration short term (limited to early phases of the Project) and infrequent.

7.2.6 Follow-up Program

Change of residency of Project employees from the LSA should be included in Project monitoring to act as a quantitative indicator of the level of migration in the LSA as a result of the Project. Qualitative data gathered from the perceptions of community members should also be collected to provide additional context to the quantitative indicator.

Education and training attainment rates should be included in early Project planning to ensure a sustainable pool of potential employees is available for the duration of the Project.

7.3 HUMAN HEALTH AND WELL-BEING

7.3.1 Introduction

Human health and well-being can refer to health of an individual, the community and to the overall social well-being of the study population.

7.3.2 Rationale for VEC Selection

The rationale for VEC selection is provided in Table 7.3-1 below.

Table 7.3-1 Human Health and Well-being VEC Selection and Rationale

VEC	Key Indicators	Rationale
Human Health and Well-being	Community health, use of emergency and protection services, trends in substance abuse and crime rates, air and water quality, food quality and quantity and country food use	The Project may have potential effects on overall human health as a result of environmental impacts and food security. Project related income and work could result in social and behavioural changes and thereby affect the well-being of individuals, families and communities.

7.3.3 Potential Interactions and Effects

The Project is expected to have the following effects that may interact with human health and well-being:

- Human health effects of the Project
- Improved household food security
- Changes in substance abuse and crime rates
- Improved quality of life and lifestyle
- Changes in parenting

A discussion regarding these potential effects is provided sections 7.3.3.1 through 7.3.3.5. An assessment of the potential human health risks as a result of the Project is provided in the Screening Level Human Health Risk Assessment TSD 16.

7.3.3.1 Human Health Effects of the Project

Noront conducted a Screening Level Risk Assessment (SLRA) to assess the potential risks and effects to human health as a result of the Project (Human Health Risk Assessment TSD 15). The results from the SLRA indicated that no adverse human health effects are anticipated as a result of the development of the Project.

The assessment determined that surface water will remain safe for all potable purposes and due to the location of the Project there will be no effect to potable groundwater supplies. All predicated air concentrations as a result of the Project are assessed to be less than the health-based air quality criteria selected for human health risk assessment purposes. No feasible or operable transport pathways into country foods have been identified based on the evaluation of air and water quality impacts. Qualitative evaluation of country foods indicated that biota, including country foods, will not be affected as a result of Project development.

The health and safety of employees is protected through workplace health and safety procedures (as identified in Volume 4, Section 5) and regulations. Noront will certify all safety regulations are met to ensure the health and safety of Project employees is maintained. To reduce the likelihood of workplace injury the Project is designed to include a strong focus on worker safety. All employees will be required to undergo safety training specific to their job and the work conditions. Personal Protective Equipment (PPE) will be required by all personnel. Details regarding workplace health and safety are provided in Volume 4, Section 5.

Overall the Project is not anticipated to have adverse effects on the health of residents in the LSA and on the health and safety of its workers. As such this effect is not carried forward to further assessment.

7.3.3.2 Household Food Security

Food security is of high importance for all households. It helps ensure individuals are able to consume the required amount of food and nutrition in order to live healthy and productive lives. In the remote First Nation communities several food security challenges exist. These are assumed to include:

- Affordability of retail food relative to household income
  - Food costs in the remote LSA communities are higher in comparison to food costs in the RSA. This coupled with generally lower household incomes impedes the ability of households in affording adequate food to ensure long term food security.
- Knowledge required to choose nutritious options
  - The quality of available nutritious food is often limited. Food is delivered by plane to communities (Attawapiskat First Nation is also eligible for the Nutrition North Canada program) thus limiting the available supply of nutritious and perishable items. Educational programs are often available in communities to help individuals make the right choice when grocery shopping.
- Spending choices
  - With limited household incomes, making wise spending choices is important to maintain food security. Managing money can be a challenge when other items need to be purchased or when vices take up a greater portion of the household budget.
- Ability to consume country foods
  - Going out on the land to practice various harvesting activities is an important activity within the communities of the LSA. Country food is a good source of nutrition for the community, although it is often expensive to be able to go on the land to harvest.

The Project is expected to have beneficial effects on food security. This is largely as a result of increasing household income which will enable individuals to purchase foods and afford to harvest country foods more regularly. The overall benefit is dependent upon the decisions individuals will make with respect to spending and money management. In order to enhance the positive effect an increased income will have on food security, Noront will offer personal life-training to all employees to help them prepare money goals and to help employees learn money management. Improved food security is an induced effect of increased income (increased income is discussed in Section 7.5) and is not anticipated to have a residual effect and is therefore not carried forward for further assessment.

7.3.3.3 Substance Abuse and Crime Rates

Substance abuse has been identified as an area of concern in many of the communities of the LSA. Substance abuse can be affected as a result of the Project in several ways, including:

- Transportation of alcohol and drugs through the transportation corridor and mine site
- Ability to afford alcohol and drugs
- Perspective toward substance abuse

Transportation of Substances

The development of an all-season transportation corridor can potentially increase the access of drugs and alcohol in remote First Nation communities. The transportation corridor will provide easier and in some instances less expensive means of transporting drugs and alcohol into communities. Availability of drugs would increase in the community while the price of addictive substances may decrease due to the easier access.

The mine site itself may potentially act as a point of transfer of alcohol or drugs. Employees travelling to site may bring these substances with them to provide them to workers leaving site or to those still on site. In order to reduce the likelihood of this occurrence, Noront will employ a strict zero-tolerance policy in compliance with the *Ontario Occupational Health and Safety Act (*1990c). No alcohol or non-prescription drugs will be permitted at any of the work sites. Individuals found to be in violation of this policy will be escorted off the Project site on the next available flight. Further details regarding the drug and alcohol policy is contained within Volume 4, Section 2.

Ability to Afford Drugs and Alcohol

Due to direct, indirect and induced employment as a result of the Project, income of individuals and households is anticipated to increase (as discussed in Section 7.5). Increased income will lead to higher levels of disposable income that can be spent at the earners discretion. If individuals are currently struggling with addiction, or have struggled with addiction the past, the temptation of being able to afford drugs and/or alcohol may increase their likelihood of making these purchases.

Perspective toward Substance Abuse

The Project may help change individuals' perspective toward substance abuse. In order to be an eligible and productive employee individuals' will have to be sober when they report to work and be able to show up in time for travel to site. Furthermore, the proposed work schedule consisting of two week rotations will require individuals to be able to be without substances for two weeks at a time.

Improved employment opportunities may provide long term goals for the younger generations which may help sway them away from recreational drug and alcohol use. During community engagement sessions it was noted that because youth do not have long term objectives, such as employment, to strive towards they are more likely to engage in destructive habits. By providing increased education and training opportunities, leading to employment at the Project, there is potential benefit in shifting their attitudes and perspectives about drug use.

Crime Rates

Potential increases in population as a result of the Project may induce increased crime rates. However, as noted in Section 7.2 increases in populations in the smaller communities are not anticipated to be significant. Where greater increases in population may occur, in the larger regional centres, the potential increase is not anticipated to be measurable and thus any potential increases in crime rates are not anticipated to be measurable.

Crime rates may also increase as a result of increased drug and alcohol abuse. Individuals suffering from the effects of these substances may be more inclined to commit criminal offenses. Low income levels, being unemployed and having low education attainment have been identified as factors that are often linked elevated risks of committing criminal offences or being victimized by a crime (Brzozowski, et al. 2006). As a result improvements in these factors from the development of the Project may result in reduced crime rates.

Mitigation Measures

Noront will, in order to reduce the potential adverse effects of substance abuse as a result of Project, employ a zero-tolerance policy that will deter the potential abuse of drugs and alcohol while on site. The two week rotational schedule will be a further deterrent to drug and alcohol abuse, as the two weeks on site will be drug free. Personal life training offered to Project employees will help individuals manage personal life and goals in light of the new employment opportunity.

7.3.3.4 Quality of Life and Lifestyle

Changes to individuals' lifestyle and overall quality of life are anticipated to improve as a result of the proposed Project. Lifestyle changes will be most prominent among individuals who are currently unemployed and receive employment through the Project. These changes may include:

- Improved education levels and training, which leads to higher levels of self-reliance and confidence
- Employment, which results in increased incomes that will ultimately lead to greater financial stability and potential changes in residency (i.e., individuals moving to larger centres).

The beneficial effects to quality of life will be more pronounced in the smaller communities than the larger centres. This is due to the fact that small changes in income and education have a much larger effect in smaller populations. These same increases in income and education will likely go unnoticed in larger centres. Furthermore, the potential beneficial effects on quality of life will be more pronounced in communities where IBAs with Noront are negotiated.

More opportunities as a result of the Project, either due to income derived from employment or monetary benefits from IBA negotiations, may result from the development of the Project. These opportunities include recreational travel, attending various cultural and entertainment events and an improved ability to go out on the land to harvest or camp.

IBAs negotiated with communities will be confidential but quality of life improvements will result. These improvements may be product of increases in funding that aim to improve health care access and/or overall community infrastructure and services.

7.3.3.5 Parenting

Parenting and parenting dynamics within households may change as a result of the Project. The fly-in/fly-out schedule of Project employees will be the largest factor changing parenting within the effected households. Parents will be in the home approximately half the time and their absence may result in additional stresses put on other parental figures in the household or on the children themselves. Concerns children may have with respect to rotation style of work are missed important occasions, such as birthdays, ceremonies or sporting events, transitions associated with the parent coming and leaving the household every two weeks, and inconsistency in routines or parenting styles.

Parents themselves may undergo changes as a result of the Project. In some instances the changes will be beneficial while in others adverse. Beneficial changes may include improved mental health and well-being as a result of employment and subsequent increases in income, increased confidence and self-reliance as a result of greater financial stability and independence and potentially reduced substance abuse. Adverse changes may include increased domestic conflict as a result of the stress of being away from home, increased fatigue leading to low desires of family interaction and anxiety over the partners' absence while he/she is away on rotation. Some families are anticipated to experience overall beneficial effect related to the changes in parenting while others may experience more adverse effects.

Mitigation Measures

Personal life training offered through the Project, as noted in Volume 4, Section 2, will help individuals to cope with the personal challenges that may arise from new employment opportunities. This will help reduce potentially adverse changes to parenting and enhance beneficial changes to parenting.

7.3.4 Potential Residual Effects and Determination of Significance

The relative significance of residual effects was evaluated based on a suite of standardized criteria including: magnitude, geographical extent, duration, frequency, reversibility, context and likelihood of occurrence. Ratings were assigned and compiled in Table 7.3-2 to the residual effects of human health and well-being.

Table 7.3-2 Significance of Residual Effects on Human Health and Well-being

Residual Effect	Predicted Degree of Effect After Mitigation Measure								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	
Substance Abuse	Adverse	Medium	Local	Medium Term	Infrequent	Reversible	High	High	Not Significant
Change in Perception to Substance Abuse	Beneficial	Medium	Regional	Long Term	Frequent	Reversible	High	High	Significant - benefit
Adverse Parenting Change	Adverse	Low	Regional	Long Term	Infrequent	Reversible	High	High	Not Significant
Beneficial Parenting Change	Beneficial	Medium	Regional	Long Term	Frequent	Irreversible	High	High	Significant benefit

7.3.5 Discussion of Significance

Substance Abuse

The potential effect of the Project on substance abuse can be both adverse and beneficial. Due to increases in disposable income and slightly improved access to drugs and alcohol substance abuse rates in the LSA may increase. The increase is anticipated to be only moderately different from the baseline and infrequent as not all individuals will be inclined to start or increase substance use. The Project is also anticipated to have beneficial effects as a result of the Project as individuals will have greater incentive to remain sober.

Parenting

Parenting effects as a result of the Project are anticipated to affect some individuals and households adversely while other beneficially. Adverse effects are anticipated to be of low magnitude, infrequent and reversible; as a result it is determined to be not significant. Beneficial effects are anticipated to be of medium magnitude, frequent and irreversible; as a result are determined to be significant but beneficial.

7.3.6 Follow-up Program

Incidents relating to substance use or abuse at the Project site should be included in Project monitoring to act as a quantitative measure of the level of potential substance use rates should be included in Project monitoring to act as a quantitative indicator of the level of substance use and abuse in the LSA as a result of the Project. Qualitative data gathered from the perceptions of community members should also be collected to provide additional context to the quantitative indicator.

7.4 COMMUNITY INFRASTRUCTURE AND PUBLIC SERVICES

7.4.1 Introduction

7.4.2 Rationale for VEC Selection

Community infrastructure and public services was selected as a VEC to address the potential effects of the Project. Changes to general community infrastructure, public services and road access are considered to be indicators of the Project effects on this VEC. The rationale for the community infrastructure and public services VEC is outline in Table 7.4-1.

Table 7.4-1 Community Infrastructure and Public Services VEC Selection and Rationale

VEC	Key Indicators	Rationale
Community Infrastructure and Public Services	General community infrastructure including water works, housing and public services; road access to remote communities	The potential effects of the proposed Project on community infrastructure and services will ultimately depend on the extent to which proposed Project activities and Project related population growth will result in increased demands on infrastructure and services. This VEC also evaluates the potential for some regional infrastructure development as a result of the proposed Project.

7.4.3 Potential Interactions and Effects

The Project is anticipated to have the following effects that may interact with community infrastructure and public services:

- Improved community access
- Strain on locally available infrastructure and services

A discussion regarding these potential effects is provided sections 7.4.3.1 and 7.4.3.2.

7.4.3.1 Community Access

Six out of the nine First Nation communities identified in the LSA are remote communities that are only accessible by winter road during the winter season or by air year-round. These communities include Webequie First Nation, Marten Falls First Nation, Attawapiskat First Nation, Eabametoong First Nation, Nibinamik First Nation and Neskantaga First Nation.

The proposed all-season road has the potential to improve community access to several of these communities. Although the all-season road proposed by Noront does not include spurs directly to communities there is some potential of improved community access. This is as a result of:

- Communities having to develop and maintain a shorter length of winter road connecting the community to the all-season road;
- Potentially increasing the length of the winter road season enabling access to communities (due to the shorter winter road segment);

- Reducing travel time as a shorter portion of road will be a winter road and higher speeds may be possible on the all-season road
- Improving safety of travellers

At the time of this assessment Noront is aware that a group of First Nation communities is planning initiatives that would enable connection to infrastructure in the south either through the development of their own all-season road or by connecting all-season spurs to the route proposed by Noront. Even though Noront is aware of these plans, it cannot with any level of certainty assess the potential impact if these initiatives proceed. As such the extent of improved community access will be slightly improved however the positive effect of improved access will be limited due to the development of the Project.

Mitigation Measures

No mitigation measures are identified for the improved community access as this effect overall will be positive. The use of the all-season road does however pose safety concerns for non-Project related travel. As such the Road Management Plan (Volume 4, Section 13) identifies mitigation measures that will be undertaken to ensure the safety of all road users. The mitigation measures include:

- Signage indicating users are entering onto an industrial road
- Speed limits that must be adhered to by all users
- Turnouts for individuals that wish to access outdoor recreational activities such as fishing, trapping and hunting locations
- Radio contact between Project related traffic indicating other users on the road

7.4.3.2 Strain on Infrastructure and Services

Infrastructure in the LSA is generally underutilized given the relatively low population levels; however the services provided are limited. For example, schools in the LSA are currently running under capacity; however there is not adequate staff in the region to support increases in the student body. Similarly, hospital and health care services are available; however the lack of medical staff impedes the accessibility of medical services in the area. Furthermore, services within the remote LSA communities are limited and unable to services large increases in populations.

The Project is expected to have minimal change in the population in the LSA during all phases of the Project. The potential effects and mitigation measures used to address the increase in population as a result of the Project are discussed in Section 7.2.

Nonetheless, if individuals do decide to move back to the remote communities in the LSA a strain on the locally available infrastructure may result. This demand will likely be placed on electricity, water and sewage and accommodations. The remote LSA communities have limited capacity with respect to supporting high increases in population, be they temporary or long-term. Electricity in the communities is currently supplied through diesel generators and as a result any additional strain placed on electricity demands within the communities will require the shipment of use of greater amounts of diesel fuel.

Accommodations within the remote communities are generally limited. Requirements for accommodations may arise in the event of delays in accessing the mine site by Project employees (due to inclement weather, plane or helicopter issues, etc.). Housing in the communities is a concern that has been raised during engagement activities and is presented in the Socio-economic Baseline TSD 14. The number and quality of homes is a concern, which is indicated by the fact that the majority of homes within the remote LSA communities are in need of major repairs and the number of persons living in homes is on average one and a half persons higher than in the non-Aboriginal communities in the LSA and the RSA overall. With the potential of increases to the local population as a result of the Project, further strain may be placed on housing within the communities.

A traffic study independent of this EA/EIS report was completed on the proposed transportation corridor. The results of the study indicate that despite traffic increases due to the Project, the already developed roads, including the Pickle Lake North Road and Highway 599, will remain within their capacity limits (BA Consulting Group Ltd., 2013). Existing traffic volumes on Highway 599 are in the range of 120 to 200 vehicles per day (average daily traffic); the increase of 12 round trips per day of concentrate and various supply vehicles is only an incremental increase to existing traffic. Overall the effect of the increased volume in traffic as a result of the Project will not be large enough to consider further assessment.

7.4.4 Potential Residual Effects and Determination of Significance

There are no residual adverse effects anticipated to the Community Infrastructure and Public Services VEC. The Project will provide limited benefit with respect to community access, however, any adverse effects on infrastructure and services will be minimal.

7.5 TRAINING, EMPLOYMENT AND INCOME

7.5.1 Introduction

The Project is expected to accrue positive effects within the region in the related areas of training, employment and income.

7.5.2 Rationale for VEC Selection

Training, employment and income was selected as a VEC due to the potential changes in training, employment and income levels as a result of the Project. Education completion rates, unemployment rates, wage employment participation and income levels are considered indicators of Project effects on training, employment and income. The rationale for VEC selection is provided in Table 7.5-1 below.

Table 7.5-1 Training, Employment and Income VEC Selection and Rationale

VEC	Key Indicator(s)	Rationale for VEC Selection
Training, employment and income	High school/post-secondary completion rates Participation rates in education and training programs Employment and workforce participation rates Median income	Training – The Project will provide and induce training programs to meet the Project's direct and indirect labour demands. The existence of the Project is also likely to induce people to seek training opportunities when they may not have otherwise done so. Employment – The Project will provide direct employment as well as indirect/induced employment via service providers in the region. Income – The resultant direct and indirect/induced employment will provide income in the region. This is expected to be measurable within the RSA but particularly notable within the First Nation communities.

In this assessment, the term "training" is inclusive of any education or training that improves labour market readiness and employability. This includes conventional education (i.e., high school, college, apprenticeships, and university), essential skills training and vocational training.

7.5.3 Potential Interactions and Effects

The Project is anticipated to have the following effects that may interact with training, employment and livelihood:

- Creation of employment
- Increased training and skills development
- Increases in median income

A discussion regarding these potential effects is provided in sections 7.5.3.1 through 7.5.3.3.

7.5.3.1 Creation of Employment

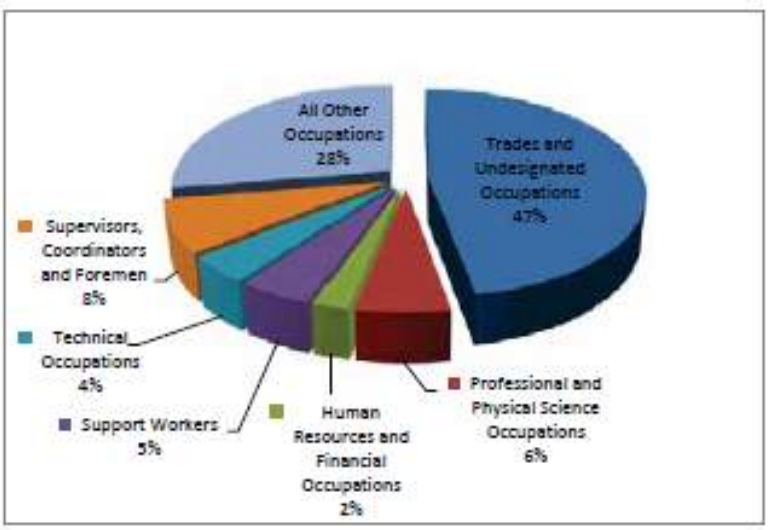
Project Employment Estimates

The Project is anticipated to create approximately 800 direct jobs during the construction phase and approximately 390 direct jobs during the operation phase. Induced and indirect jobs are estimated to be a factor of 2.5 to one for the Project (MAC, 2012). The Thunder Bay Community Economic Development Commission (Thunder bay CEDC, 2013) predicted GDP induced employment of a factor of three induced and indirect jobs for every direct mining job (discussed further below). Therefore, the total of direct and indirect employment opportunities created by the Project could reach 2,000 to 2,400 positions during the construction phase, and 975 to 1,170 positions during the operation phase.

Direct employment opportunities are anticipated to be within the following job categories (Thunder bay CEDC, 2013):

- Trades and undesignated occupations
- Support workers
- Technical occupations
- Professional and physical science occupations
- Human resources and financial occupations
- Supervisors, coordinators and foremen

These employment categories are shown graphically on Figure 7.5-1.



Sources: NSWPB, 2012 and NTAB, 2013 (TBCEMC, 2013)

Figure 7.5-1 Major Mining Job Categories

Regional Employment Forecasts for Northwestern Ontario

A number of labour market assessments have been carried out in the Kenora, Rainy River and Thunder Bay Districts of northwestern Ontario in the past couple of years in anticipation of a surge in mining in the region and in part the ROF (NSWPB and MiHRC, 2012 and 2013; NTAB, 2013; Thunder Bay CEDC, 2013). These labour force surveys evaluated the existing skills in the region, the existing workforce, and the projected labour force requirements due to mining in northwestern Ontario. Thunder Bay CEDC (2013) is a mining readiness strategy that draws from previous work by others and provides a comprehensive characterization of the labour force and an assessment of future labour demand within the Districts of Thunder Bay, Kenora and Rainy River due to mining. The Mining Readiness Strategy is based upon 10 mining projects starting operations in the next five years. The TBCEDC study forecasted employment demand by estimating Gross Domestic Product (GDP) dollars produced per employee/job and then used that estimate in an economic multiplier estimate.

It was estimated that 3,563 direct jobs from mining will translate into 10,586 direct, indirect and induced jobs available annually in northwestern Ontario in the near term (i.e., 2015) as a result of the projected growth in the mining sector consisting of 10 mining projects (Thunder Bay CEDC, 2013). Over the period of 2013-2022, it is estimated that between 35,634 and 40,295 direct mining jobs will be created during the 2013-2022 period. It is estimated that 28% of new direct mining jobs will be for low skilled workers and 72% will be in the skilled labour category. A detailed breakdown of the types of employment (direct, indirect and induced) is presented in Figure 7.5-2 (from Thunder Bay CEDC, 2013).

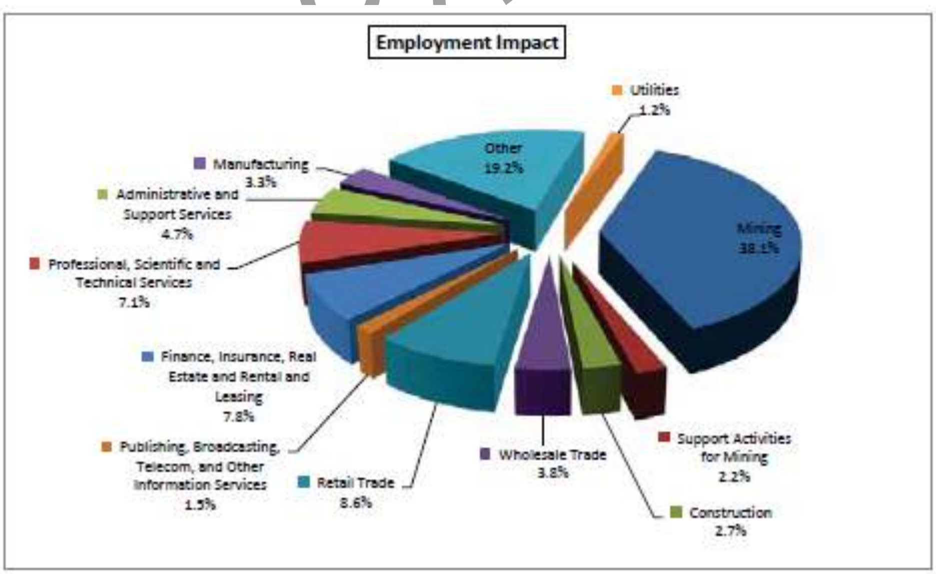


Figure 7.5-2 Categories of Direct, Indirect and Induced Employment from New Mining in Northwestern Ontario

If the lower estimate of direct mining jobs over 2013-2022, approximately 9,918 jobs (28%) are expected to be for low skilled workers and 25,816 jobs (72%) would be in the skilled labour category.

The conclusions of the Mining Readiness Strategy were that across the entire northwestern Ontario region, there are 9,881 (6,961 non-Aboriginal and 2,920 Aboriginal) unemployed residents; just enough to fill the jobs available in a single year of production. Relating these numbers back to the Eagle`s Nest Project only, employment opportunities presented by the Project (2,500 to 3,000 direct, indirect and induced jobs during the construction phase, and 750 to 900 jobs during the operation phase) represents a substantial proportion of unemployment in the region.

Regardless of the assumptions underlying the Thunder Bay CEDC (2013) study regarding 10 mining projects proceeding to development in the short-term, the Eagle`s Nest Project will not be providing employment to the region in a vacuum. The Project will be competing for human capital in the region.

It is expected that the Eagle's Nest Project will be the first mining development in the ROF. The establishment of all-season road access into the ROF, as a result of the Project will significantly lower the cost of mineral exploration in the area. This indirect effect can reasonably be expected to facilitate a higher intensity of mineral exploration in the ROF and the likelihood that other mining projects meet economic thresholds, both of which will contribute to labour demand in the region in the coming decades. This has not been accounted for in this assessment but is recognized as an opportunity.

Regional Challenges in Employment

Thunder Bay CEDC (2013) reported on the following challenges in regard to mining employment in northwestern Ontario:

- Labour shortage – the labour market in northwestern Ontario is tight, especially for positions requiring advanced training, certification and/or education. Because people with skilled trade qualifications have highly transferrable/mobile skills, the mining sector will find considerable competition in attracting and retaining them.
- Highly mobile mining workforce - the workforce in the mining industry is highly mobile as the industry is global. The MiHRC (2012) notes that many skilled mining workers have left the Thunder Bay District and have relocated to southern Ontario, Alberta, Saskatchewan and other locations in Canada.
- Aging workforce - this is particularly true for positions as supervisors, coordinators and foremen; these jobs are usually filled by employees with substantial experience in the mining industry, and the majority of people currently in these positions are eligible for retirement in the near future.
- Low levels of education and essential workplace skills – the region as a whole and Aboriginal communities in particular have low levels of education and essential workplace skills which unaddressed present a barrier to meaningful uptake of employment opportunities.

Unemployment and Employment Participation Rates in First Nation Communities

As noted in Table 3.19-2, unemployment rates in the First Nation communities within the LSA are high, ranging from 19 to 40%. In addition, the communities have lower employment participation rates, ranging from 49 to 65.6% compared to participation rates of 61.9%, 64.3% and 66.3% for the Thunder Bay District, Kenora District and Ontario, respectively. The lower participation rates in the First Nation communities are likely due to a combination of factors, including a higher dependency rate owing to a young population, lifestyle choice, and the fact that high unemployment discourages people from entering the workforce.

Educational Attainment and Skills of the Aboriginal Workforce

The educational attainment within the LSA and RSA is low relative to the provincial average, and the First Nation LSA communities are particularly low. Table 7.5-2 shows the percentage of the population between 25 and 64 years of age that have no formal high school completion certificate, diploma or degree.

Table 7.5-2 Educational Attainment Levels in the RSA and LSA

Community / Region (Census Year)	No Certificate Diploma or Degree, Ages 25 to 64 Years (%)
Local Study Area Communities	
Aroland (2011)	64.5
Attawapiskat (NA)	NA
Eabametoong (2011)	58.3
Marten Falls (2011)	83.3
Mishkeegogamang (2011)	78.8
Neskantaga (2011)	60.0
Nibinamik (2011)	46.7
Ojibway Nation of Saugeen (2011)	36.7
Webequie (2011)	66.1
Greenstone (2013)	26.8
Ignace (2013)	30.4
Pickle Lake (2013)	24.9
Regional Study Area	
Thunder Bay District (2013)	16.9
Kenora District (2013)	25.4
Ontario (2011)	13.3

The results for the First Nation communities are not unsurprising given that most of the First Nation communities are not equipped with high schools in their communities. A more complete breakdown of educational attainment levels is presented in Technical Supporting Document 14.

The Ring of Fire Aboriginal Training Alliance (ROFATA), established in partnership with Kilikenomaga Kikenjigewen Employment and Training Services (KKETS), Confederation College and Noront, is a recent imitative assisting and supporting members of nine Matawa First Nation communities in pursuit of specialized training, and making informed career decisions in their transition from training to employment. Essential skills testing on over 1,000 Aboriginal individuals across northwestern Ontario including about 300 from Matawa First Nation communities indicate that the majority of participants are below a Level 3 in essential skills. The conclusions of the assessment are as follows:

- There are many candidates in the RSA interested in accessing employment and training opportunities as evidenced by the rate of participation accessing employment services
- There is great need for additional training to enable employment candidates to participate meaningfully in the workforce

- Alternative modes of learning outside of the school system such as technology enabled learning is a proven approach based on the current level of utilization as well as before and after Test of Workplace Essential Skills (TOWES) testing results.

The recent reports reflecting Literacy and Basic Skills (LBS) program learner activity data strongly align with these findings (Ministry of Training, Colleges and Universities, 2013). There is high demand for academic upgrading, even when the learner has already obtained "Grade 12".

In contrast with the overall Ontario statistics for accessing LBS programs, which show 14% of the number of in-person learners are e-channel learners, the "Aboriginal" stream data shows that 56% of the number of in-person learners are e-channel learners.

Through various discussions Noront has had with First Nations and the public in the LSA and RSA, it is evident that community members are interested in the potential employment opportunities resulting from the Project. Elders, adults and youth alike have expressed their interest in pursuing work with the Project and through induced/indirect jobs in the region. It was expressed that long term goals for youth will give them something to strive and work towards and potentially keep them from engaging in dangerous activities such as drug and alcohol consumption.

Summary Conclusion on Potential Effects to Employment without Mitigation

The Project has the potential to provide substantial benefit to employment in the region.

The lower education rates and essential skills of the regional workforce and the Aboriginal individuals in the First Nation LSA communities in particular will make meaningful uptake of jobs in the region a challenge without significant intervention. Currently, the region cannot meet the requirements for semi-skilled to skilled labour as there is considerable competing demand. Thus it will likely be necessary to bring skilled labour in from other parts of Canada. Similarly, a lack of minimum educational attainment and workplace essential skills present a challenge to entry into the Project's lower skill positions.

Finally, rotational employment at an industrial work place that is outside of the communities is not universally appealing. There will be unemployed in the region who will not select this form of employment irrespective of what is or is not available as an alternative.

Mitigation Measures to Maximize Uptake of Aboriginal and Regional Workers

The challenges and barriers to employment in the region are well understood and there are many existing training programs in the region delivering essential skills programs including through community services organizations and on-line learning. As mentioned above, the ROFATA was formed to specifically address the training to meet the employment requirements of the Eagle's Nest Project and other regional mining developments.

Noront has developed a state of the art Human Resources Management Plan (HRMP), presented as Section 2 in Volume 4. The HRMP outlines the measures and commitments of the company to maximize Aboriginal and local employment on the Project. Highlights of the mitigation measures outlined in the HRMP include:

- Ongoing support of regional training initiatives with regional partners through the ROFATA and other initiatives
- Pre-employment job readiness training

- Providing education and training opportunities to employees to upgrade education and skill levels while at the workplace
- On-going personal development orientation and training at the site
- Cross-cultural awareness training
- Establishment of a human resources information system to maintain an inventory of potential candidates and streamline the hiring process
- A commitment to prioritize the hiring of Aboriginal candidates from the First Nation communities and the region, and all candidates from the region
- Hiring of First Nations Employment and Training Coordinators
- Establishing each of the potentially affected First Nation communities as a direct point of hire in which Noront will cover the cost of transportation to and from the work place
- Where possible, identifying job positions where fluency in English is not mandatory, so that unilingual Aboriginal language speakers may potentially be employed by the Project
- Implementing employee relations procedures including grievance and discipline procedures
- Prioritizing contracting to Aboriginal firms and companies that prioritize Aboriginal hiring
- Second chance policy related to hiring

Noront wants to ensure that the individuals most likely to be affected by the Project are the ones that are able to realize the greatest number of benefits. To this end, Noront has established a number of initiatives to help individuals gain benefits.

While on the job, employees will continue to undergo on-going training and personal development through various training programs and through the completion of the required objectives of their job. Cross-cultural awareness will be implemented across all Project phases and components, employees will be required to respect each other’s cultures in order for all individuals to be able to gain and use their skills in a safe and respectful work environment.

Noront’s policy related to hiring of workers will generally recognize the limited experience of the local labour force and provide “second chances” to individuals who may run into problems. The expectation is that significant errors in judgement will lead to consequences, but that opportunities to learn from past mistakes will be provided in the appropriate circumstances. The opportunity to learn from mistakes is considered to be an important condition for gaining skills.

The ROFATA and Noront’s other training initiatives are forward-thinking and progressive in terms of the advanced stage of the training in relation to the stage of the Project’s development. Few mining proponents commit the extent of resources that Noront has at the development stage of the Project in advance of receiving the necessary approvals and the commercial decision to go ahead with the Project.

To understand what is possible, Noront looked to the levels of Aboriginal employment at Goldcorp`s Musselwhite Mine in northwestern Ontario, and De Beers’ Victor Mine in northeastern Ontario. As of 2007, the Musselwhite Mine employed approximately 369 workers of which about 25% are self-identified Aboriginal persons. The mine has a target of 30% employment from communities’ signatory to agreements with the company, and in 2007 16% of the Aboriginal work force came from these signatory communities (NRC, 2007)

At the Victor Mine, slightly greater than 40% of employees are self-identified Aboriginal; more than 180 employees of a total of 440 employees (OMA, 2012).

Table 7.5-3 provides a sensitivity analysis of what different proportions of the Project's Aboriginal workforce would mean in terms of the number of positions. Noront has not identified specific targets for Aboriginal employment, but the company commits to implementing best practices to achieve high levels of Aboriginal employment in the company.

Table 7.5-3 Target Employment Rates at Eagle's Nest Mine

Project Phase	Number of Jobs	Percentage of Aboriginal Workforce	Number of Aboriginal Jobs
Construction	780	10%	78
		20%	156
		30%	234
		40%	312
Operation	390	10%	39
		20%	78
		30%	117
		40%	156

An Aboriginal workforce of 20% to 40% would represent between 156 to 312 positions during the construction phase and 78 and 156 positions during the operation phase. These are direct jobs as a result of the Project; indirect and induced jobs that may accrue to Aboriginal individuals (representing up to 200% of direct employment numbers) have not been factored into these ranges of numbers.

7.5.3.2 Education Attainment Rates

The employment effects of the Project and the various training and human resource measures to be implemented by Noront are expected to positively influence the level of education attainment of local residents, inclusive of the development of essential workplace skills and life skills. This effect is expected to be pronounced within the LSA First Nation communities, where few employment opportunities currently exist, and much more subtle at the regional scale. The tangible value of education will be enhanced as a result of the Project introducing jobs to the local economy where those who gain higher levels of education and skill are rewarded. Regional pre-work training and on-the-job upgrading will contribute to increased educational attainment rates.

Individuals employed by Noront will have the opportunity for advancement through on-going training and promotion. The possibility of future advancement may help encourage individuals to strive for higher levels of education and training rather than settling for entry level positions.

7.5.3.3 Changes in Income

With the development of the Project and the subsequent creation of direct jobs the individual incomes of those employed is expected to increase, measurable by an increase in the average income in the respective communities and the region as a whole. The amount of income earned by individuals and households will vary based on the length of time individuals remain employed at the Project and on their respective position, which in turn is related to the level of educational attainment and essential and vocational skills an individual possesses. The average weekly wage paid in the mining industry was almost 60% more than the Ontario's average industrial wage, while wages paid in the mining support sector were almost 95% higher (Table 7.5-3; Dungan and Murphy, 2012).

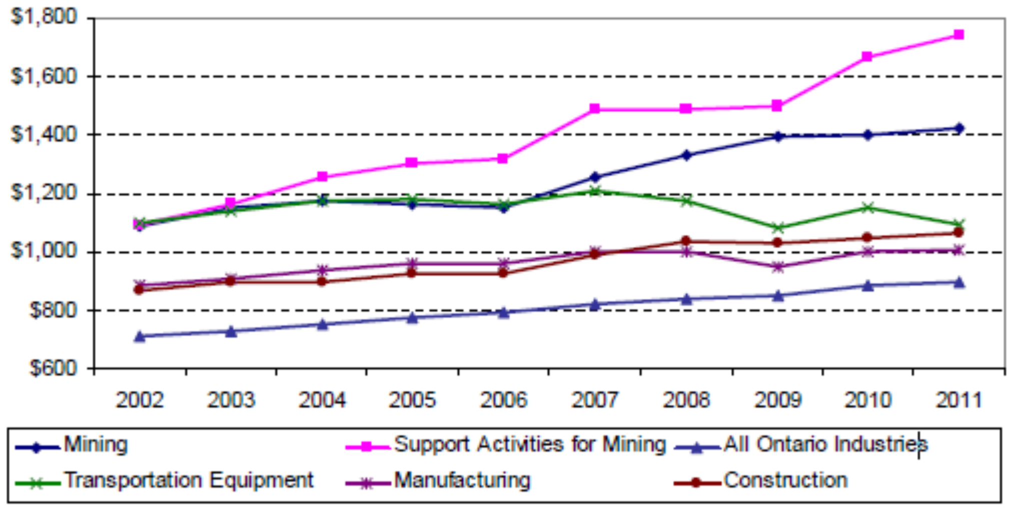


Figure 7.5-3 Average Weekly Wages by Industry in Ontario

During the construction phase, a greater number of individuals and households will experience a rise in income levels; this rise will be relatively short termed and not sustained. Given that employment in mine construction can require specialized skills for short periods of time, individuals employed at the Project during the operation phase will experience higher incomes for a longer term. Furthermore, those conducting occasional work will see more modest gains in income compared to individuals receiving a full-year of wages.

The effects of earned income on households will be influenced by the decisions made about how income is managed and spent. In general, increased income has a positive effect on the well-being of households as well as on the local economy (Stevenson and Wolfers, 2013). This is expected to be particularly so for individuals and families that currently experience poverty. Modest increases in income, income may be expected to improve grocery purchases, ability to travel out on the land and enable modest discretionary purchases. In cases where a greater employment relationship with the Project exists, income levels are anticipated to provide substantial discretionary purchasing power, including large item purchases such as vehicles, boats and other big ticket items.

The potential for poor spending decisions, which would affect the positive outcome of increases in income, is acknowledged. Noront recognizes the need help individuals establish positive money management strategies, to this end Noront plans to provide personal life management training its employees with which includes money management as identified in the Human Resources Management Plan (Volume 4, Section 2).

Potential disparity between those employed at the Project and those not employed at the Project will exist. Income disparity may result in negative feelings towards the Project and the people employed by the Project, by those who were unable or unsuccessful in gaining employment. This is discussed further in Section 7.2. However, benefits to communities as a result of the Project will not be limited to only those who are employed. Noront will negotiate with IBAs to ensure benefits of the Project are not only experience at individual and household levels but also at the overall community level.

At the end of the mine life many individuals will find themselves without employment. This will directly affect the individual and household incomes of residents. This negative consequence of the mining projects is generally anticipated and expected by employees. Nonetheless, through the personal life management training individuals will be encouraged to plan for future events such as mine closure. The experience gain through employment will be transferable to other mine development projects and will enable individuals to retain new positions following mine closure.

Mitigation Measures

In order to enhance the anticipated positive effects of increases in income Noront plans to hire individuals from the local area, particularly those from potentially directly affected communities. Furthermore, as noted in the Human Resources Management Plan (Volume 4, Section 2), Noront will provide employees personal life training in order to improve money management and set saving goals.

Through negotiations with communities on IBAs Noront intends to extend potential business opportunities to the community as well as single individuals, thereby reducing negative feelings between community residents and the Project.

7.5.4 Potential Residual Effects and Determination of Significance

The relative significance of residual effects was evaluated based on a suite of standardized criteria including: magnitude, geographical extent, duration, frequency, reversibility, context and likelihood of occurrence, as defined for socio-economic effects in Table 7.1-3. Ratings were assigned and compiled in Table 7.5-4 to the residual effects of employment, educational attainment and change in income.

Table 7.5-4 Significance of Residual Effects on Training, Employment and Income

Residual Effect	Predicted Degree of Effect After Mitigation Measure								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	
Employment	Beneficial	High	LSA	Medium Term	Frequent	Reversible	High	High	Significant - beneficial
Educational attainment	Beneficial	High	LSA	Long Term	Frequent	Irreversible	High	High	Not significant - beneficial
Change in Income	Beneficial	High	Local	Medium Term	Frequent	Reversible	High	High	Significant beneficial

In the assessments above, a focus has been on the First Nation communities in the LSA, as effects at this scale will be the most notable due to the small size of the communities. Project-related effects of employment, educational attainment and income will certainly occur throughout the RSA but the effects will be less distinguishable at this scale. A high magnitude rating was assigned to all three effects evaluated since community-level changes in the First Nation LSA communities are anticipated. The extent of this effect is confirmed to the LSA. Benefits of employment and income will occur for the life of the Project (medium term) and will be reversible. Educational attainment however is a permanent effect (long-term and irreversible). At the scale of the LSA, the context of these effects is considered to be high due to the high level of unemployment, low levels of educational attainment and lower average incomes currently experienced by the communities.

7.5.5 Discussion of Significance

Employment as a result of the Project (inclusive of direct, indirect and induced jobs) is assessed to be a beneficial significant effect. The Project on its own will require a substantial proportion of the available labour based on regional unemployment rates.

In order to successful compete for jobs available at the Project, educational attainment rates will need to be improved. The overall improvement of educational attainment are anticipated to provide long term benefits beyond the life of the Project; particularly to the First Nation communities of the LSA, where education attainment rates are low.

At the community level, increases in income are expected to result from the Project as a beneficial effect, with a subsequent indirect beneficial effect to health and well-being (Section 7.3).

7.5.6 Follow-up Program

In order to ensure the beneficial effects of changes in income continue to be realized during the life of the Project, Noront will implement its HRMP. As part of this, records will be maintained of employees who completed personal life management training.

7.6 LOCAL AND REGIONAL ECONOMY

7.6.1 Introduction

The Local and Regional Economy VEC concerns the potential effects of the Project on economic development, indicated by government revenues and opportunities for regional businesses. Over the life of the Project substantial numbers of staff, contracted employment, and procured goods and services will be needed to meet the demands of the construction, operations and closure phases. Effects are considered for the LSA and RSA, including First Nations.

7.6.2 Rationale for VEC Selection

Local and Regional Economy was selected as a VEC due to the changes in the local and regional economies that may result from the Project (Table 7.6-1). The VEC was selected through consultation with the public, Aboriginal groups, local communities, and government stakeholders. The indicators were also selected based on professional judgement and experience in conducting environmental effects assessments for similar projects.

Table 7.6-1 Local and Regional Economy VEC Selection and Rationale

VEC	Key Indicator(s)	Rationale for VEC Selection
Local and Regional Economy	Government Revenues and Business Opportunities	Construction, operations, and closure of the Project will generate government revenues, and business opportunities throughout the LSA and RSA. Local and Regional Economy was chosen as a VEC because the Project development will result in increased activity within the local and regional economies.

7.6.3 Potential Interactions and Effects

The Project is anticipated to have the following effects that may interact with the local and regional economy:

- Economic Impacts
  - Direct, Indirect and Induced Impacts
  - Increased Government Revenue
- Induced Economic Development
- Increased Business Opportunities

The assessment of economic effects, in terms of quantitative estimates of economic growth and government revenue, is based on the Advantage Northwest Mining Readiness Strategy (Thunder Bay CEDC, 2013).

A discussion regarding these potential effects is provided in sections 7.6.3.1 to 7.6.3.3.

7.6.3.2 Economic Impact

Direct, Indirect and Induced Impacts

The development of the Eagle's Nest Project will result in economic growth to the Local and Regional economy. Economic effect takes into account the direct construction and operating expenditures, as well as the indirect and induced, or "spin-off" spending that occurs as a result of the Project.

An economic impact assessment was not completed for the Eagle's Nest Project; however, a economic impact assessment was completed by the Thunder Bay CEDC for mining development in Northwestern Ontario (Thunder Bay CEDC, 2013). Noront's Eagle's Nest Mine was one of the ten Projects considered in this study.

The following economic impact assessment is based on the MSR Approach to Calculating Annual Economic Impact presented by the Thunder Bay CEDC (2013).

The total economic impact of the Project is formulated by combing the direct, indirect and induced impacts.

- Direct Impacts
  - Direct expenditures on wages and salaries for the Project include capital, supplies, materials and equipment.
- Indirect Impacts
  - Wages and economic activity created by businesses that provide goods and services to the Project
- Induced Impacts
  - Spending and resulting recirculation of employee incomes

Direct and indirect expenditures are taken from Noront's Feasibility Study (Micon, 2012). The induced spending is calculated based on multipliers presented in Advantage Northwest Mining Readiness Strategy (Thunder Bay CEDC, 2013).

Economic leakage refers to the estimated proportion of the direct and indirect expenditures that will remain within the regional economy. The amount that leaks out may go to other portions of the province, to another province or another country. A leakage rate of 25 % was adopted from the Advantage Northwest Mining Readiness Strategy (Thunder Bay CEDC, 2013). The estimated economic impact for the construction and operation phases of the Project is summarized in Table 7.6-2.

Table 7.6-2 Estimated Annual Economic Impact

Phase	Construction (CAPEX = $610,000)($ 000)	Operation (OPEX = $1,080,000) ($ 000)
GDP Impact		
Low	572,875	1,012,500
Medium	686,250	1,215,000
High	800,625	1,417,500
Total Government Revenues		
Low	172706	305,775
Medium	207,248	366,930
High	241,789	428,085

NOTES:

1. LOW, MEDIUM AND HIGH ARE BASED ON MULTIPLIERS OF 1.23, 1.50 AND 1.75 AS PER THE INCOME-EXPENDITURE APPROACH USED BY THUNDER BAY CEDC, 2013.
2. CAPEX AND OPEX NUMBERS BASED ON NORONT' RESOURCES 2012 FEASIBILITY STUDY (MICON, 2012).
3. CAPEX AND OPEX NUMBERS DO NOT INCLUDE THE COST TO CONSTRUCT A ROAD, JUST USER FEES.
4. GOVERNMENT REVENUES ARE BASED ON A 30.2% OF THE GDP FROM (DUNGAN AND MURPHY, 2007). THE LOWER RATIOS WERE USED TO PREVENT OVERESTIMATION.

Increased Government Revenues

Potential effects of the Project to government revenues throughout the life of the Project arise from increases to tax revenues. Increased government tax revenues will be realized at three levels: Federal, Provincial and Municipal. Additional revenues will accrue to the following:

- Government of Canada
  - Corporate and personal income taxes
  - EI contributions
  - Sales taxes
  - CPP contributions
- Government of Ontario
  - Personal and corporate income taxes
  - Workplace safety contributions
  - Employer health tax
  - Sales tax
- Municipal government
  - Fees
  - Property tax

Total estimated government revenues for the project are presented in Table 7.6-2. Additional revenues will also be realized by First Nation communities that enter into an IBA with Noront. Details of these agreements are generally kept confidential and will be negotiated on a community by community basis.

The Project is situated in the unorganized Kenora District, as such there are no property tax revenues accrued by a municipal government. However, it is possible that induced development of houses or commercial/industrial buildings will generate municipal property tax revenues.

7.6.3.3 Potential for Induced Economic Development

The Project proposes the development of the east-west transportation corridor. This infrastructure has the potential to reduce the capital costs associated with the development of numerous other mineral deposits located in the Ring of Fire region. Several early stage exploration projects exist in the area that would benefit from the development of the Project and associated infrastructure.

The spin-off effects of the infrastructure investment are uncertain and depend on many other factors outside this analysis. However, it is likely that the infrastructure investments associated with this Project have the potential to facilitate the development of future projects in the area. Development of these projects would produce noticeable effects on the local and regional economies.

7.6.3.4 Increased Business Opportunities

The Project is expected to affect the Local and Regional economy through expenditures on goods and services, which will help diversify the economic base of the LSA and RSA. The Project will strengthen economic development in the region by creating new opportunities for contractors and companies supplying goods and services during the construction and operation phases. Thunder Bay will be the largest beneficiary since it is the largest and most established service centre in the region. Companies in rural communities, including entrepreneurs in local First Nation communities, do not have the capacity to bid for major service contracts, but with support in the structure of procurement processes and policies, could bid on appropriately scoped contracts. Even these smaller contracts, given the small populations of these communities, would have a larger relative effect for local residents.

The extent to which business opportunities translates into economic development benefits depends on general economic conditions, the investment climate, and the competitiveness of local suppliers.. Noront will contract local businesses to supply materials, goods and services, when possible. Noront will require numerous construction, contracting, supply, and service companies.

During operations, procurement, and contracting will follow a transparent process that requires reporting of local content both by Noront and its contractors. The most likely candidates for local content include:

- Trucking and other transportation
- Fuel supply
- Air transportation
- Consulting services
- Hospitality and travel services
- Medical services
- Services to employees
- Road and tire services
- Equipment supplies and maintenance
- Communications

- Human resource and employment services

The development of the Project may result in the expansion of existing businesses, the creation of new businesses or the attraction of outside businesses into the region. These are positive effects of the Project.

7.6.4 Potential Residual Effects and Determination of Significance

The relative significance of residual effects was evaluated based on a suite of standardized criteria including: magnitude, geographical extent, duration, frequency, reversibility, context and likelihood of occurrence, as defined for socio-economic effects in Table 7.1-3. Ratings were assigned and compiled in Table 7.6-3 to the residual effects of government revenues and business opportunities.

Table 7.6-3 Significance of Residual Effects on Local and Regional Economy

Residual Effect	Predicted Degree of Effect After Mitigation Measure								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	
Government Revenues	Beneficial	Medium	Country	Medium Term	Frequent	Reversible	High	High	Significant - beneficial
Business Opportunities	Beneficial	Medium	Regional	Medium Term	Frequent	Reversible	High	High	Significant - beneficial

7.6.5 Discussion of Significance

Throughout the life of the Project additional government revenues will be generated; these additional revenues are a significant benefit of the Project. Likewise the Project will also have a significant benefit on business opportunities. Noront is actively engaging, and will continue to engage, First Nation communities on businesses development opportunities.

7.7 CULTURAL RESOURCES

7.7.1 Introduction

Cultural resources provide a glimpse into the cultural fabric of a society. They not only are a representation of a culture in time, but also point to current cultural practices. Cultural resources, such as spiritual and culturally important sites, are of great importance to First Nation communities in the area. These sites, along with archaeological sites, are protected by communities to avoid any potential adverse effects that may result from the public having general knowledge of their locations. The following section provides an assessment of the potential effects of the Project on cultural resources in the LSA.

7.7.2 Rationale for VEC Selection

Cultural resources were selected as a VEC to address the potential of the Project to affect sites of archaeological, cultural and spiritual importance. Project related changes to archaeological sites, artifacts, cultural and spiritual sites are considered to be indicators of the Project effects on cultural resources. The rationale for the cultural resources VEC is outlined in Table 7.7-1.

Table 7.7-1 Cultural Resources VEC Selection and Rationale

VEC	Key Indicators	Rationale
Cultural Resources	Project-related changes to archaeological/burial sites and artifacts and the location of the Project in relation to cultural or spiritual sites	Cultural resources was selected as a VEC to address the potential of the Project in interacting and potentially disturbing site of archaeological, cultural or spiritual importance

7.7.3 Potential Interactions and Effects

Project components and activities will interact with and potentially affect cultural resources primarily through physical loss or alteration of archaeological, cultural or spiritual sites by ground disturbance activities within the Project development area during the construction phase and through regular Project induced activities during the operation phase.

A discussion regarding potential effects is provided in sections 7.7.3.1 and 7.7.3.2 below.

7.7.3.1 Physical Loss or Alteration of Archaeological Sites

Archaeological sites and artifacts contain valuable information about past and contemporary life, cultural identify and relations and interactions between cultures and the cultural environment. A Stage 1 archaeological assessment was completed for the purposes of the EA along the transportation corridor and at the mine site. The Stage 1 assessment identified sites of archaeological potential along the proposed transportation corridor and near the mine site. These sites have the potential to be lost or altered as a result of Project activities.

Because this archaeological assessment was a Stage 1 desk top study it is possible that other archaeological sites have not yet been identified.

During construction activities it is possible that these sites may be altered or lost if not properly documented prior to the commencement of construction. Alteration and/or loss of sites, although much more limited, may arise during the operation phase through unauthorized activities by Project employees or through regular activities.

Proposed Mitigation Measures

Prior to conducting any ground disturbance activities Noront will conduct a Stage 2 archaeological assessment on the sites identified as having high archaeological potential within the Project development area. Namely sites along main rivers and along eskers have been noted as having high potential for archaeological finds. The Stage 2 archaeological assessment will be completed in accordance to the *Ontario Heritage Act* by a licensed consultant archaeologist. Furthermore, a setback of 50 m for quarry and borrow source locations from water bodies (areas noted as having possible high archaeological potential) will be established. This setback distance is prescribed by the Ministry of Tourism, Culture and Sport.

Noront has developed a Cultural Resources Action Plan (Volume 4, Section 16) to ensure the integrity of cultural resources is maintained. The Action Plan includes a Chance Find Procedure in compliance with Section 48(1) of the *Ontario Heritage Act* (1990d). Project employees will be prohibited from accessing sites identified as having archaeological potential.

Mitigation procedures mandated by the Ontario Heritage Act will be adhered to prior to the commencement or continuation of Project activities. As a result residual effects to archaeological sites are not assessed.

7.7.3.2 Physical Loss or Alteration of Cultural or Spiritual Sites

The cultural of First Nation communities in the LSA spans thousands of years and is not limited to a single geographical area as communities were nomadic and moved according to the availability of food resources. Cultural and spiritual sites used by ancestors are still revered in modern Aboriginal culture. As such, it is important to ensure the integrity of these sites is retained.

To date Noront has not identified sites of cultural or spiritual importance in the mine site area. During road alignment recognisance along the transportation corridor in the Fall of 2013, Noront was asked to divert their routing south of Webequie First Nation in order to avoid an area of importance. This resulted in a realignment of the proposed transportation corridor by approximately 6 km, demonstrating Noront's commitment to work with First Nation communities in avoiding sites of importance.

Although sites of cultural and spiritual importance have not been readily identified, Noront recognizes the possibility of their existence. Without being aware of the potential existence of culturally and spiritually important sites it is not possible to assess the potential effects on these sites as a result of Project development.

Discussion of Aboriginal cultural land uses and practices are discussed and assessed in Section 7.8.

Mitigation Measures

Noront has developed an Aboriginal Traditional Knowledge Study Plan (Volume 4, Section 15) to help facilitate the identification of sites that may be culturally or spiritually important to the First

Nation communities. It is not the intent of Noront to identify these cultural or spiritual sites; the intent is to avoid these sites during Project development.

7.7.4 Potential Residual Effects and Determination of Significance

The relative significance of residual effects was evaluated based on a suite of standardized criteria including: magnitude, geographical extent, duration, frequency, reversibility, context and likelihood of occurrence. Ratings were assigned and compiled in Table 7.7-2 to the residual effect of the potential loss or alteration of cultural or spiritual sites.

Table 7.7-2 Significance of Residual Effects on Cultural Resources

Residual Effect	Predicted Degree of Effect After Mitigation Measure								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	
Potential loss or alteration of cultural or spiritual sites	Adverse	Low	Local	Long Term	Infrequent	Irreversible	Low	Low	Not Significant

7.7.5 Discussion of Significance

The potential loss or alteration of cultural or spiritual sites is assessed to be adverse; however the overall residual effect is determined to be not significant because following proper procedures of identifying potential cultural and spiritual sites the possibility of effecting a site will be low.

7.7.6 Follow-up Program

Noront is committed to engaging First Nation communities in the collection of ATK data to better inform the Project's potential effects on cultural and spiritual sites (as identified in the ATK Study Plan Volume 4, Section 15). As noted above a Stage 2 archaeological assessment will be conducted in areas identified as having high archaeological potential.

7.8 ABORIGINAL RESOURCES AND LAND USE

7.8.1 Introduction

First Nation communities in the LSA continue to practice traditional land use activities. These activities include traveling both on land and in water, tending to traplines in their traditional territories, fishing, hunting and gathering various plants. Members of the First Nations also travel to camps on their traplines. These camps serve as a home base while out on the land and as a place of retreat. Several First Nation community members own outposts camps and rent them out for recreational purposes.

Community members continue to practice traditional activities throughout the year including hunting, trapping, fishing and gathering flora for food and medicines in their traditional territory. A wide variety of game, including birds, water fowl, large game, wolf, wolverine, fox and marten, is sought for food

7.8.2 Rationale for VEC Selection

The Aboriginal Resource and Land Use LSA is situated within the overlapping traditional territories of Marten Falls, Webequie Neskantaga, Eabametoong, Nibinamik, Mishkeegogamang, Ojibway Nation of Saugeen. The Project also enters into the Metis Nation of Ontario Traditional harvest area near the trans-load facility. The Project will interact with traditional land use activities including travel routes, trapping, fishing, hunting and gathering of various plants. The project will also interact with commercial outpost camps operated by First Nations. Table 7.8-1 provides an overview of the indicators and a rationale for the VEC selection.

Table 7.8-1 Aboriginal Resources and Land Use VEC Selection and Rationale

VEC	Key Indicator(s)	Rationale for VEC Selection or Exclusion
Aboriginal Resources and Land Use	Harvesting of plants and wildlife, travel routes and camps, culturally and spiritually important areas, commercial activities	The Project may affect plants, animals and fish that have been traditionally harvested and consumed by Aboriginal people. The Project may affect traditional land uses including travel routes, spiritually important areas and commercial activities.

The indicators selected for the Aboriginal Resources and Land Use VEC are based on the available information compiled in the Socio-Economic Baseline Report (Technical Supporting Document 14). This VEC was assessed using the following indicators:

- Hunting Opportunities
- Fishing Opportunities
- Plant Harvesting Opportunities
- Adverse Effects to Tenured Trapline Areas

- Adverse Effects to Commercial Activities (i.e., First Nation owned and operated outfitting camps and lodges)
- Adverse effects to Travel Routes
- Adverse effects to Spiritually Sensitive Areas

7.8.3 Potential Interactions and Effects

7.8.3.1 Hunting, Fishing and Plant Harvesting Opportunities

Effects related to hunting, fishing and plant harvesting opportunities will occur during the construction phase. Potential effects to fishing opportunities will be temporary and will only last during the construction phase. The construction of water crossings may temporarily restrict access to fishing areas. Effects to these resource uses will be restricted to the LSA and would not measurably reduce the overall opportunities for resource use in the RSA. In addition, based on the Human Health and Well Being, Wildlife and Fish and Fish Habitat effects assessments, Sections 7.3, 6.8, 6.6, no significant results on these VECs are expected as a result of the Project.

7.8.3.2 Trapping

Potential effects of the Project on trapping would result from the removal and fragmentation of land that currently supports trapping. Effects to trapping would primarily occur during the construction, phase but would continue through the operation and closure phases of the Project at the mine site. Effects to trapping at the trans-load facility will be minimal as the property is a brownfield site that is already tenured to support other land uses. Following mine closure the mine site would be return to pre-development conditions and would no longer have an effect on trapping activities. The construction of the all-season road will cause an irreversible effect to the traplines.

The MNR is responsible for the management of traplines. There are no changes predicted to harvest volumes as a result of the Project development. The focus of the assessment is on the change to trapping as a result of changes (i.e., trapline area loss/degradation) to tenured trapline areas. Table 7.8-2 summarizes the trapline areas that will be affected by each component of the Project and the relative area lost.

Table 7.8-2 Project Interaction with Tenured Trapline Areas

Project Component	Trapline Area	% of Trapline that falls within LSA
Trans-load Facility	IG003	0.64
	SL153	0.54
	IG005	1.59
Mine Site	GE160	0.81
Transportation Corridor	GE229	8.16
	SL230	3.71
	SL83	2.19
	GE234	5.03
	GE319	6.67
	GE228	6.95

Project Component	Trapline Area	% of Trapline that falls within LSA
	83	11.32
	GE155	3.26
	GE160	0.52
	GE209	12.17
	GE222	5.74
	GE211	11.99
	GE231	5.16
	GE202	8.61
	GE318	0.11
	GE324	2.12

Adverse effects on furbearers and their habitat important to trapping were also considered in the effects assessment Section 6.8). No significance effects to furbearers are expected to furbearers or their habitat.

The construction of the all-season road will provide improved access to adjacent trapline areas. Improved access to these areas is considered a benefit to the resource users.

Noront will provide compensation for effects to traplines as mitigation measure. Negotiations will occur on a community basis for traplines belonging to First Nations. Upon approval of the EA and a decision to construct Noront will begin the negotiation process. Satisfactory completion of negotiations should fully mitigate effects to traplines resulting from the Project.

7.8.3.3 Commercial Activities

There are no commercial outpost camps located in the LSA; however, there are numerous outpost camps located in the RSA. The closest known tourist outpost camp is the Fish Basket Outpost Camp, which is owned and operated by the Nibinamik First Nation. The outpost is located approximately 6 km upstream (north) of the proposed all-season road. As such, the Project will not have a measurable effect on known existing outpost camps.

It is possible that the construction of the all-season road and mine will affect people's perception of the area as a remote, pristine wilderness area. However, development of the mine and related infrastructure will not take place in proximity to the outfitter camps/lodges, as such there are no anticipated effects to the visual landscape. It is expected that most of these negative perceptions can be mitigated by reinforcing through advertising and media the unique outdoor experience that Northern Ontario has to offer. In addition, mining and mineral development is a huge part of northern Ontario's culture. Mineral exploration and mine development has been occurring hand in hand with tourism in the north for decades.

First Nations have also indicated that the construction of the all-season road may help reduce the transportation costs for tourists. Currently, people coming to the area to fish or hunt rely on charters that fly out of Pickle Lake, Savant Lake, or Nakina. Reducing the transportation costs may bring additional non-residents into the area for the hunting and fishing opportunities.

7.8.3.4 Adverse Effects to Travel Routes

Noront does not currently know the location of traditional travel routes in the RSA. However, effects to established travel routes will be negligible and restricted to the LSA. Effects to traditional travel routes would not be measureable in the RSA. Potential effects to navigable waters are discussed in Section 7.10.

7.8.3.5 Adverse effects to Spiritually Sensitive Areas

Noront has not identified any existing sources of ATK belonging to the potentially affected First Nations communities that impact the proposed development. Noront is committed to the collection of ATK and consideration of this information in its Project planning. To date Noront has completed various road studies and field work programs along the proposed transportation corridor. These activities have included knowledgeable local guides. The current road alignment has been based on the information provided by the guides.

Noront will continue to disclose development plans with Aboriginal communities to cooperate in the protection of spiritually sensitive areas. By following this procedure the Project will not cause an adverse effect to spiritually sensitive areas.

7.8.4 Potential Residual Effects and Determination

The relative significance of residual effects was evaluated based on a suite of standardized criteria including: magnitude, geographical extent, duration, frequency, reversibility, context and likelihood of occurrence. A rating was assigned and compiled in Table 7.8-3 to the residual effect of fishing, hunting and plant harvesting opportunities, as well as travel routes.

Table 7.8-3 Significance of Residual Effects on Community Dynamics

Residual Effect	Predicted Degree of Effect After Mitigation Measure								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	
Fishing Opportunities	Adverse	Low	Local	Short Term	Infrequent	Reversible	High Resilience	Low	Not Significant
Hunting Opportunities	Adverse	Low	Local	Short Term	Infrequent	Reversible	High Resilience	Low	Not Significant
Plant Harvesting Opportunities	Adverse	Low	Local	Long Term	Frequent	Irreversible	Low Resilience	Low	Not Significant
Travel Routes	Adverse	Low	Local	Long Term	Frequent	Irreversible	Low Resilience	Low	Not Significant

There are no significant adverse effects to hunting, fishing or plant harvesting opportunities. Potentially adverse effects related to spiritually sensitive areas, trapping, and land use based commercial activities (i.e. First Nation owned outpost camps) can be mitigated.

7.8.5 Discussion of Significance

Effects to navigable waters are discusses in Section 7.10. Overall Project effects to navigable waters were determined to be not significant. Effects to hunting and fishing opportunities will only last during the construction phase. Following the construction phase any restricted areas will be available for hunting or fishing. Effects to plant harvesting opportunities are not reversible as areas will be permanently lost; however, the effects are of low magnitude and restricted to the LSA.

7.8.6 Follow-up Program

ATK is important source knowledge relevant to this effect assessment and the overall environmental assessment. To date Noront has not been able to integrate ATK into the assessment of effects. Noront has developed an ATK Study Plan (Volume 4, Section 15) as a commitment to collecting ATK.

7.9 CURRENT USE OF CROWN LANDS AND RESOURCES FOR RECREATIONAL PURPOSES

7.9.1 Introduction

Ontario's Far North is recognized as one of the last great undeveloped areas at a provincial, national and international level. Tourists come to the Far North for the unique outdoor experience. The area supports hunting, fishing, camping, sight-seeing and other outdoor recreational activities.

7.9.2 Rationale for VEC Selection

The Current Use of Crown Lands and Resources for Recreational Purposes VEC examines the potential interactions of the Project on recreational land uses in the area. Table 7.9-1 provides an overview of the indicators and a rationale for the VEC selection.

Table 7.9-1 Current Use of Crown Lands and Resources for Recreational Purposes VEC Selection and Rationale

VEC	Key Indicator(s)	Rationale for VEC Selection or Exclusion
Current Use of Crown Lands and Resources for Recreational Purposes	Existing land, water and resources available for hunting, fishing, camping, and general recreation	Current Use of Crown Lands and Resources for Recreational Purposes were selected as VECs due to the potential interactions of the Project with other land users in the area.

The indicators selected for the Land Use and Tenure VEC are based on the available information compiled in the Socio-Economic Baseline Report (Technical Supporting Document 14). The Current Use of Crown Lands and Resources for Recreational Purposes VEC is assessed using the following indicators:

- Use and loss of Parks and Protected Areas
- Hunting Opportunities
- Alteration to Tenured Trapline Areas
- Proximity to Outfitting Camps and Lodges
- Fishing Opportunities
- Recreation and Tourism Opportunities
- Effects to Navigable waters

7.9.3 Potential Interactions and Effects

The Project is anticipated to have the following effects that may interact with current use of Crown lands and resources for recreational purposes:

- Provincial Parks and Conservation Areas
  - Increased Access
  - Aesthetics and Perception of the Area
- Hunting Opportunities

  - Disturbance to Wildlife Management Units/Areas
  - Increased access to resources
- Outfitter Camps and Lodges
  - Aesthetics and Perception of the Area
- Fishing
  - Increased access to resources
- Recreation and Tourism Opportunities
  - Increased access
  - Aesthetics and Perception of the Area

A discussion regarding these potential effects is provided in Sections 7.9.3.1 to 7.9.3.5.

7.9.3.1 Provincial Parks and Conservation Areas

There will be no direct effects to provincial parks or conservation areas from the Project. The construction of the all-season road will approach the Otoskwin/Attawapiskat Provincial Park but will remain outside of the park boundary. As such, there will be no effects or conflicts with the Park's land plans or its current goals and objectives (Ontario Parks, 2002).

No additional access zones will be created by the Project but access may be facilitated in areas where the road encroaches on the park boundaries. Currently the park is accessed from Neskantaga First Nation and at the Pickle Lake North Road crossing at the Otoskwin River. It is hard to determine, if, and how many people, would use these areas to access the Park. Known methods of access into the park include, aircraft, power boat, canoe, snowmobile and ATV. The additional access zones may benefit park users trying to gain access to the park.

It is possible that the construction of the all-season road and mine will affect people's perception of the park as a remote, pristine wilderness area. However, the Project components will not change the visual aesthetics from within the Park, so there is no effect and mitigation will not be required.

7.9.3.2 Hunting

The Project is located within four Wildlife Management Units: 01C, 01D, 16A and 16B. No changes are expected to the current hunting opportunities in units 16A, 16B or 01C. However, construction of the all-season road to the mine site will provide access to unit 01D, which was previously only accessible via the winter road and by air. Increased access to this area is considered to be a benefit to hunters as it opens up additional areas for hunting. Disturbance to the Wildlife Management Units from the Project are minimal (< 1 %) and represent a small fraction of the Wildlife Management Units.

There are no bear management areas located at the mine site or along the transportation corridor. The trans-load facility will be located on a brownfield site; therefore, there will be no effects to Bear Management Area IG-5A-036 because no land within this area will be lost as a result of the Project.

7.9.3.3 Outfitter Camps and Lodges

There are numerous outpost camps located within the RSA; however, none of the camps are located within the LSA. The closest known tourist outpost camp is the Fish Basket Outpost Camp, which is owned and operated by the Nibinamik First Nation. The outpost is located approximately 6 km upstream (north) of the proposed all-season road. As such, the Project will not have a direct effect on known existing outpost camps.

It is possible that the construction of the all-season road and mine will affect people's perception of the area as a remote, pristine wilderness area. However, development of the mine and related infrastructure will not take place in proximity to the outfitter camps/lodges, as such there are no anticipated effects to the visual landscape. It is expected that most of these negative perceptions can be mitigated by reinforcing through advertising and media the unique outdoor experience that Northern Ontario has to offer. In addition, mining and mineral development is a huge part of northern Ontario's culture. Mineral exploration and mine development has been occurring hand in hand with tourism in the north for decades.

7.9.3.4 Fishing

The Project will not result in the removal, or restrict access to, existing fishing areas. The Project spans three Fisheries Management Zones: 2, 3 and 4. The Project will not affect the current use of fisheries resource use in Zone 4; however, the Project will result in increased access to Zones 2 and 3. Areas that will become available to the public were previously only accessible in the winter or by air. The increased access to remote fishing areas will increase fishing opportunities in the region and is considered to be a benefit to resource users; as such no adverse effects were identified.

7.9.3.5 Recreation and Tourism Opportunities

The Project will not restrict current recreation or tourism activities in the area. The Project, through the creation of an all-season road, will provide increased access to previously inaccessible areas for individuals looking for remote wilderness experiences. There are no known camping sites located within close proximity to the all-season road or mine site. However, if there are campsites in proximity to the Project they could easily be relocated away from the Project infrastructure to similar sites nearby.

As discussed above, it is possible that the construction of the all-season road and mine will affect people's perception of the area as a remote, pristine wilderness area; however, changes to the visual landscape will be limited to the Project footprint. As such, no significant changes to the Project will provide increased access to wilderness areas, which is a benefit to recreationalists; as such no direct adverse effects were identified.

7.9.4 Potential Residual Effects and Determination of Significance

There are no residual adverse effects anticipated to the Current Use of Crown Lands and Resources for Recreational Purposes VEC. The Project will benefit local resource users by providing increased access to previously hard to access or inaccessible areas. Adverse effects related to changes in general public perception can be mitigated through media.

7.9.5 Follow-up Program

No follow-up program.

7.10 NAVIGABLE WATERS

7.10.1 Introduction

The proposed Project will interact with navigable waters, as defined by the Navigable Waters Protect Act (NWPA, 1985). The NWPA prohibits the construction of temporary or permanent works in Canadian navigable waters and interference to navigation unless approved by the Minister of Transport or if the works are determined to be minor. Effects to navigable waters will occur along the transportation corridor through the construction of stream crossings (i.e., culverts and bridges). No effects on navigable waters will occur at the trans-load facility or mine site.

Screening of navigable waters along the transportation corridor was undertaken following the Minor Waters User Guide (TC, 2010). The screening was conducted to determine if any of the watercourses could be classified as a minor navigable water, as defined in the Minor Works and Waters Order (TC, 2009). If the watercourses are deemed to be minor navigable waters, they are exempted from the NWPA application process. Works proposed on minor navigable waters do not significantly affect navigability. The results of the navigable waters screening are presented in Technical Supporting Document 16.

7.10.2 Rationale for VEC Selection

Navigable waters were selected as a VEC because of the potential changes to navigability caused by the construction of the transportation-corridor. Table 7.11-1 provides an overview of the indicators and a rationale for the VEC selection.

Table 7.10-1 Navigable Waters VEC Selection and Rationale

VEC	Key Indicators	Rationale for VEC Selection
Navigable Waters	Location and quantity of navigable waters	Navigable Waters were selected as a VEC due to the potential effects of the Project on Navigable Waters. Navigable waters are protected under the Navigable Waters protection Act.

7.10.3 Applicable Guidance

The protection of navigable waters in Canada is built into NWPA, which is administered by Transport Canada.

7.10.4 Potential Interactions and Effects

The installation of stream crossings (i.e., culverts and bridges) at watercourses located along the transportation corridor could potentially interfere with navigation. Based on the results of the navigable waters screening (Technical Supporting Document 16) the project will potentially affect the navigability of 66 watercourses located within the LSA. Little is known about the current use of watercourses in the area; however, based on the remote location of the Project and the current lack of access to the area, interference with navigability is unlikely. In addition many of the watercourses are isolated from other known transportation routes, such as the Attawapiskat River.

Several of the larger watercourses including the Muketei River, Totogan Creek, and the Pinemuta River are more likely to support recreational activities. However, larger watercourses will be crossed using bridges. The bridges are expected to be designed to maintain the navigability of the watercourse. If this isn't the case, provisions will be made for appropriate signage and trails for portages.

During the construction phase it may be necessary to temporarily close watercourses to users for safety reasons. During these periods, the navigability of the watercourse would be limited or prohibited, necessitating temporary avoidance of the area or use of exit/entry points before and after the crossing location. Temporary portage routes and appropriate signage will be put into place if it is determined to be necessary.

7.10.5 Potential Residual Effects

The loss of navigability to watercourse was considered to be a residual effect that cannot be completely mitigated. The relative significance of the residual effect was evaluated based on standardized assessment criteria including: magnitude, geographical extent, duration, frequency, reversibility, context, and probability of occurrence, as defined for socio-economic effects (CEA Agency 1992; amended in 2010; Table 7.11-2).

Table 7.10-2 Significance of Residual Effects on Navigable Waters

Residual Effect	Predicted Degree of Effect After Mitigation Measure								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	
Loss of Navigability	Adverse	High	Local	Long Term	Infrequent	Irreversible	Low Resilience	Low	Not Significant

7.10.6 Discussion of Significance

The effect on navigable waters, as described above, is limited in geographical extent. The changes to navigability are deemed to be of minimal consequence since the majority of effected watercourses are not easily accessible. Any of the larger crossings that are more likely to be accessed will only be temporarily impacted during construction and maintenance of bridges. A majority of the effected crossings would not be considered a preferred destination for recreational activities such as boating, canoeing and/or kayaking. In consideration of the above factors and mitigation no significant adverse effects are expected.

7.10.7 Follow-up Program

Upon receipt of additional engineering design, gained during the detailed engineering phase, a revised assessment package will be submitted to Transport Canada. The package will include representative width, depth, gradient and flow measurements of each crossing, as well as upstream and downstream photographs.

Detailed bridge drawings will be formally submitted to Transport Canada for review for all crossings determined to be navigable. Drawings will include the watercourse name, photographs of the crossing, crossing width, height to the bridge measured from the high water mark, bankfull depth, longitude, and latitude.

Section 8

Additional Effects of the Project

Knight Piésold
CONSULTING
www.knightpiesold.com

TABLE OF CONTENTS

PAGE

TABLES

FIGURES

8 – ADDITIONAL EFFECTS OF THE PROJECT

8.1 ABORIGINAL TREATY RIGHTS

8.1.1 Background

When the Crown contemplates conduct that may have potential adverse impacts on potential or established Aboriginal or Treaty rights, it has a legal duty to consult with, and where appropriate to accommodate Aboriginal groups before making a decision to proceed with the proposed conduct (CEA Agency, 2012).

For the purposes of the federal Crown consultation, the CEA Agency required Noront to describe in the EIS how the concerns respecting Aboriginal groups shall be addressed. This description should include a summary of discussions, the issues or concerns raised, and should identify any potential or established Aboriginal or Treaty rights and related interests as conveyed to the proponent.

The CEA Agency (2012) indicated that this information will be used by the Crown to assess the potential impact of the Project on potential or established Aboriginal rights or Aboriginal and Treaty rights, and related interests, and the measures to prevent, mitigate, compensate or accommodate those potential effects.

In the Detour Gold Project Comprehensive Study Report, the CEA Agency (2012) noted that the federal government has a duty to consult and accommodate where appropriate when it has knowledge that its proposed conduct might adversely impact an established or potential Aboriginal or Treaty right. In addition to the federal government's broader obligations, the CEAA (1992; amended in 2010) requires that all federal EAs consider:

- The effect of any project-related change in the environment
- The effect of that change on current use of land and resources for traditional purposes by Aboriginal peoples
- Consideration of the effect of any project-related change in the environment on physical and cultural heritage, as well as "any structure, site, or thing that is of historical, archaeological, paleontological or architectural significance," such as sites historically occupied by Aboriginal peoples.

Consultation undertaken on the Project to date is summarized in Section 5, and a consultation plan is included in the Environmental and Social Management Plan (ESMP) in Volume 4. This section provides the following:

- A description of Noront's understanding of Aboriginal Rights in respect of the Project and the Government's decision-making role on the Project
- Information relevant to the Project from First Nations asserting rights in regard to the Project and/or the Ring of Fire mining camp
- An assessment of the Project's effects on established or asserted rights

8.1.2 Signatory First Nations to Treaty No. 9

In response to continuous petitions from the Cree and Ojibwa people of northern Ontario, and in keeping with its policy of paving the way for settlement and development, the federal government in 1905-1906 negotiated Treaty No. 9, also known as the James Bay Treaty (AANDC, 2013a). For the first and only time, a provincial government took an active role in negotiations. Together with the area acquired by adhesions in 1929-1930, Treaty No. 9 covers almost two-thirds of the area that became northern Ontario. The components of the Project (mine site, transportation corridor, and trans-load facility) are all located within the Treaty No. 9 area.

The so-called Numbered Treaties promised reserve lands, annuities, and the continued right to hunt and fish on unoccupied Crown lands in exchange for Aboriginal title. Many of the numbered treaties also held clauses that were very similar to many of the civilisation programs undertaken in central Canada, including clauses for schools or teachers to educate children, and agricultural implements were promised to assist Aboriginal signatories in their transition towards an agricultural lifestyle. Aboriginal signatories were encouraged to settle on reserve lands in sedentary communities, learn agriculture and receive an education. Treaty No. 9, however, did not provide for an issue of agricultural implements, cattle, ammunition or seed-grain owing to the northerly location unsuitable for agriculture.

8.1.2.1 Established Treaty Rights under Treaty No. 9

Treaty rights are those rights expressly set out in treaties and agreements between Aboriginal peoples and the Crown, or subsequently inferred as a result of judicial interpretation.

Key articles of Treaty No. 9 are as follows (from AANDC, 2013b):

And His Majesty the King hereby agrees with the said Indians that they shall have the right to pursue their usual vocations of hunting, trapping and fishing throughout the tract surrendered as heretofore described, subject to such regulations as may from time to time be made by the government of the country, acting under the authority of His Majesty, and saving and excepting such tracts as may be required or taken up from time to time for settlement, mining, lumbering, trading or other purposes.

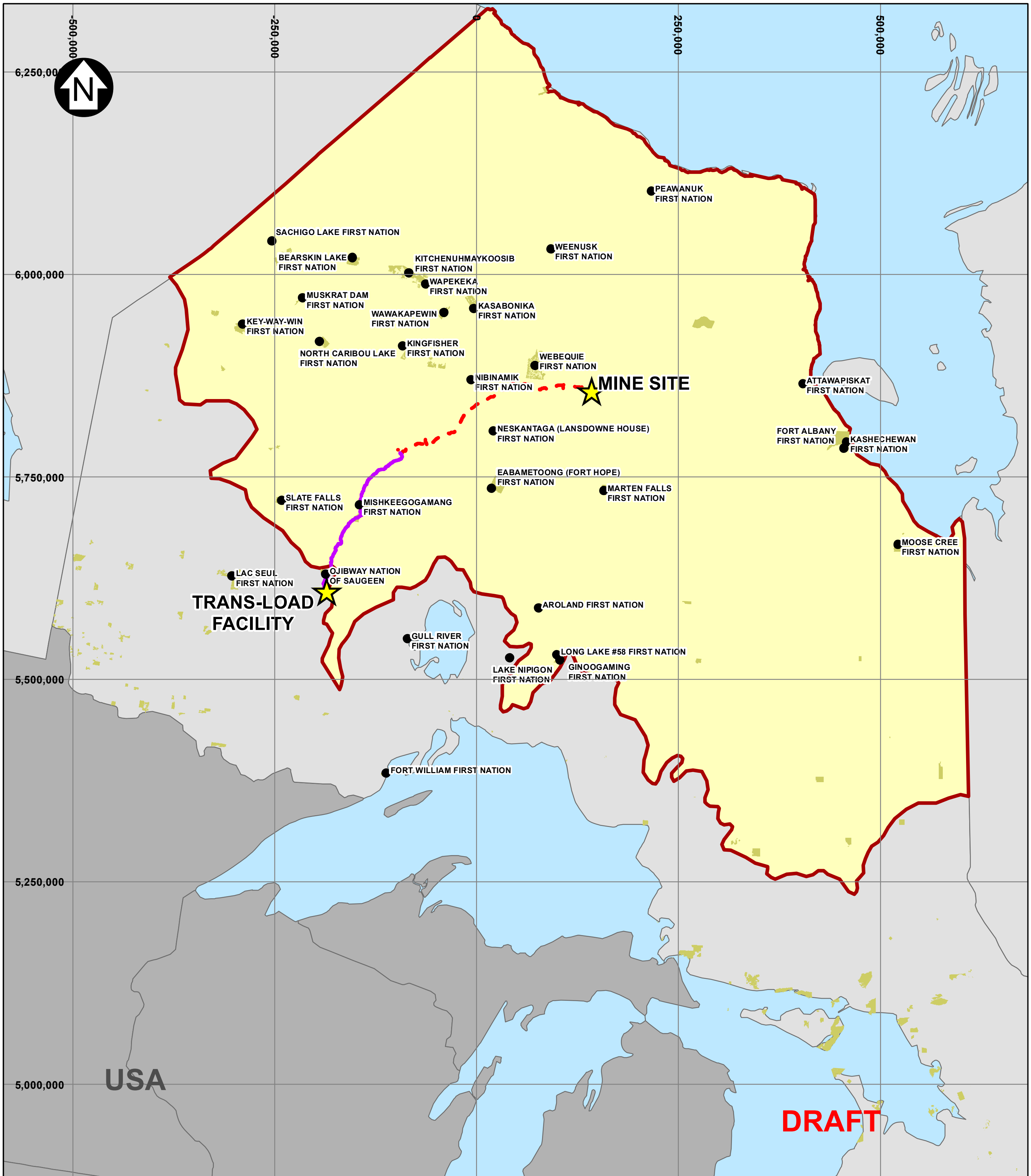
Further, His Majesty agrees to pay such salaries of teachers to instruct the children of said Indians, and also to provide such school buildings and educational equipment as may seem advisable to His Majesty's government of Canada.

Like other numbered treaties, the right to hunt, trap and fish throughout the surrendered lands is central to Treaty No. 9. Also explicit is the payment of annuities and a commitment to provide education to the Aboriginal peoples.

8.1.2.2 Asserted Treaty Rights

Asserted treaty rights:

- NAN Resolution No. 12/40 - Support for Matawa First Nations Moratorium and Re-establishment of Jurisdiction in the High Mineral Area of Treaty No. 9 Referred to as the Ring of Fire
- Mushkegowuk Council’s July 22, 2013 letter to Noront
- Marten Falls June 1, 2011 letter to the Canadian Environmental Assessment Agency



LEGEND:

- MINE SITE AND TRANS-LOAD FACILITY
- CONCENTRATE HAUL ROUTE
- PROPOSED ALL-SEASON TRANSPORTATION CORRIDOR
- WATER
- FIRST NATIONS RESERVE
- TREATY NO. 9 BOUNDARY

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N.
3. PROPOSED ALL-SEASON TRANSPORATION CORRIDOR AND WATER CROSSING LOCATIONS PROVIDED BY KIEWIT INFRASTRUCTURE ENGINEERS (NOVEMBER 26, 2013).
4. TREATY NO. 9 BOUNDARY OBTAINED FROM http://files.ontariogovernment.ca/pictures/firstnations_map.jpg (2013).

SCALE 50 25 0 50 100 150 200 250 km

NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

TREATY NO. 9 BOUNDARY

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-390/1	34

FIGURE 8.1-1 REV A

A	20DEC'13	ISSUED WITH REPORT	RAC	AS	SRA	RAM
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D

SAVED: I:\102\00390\01\A\GIS\Figs\A577_rA.mxd; Dec 13, 2013 8:38 AM; asimpson

8.1.3 Métis Nation Aboriginal Rights

In 2003, the Supreme Court of Canada recognized that Métis communities hold constitutionally protected Aboriginal rights (R. v. Powley). In July 2004, the Métis Nation of Ontario (MNO) and the MNR entered into a province-wide accommodation agreement on Métis harvesting based on credible harvesting rights claims throughout the province. In 2008, the Ontario government and the Government of Canada provided resources to the MNO to undertake consultation on the duty to consult and accommodate with its citizens with a view to increasing Métis input and involvement in Ontario's resource sectors and to develop an Ontario Métis Consultation Framework.

8.1.3.1 The Right to Hunt for Food

The crux of the MNO's protected rights is the right to hunt for food. In 2004, MNR granted the MNO and its membership the right to hunt for food under an Interim MNR/MNO Harvesting Agreement. In an October 7, 2004 news release, the MNR states that on September 19, 2003, the Supreme Court of Canada ruled in *R. v. Powley*, that Métis may exercise Aboriginal rights to hunt for food (MNR, 2004). In the same news release, the MNR announced that it agreed to the *Points of Agreement for an Interim MNR/MNO Harvesting Agreement* (MNO, no date) and the MNO's proposed self-regulating harvesting system using MNO Harvester Cards. In 2011, the MNO established in MNO Harvesting Policy (MNO, 2011). Within the MNO Harvesting Policy, Métis harvesting is defined as:

"…the taking, catching or gathering for reasonable personal use in Ontario of renewable resources by MNO citizens. Such harvesting includes plants, fish, wildlife and firewood, taken for heating, food, medicinal, social or ceremonial purposes and includes donations, gifts and exchange with Aboriginal persons. For greater certainty such Métis harvesting is for reasonable personal use only and does not include harvesting for commercial purposes."

Figure 8.1-2 shows the asserted traditional territories of the MNO. The Project's trans-load facility is located within the northerly extent of the MNO Lakehead Traditional Territory near to the boundaries of both the MNO Lake of the Woods/Lac Seul and the MNO Nipigon Traditional Territories. The trans-load facility will be the re-development of a brownfield development area on privately owned land.

Figure 8.1-2 Métis Nation of Ontario Harvesting Traditional Territories

8.1.3.2 Duty of the Crown to Consult with Métis as Aboriginal Peoples

The MNO website states the following regarding the duty of the Crown to consult with Ontario Métis (MNO, 2013):

Duty of the Crown and Ontario

Based on credible Métis rights assertions and claims throughout Ontario, the provincial government has accommodated Métis rights on a regional basis, within Métis harvesting territories identified by *the Métis Nation of Ontario (MNO). This accommodation has been held to be legally enforceable by the Ontario Court of Justice in 2007 in R. v. Laurin.*

In Métis traditional harvesting territories, the Crown's duty to consult is triggered when it plans, undertakes or authorizes a policy, project or development that has the potential to affect the rights, interests or way of life of the regional Métis communities that rely on these territories. Industry may undertake procedural aspects of the Crown's duty, but the duty itself remains solely with the Crown. The MNO, in partnership with its Community Councils, has established a process to achieve effective consultation with Métis in Ontario. This process requires government or industry to provide written notice to the potentially affected regional rights-bearing Métis communities. Through established Regional Consultation Protocols, the MNO and its Community Councils will undertake an assessment of all consultation requests.

Following this, a response from the regional rights-bearing Métis community will be provided, identifying whether consultation is required, and, if so, how consultation should take place. It is at this point that a formal consultation process would begin.

The MNO have developed regional consultation protocols, the applicable one to the Project being the Consultation Protocol for Lakehead/Nipigon/Michipicoten Traditional Territories (MNO, 2008).

8.2 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

8.2.1 Introduction

The EIS Guidelines (Sub-section 10.5, CEAA, 2012) require that the environmental assessment include a characterization of the potential effects of the environment on the project, including the predicted effects of climate change. The assessment will include the prediction of potential effects of extreme environmental conditions such as natural hazards, such as severe and/or extreme weather conditions and external events on the Project. In addition, Noront is required to identify and describe the predicted effects of climate change on the Project up to and during the projected post-closure phase of the Project (CEAA, 2012). The procedural guide Incorporating Climate Change Considerations in Environmental Assessment: General Guidance for Practitioners (2003) was used to provide guidance on incorporating climate change in the assessment.

Environmental conditions with the potential to adversely affect the Project components and activities were identified for the assessment. The range of environmental events that will have a potential to affect the Project components and activities during the construction, operations, decommissioning and closure, and post-closure phases include:

- Seismic activity
- Extreme weather events
- Forest fire
- Climate change

8.2.2 Seismic Activity

Potential Effect

A review of the regional tectonics and historical seismicity is provided in Section 3.4.7. The Project is situated within a stable Precambrian craton (continent) and no major active tectonic zones have been identified within hundreds of kilometres of the area. Thus, any seismic activity in the area is likely to occur along older, currently non-active, fault systems.

A number of federal governmental agencies record seismic activity, and have records dating back several hundred years. These records, shown in Section 3.4.7, itemise major earthquakes recorded in Canada and generally demonstrate areas of varying earthquake hazard potential. Digital data recordings are available for every major earthquake in Canada since 1985. In the Project region, there have been very few earthquakes during the period of record and the magnitudes of the recorded events were on the order of 3 to 4 on the Richter scale (i.e., quite low).

There is potential for seismic activity in the area, but the hazard rating is very low. If an earthquake were to occur and affect the Project, the damage potential of the earthquake would depend largely on the proximity of the Project to the epicentre of the earthquake. Damage to Project infrastructure can occur directly through ground shaking and indirectly as a result of falling objects. All Project components could be affected by seismic activity, though the level of damage depends on the nature of the seismic event.

Under likely earthquake scenarios, buildings and facilities are not expected to fail and Project components, activities and critical services would not be shut down. The consequences to surface stockpiles and other infrastructure including the surface water collection pond are expected to be negligible and restricted to minor displacement or aggregate or topsoil stockpiles. In terms of the mine, there are few documented examples of regional seismic activity disrupting underground operations. If an event did occur, it is anticipated that the resulting ground motion would be well within the capabilities of the mine's ground support system.

Mitigation Measures

The Project design will ensure that components and activities will perform at earthquake exposure up to the expectations and in compliance with current standards in Canada. All buildings on site including the accommodations camp, surface processing facility, waste management facility and the power generators will be designed according to the Ontario Building Code (Ontario, 1992). The OBC incorporates technical requirements to ensure that buildings are protected against earthquakes based on local seismic conditions.

The slopes of the aggregate and topsoil stockpiles will be relatively low and flat, with gently sloped faces and an overall slope angle of about 14 degrees (4H:1V) to provide stability. All stockpiles will be removed before or at closure of the Project.

The overall potential effects of seismic activity on the Project are not considered significant because the likelihood of occurrence is low and the mitigation measures will reduce the possibility of a negative effect.

8.2.3 Extreme Weather Events

In general, the climate of the Project area is characterized by long cold winters and short cool summers. Climate data collected for the Project are summarized in Technical Supporting Document 1. Extreme weather events are unusual, severe or unseasonal weather at the extremes of the historical distribution. Data from regional stations were used to estimate potential extreme weather conditions.

Annual extreme 24-hour rainfall values were obtained from the Environment Canada return period rainfall values for Pickle Lake. The 24-hour rainfall depths range from 44 mm for a 2-year return period, to 100 mm for a 100-year return period. For comparison, the maximum daily rainfall recorded at the mine site in the Yukon from 2009 to 2013 was 50.6 mm, which corresponds to a return period of between 2 and 5 years at Pickle Lake. The maximum daily rainfall recorded at the Pickle Lake Station is 108 mm. Scaled to the mine site (according to the regression relationship for monthly precipitation), the calculated extreme 24-hour rainfall value is 105 mm.

The maximum and minimum temperatures recorded at the Project climate station between 2009 and 2013 are 32°C and -41°C, respectively. The extreme maximum and minimum recorded temperatures at Lansdowne House are 36°C and -48°C, respectively. Scaled to the mine site (according to the regression relationship for temperature), the calculated maximum temperature at the mine site is approximately 35°C. The calculated minimum temperature at the mine site is approximately -47°C.

Potential Effects

Extreme weather events have the potential to affect Project components and activities if not mitigated. For example, extreme precipitation can cause releases of water from water management components, such as the surface water collection pond. Extreme precipitation can also cause erosion of material from stockpiles, flooding of structures and access and haul roads, or increase the snow loading on buildings. Prolonged periods of extreme snowfall can decrease visibility and be a major issue that impedes mine and transportation operations. A summary of the potential effects of the extreme weather events on the Project components and activities is presented in Table 8.2-1.

Table 8.2-1 Potential Effects on the Project from Extreme Weather Events

Project Component or Activity	Project Phase	Range of Potential Effects	
		Likely Scenario	Worst Case Scenario
Water management structures (surface water collection pond)	C, O,	Extreme precipitation will increase water level within the collection pond and the discharge from the pond.	Extreme precipitation will increase water level within the collection pond and the discharge from the pond.
Mine site roads and all-season access road	C, O, CL	Temporarily (short-term) impassable sections of roads due to flooding from extreme precipitation or visibility issues related to extreme snow are mitigated quickly so that Project activities and critical services are not interrupted for more than 24 hrs.	Large sections of roads are impassable due to flooding from extreme precipitation or snow for an extended period of time, so that Project activities and critical services are interrupted for more than one week.
Mine operations	C, O	Short term visibility issues from extreme snowfall may interrupt mine operations. The majority of Project activities and critical services are not interrupted for more than 24 hrs.	Extended visibility issues from extreme snowfall may affect Project activities and critical services for more than one day.

NOTES:

1. CONSTRUCTION (C), OPERATIONS (O), CLOSURE (CL). A RANGE OF POTENTIAL EFFECTS ARE DESCRIBED TO REPRESENT THE MOST LIKELY PREDICTED SCENARIO AND THE UNLIKELY WORST CASE SCENARIO.

Mitigation Measures

The Project will incorporate design-based mitigation measures into the design of Project and activities. This will prevent and minimize the potential effects of extreme weather events on critical Project components and activities. Extreme weather conditions for the Project were used as the design values for engineering the Project's key mine site components, including surface water management structures and road water crossings. For example, the capacity of the surface collection pond has been sized taking into consideration extreme precipitation events. Along the transportation corridor, any areas in close proximity to flood plains, watercourses and unstable terrain, have been avoided where possible. Road culverts on haul roads and access roads will be designed to account for a 1 in 100 year flood event. Bridges along the all-season access road will be designed with adequate freeboard above the 1 in 100 year flow elevation to allow for clearance of ice and debris during a potential ice-jam flood event.

During the life of the Project, the Emergency Response Plan and other associated environmental management and monitoring plans will define actions and procedures to ensure that human and environmental health and safety is considered in relation to potential effects on the Project from extreme weather events.

8.2.4 Forest Fire

Forest fires occur throughout Ontario, but most large fires occur in the boreal forest of northwestern Ontario. Forest fire can threaten human safety, destroy property or disrupt economic activities. The MNR is charged with managing forest fires to both protect public safety and property while enabling fire's role in ecosystem health. In 2004, MNR released a Forest Fire Management Strategy for Ontario, which guides the response to forest fires across Ontario. It outlines the areas where greater potential for damage from forest fires require more intensive suppression efforts and where fire can continue to play an important beneficial ecological role (MNR, 2013). The Strategy also addresses how MNR will work on developing partnerships as well as forest fire education and prevention activities.

The environment in which fire management operates is constantly changing. For example, there are increasing signs that shifts in climate and forest conditions may result in more difficult fire seasons. In addition, expanding economic activity in the Far North Region is likely to increase the number of fires that require action to reduce the threat to people and infrastructure (MNR, 2013).

On average, Ontario experiences more than 1,000 forest fires and 140,000 hectares burned annually. The number of fires and their impact is highly variable from year to year (Figure 8.2-1).

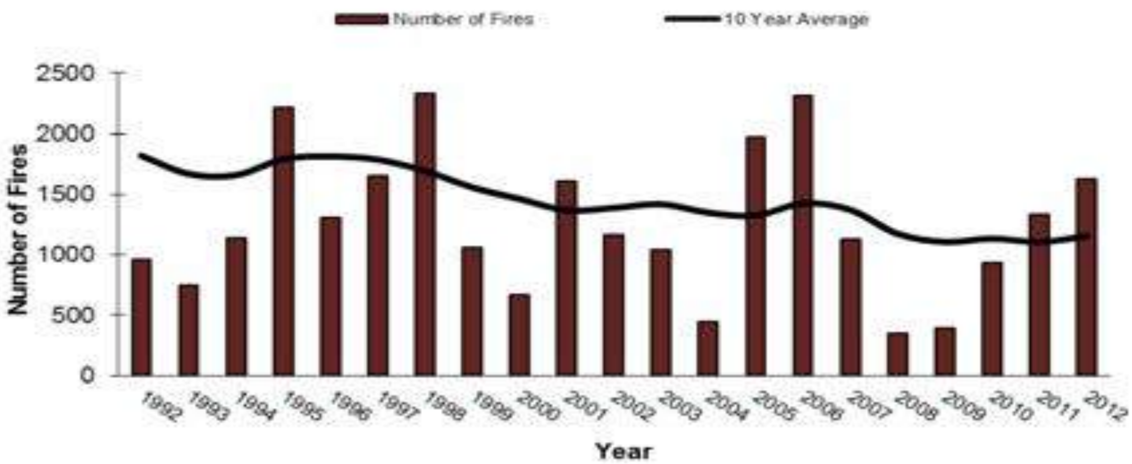


Figure 8.2-1 Forest Fires in Ontario

Potential Effects

Wildfires have the potential to cause widespread damage to ecosystems and property if not contained. Wildfire behavior is a function of forest moisture levels, precipitation, wind speed, humidity, and air temperature. The amount of fuel onsite determines the heat and the potential damage that can be caused by a fire. Generally, areas that have a high fire frequency tend to have lower fuel loading and will burn through the understory quickly and with less destructive force. Forests with a lower fire frequency (common in areas where fire suppression is active), have higher fuel loading, and consequently in the event of a wildfire, burn hotter and more destructively.

Due to its remote location, the majority of the forest fires in the Project region are caused by lightning strikes during frequent summer thunderstorm activity. Fires also originate from accidents, malfunctions, careless human activity, and deliberate criminal acts. Environmental factors such as dry summer weather, high winds, and lightening will increase the fire risk and risk of accidental fire.

The potential effects of wildfires on the Project include damage to on-site buildings and structures at the mine site and at the trans-load facility. Project components at risk from wildfire also include mine supply traffic along the all-season access road. At the mine site, of particular concern is the ability for critical Project components to operate safely if the main or supplementary power plants fails to generate power.

A range of potential effects to the Project components or activities from forest fire is shown in Table 8.2-2.

Table 8.2-2 Potential Effects on the Project from Forest Fire

Project Component or Activity	Project Phase	Range of Potential Effects	
		Likely Scenario	Worst Case Scenario
All-season access road to the mine site	C, O	Minor damage to bridges and culverts are repaired and Project activities and critical services are not interrupted.	Multiple bridges and culverts along the access road are destroyed by wildfire causing Project activities and critical services to be interrupted for more than one month while repairs are completed.
Mine site buildings and structures including the accommodations camp, offices, maintenance shops	C, O	Minor damage or no damage to buildings and structures at the mine site and activities and critical services are not interrupted.	Buildings and structures at the mine site are destroyed and there is a complete shutdown of Project components, activities and critical services for more than one month.
Explosive facility	C	Unintended explosion and fire is within the buffer established and does not affect other buildings at the mine site. The Project activities are not interrupted.	Unintended explosion and fire will destroy other buildings at the mine site. There is a complete shutdown of Project components and activities and critical services for more than one week.
Power plant	C, O	Minor damage if any to the power generators. Backup generators are available and critical services are not interrupted for more than 24 hrs.	Wide spread power outage at the mine site due to damage to generators. Backup generators are insufficient, and Project activities and critical services are interrupted for more than a week until additional generators are brought to the mine site.

Mitigation Measures

Cleared areas around site facilities and the design of the layout of the mine site will minimize the likelihood of direct damage by fire to site infrastructure. Design considerations include protection of fuel storage areas by clearing of trees and brush around the facilities. In addition, these facilities will be equipped with emergency fire-fighting equipment.

The all-season access road to the mine site will operate as a resource/industrial road with controlled and limited access. Brushing and clearing along the road right-of-way will help minimize the risk of wildfires.

The likelihood of occurrence for a wildfire event during the life of the Project is considered moderate due to the prevalence of natural forest fires in the Far North Region. The Project will incorporate design-based measures to avoid wildfires and minimize the potential severity and consequence of fire to the Project. As such, the overall impact of wildfires to the Project is considered to be low.

8.2.5 Climate Change

The Earth's climate has changed over the last 1,000 years and there have been several periods of relatively warm and cool conditions (Jones, 1990). In the last 100 years, the Earth's climate appears to have changed at a more rapid rate than in the past, during a time that corresponds to the exponential increase in the consumption of fossil fuels. Climate scientists generally agree that the atmospheric concentrations of CO_2 and other greenhouse gasses (gas molecules that trap outgoing longwave radiation) produced by the burning of fossil fuels and other human activities have markedly increased in the last century, and that these increases have caused the climate to warm. However, there remains scientific debate as to whether or not the greenhouse gas emissions explain some, all, or little of the observed warming (Ruddiman, 2008). Nonetheless, there is a large body of evidence that supports the view that the climate warming in the last 100 years is mainly because of human activity (IPCC, 2007). The potential changes to climate in Ontario's Far North Region are important to understand in order to address the sensitivity of the Project to long-term climate variability and because climate change has been identified as a valued ecosystem component (VEC) in the EIS Guidelines (CEA Agency, 2012).

8.2.5.1 Trends in Climate

Temperature

Short-term variability in seasonal or annual climate is expected to have a greater influence on the Project than long-term trends that occur more gradually. Trends in climate were assessed through an examination of long-term precipitation and temperature records and are discussed in Technical Supporting Document 1.

The trends in regional surface air temperature for January and July and the mean annual surface air temperature are shown in Technical Supporting Document 1 and summarized in Table 8.2-3. The trends in surface temperature were evaluated from Environment Canada data from the Pickle Lake and Lansdowne House stations.

Table 8.2-3 Summary of Trends in Survey Air Temperature

Station	Mean January Temperature	Mean July Temperature	Mean Annual Temperature
Lansdowne House 1941-2012	Positive trend (Slope: 0.04)	No significant trend	Positive trend (Slope: 0.01)
Lansdowne House 1980-2012	No significant trend	No significant trend	No significant trend
Pickle Lake 1934-2012	Positive trend (Slope: 0.03)	No significant trend	Positive trend (Slope: 0.02)
Pickle Lake 1980-2012	No significant trend	No significant trend	No significant trend

A positive trend is evident in the mean January temperatures and the mean annual temperatures at the Lansdowne House and Pickle Lake over the entire data record. No significant trends were observed in the mean July temperatures at either station. Significant trends were evident in the mean January temperatures, but the slopes of 0.3 and 0.4°C per decade indicate a relatively minor change. The data from 1980 to 2012 at both stations show considerably more variability in the mean annual temperature than during the entire period of record. Although many have suggested that temperatures have been rising at a greater rate in the last several decades (IPCC, 2007), no significant trends were evident in the July, January, or annual mean temperature from 1980 to 2012. Based on this pattern, and the relatively minor long-term trends, no substantial changes in temperature are expected over the construction and operation phases of the mine (2015 to 2029).

Precipitation

The trends in regional precipitation were evaluated from the Pickle Lake adjusted precipitation dataset (snowfall, rainfall, and total annual precipitation) and are shown in Technical Supporting Document 1 and Table 8.2-4.

Table 8.2-4 Summary of Trends in Precipitation

Station	Annual Snowfall	Annual Rainfall	Total Annual Precipitation
Pickle Lake 1934-2011	Positive trend (Slope: 1.5)	Positive trend (Slope: 2.1)	Positive Trend (Slope: 3.3)
Pickle Lake 1980-2011	No significant trend	Positive trend (Slope: 8.0)	Positive trend (Slope: 9.7)

The trends in the Pickle Lake adjusted precipitation data show that annual snowfall, rainfall, and total annual precipitation all increased from 1934 to 2011. The strongest positive trend is evident in the total annual precipitation, especially during the 1980 to 2011 period, when precipitation increased at an average rate of 97 mm/decade. The increase in total annual precipitation from 1980 to 2011 appears to be driven by an increase in the annual rainfall as there was no significant trend in annual snowfall during this period. Based on this these trends, notable increases in annual rainfall and total precipitation are likely to occur over the construction and operation phases of the mine (2015 to 2029).

8.2.5.2 Estimates of Climate Change for the Project

The Canadian Centre for Climate Modelling and Analysis (CCCMA) has developed a number of climate models to study climate change and variability and to understand the various processes which govern the climate system. To provide a forecast of potential changes in climate, the results from the CRCM 4.2.3 simulations were obtained for the 45 km horizontal grid cell closest to the mine site. The simulations were obtained for years 1961 to 2100 and were driven by the CGCM3.1/T47, following the Intergovernmental Panel on Climate Change (IPCC) observed 20th century 20C3M scenario for years 1961 to 2000 and the SRES A2 scenario for years 2001 to 2100 (CCCMA, 2013).

The CRCM 4.2.3 estimates of temperature and precipitation for the mine site are discussed in Technical Supporting Document 1 and summarized in Table 8.2-5.

Table 8.2-5 Summary of CRCM Estimates of Mine Site Temperature and Precipitation

Date Range	January Mean Temperature	July Mean Temperature	Total Annual Precipitation
1961-2000	No significant trend	Positive trend (Slope: 0.04)	No significant trend
2000-2100	Positive trend (Slope: 0.08)	Positive trend (Slope: 0.06)	Positive trend (Slope: 0.85)
2015-2029	No significant trend	No significant trend	No significant trend

The CRCM results from 1961 to 2000 show no significant trend in January mean temperatures or total annual precipitation. However, the observed temperature and precipitation data from Lansdowne and Pickle Lake showed significant positive trends over the same time period, which raises questions about the validity of the model results.

The CRCM forecasts in temperature and precipitation for 2000 to 2100 show significant positive trends in January and July mean temperatures and total annual precipitation. The January mean temperatures are forecasted to increase by eight degrees, the July mean temperatures by 6 °C, and the total annual precipitation by 85 mm from 2000 to 2100. These forecasted changes in temperature are double the observed trend in mean January temperature from the 1941-2012 Lansdowne House data and over double the observed trend in January temperature from the 1934-2012 Pickle Lake data. No temperature trends were evident in the observed Pickle Lake or Lansdowne House July mean temperature so the forecasted increase of six degrees is quite different than what has been observed. The forecasted increase in total annual precipitation is less than one third of the observed trend in the 1934-2011 Pickle Lake total annual precipitation data. Therefore, the forecasted increase in precipitation is expected to occur at a slower rate than has been observed in the past.

8.2.5.3 Potential Effects of Climate Change on the Project

The CRCM forecasts over the construction and operation phases of the mine (2015 to 2029) were analysed (Table 8.2-5). No significant trends in temperature or precipitation are forecasted over the life of the mine. The forecasted longer-term change in climate modelled from 2000 to 2100 will have an impact on the Project post-closure. At closure, all of the Project infrastructure will be rehabilitated to pre-development conditions. The predicted increase in temperature may make it easier to re-establish vegetation. The forecasted increase in atmospheric CO_2 and a longer growing season could also benefit reclamation efforts.

8.3 EFFECTS OF POSSIBLE ACCIDENTS OR MALFUNCTIONS

8.3.1 Scope of the Assessment

As outlined in Sub-section 10.6 of the EIS Guidelines (CEAA, 2012), Noront is required to identify potential accidents and malfunctions that may occur during the life of the Project. Accidents and malfunctions were identified based on: the EIS Guidelines; comments received from regulatory, Aboriginal and/or public consultation; and experience with similar projects. For each potential accident and malfunction scenario identified, consideration was given to:

- Its nature, mechanism and magnitude
- Its probability (high, medium, low, remote)
- Its consequence(s) (i.e., the potential environmental effect)
- Established safeguards/mitigation
- Contingency and emergency response procedures

Noront has assessed the potential for accidents and malfunctions to affect the environment in all phases of the Project (i.e., construction, operation and closure) for each of the project components:

- Mine site
- Transportation corridor
- Trans-load facility

8.3.2 Accident and Malfunction Scenarios

Accident and malfunction scenarios have been assessed for the following activities:

- Fuel spill during transportation
- Fuel spill from on-site storage facilities
- Fuel spill during on-site dispensing
- Concentrate transport incident
- Concentrate load-out incident
- Chemical spill during transportation to site
- Chemical spill at site
- Sewage treatment plant incident
- Embankment failure (surface water collection ponds)
- Explosives incident
- Crown pillar failure
- Premature closure of the Mine

The nature, mechanism, magnitude and probability of each of the assessed scenarios, as well as potential environmental issues, mitigation strategies and response procedures, are summarized in Table 8.3-1.

Knight Piésold CONSULTING

TABLE 8.3-1

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

SUMMARY OF ACCIDENT AND MALFUNCTION SCENARIOS

Print 20/12/2013 9:19:34 PM

Accident and Malfunction Scenario	Probability	Potential Consequences	Established Safeguards/Mitigation	Applicable Contingency and Response Plans
Fuel Spill during Transportation				
• Fuel will be shipped by tanker truck • A release of fuel (diesel or gasoline) could result from a collision or other accident • Maximum volume of fuel release would be 20,000 to 50,000 L	Low	• Contamination of terrestrial habitat in the immediate area of release. Potential toxicological effects to soil dwelling invertebrates and local vegetation. • Contamination of aquatic habitat. Potential toxicological effects to aquatic biota (fish, benthic invertebrates). • Potential for contamination of surface water quality and groundwater quality, which could impact drinking water sources	• Only licensed companies/drivers will be permitted to deliver fuel for the Project • All drivers will be required to have appropriate training, including spill response training • All trucks to have appropriate communications capabilities • Communities will be notified of a spill potentially impacting drinking water sources • Drivers will be required to follow the Road Management Plan and posted speed limits	• Third-party contractors are expected to have their own Emergency Response Plan • Spill Contingency Plan • Emergency Preparedness Plan
Fuel Spill from On-Site Storage Facilities				
• A release from a storage facility could result from vehicular collisions, malfunctioning equipment or human error • The maximum theoretical release would be one full storage tank volume (850,000 L)	Low	• Contamination of terrestrial habitat in the immediate area of release. Potential toxicological effects to soil dwelling invertebrates and local vegetation. • Contamination of aquatic habitat. Potential toxicological effects to aquatic biota (fish, benthic invertebrates).	• Storage facilities will be located 100 m from sensitive environmental features • Fuel storage equipment to comply with applicable legislative requirements • Tanks to have secondary containment and/or will be double-walled, as well as have collision protection • Spill kits to be maintained at each site • Detailed operational procedures will be posted at all storage facilities	• Spill Contingency Plan • Emergency Preparedness Plan • Testing and remediation or removal of contaminated soil from site to a licensed facility
Fuel Spill during Dispensing				
• A release could result from an equipment malfunction during dispensing or human error • Most likely scenario involves a minor spill during refueling with the spill going to ground • The maximum theoretical release would be the full volume of fuel carried by the dispensing equipment but a probable event would be much less	Medium	• The probability of potential environmental issues is low, as dispensing will occur in the immediate vicinity of sensitive features • Potential for contamination of surface water quality and groundwater quality, in the vicinity of the storage facilities • Contamination of terrestrial habitat in the immediate area of the spill. Potential toxicological effects to soil dwelling invertebrates and local vegetation. • Contamination of aquatic habitat. Potential toxicological effects to aquatic biota (fish, benthic invertebrates)	• Fuel dispensing equipment to comply with applicable legislative requirements • Minimum setbacks of 100 m from sensitive environmental features to be maintained for portable dispensing equipment • Spill kits to be maintained at each site • Equipment to be equipped with emergency shutoff valves • Detailed operational procedures will be developed and provided to relevant employees	• Spill Contingency Plan • Emergency Preparedness Plan • Testing and remediation or removal of contaminated soil from site to a licensed facility

Knight Piésold CONSULTING

TABLE 8.3-1

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

SUMMARY OF ACCIDENT AND MALFUNCTION SCENARIOS

Print 20/12/2013 9:19:34 PM

Accident and Malfunction Scenario	Probability	Potential Consequences	Established Safeguards/Mitigation	Applicable Contingency and Response Plans
Concentrate Haul Incident				
• A concentrate spill along the transportation corridor could result from a collision or another accident • The maximum release would be 35 tonnes	Low	• Concentrate loss will cause physical disturbance in vicinity of the spill (both the loss and its subsequent clean-up will disturb the release area) • Short-term increase in TSS to receiving aquatic environment. Acute health effects to aquatic biota dur to sediment loading (fish, benthic invertebrates). Potential effects to spawning habitat from sediment deposition.	• Drivers will have appropriate licensing and training, including spill response • Trucks will have covers • Trucks will have means of communicating with their own dispatch and Noront personnel • Drivers will adhere to posted speed limits	• Road Management Plan • Spill Contingency Plan • Emergency Preparedness Plan
Concentrate Load-Out Incident				
• Concentrate load-out will occur in specially designed facilities, where concentrate may spill on the floor of the facility as a result of equipment malfunction or human error • Probability of small spills occurring is higher than large spills	Medium	• None envisaged - any loss would occur within an enclosed and contained area	• Load-out facility design makes a release to the environment implausible • Concentrate handling procedures will be defined • Personnel to have appropriate training, including spill response • Trucks and rail cars to be inspected to ensure no concentrate leaves facility	• Concentrate spilled onto floor of the facility will be transferred to holding bins, trucks or rail cars, as appropriate
Chemical spill during transport				
• The severity of a release would depend on several factors, including the physical characteristics of the chemical, the location of the spill, the time of year and the volume • Chemical spills during transport could result from a collision, vehicle malfunction or human error • Largest volume event related to transport of mill process chemicals	Low	• Negligible to severe toxicological effects may occur to terrestrial and aquatic flora and fauna depending on the chemical released	• Only licensed companies/drivers will be permitted to deliver chemicals to site • Third-party contractors will be required to have their own operating procedures and emergency response plans • All drivers to have appropriate training, including spill response training • All trucks to have appropriate communications capabilities • Drivers will adhere to posted speed limits	• Third-party contractors are expected to have their own Emergency Response Plan • Road Management Plan • Spill Contingency Plan • Emergency Preparedness Plan

Knight Piésold CONSULTING

TABLE 8.3-1

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

SUMMARY OF ACCIDENT AND MALFUNCTION SCENARIOS

Print 20/12/2013 9:19:34 PM

Accident and Malfunction Scenario	Probability	Potential Consequences	Established Safeguards/Mitigation	Applicable Contingency and Response Plans
Chemical Spill at Site				
• A chemical release in a mine site could occur as the result of malfunctioning equipment, human error or some other mishap • A chemical release could occur in a contained structure or building • A chemical releases could occur outside of a contained structure or building	High (Remote outside of buildings)	• No potential for significant environmental issues envisaged • Releases within contained facilities will not reach the environment • Releases outside of contained facilities are most likely to occur in developed or built-up parts of the site	• Building design to include sealed floors and sumps or drains to contain spills • All chemicals to be stored and handled according to MSDS information • All personnel handling chemicals will have appropriate training (e.g., WHMIS)	• Spill Contingency Plan • Emergency Preparedness Plan • Healthy and Safety Plan
Uncontrolled Discharge for the Mine Site Sewage Treatment Facility				
• The severity of the accident would depend on the duration and quality of the discharge	Low	• Partially treated or untreated water will release into the receiving wetland and be diluted in receiving waters • Short term release is not expected to have long term toxicological effects on terrestrial or aquatic biota	• Site-specific training • Daily inspections of the sewage treatment plant will occur • Treatment plant will be operated as per legislative requirements	• Spill Contingency Plan
Uncontrolled Discharge from the Surface Water Collection Ponds				
• Uncontrolled discharge could result from an embankment failure or flood event	Remote	• Short term increases in total suspended solids within adjacent aquatic habitats, though there are no water bodies located near the surface water collection pond	• Design of the surface water collection ponds and spillway is expected to mitigate any potential failures/events	• Spill Contingency Plan
Crown Pillar Failure				
• Instability of underground workings	Remote	• Environmental effects would be limited to the area located immediately above the crown pillar • Direct loss of terrestrial flora • Unexpected flows of surface and/or groundwater into the underground workings	• Mine design will directly mitigate the probability of crown pillar failure • Crown pillar assessment will be completed in concordance with legislative requirements	• Emergency Preparedness Plan
Explosives Accident				
• An explosives accident could result from improper handling of explosive materials, faulty equipment, improper blast notification and or guarding practices or because of an overuse of blasting agent producing release of sporadic fly rock • The most likely accident scenario would involve bodily harm or building damage rather than significant environmental impacts	Low	• Direct damage limited to the blast zone • Primary concerns related to an explosives accident are worker health and safety related	• Follow appropriate regulatory requirements • Employ a licensed third-party contractor to operate the manufacturing plant • Follow good housekeeping practices • Develop explosives storage and handling and blasting procedures and train personnel • Provide suitable protect for above ground fuel tanks used in the explosives manufacturing process in accordance with Subsection 4.3.7 of the National Fire Code of Canada (2005)	• Emergency Preparedness Plan

Knight Piésold CONSULTING

TABLE 8.3-1

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

SUMMARY OF ACCIDENT AND MALFUNCTION SCENARIOS

Print 20/12/2013 9:19:34 PM

Accident and Malfunction Scenario	Probability	Potential Consequences	Established Safeguards/Mitigation	Applicable Contingency and Response Plans
Project-related Fires				
• A fire may occur at any Project location that would result in a major forest fire depending on location, environmental conditions and reaction time	High	• Loss of terrestrial habitat • Short-term air quality effects	• Regular fire suppression system inspections • Combustibles and flammable materials will be stored in designated areas	• Emergency Preparedness Plan
Premature Closure of the Mine				
• Premature closure of the mine could occur during any phase in the mine life	Low	• No notable environmental issues are apparent • Mine site would be closed in accordance to O.Reg. 240/00	• O.Reg. 240/00 • Mine Closure Plan	• Mine Closure Plan

I:\1\02\00390\01\A\REPORT\REPORT 34, EA VOLUME 2 - EA REPORT\REV A\13 - SECTION 8 - ADDITIONAL ENV EFFECTS\2 - DRAFT\SECTION 8.3\TABLE 8.3.1 - ACCIDENT AND MALFUNCTION SCENARIO TABLE.DOCX

A	20DEC'13	ISSUED WITH REPORT	SCP	DMMD	SRA
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

8.3.2.1 Fuel Spill during Transportation

Nature, Mechanism and Magnitude

Fuel will be transported to the mine site and trans-load facility during all phases of the Project. Fuel will also be trucked to the temporary construction camps during the construction of the all-season road to fuel generators, machinery and equipment. Fuel will be shipped by tanker truck from a local or regional supplier.

The largest quantities of fuel being transported will be off-road (dyed) diesel. Smaller amounts of gasoline and aviation fuel will also be required at the mine site and construction camps. Gasoline and aviation fuel may be brought to site in barrels or smaller fuel trucks.

The most likely mechanism for a spill during transportation involves a road accident. An accident could result from human error, a vehicle mechanical failure or a traffic-related incident. A spill could take place anywhere along the transportation corridor. As such, the spill response time could vary from minutes to hours depending on the location and resources required to respond to the incident.

The maximum volume of fuel that could be spilled in this scenario would be the entire contents of a tanker truck (typically 20,000 to 50,000 L). The estimated duration of the discharge could last from minutes to hours without intervention. The duration of the discharge will depend on the severity of the incident.

Probability

The probability of a fuel release during transportation is low. Noront will ensure that only licensed companies are retained to transport fuel and that all drivers have the appropriate licencing and training. Regulations are in place that govern the transportation of fuel and other dangerous goods (i.e., Transportation of Dangerous Goods Act, 1992).

Consequences

A fuel spill along the transportation corridor could cause an effect to the terrestrial and aquatic environments. Toxicological effects may occur to terrestrial and aquatic species present in the vicinity of the spill. Although the probability is remote, impacts to a community's drinking water source are possible if a fuel spill occurs near or upstream of a community's drinking water source.

Established Safeguards/Mitigation

As indicated above, fuel will only be delivered to the site by licenced drivers that have received appropriate training. All drivers will be required to have training in incident response and management, as well as a means of communicating with the Project site, their depot and the MOE Spills Action Centre. If a spill occurred near a drinking water source the community would be notified.

Fuel tankers typically have a multi-compartment design to mitigate such incidents, only under a catastrophic incident would the entire contents of a tanker be released into the environment.

Contingency and Emergency Response Procedures

The third party contractor will be expected to have their own emergency response plan and procedures. However, any such accidental spill will be responded to as prescribed by Noront's Spill Contingency Plan and the Emergency Preparedness Plan.

8.3.2.2 Fuel Spill from Storage Facilities

Nature, Mechanism and Magnitude

Fuel will be stored at the mine site and trans-load facility during all phases of the Project, as well as at the temporary construction camps located along the transportation corridor.

A fuel storage facility (tank farm) will be located within the mine site production area to supply equipment and power generators with diesel fuel. The tank farm will consist of three steel fuel storage tanks, each with a capacity of 850,000 L. Minor quantities of gasoline and aviation fuel will likely also be required and may be stored in a double-lined Envirotank or in drums within a bermed storage area. All stand-alone day storage facilities, whether temporary or permanent, will be double-walled “isotanks” and will be located within a contained area.

Fuel spills could occur as the result from human error, a vehicular collision, or equipment malfunction. The maximum amount of fuel that could be accidentally released to the environment is estimated to be 850,000 L, which is equal to the amount of fuel stored in the largest storage tank at the mine site.

Probability

The probability of a fuel spill from the storage facilities is low based on the safeguards and mitigation measures available.

Consequences

The potential environmental issues related to a fuel spill include contamination of soils, surface water and groundwater in the vicinity of the storage facilities. The contamination could result in toxicological effects to the terrestrial and aquatic biota. The storage tanks will be located away from sensitive areas to avoid potential interactions in the event of an accident or malfunction.

Established Safeguards/Mitigation

Fuel storage equipment will comply with applicable legislations including the Technical Standards and Safety Act (2000). The fuel storage facilities will be situated within secondary spill containment and away from environmentally sensitive areas. Secondary spill containment for the tank farm is designed for a volume equal to the capacity of the largest tank plus 10% of the capacity of the remaining tanks or 110% of the capacity of the largest tank.

Temporary and day fuel storage areas will be afforded secondary containment. Fuel tanks will be situated behind an adequate barrier to prevent vehicular collisions. Inspections of the fuel storage facilities will take place on a daily basis to ensure early detection of leaks, if they occur.

Fuel storage areas will be equipped with spill kits for emergency response and a copy of the current Spill Contingency Plan. The spill kits will contain the appropriate type, size and quantity of equipment for the volume/type of fuel present in the storage location.

Contingency and Emergency Response Procedures

Any accidental spill will be responded to as prescribed by Noront’s Spill Contingency Plan and the Emergency Preparedness Plan. Any potentially contaminated soils will be tested and remediated or removed from site to a licensed facility.

8.3.2.3 Fuel Spill during Dispensing

Nature, Mechanism and Magnitude

Fuel will be dispensed at the mine site, and potentially at the trans-load facility, during all phase of the Project. Temporary storage tanks will be located at the all-season road construction camps and trans-load facility to supply machinery and equipment during construction.

A spill may result during dispensing as due to a malfunction in the fuel transfer process or with the equipment and/or due to human error. The magnitude of the spill will be directly related to the amount of fuel stored within the fuel dispensing equipment.

Probability

Due to the frequency of fuel dispensing activities there is a medium probability of an accident or malfunction occurring.

Consequences

The potential environmental issues related to a fuel spill include contamination of soils, surface water and groundwater in the vicinity of the storage facilities. The contamination could result in toxicological effects to the terrestrial and aquatic biota. The storage tanks will be located away from sensitive areas to avoid potential interactions in the event of an accident or malfunction.

Established Safeguards/Mitigation

Refuelling stations will be equipped with a lined and bermed area to contain minor spills or leaks during refuelling. The liner will be protected by sand bedding that vehicles and other mobile equipment can drive on for refuelling. All fuel transfer will be done by pumps with auto shutoff valves. Staff will be trained on the proper use of the equipment.

All fuel storage areas will be equipped with spill kits for emergency response and a copy of the current Spill Contingency Plan. The spill kits will contain the appropriate type, size and quantity of equipment for the volume/type of fuel present in the storage location.

Contingency and Emergency Response Procedures

Any accidental spill will be responded to as prescribed by Noront’s Spill Contingency Plan and the Emergency Preparedness Plan. Any potentially contaminated soils will be tested and remediated or removed from site to a licensed facility.

8.3.2.4 Concentrate Haul and Transportation Incident

Nature, Mechanism and Magnitude

During operations concentrate will be trucked approximately along the all-season transportation corridor from the mine site to the trans-load facility near Savant Lake. This route includes a new all-season road constructed from the Pickle Lake North Road to the mine site. Traffic from the mine site to the trans-load facility is expected to average 12 truck-loads per day, each carrying approximately 35 tonnes of concentrate using B-train trucks with 2 trailers. A fleet of 12 hopper trucks would complete a round trip each day based on multiple drivers and 24 hour operation.

Concentrate will then be loaded into rail cars and shipped via the Canadian National Railway to an existing smelter. Transportation of concentrate along the CN railway would be done in accordance with applicable CN operating procedures and any other applicable regulatory requirements.

Potential causes for a transportation accident leading to a concentrate spill include human error, vehicle mechanical failure or a traffic-related incident. A spill resulting from an accident with a concentrate truck could take place anywhere along the transportation corridor. As such, the spill response time could vary from minutes to hours depending on the location and resources required to respond to the incident.

In the event of an accident or malfunction it is possible that the entire contents (35 tonnes) of the truck are lost to land, or less likely, into water. Since the concentrate is a solid the spill would be confined to the area immediately adjacent to the accident.

Probability

Although the frequency of concentrate transportation is moderate the probability of a concentrate spill is rated as low.

Consequences

The most likely incident would involve a concentrate haul truck releasing a portion of its load (up to 35 tonnes) on land (soil, or snow in winter). In this instance, the accident would be limited to the immediate vicinity of the loss. The worst case scenario would be a concentrate spill within a sensitive area, such as a lake or river.

The concentrate is a non-hazardous sand-like material. The expected effects to the terrestrial environment would be physical damage to flora caused by the spill. Effects related to aquatic life or habitat would be a result of sediment loading and less likely subsequent deposition of concentrate on fish spawning habitat. Concentrate has limited mobility in most environments (i.e., mobility would be higher in higher energy lotic environments) and its constituents have low solubility. Only acute effects would be expected to aquatic biota.

Established Safeguards/Mitigation

Drivers will be required to have, or receive, appropriate licencing and training. Drivers transporting concentrate along the transportation corridor will be required to follow the Road Management Plan and posted speed limits along the transportation corridor. CN will operate under established operating procedures and in accordance with federal rules and regulations.

Contingency and Emergency Response Procedures

Drivers will be required to abide by Noront's Road Management Plan. Any accidental spill will be responded to as prescribed by Noront's Spill Contingency Plan and the Emergency Preparedness Plan. Any rail-related incidents will be handled by CN's emergency response processes.

8.3.2.5 Concentrate Load-Out Incident

Nature, Mechanism and Magnitude

Loading and off-loading off concentrate will occur at the mine site and trans-load facility, respectively. These activities will take place within specially designed facilities that are equipped to ensure that concentrate is not released into the environment.

At the mine site a truck driver will position the loading spout above the truck hopper inlet and initiate a fill sequence. Upon starting a fill sequence, a multiple inlet air gravity conveyor will accept discharge from one of three bins via a pneumatic rotary valve, and will discharge into a loading hopper. The storage bins will be equipped with bin aerator to assist in fluidizing material while discharging from the bins. The discharge of the loading hopper will be equipped with a truck loading spout which will fill the concentrate truck at a rate of 200 tonnes/hour. A 35 tonne hopper truck will be filled in approximately 10 minutes. The automated truck scale will eliminate the risk of overfilling and material spillage by automatically reducing and stopping the flow rate at predetermined set points. The loading spout lowers into the truck to reduce dusting and loss of material.

At the trans-load facility hopper truck trailers will discharge from the rear of the trailer into an unloading hopper. Screw conveyors will transport the dry concentrate to a bucket elevator at a design throughput of 200 tonnes/hour. Dust collectors will be used throughout the concentrate handling process and any material trapped by the dust collector will re-enter the process flow in a controlled manner by a rotary valve. At the trans-load facility a total of 166 rail cars will be loaded per month (5.5 per day). When an empty rail car is in position on the rail car scale, the operator will position the loading spout and initiate a fill sequence. When a fill sequence is initiated, the storage bin aeration system will start to assist in fluidizing material discharging into the bins. The rotary valve at the bin discharge will control the flow of material into the loading spout. The system will automatically shut down when the rail car is full to minimize spillage in the loading area.

In all of the loading scenarios presented above, concentrate may spill onto the floor of the load-out facility/building as a result of an equipment malfunction or human error. Any loss of concentrate would be confined to the load-out facilities.

Probability

There is a medium probability of a concentrate spill occurring during loading. Smaller quantity spills have a higher probability of occurring than larger spills.

Consequences

There are no scenarios in which an interaction with the environment is expected to occur. Spills will be confined to the inside of the building on cement floors.

Established Safeguards/Mitigation

Design of the load-out facilities mitigate the possibility of concentrate releasing into the environment. Personnel that are involved in concentrate handling will receive appropriate training relating to load-out procedures. Concentrate is the economic product of the mining and milling process and it will be handled with extreme care.

As a final step of the load-out procedures, trucks or rail cars leaving the load-out facility/building will be inspected to ensure that no concentrate leaves the facility on their outer surface. A truck wash will be located at the trans-load facility to ensure that concentrate dust does not leave the confines of the facility.

Contingency and Emergency Response Procedures

Concentrate spilled within the confines of a load-out will be scooped up and transferred into holding bins, trucks or rail cars. Proper housekeeping practices will be followed to limit contact between equipment and concentrate.

8.3.2.6 Chemical Spill during Transportation to Site

Nature, Mechanism and Magnitude

The following is a list of key reagents, and estimated quantities, which will be shipped to the mine site during operations (other chemicals will be shipped to the mine site in smaller quantities):

- Sodium isopropyl xanthate: 55 to 77 tonnes/year
- Methyl isobutyl carbinol: 22 to 28 tonnes/year
- Carboxyl methyl cellulose: 66 to 1,101 tonnes/year
- Quicklime: 632 to 1,016 tonnes/year
- Ferric sulphate: 0 to 32 tonnes/year
- Aluminium compound: 158 to 1,182 tonnes/year
- Hydrochloric acid: 237 to 396 tonnes/year
- Cement: 12,000 tonnes/year

Potential causes for a transportation accident leading to a chemical spill include human error, vehicle mechanical failure or a traffic-related incident. A spill resulting from an accident with a truck could take place anywhere along the transportation corridor. As such, the spill response time could vary from minutes to hours depending on the location and resources required to respond to the incident.

Probability

The probability of a chemical spill during transportation has been ranked as low. Transportation of chemicals occurs without incident on a regular basis throughout the rest of the province and Canada. Regulations are in place that govern the transportation of dangerous goods (i.e., Transportation of Dangerous Goods Act, 1992). Noront will ensure that only licensed companies/contractors are retained to transport chemicals for the Project and that all drivers have the appropriate licencing and training.

Consequences

The most likely incident would involve a transport truck releasing a portion of its load on land (soil, or snow in winter). In this instance, the spill would be limited to the immediate vicinity of the loss. The worst case scenario would be a spill within a sensitive area, such as a lake or river. Effects to aquatic and terrestrial environments are likely as a result of a chemical spill. The severity of the effect depends on the toxicity of the chemical being released. Severe toxicological effects may occur to terrestrial and aquatic flora and fauna.

Established Safeguards/Mitigation

Drivers transporting concentrate along the transportation corridor will be required to follow the Road Management Plan, and posted speed limits along the transportation corridor.

Contingency and Emergency Response Procedures

Drivers will be required to abide by Noront's Road Management Plan. Any accidental spill will be responded to as prescribed by Noront's Spill Contingency Plan and the Emergency Preparedness Plan.

8.3.2.7 Chemical Spill at Site

Nature, Mechanism and Magnitude

Chemicals will be stored and handled within contained areas. These areas will be contained and equipped with collection systems, as required. The collection system will collect spilled chemicals and transfer them to a retrieval or storage location (i.e., collection tanks). A spill could occur while the chemicals are being transported between mine-related facilities. This could result in chemicals being released to the environment. Mill reagents would represent the highest volume chemicals that would be transported between facilities at the mine site.

The following is a list of key reagents, and estimated quantities, which will be shipped to the mine site during operations (other chemicals will be shipped to the mine site in smaller quantities):

- Sodium isopropyl xanthate: 55 to 77 tonnes/year
- Methyl isobutyl carbinol: 22 to 28 tonnes/year
- Carboxyl methyl cellulose: 66 to 1,101 tonnes/year
- Quicklime: 632 to 1,016 tonnes/year
- Ferric sulphate: 0 to 32 tonnes/year
- Aluminium compound: 158 to 1,182 tonnes/year
- Hydrochloric acid: 237 to 396 tonnes/year
- Cement: 12,000 tonnes/year

Probability

The probability of a chemical spill occurring within the confines of a building is ranked as high. The probability of a chemical spill at the mine site during transport between facilities is characterized as low.

Consequences

No environmental issues are envisioned as the result of a chemical spill within a building. A chemical spill occurring during transport between buildings is not expected to cause significant environmental issues. Transportation will only occur within developed areas of the mine site; therefore, spills will occur within already disturbed areas.

Established Safeguards/Mitigation

Collection systems located within the buildings will ensure that the chemicals are contained in the event of an accidental spill. All staff will be properly trained (i.e., WHMIS) so that they are trained in the proper handling and storage procedures. Material Safety Data Sheets (MSDS) will be available to staff and explained in Noront's Health and Safety Plan.

Contingency and Emergency Response Procedures

Any accidental spill will be responded to as prescribed by Noront's Spill Contingency and the Emergency Preparedness Plans.

8.3.2.8 Uncontrolled Discharge from the Mine Site Sewage Treatment Facilities

Nature, Mechanism and Magnitude

All domestic wastewater generated at the mine site will report to the sewage treatment plant prior to discharge to the environment. Domestic wastewater generated from underground facilities will be stored in holding tanks. The tanks will be pumped when required and transported to the sewage treatment plant using a sewage truck.

The existing exploration camp ("Esker Camp") will be utilized to support mine site construction activities. The sewage treatment plant at Esker Camp will be used during construction until the new facilities are operational. The sewage treatment system will consist of an appropriately sized package sewage treatment plant such as a rotating biological contactor (RBC). The package sewage treatment plant would be fed by a pair of alternating duty, constant feed submersible pumps, which are installed at the bottom of an in-ground concrete surge tank and pump chamber.

The total workforce at the mine site is expected to be 600 to 700 people during construction and 300 people during operations and the expected discharge from the sewage treatment plant is 2 to 4 m^3/h.

Failures of the on-site sewage treatment facilities could result from mechanical failure, instrumentation error and/or operator error. The quantity of the spill or accidental release depends on the duration of the discharge.

Probability

The probability of a sewage treatment plant incident of the nature described above is low. Both design and operational safeguards will be put in place to protect against such scenarios.

Consequences

In the event of a sewage treatment plant incident, partially treated or untreated water would be released to the receiving wetland. The quantity of water that will be released would be minimal and will be diluted in the receiving waters. Short-term release of untreated or partially treated waters is not expected to cause long-term toxicological effects to the receiving environment.

Established Safeguards/Mitigation

Staff operating the mine site sewage treatment plant will have appropriate expertise and site-specific training. The operator will complete daily inspections of the sewage treatment plant (i.e., an equipment maintenance program will be developed and implemented to ensure that all equipment is in proper working condition). The treatment plant will be operated as per the requirements outlined in the Environmental Compliance Approval issued by the MOE.

Contingency and Emergency Response Procedures

Untreated release of sewage will be responded to as prescribed by Noront's Spill Contingency Plan and properly reported to the MOE.

8.3.2.9 Uncontrolled Discharge from the Surface Water Collection Ponds

Nature, Mechanism and Magnitude

A surface water collection pond will be constructed at the mine site to collect surface runoff from the portal and laydown area, aggregate crusher and conveyor area, storage area, diesel storage facility and the concentrate drying and loading facility, and to receive groundwater pumped from the underground workings during initial development of the mine. During operations, surface water will be collected and discharged from the surface water collection pond. The pond water quality will be monitored at regular intervals for total suspended solids (TSS) and to ensure the discharge water meets the effluents limits outlined in O. Reg. 560/94 and the MMERs.

At the trans-load facility surface runoff from the exit area of the concentrate loading building and the truck and equipment wash bay will be collected and diverted to the surface water collection pond. Water from the surface water collection pond will be discharged to the environment away from surface waters. As part of the surface water monitoring commitments during operations, the pond water quality will be monitored periodically for total suspended solids (TSS) and to ensure the discharge water meets the effluents limits outlined in O. Reg. 560/94.

The magnitude of the potential discharge depends on the type of incident (i.e., embankment failure or flood event).

Probability

The probability of an uncontrolled discharge is remote given the short duration of the mine life. The surface water collection ponds will be designed to temporarily hold the runoff resulting from a 1 in 10 year, 24-hour storm event (rain plus snowmelt). The spillway for each pond will be designed to pass the 1 in 200 year, 24-hour storm event (rain plus snowmelt). The surface water collection ponds will be designed to meet applicable standards.

Consequences

Due to the limited duration of the incident no adverse effects are expected to the terrestrial or aquatic environments. Short-term increases in TSS may occur within adjacent aquatic habitats in the event of an embankment failure; however, this is not expected to be an issue as there are no waterbodies located in close proximity to the surface water collection pond.

Established Safeguards/Mitigation

The design of the surface water collection pond will mitigate the scenarios discussed above. Due to the short mine life the probability of a flood event or embankment failure occurring is less than 10 percent.

Contingency and Emergency Response Procedures

Any such event will be responded to as per Noront's Spill Contingency Plan and properly reported to the MOE.

8.3.2.10 Crown Pillar Failure

Nature, Mechanism and Magnitude

The crown pillar is relatively small at the mine site due to the vertical structure of the Eagle's Nest Deposit. Typical crown pillar failures result in subsidence of land, which may cause one or many sink holes to form at surface. The size of the sink hole depends on the magnitude of the crown pillar failure. Noront plans on extracting the crown pillar containing ore during the third and fourth year of operations, as such little infrastructure will be located above the majority of the crown pillar.

The extraction of the crown pillar will begin concurrently with the development of the lower zone of the mine in the third year of production and will be completed over a one year period. On surface, the perimeter of the crown pillar will be excavated and a concrete barrier will be constructed using cemented aggregate rock from the paste backfill plant. The concrete barrier will extend from surface to bedrock. The upper bedrock horizon at the crown pillar is fractured and weathered and more permeable than the rock below. This area of bedrock will be drilled with a ring of holes and injected with cement grout to reduce water ingress to the mine during the extraction of the crown pillar.

Once the concrete barrier is in place, overburden material (peat, clay, sand) inside the perimeter will be extracted and stockpiled for later reclamation. The crown pillar, which extends to a depth of 25 m below the top of the bedrock, will be drilled, blasted, and extracted from below and the ore will be transported to the processing facility via underground tunnels and passes. Once extracted, the crown pillar will be backfilled up to several metres below the water table using cemented tailings.

Probability

The probability of a crown pillar failure is remote as a majority of the crown pillar will be extracted and mined out during the third year of operations. In addition, proper mine design and completion of a crown pillar stability assessment in accordance to O.Reg. 240/00 will limit the probability of such a scenario from occurring.

Consequences

Based on the location and nature of the crown pillar, environmental effects would be limited to the area located immediately above the crown pillar. Direct loss of terrestrial flora is possible. Unexpected surface and groundwater flows into the underground workings are also a possible consequence. Effects to surface water and groundwater quantities are possible as well.

Established Safeguards/Mitigation

The mine design will directly mitigate the probability of a crown pillar failure. Underground monitoring of the workings will be completed by qualified professional engineers. A crown pillar assessment will be completed as per O.Reg. 240/00.

Contingency and Emergency Response Procedures

Emergency response procedures will be set out in the Emergency Preparedness Plan. The MOL and other applicable agencies will be contacted and informed of the incident.

8.3.2.11 Explosives Accident

Nature, Mechanism and Magnitude

A qualified explosives contractor will establish manufacturing, storage and delivery services for bulk and packaged explosives. During the construction phase, the ammonium nitrate fuel oil (ANFO) blasting agent for the development of the underground mine will be manufactured on site in a temporary manufacturing and storage facility meeting NRCan's requirements under the *Explosives Act* (1985). Stick-type explosives, boosters and detonators will be stored in three separate magazines, located away from the explosives plant in accordance with NRCan and provincial *Mining Act* requirements. The ANFO production will be less than 1,000 kg/day. Similarly, any explosives required for road construction will be supplied by a qualified third party contractor.

Raw materials will be stored away from the plant so the separation requirements from other work areas will be minimized. The explosives magazines will be sized to store a one year supply of material in two locations (50,000 tonnes at each site), bermed and separated by 500 m (distances to be confirmed with NRCan during licensing). Waste materials from the ANFO plant will be collected for shipment to a licensed off-site landfill. During operations, explosives will be prepared off site and transported to the mine for direct shipment to underground storage magazines.

An explosives accident could occur as the result of improper handling, faulty equipment, improper blast notification and/or guarding practices. An accident could also occur as a result of blasting agent overuse, which may result in the release of sporadic fly rock.

Probability

The probability of an explosives accident has been determined to be low. The likelihood of such an accident is minimized by following the regulatory requirements and ensuring that standard operating procedures are followed.

Consequences

The most probable accident scenario would involve bodily harm or damage to mine-related infrastructure, rather than an environmental interaction. There are minimal environmental impact concerns and any effects would be limited to the immediate blast area and would also be short term.

Established Safeguards/Mitigation

Noront will only hire a qualified third party contractor that will be recorded to adhere to regulatory requirements and standard operating procedures. All personnel using explosives will have appropriate training. Noront will ensure that an Emergency Response Plan is developed by the third party contractor or that their Emergency Preparedness Plan followed.

Contingency and Emergency Response Procedures

Emergency response procedures will be set out in the Emergency Preparedness Plan, as required. Applicable regulatory agencies would be notified if such an event occurred.

8.3.2.12 Project-Related Fires

Nature, Mechanism and Magnitude

A fire could occur during any phase of the Project. There are many scenarios that could result in a fire. A fire started at the mine site, trans-load facility or along the transportation corridor could result in a major forest fire depending on the environmental conditions, location and reaction time by Noront staff and the MNR.

Probability

The probability of a fire occurring during the life of the mine has been determined to be high.

Consequences

Potential environmental impacts associated with forest fires include loss of terrestrial habitat and short-term air quality effects. It should be noted that forest fires in this area of Northern Ontario are common and often left to burnout by the MNR. Forest fires are an important natural phenomenon in the Boreal Forest ecosystem.

Mitigation

Regular fire suppression system inspections are essential to ensure the integrity of all systems. Scheduled maintenance and repairs are imperative in order to maintain the integrity of fire suppression systems.

Particular attention to housekeeping and applicable fire regulations will ensure that fire protection remains effective at all times. Combustibles will be properly stored in designated areas. Flammable materials such as solvents, paints and aerosols will also be stored in approved locations.

Contingency and Emergency Response Procedures

Fire prevention and response measures are outlined in the Emergency Preparedness Plan.

8.3.2.13 Premature Closure of the Mine

Nature, Mechanism and Magnitude

Premature closure of the Project may occur for multiple reasons including decreases in commodity prices, corporate bankruptcy or unsafe work conditions caused by unforeseen instability in the underground workings. The worst case scenario would be mine closure due to unsafe work conditions. In this scenario mine closure may not be able to occur as outlined in the Mine Closure Plan.

The magnitude of the effect is low based on the limited amount of surface infrastructure present at the mine site and the current mine plans (i.e., waste rock and tailings will be stored in the underground workings). As such, there will be limited mine hazards left on surface in any premature closure scenario.

Probability

The probability of a premature closure is remote. It is more likely that the mine would enter into a State of Temporary Suspension or a State of Inactivity, which will be covered by the Mine Closure Plan in accordance to O.Reg. 240/00.

Consequences

There are no apparent environmental issues apparent related to a premature closure of the mine site. As indicated above there are very few mine related hazards on surface during any phase. In any case, the mine would be closed in accordance with O.Reg. 240/00. Even in a bankruptcy scenario the site would be rehabilitated by the province with the financial assurance provided to the MNDM as per O.Reg. 240/00.

Established Safeguards/Mitigation

As mentioned above, Noront will not be able to proceed with mine development until they have submitted and received verification of their certified Mine Closure Plan.

Contingency and Emergency Response Procedures

In the event of a premature closure, Noront or the MNDM would begin to implement the rehabilitation measures outlined in the Mine Closure Plan.

Section 9

Consultation

Knight Piésold
CONSULTING
www.knightpiesold.com

TABLE OF CONTENTS

PAGE

9 – CONSULTATION

Noront has engaged with the Federal and Provincial Governments, First Nation communities and Tribal Councils, non-government organizations (NGOs) and the public in the study area and regionally. Efforts have been made to inform these communities and stakeholders of the scope and potential effects of the proposed Project and to understand and address their concerns and issues. During the last four years, the Project design has also advanced and engineering design was refined, as more information became available. Some of the modifications to the Project have been made in response to feedback received from First Nation communities and other stakeholders. The following sections report on these engagements.

The Federal and Provincial requirements for consultation differ. For the Provincial Environmental Assessment (EA), Noront prepared a draft Terms of Reference (ToR) which describes how consultation (and the other aspects of the baseline studies) will be carried out. The draft ToR was then reviewed by the Province, Aboriginal communities and the public. Following this initial review period the draft ToR was adjusted to address comments to create a final Amended TOR which was submitted to the Ministry of the Environment on October 6, 2012. The Federal Environmental Impact Statement (EIS) Guidelines were prepared by the Canadian Environmental Assessment Agency (CEA Agency), finalized in January 2012 and are posted on the CEA Agency website. As with the ToR, draft EIS Guidelines were produced and subject to a public review period to fulfil the Agency's requirements for public and Aboriginal consultation during the preparation of the guidelines. The comments received on the draft EIS guidelines were integrated by CEA Agency into the final EIS guidelines. A Project Description (PD) was also developed by Noront as part of the Federal EA process. This document in both draft and final versions was utilized as an early engagement tool by Noront and was distributed to the government review team, Aboriginal groups, the general public and other interested parties (the PD was developed in English, Oji-Cree and Cree to reflect the report's intended audience). The final PD was accepted on August 3, 2011. In addition, Noront produced Project brochures for distribution. The brochures and Project Description are available on Noront's website for download.

Noront has been engaging with various Aboriginal groups and stakeholders since 2007. Engagement between 2007 and 2010 was focused on making introductions between Noront, Aboriginal groups and other stakeholders. Following the initial definition of the Project, Noront commenced formal engagement activities with Aboriginal groups in March 2010.

9.1 ABORIGINAL CONSULTATION

Early in the mine development process, Noront recognized the significance of the local Aboriginal people to the future of the Project. These First Nation communities will be Noront's closest neighbours and have the greatest interest in how the developments proceed since the mine and infrastructure will be built on or near their traditional lands. When the mining is finished in many years the communities will want these lands to remain available for them to continue their traditional activities. Noront also recognized that the local First Nation communities have the potential to develop businesses to support the mine or to be employed by the mine or the various suppliers or service providers to the mine. However, the first step for Noront was to meet its new neighbours and learn about them.

Initial exploration activities in the Ring of Fire were not well coordinated with the local people, as companies rushed to gain a position in this new mining region focussed on delivering exploration results to their investors. Under new management leadership in 2009, Noront implemented several measures to improve its involvement with local First Nation communities, summarized as:

- Senior management positions were filled with seasoned executives having extensive experience working with Aboriginal people at other mines and in other communities. Notable examples are:
    - Paul Semple, Chief Operating Officer, grew up in Northern Ontario and has delivered mining projects around the world with a diverse experience successfully interacting with local indigenous peoples.
    - Glenn Nolan, Vice President, Aboriginal Affairs, had three terms as Chief of the Missanabie Cree First Nation of Northern Ontario. He has worked for many years conducting mineral exploration work throughout western and northern Canada, working closely with many Aboriginal people and communities. He is the first Aboriginal President of the Prospectors and Developers Association of Canada.
    - Leanne Hall, Vice President, Human Resources, relocated to Ontario from Northern Alberta where she provided local Aboriginal people with professional human resources, employment, career development and training programs and services. She also brings strong entrepreneurial experience and is on the boards of several groups that represent industry, women and Aboriginal people.
- In 2009 Noront established a First Nations Advisory Board which included the three people noted above plus the following two former/current First Nation Chiefs who are industry and community leaders and builders:
    - Jerry Asp is a former Chief of the Tahltan First Nation of Northern BC. He is a co-founder of the Canadian Aboriginal Minerals Association (CAMA), founder of many First Nation businesses, including the Tahltan National Development Corporation which became the largest native owned and operated heavy construction company in Western Canada, and the recipient of several awards including the Queen Elizabeth II Diamond Jubilee Medal and the PDAC *Skookum Jim Award* for Aboriginal Achievement in the mineral industry. He is President of C3 Alliance Corp.
    - Roy Whitney is a former chief of the Tsuu T'ina First Nation, which is located near Calgary Alberta, brings his experience as a leader and developer of First Nation communities and businesses. He is President of Wynterose Consulting Group Ltd. He is the former Chairman of the National Aboriginal Economic Development Board. He has received several awards, including the National Aboriginal Achievement Award (2000) for business and commerce.
    - Scott Jacob is a former chief of the Webequie First Nation and has been a strong advocate for community business development in the mining sector. Scott was instrumental in one of the first business development projects in Ontario's north with the partnership between Webequie and an International Drilling company. Besides sitting on the Advisory Board, Scott is the Manager of Community Relations for Noront.
    - In 2010 the First Nations Advisory Board developed the *Noront Aboriginal Policy* respecting Aboriginal culture, lands and traditions.

- Noront increased its efforts to hire people from local communities to support the exploration and environmental studies. Noront also had its contractors hire and train local people. Since 2009, Noront had 103 different members of local First Nation communities employed at the exploration camp, aiding environmental studies, working in the Thunder Bay office or employed by the services supporting Noront. Local First Nations have comprised up to one third of the people at site, averaging 35%. Currently, the number of Aboriginal people employed in the Thunder Bay office is at 50%.
- Noront has endeavoured to hire people and contractors that understand the important role the local First Nation communities will have in the development, operation and closure of the mine and related infrastructure. Companies like Nuna Logistics Inc., Kewit and Cementation Inc. have broad experience developing joint venture partnerships with the local Aboriginal people in the areas where they work: Nuna Logistics, specifically, is 51% Inuit owned.

Through these actions and many more, Noront has gained a much better understanding of the local First Nation communities and their concerns and issues. Noront has worked to explain the Project and what will be the potential impacts (positive and negative) of the infrastructure and mine development.

Consultation is the duty of the Crown. Through engagement, Noront has become more familiar with the local First Nation communities and, in turn, these communities have become more familiar with the proposed Project. The communities have reviewed the project plans and provided feedback on concerns and issues. The plans have been adjusted with their feedback. The information in this report can be used by the Crown to further its Legal Duty to Consult, which applies when the Crown contemplates conduct that may have potential adverse effects on potential or established Aboriginal or Treaty rights.

It should be noted that none of Noront's discussions with Aboriginal communities to date fall into the category of "Consultation" as defined by the Aboriginal communities, but they do meet the definition and requirements of consultation under the *Canadian Environmental Assessment Act (CEAA*) and the *Ontario Environmental Assessment Act (OEAA).* Despite the communities' views that these engagement activities are not consultation, Noront has continued to engage formally with communities and has recorded and transmitted the results of the discussions for use in the Crown's assessment of the requirements for consultation under the *OEAA* and associated guidance material.

9.1.1 Identification of Potentially Affected or Interested Communities and Groups

A desktop review of publicly available information concerning Aboriginal interests was conducted by Noront as a due diligence exercise. This information was available on Canadian and Aboriginal government websites and verified by local sources. A series of seven questions were developed as a transparent and repeatable method for the preliminary determination of Aboriginal communities that may have an interest in the Project. Preliminary areas of consultation focus were defined based on the potential of direct and indirect interaction with the Project. The area of potential indirect interaction was defined as the Treaty 9 and Treaty 3 area, and the area of potential direct interaction was defined by the communities closest to the Project facilities.

The following seven questions were asked to complete the screening:

- Is an Indian Reserve or First Nation identified in the area of potential indirect interaction by Aboriginal Affairs and Northern Development Canada (AANDC)?
- Are there licensed traplines identified in the area of potential indirect interaction?
- Is a current settlement or community identified in the area of potential indirect interaction by the Métis Nation of Ontario?
- Is a traditional harvesting area identified in the area of potential indirect interaction by the Métis Nation of Ontario?
- Is a historic community or archaeological complex identified in the area of potential indirect interaction by Natural Resources Canada?
- Is a treaty area identified in the area of potential indirect interaction and are there any applicable treaty rights?
- Are active land claims in the area of potential indirect interaction identified by AANDC?

9.1.1.1 Summary of Screening

The following points summarize the results of the screening:

- There are 36 First Nation communities in the potential indirect area of interaction
- The closest First Nation community to the proposed project is Webequie First Nation
- There are three communities that claim direct impact to the Project site in an overlapping territorial claim (Webequie, Marten Falls and Neskantaga First Nations)
- The closest identified Métis group is more than 300 km to the southwest
- The area of potential indirect interaction covers parts of two treaty areas (Treaty 3 and Treaty 9)
- The Reserves in the areas of potential direct and indirect areas of interaction have their origins in a pre-contact existence (historical settlements), where the Ojibwe, Oji-Cree and Cree practised traditional activities
- After contact with Europeans, Treaty 9 and the Adhesion to Treaty 9 were signed guaranteeing the Ojibwe, Oji-Cree and Cree Tribes the right to hunt and fish
- The area of potential indirect interaction includes one possible Métis harvesting areas where Métis rights are exercised and managed through local Métis Councils and Captains of the Hunt
- Lands within the area of potential indirect interaction are the subject of ongoing legal actions with the Crown, mostly the result of breach of alleged treaty obligations under Treaty 9 and 3 between the governments of Canada and Ontario

9.1.1.2 Identified Aboriginal Communities

The mine site is on the traditional lands of the following First Nation communities: Marten Falls, Webequie and Neskantaga. The access corridor crosses the traditional lands of these three communities and the First Nation communities of Nibinamik and Eabametoong. Aroland First Nation lies at the southern end of the alternative transportation corridor near Nakina. Attawapiskat First Nation is downstream of the mine site. Noront has determined that these seven communities are the primary communities for engagement and consultation, and Noront has had several meetings with each of these communities. Noront has also had several meetings with Chief, Council, and the community members of Mishkeegogamang First Nation which is located south of Pickle Lake, and has conducted two Open Houses in this community.

The CEA Agency noted a larger list of First Nation communities most likely to be affected by the project in their Guidelines for the Preparation of an Environmental Impact Statement Pursuant to the Canadian Environmental Assessment Act for the Eagle's Nest Project. However, given the potential interaction these communities will have with the proposed Project, Noront has included the First Nation communities of Marten Falls, Webequie, Neskantaga, Nibinamik, Eabametoong, Attawapiskat, and Aroland as the communities most likely to be affected and has held and will hold meetings with them and facilitate these by making key EA summary documents (Draft/Final EIS and key findings) accessible and providing plain language summaries of these documents available in English, French, Cree, Ojibwe, and Oji-Cree.

Below is a list of the various communities that Noront has and will continue to engage and consult with directly as part of the EA process. Communities on the CEA Agency list that are not noted above as most potentially affected will, however, have access to the EA/EIS documents and plain language summaries of these documents in English, French, Cree, Ojibwe, and Oji-Cree.

The project does not directly impact the Métis Nation of Ontario. Nonetheless, Noront has engaged with them, and will provide access to the documents.

Primary Communities

- Aroland First Nation
- Marten Falls First Nation
- Webequie First Nation
- Attawapiskat First Nation
- Neskantaga First Nation
- Eabametoong First Nation
- Nibinamik First Nation

Secondary Communities

- Bearskin Lake First Nation
- Ginoogamang First Nation
- Kasabonika First Nation
- Long Lake #58 First Nation
- Mushkegowuk Tribal Council
- Ojibway Nation of Saugeen
- Wawakapawin First Nation
- Windigo First Nation
- Winnumin Lake First Nation
- Constance Lake First Nation
- Independent First Nation Alliance
- King Fisher First Nation
- Matawa First Nations
- Muskrat Dam First Nation
- Sachigo Lake First Nation
- Weenusk (Peawunuk) First Nation
- Fort Albany First Nation
- Kashechewan First Nation
- Kitchenuhmaykoosib Inninwug
- Métis Nation of Ontario
- Mishkeegogamang First Nation
- North Caribou Lake First Nation
- Wapekeka First Nation

9.1.2 Consultation Activities

Initial engagement in 2009 and 2010 was by letters, telephone calls, emails and meetings with a few of the Chiefs and Councillors of some of the remote First Nation communities near the Ring of Fire; please see the appended Records of Consultation for details (Table C1.1 and C1.2). Noront held informal meetings with Chiefs and/or Councillors at events like the Canadian Aboriginal Minerals Associations (CAMA) annual meetings or at the Prospectors and Developers Association of Canada (PDAC) annual conferences in Toronto in 2010, 2011, 2012, and 2013, and at various events held in Thunder Bay.

Since 2010, communications by telephone, email and letters have been made almost daily, attempting to connect with all local Aboriginal people, both First Nation and Metis. Noront has visited the local First Nation communities, provided bursaries and scholarships, run youth camps, developed training alliances (Ring of Fire Aboriginal Training Alliance; see Volume 4, Section 2 Human Resource Management Plan for details), supported (in part) a drug diversion program in Marten Falls First Nation and worked on other initiatives to engage with and demonstrate its commitment to involving the local First Nation communities in the pending developments on or near their traditional lands. Noront developed the Mikawaa.com (Oji-Cree word for Discover) website to act as a portal for information exchange with local communities and the broader internet community. Over two and half years Mikawaa was visited by 14,363 unique visitors. On average visitors remain on the site for almost six minutes, viewing approximately 5 pages per visit. Of all visitors to the website in the past two and a half years approximately 54% were new visitors.

As more communities were visited and meetings included more of the band membership, the process of engagement was able to provide broader feedback to Noront. In 2011, an Executive Summary brochure covering the Project Description and EA process was prepared in English, Cree and Oji-Cree and mailed to the communities closest to the Project. Early in 2012 Open House meetings were held in several communities to explain the project and environmental assessment processes, and to receive feedback from the communities. Noront prepared summary documents explaining aspects of the project design and environmental baseline studies, which were handed out at Open Houses (Appendix C2).

In the fall of 2012, following the completion of the Feasibility Study, a second Executive Summary brochure was prepared in English, Cree and Oji-Cree and forwarded to the local communities and provided at Open House meetings. The design changes to the Project were discussed and the Project schedule was updated.

In the winter and spring of 2013, presentations were made in Attawapiskat, Kashechewan (spring only) and Fort Albany First Nation communities which are members of the Mushkegowuk Tribal Council. Attawapiskat lies on the Attawapiskat River, which is down-stream of the mine site (260 km east of the site) The Spring 2013 community meetings had separate sessions with elders, youth and general band membership. These meetings were also attended by representatives from the Federal and Provincial Governments and Cliffs Natural Resources. The format included presentation by the visitors followed by question and answer periods.

In the Fall of 2013, continuing into 2014, Noront has started a series of Open Houses in local communities to discuss presenting the results of the environmental investigations and to explain the environmental assessment process steps ahead These included discussions of opportunities for reviews of the pending documents to be developed, updated and circulated as part of the ongoing review process, and to seek further opportunities for local communities to discuss Noront's project and present community concerns and issues. Noront also circulated some of the Technical Support Documents (TSDs) to share the results of the baseline environmental studies with the potentially impacted communities, non-government organizations, and government agencies; the TSDs that were not completed in time for review before releasing the draft EIS/EA document are in included in as part of this circulation, along with the TSD's that were released.

9.1.2.1 Telephone and Electronic Correspondence

On a regular basis Noront is in contact with First Nation communities in particular with Chief and Council and band office staff. Telephone and electronic correspondence are used to set up various in-person engagement activities as well to provide Project updates to Chief and Council. The various topics of discussion include, but are not limited, to employment and economic development opportunities, Project updates, community concerns, community funding requests and community based initiatives (Table C1.1).

Noront also disseminates Project information through other electronic means including a project website (www.eaglesnestmine.com), a company website (www.norontresources.com) and it has established a consultation portal (www.mikawaa.com). The consultation portal is aimed at Aboriginal consultation activities and allows visitors to access information about the Project, the various activities in which Noront is engaged, and provides a forum in which Aboriginal communities are able to hold discussions about the Project and have their questions answered.

Noront has also established a consultation e-mail account (consultation@norontresources.com) to which any community or stakeholder can send their comments, questions or concerns. The e-mail account is monitored on a weekly basis with e-mails being answered by the appropriate Noront staff.

9.1.2.2 Open Houses

Noront held a number of Open House events to discuss the proposed Project, preparation of the ToR, the EA processes, and to receive feedback from stakeholders. Attempts were made by Noront to host Open Houses at each of the most potentially affected communities. In the cases of Marten Falls First Nation and Attawapiskat First Nation Open Houses were scheduled in 2012, but had to be cancelled at the last minute due to weather conditions and a death in the community, respectively.

Noront held Open House events at the following locations:

- Webequie First Nation - December 1, 2011
- Neskantaga First Nation - January 18, 2012
- Eabametoong First Nation - January 19, 2012
- Mishkeegogamang First Nation - January 24, 2012
- Marten Falls First Nation (off-reserve membership) - September 13, 2012
- Webequie First Nation - June 11, 2013
- Aroland First Nation - July 22, 2013
- Mishkeegogamang First Nation - November 19, 2013

During the Open House events, video logs were taken to record the sessions and document the community/consultation process. Open House sign-in/attendance sheets are provided in Appendix C3. The presentation provided during the Open House events is provided in Appendix C4. Appendix C5 provides an overview of the questions and comments received during the Aboriginal community Open House events held in 2011 and 2012 and Noront's response to the comments and questions received. Detailed records of questions and answers from the 2013 Open House will be provided in subsequent versions of this report, although the general comments and themes are recorded in Table C1.1 and C1.2. Many of the comments and questions received during the Open House events referred to the same topic and/or issue and have been grouped in the tables. Over 100 hours of video recordings at Open Houses of both group and one-on-one interviews have been made to help ensure Noront that heard and recorded the concerns, comments and issues of the members of the various communities.

9.1.3 Memoranda of Understanding and Agreements

Noront has been pursuing various Memoranda of Understanding (MOU) and agreements with the First Nation communities since 2009. To date several MOUs have been signed with First Nation communities. Exploration Agreements have been signed with the communities of Webequie First Nation and Marten Falls First Nation. Other agreements signed with Webequie First Nation include an MOU concerning the continued development of business agreements and recognition of the community's Aboriginal and Treaty Rights and an agreement regarding a strategic partnership initiative. Noront has also signed an MOU with Eabametoong First Nation regarding an agreement to work together and an MOU with Aroland First Nation to work together on the EA and EIS. A group agreement with Nibinamik, Neskantaga, Webequie and Eabametoong First Nations regarding the proposed winter and all season development has been proposed. An airstrip agreement with Marten Falls First Nation has also been proposed. Other proposed agreements regarding working together on the EA and EIS and ATK collection have been presented to the First Nation communities of Attawapiskat, Constance Lake, Eabametoong, Ginnoogaming, Mishkeegogamang, Neskantaga, Nibinamik, Webequie and Marten Falls.

9.1.4 Issues Identified

Summaries of Aboriginal engagement and consultation activities from 2010 to present are provided in Tables C1.1 and C1.2. Issues and concerns that were identified during consultation include:

- Business, employment and training opportunities
- Concerns about having employment quotas applied for hiring First Nation members and how that has not been positive with other mining projects, in conjunction with concerns about limitations on the level of advancement of First Nation people in the mining project
- Completion of Project Open Houses in the communities
- Environmental concerns, including route and exploration activity, mainly concerning the impact on water
- Social concerns in regards to demands on community infrastructure
- Concerns around more possible access to drugs and other illegal activities once individuals are earning steady paychecks
- Ensuring the discussions with Noront are not described as "consultation", as this term has a different meaning to local First Nation communities than that defined in the EA process
- Impact to traditional territory from Project development
- Impacts to water near mine project
- Presentation of Project updates to community members to ensure meaningful engagements
- ATK studies
- All-season road development and access for communities
- Increases in hunting from the development of the road
- Power lines in the region and connection to the communities
- Limited job opportunities due to criminal convictions
- Limited job opportunities due to incomplete high school education (less than grade 12 equivalent)
- Slurry pipeline

9.1.5 Commitments and Responses

Noront has listened diligently to understand and respond to the comments and concerns of the local First Nation communities. This exchange of information has influenced the scope and design of the Project. It has also guided and fueled the efforts on education and training for youth and other band members that may want to operate or be employed by businesses associated with the Project or by the mine itself.

9.1.5.1 Transportation Corridor

From the start of the mine design activities access to the mine from Provincial highways and national railways have been considered. The shortest route from the mine site to a rail line is directly south along a series of eskers; the North-South Route that was being studied by Cliffs Natural Resources as part of their environmental assessment work. However Noront has maintained a preference to develop a route to the west to connect with the Pickle Lake North Road. The proposed transportation corridor does not cross Provincial parks and major rivers with associated archaeological prospects and does not travel along the best habitat for animals in the wetland. As importantly, the proposed transportation corridor brings the most benefit to local remote communities by developing the backbone route from which they can extend roads to these communities that currently can be reached only by aircraft year round or during the winter season with ice roads. There is a good possibility that the proposed transportation corridor will allow for a power line development in the future, also benefiting the local First Nations. Currently the remote communities rely on diesel generated electricity for their electrical power at a cost many times the provincial average.

During the road alignment design work, Noront has reviewed the possible routes with local First Nation communities at Open Houses in the communities and through discussions with trappers whose lines may be crossed or individuals whose traditional lands may be crossed. This work has helped to define the preferred routing, including a revision of the route in one area following a request to avoid a lake and the waterways immediately around it.

9.1.5.2 Slurry Pipeline

Until Noront resolved how to develop roads, the Project design included the use of a buried pipeline to transport the mineral products from the mine to a facility south of Webequie. The pipeline was a major topic of discussions with the communities, mainly concerning leakage into the wetland or water. Pipelines have been used worldwide and newer designs have resolved this risk significantly. Nonetheless, Noront received strong adverse reaction to the idea of a pipeline, and dealt with that by retaining global expertise on wetland construction, utilizing new road-bed development in wet environments, to extend the all-season road to site.

9.1.5.3 Employment Opportunities

Concerns about barriers to employment have been addressed through skills and capacity assessments, defining training requirements to meet the prospective jobs and business opportunities that are likely to develop, and starting the establishment of means to train members of the local First Nation communities. Previous mine development projects limited job and training programs for local community members. Noront identified this stage as critical in hiring as many local workers, and the development of a consistent practice of hiring communities who want to work and developing training programs that would encourage job movement into more skilled and responsible positions with the company. Please see Volume 4, Section 2 Human Resource Management Plan for a description of these initiatives and the policies Noront has developed to ensure local First Nation members are given opportunities to develop the needed skills and qualify for the business and employment opportunities.

Employment with Noront

Noront has hired local band members to work at the exploration camp, and to participate as part of the crews performing environmental sampling and other reviews in the region. Noront has also hired off-reserve members of local bands in Noront's office in Thunder Bay. Noront has arranged with service suppliers to have local band members trained and employed for their work at the Noront Project site. A priority has been set to encourage and support contractors to hire as many local community members as possible throughout the project work cycle.

Please refer to Volume 4, Section 2 Human Resource Management Plan for details on Noront's hiring and training plans and policies for promoting the development and employment of local First Nation community members at the mine and in the businesses that will be developed to support the mine and associated with the access infrastructure.

Muketei Airstrip

Through early discussions with Marten Falls First Nation the development of an airstrip on higher ground near the Muketei River and the Project site was identified as an opportunity for the band. In 2009 Noront signed an agreement with Marten Falls Logistics to have them develop an airstrip near the Project site. This was permitted by the Province, but issues arose and the airstrip development was stopped. Since then Marten Falls First Nation has taken over 100% ownership of Marten Falls Logistics, and in 2013 resumed discussions with Noront about developing the airstrip and businesses associated with it.

East-West Road Consortium

Since 2010 Noront has contended that the road to the Project site should not be a private road for the mine since a private road would have to be removed when the mine closes in the future. In Noront's view, the road should support other resource development and local communities. The four First Nation communities currently served by the winter road that leads to Webequie (Eabametoong First Nation, Neskantaga First Nation, Nibinamik First Nation and Webequie First Nation) and other local communities have expressed interest in being part of the consortium that will establish and operate the proposed all-season road to the mine Project site.

To address concerns about increased hunting along the new road, the consortium may decide to restrict or control access, or otherwise control hunting and fishing, measures with which the Province would have to agree.

Providing road and power access to the remote First Nation communities looked at alternatives from Pickle Lake and Nakina (Nipigon for power). Selecting either alternative raises challenges for the communities not located along or near the selected access corridor. Due to the decision by Cliffs Natural Resources to stop design and assessment work for the route from Nakina, the only alternative that has been studied and designed is the route from Pickle Lake. This provides a central corridor to which local First Nation communities can connect. However, Marten Falls First Nation will have to be connected to Ontario roads and power separately. This matter continues to be discussed by the Provincial and Federal Governments (both have jurisdictional responsibilities for Aboriginal people and power to them), Marten Falls First Nation and Noront.

Other Business Opportunities

Noront has discussed several business opportunities with the local communities. The decisions by the communities will help to define the types of training they will require to ensure success. Additionally, Noront has met with suppliers experienced in joint-venture partnerships who can help to establish businesses and begin training and giving band members the experience to take on more senior roles in these businesses. Agreements with these joint-venture partners may include "sunshine" clauses where in the future the partner would step out of the business, allowing the band(s) to run it on their own. The list of support businesses includes, but is not limited to:

- Transportation companies to ship concentrate and supplies
- Quarry operations to supply the on-going needs of the infrastructure and support other development in the region, such as all-season roads to the communities
- The camp and administration facilities at the mine
- The aggregate operations at the mine site, once Noront has mined the rock and stockpiled it on site near the portals, which could include the trucks needed to transport granular material
- Other, smaller businesses like gas stations, hotels, and resorts to take advantage of the possible tourism increase

9.1.5.4 Protecting the Water

The issue of protecting the environment in general has been raised, but protecting the water was emphasized during discussions with local First Nation communities. This influenced the design of the road, infrastructure at the site, and the overall water balance at the mine. The road design across the wetland uses regularly spaced culverts across the roadbed to ensure water continues to flow within the peat bog. It also employs building techniques to minimize harm to the peat that is crossed. The handling of water at the Project considered reducing or eliminating discharge of process water to the wetland or creeks and rivers. The application of a water treatment facility underground at the mine process plant and the retention of water in the underground storage of tailings resulted in a design with no discharge of process water from the mine to the environment.

At the exploration camp, Noront has already installed a rotary bio-contactor for processing sewage and grey water.

9.1.6 Outstanding Concerns

Noront has tried to address and mitigate all concerns raised by the Project stakeholders and communities. The following concerns are yet to be resolved.

9.1.6.1 Unlawful Activity

The Province and Federal Governments, the Nishnawbe Aski Nation which represents First Nation members in Northern Ontario, Matawa First Nation Tribal Council which represents the nine

Matawa First Nation bands and each of those communities will have to determine how to address the concern of potential increase in unlawful activities due to improved access and higher levels of income. During discussions with First Nation communities it was concluded that generally the benefits of the access and mine developments and employment outweigh the potential negative impacts, but there is a continued concern about increased substance abuse as more money flows into the region, and for increased organized crime associated with illegal drugs.

9.1.6.2 Compliance with the Far North Act

In 2010, the Province of Ontario implemented the Far North Act with respect to land use planning and protection in the Far North. The local First Nation communities did not support the Act when it was brought into law. The Nishnawbe Aski Nation (NAN) lands comprise 100% of the land covered by the Act. The NAN website included the following posting late in 2013: *"The Far North Act is viewed by First Nations in NAN as an invalid law and a new form of colonialism. NAN will continue to advocate the positions of the Chiefs-in-Assembly with respect to the Far North Act and for the adherence to international human rights standards by governments and all other third-party interest groups."*

Some communities had developed community based land use plans before the Act, but the requirements changed with the implementation of the Act. With provincial funding, there has been some advancement by the local First Nation communities of their community based land use planning, which is required under the Act before a mine permit can be signed.

9.2 PUBLIC STAKEHOLDER CONSULTATION

9.2.1 Identification of Interested Parties

The communities of Thunder Bay, Pickle Lake, Ignace, Greenstone, Timmins, Sudbury and others in northern Ontario have expressed interest to Noront about being involved in the development of the Ring of Fire. Other companies working in the region have also been contacted, formally and informally. Suppliers and potential suppliers from the region and elsewhere have met with Noront to discuss the project and potential joint-venture relationships with Noront and/or local First Nation groups/communities for development and operation phases of the Project.

9.2.2 Consultation Activities

9.2.2.1 Meetings

Noront has participated in meetings of Chambers of Commerce, conferences on mining in Northern Ontario, and other community meetings and gatherings. Noront has organized, advertised and held Open Houses in Thunder Bay (2012, 2013), Ignace (2012), and Pickle Lake (2012, 2013) where presentations have been made about the Eagle's Nest Project and feedback was received (Appendix C6). Conferences where Noront has presented information about the Project include the Canadian Institute of Mining, Metallurgy and Petroleum (CIM), the Prospectors and Developers of Canada (PDAC), and the Canadian Association of Mining Equipment and Services for Export (CAMESE), PARO - Center for Women's Enterprise conference - Thunder Bay, Centre of Excellence on Sustainable Mining and Exploration (CESME) - Thunder Bay.

Noront has had meetings with businesses, mayors and councillors of Thunder Bay, Timmins, Greenstone, Pickle Lake, Sudbury, and Ignace to discuss possible impacts of the project on their businesses and communities.

Noront has had several meetings with Cliffs Natural Resources since 2011 to discuss access and common infrastructure. Less formal discussions have taken place since before then between their respective exploration camps. The companies have collaborated on the development of the winter ice strip that has been prepared and maintained each winter for the last few years. The companies also participated in meetings with Goldcorp to review ways to bring grid power to the Ring of Fire, specifically associated with the Watay Power initiative which is looking to upgrade electrical power supply to Pickle Lake and on to the remote First Nation communities north and west of Pickle Lake. The Watay Power initiative is also looking at supplying power to the communities along the access corridor proposed by Noront and on to the mine site.

9.2.2.2 Open Houses

Noront has held several Open House events in communities to invite feedback from its stakeholders. These Open Houses included

- Township of Pickle Lake - January 23, 2012
- Township of Ignace - February 22, 2012
- City of Thunder Bay - February 23, 2012
- Township of Pickle Lake - November 19, 2013
- City of Thunder Bay - November 20, 2013

During the Open House events, video logs were taken to record the sessions and document the community/consultation process. Comment sheets were distributed at the Thunder Bay 2012 Open House and are included in Appendix C7. Open House sign-in/attendance sheets are provided in Appendix C4. The presentation provided during the Open House events is provided in Appendix C5. Appendices C5.1 and C5.2 present the questions and comments received during the public Open Houses and Noront's response to the comments and questions raised.

Detailed records of questions and answers from the 2013 Open House will be provided in subsequent versions of this report, although the general comments and themes are recorded in Appendix C5. Many of the comments and questions received during the Open House events referred to the same topic and/or issue and have been grouped in the tables. Over 100 hours of video recordings at Open Houses of both group and one-on-one interviews have been made to help ensure Noront that heard and recorded the concerns, comments and issues of the members of the various communities.

9.2.3 Issues Identified

The topic of employment opportunities was the most common area brought up in meetings, and about how their communities could be involved in the Project and benefit from it. The impacts on the environment and local First Nation and public communities were also raised.

The alternative road routes (north-south and east-west) have been discussed at events in northwestern Ontario. Concerns have been raised around business and employment opportunities, and also about the impacts of spills of fuel or metal concentrates, and the impacts on communities of higher traffic volumes on the existing roads.

Alternative access methods (railway, hovercraft, airships, canals) have also been mentioned at the meetings.

9.2.4 Commitments and Responses

Noront has been consistent about supporting local business development and the First Nation communities that could be most affected by the Project. Induced and indirect jobs are estimated to be a factor of 2.5 to one for the Project (Mining Association of Canada, 2012). Therefore, the total of direct and indirect employment opportunities created by the Project could reach 2,000 to 2,400 positions during the construction phase, and 975 to 1,170 positions during the operation phase.

Some of these jobs will be filled by local First Nation community members and Noront is implementing many initiatives to aid them in developing the skills and experience to take advantage of these business and employment opportunities. However, the communities do not have enough members (already skilled or able to be trained) to fill all positions and be the only support for the mine and infrastructure, so the local public and others will be required to complete the employment and other support needed for this Project.

To address concerns for due process regarding the environment, Noront described the Environmental Assessment process and the multiple opportunities during this process for the public to comment to Noront and Federal and Provincial Government agencies. This process of consultation is being continued. The manner of involvement of First Nation communities was also discussed, including the various consultation methods.

The access alternatives described in Volume 2, Section 4 Alternatives Assessment describes Noront's response to questions on this aspect of the Project. At the events, Noront discussed the logic behind its access selection and listened to the feedback and opinions provided. There was little opposition to Noront's selection of the east-west access road; in fact, as noted above, several of the communities have expressed interest in being part of a consortium to build that road.

9.2.5 Outstanding Concerns

All efforts have been made to address outstanding concerns. Many of the comments received to date include concerns about the Project design and the potential environmental and social effects of the Project that are presented in this report. Noront is committed to addressing any additional concerns that may arise.

9.3 NON-GOVERNMENT ORGANIZATION CONSULTATION

9.3.1 Identification of Interested Parties

Noront has met with several non-government organizations (NGOs) since the start of the Project. Introductions include meeting people at Noront's Open Houses in Thunder Bay and at the Greenstone Economic Development Corporation event in Geralton in 2011, telephone calls or emails received by Noront, and in one case by contacting the NGO.

9.3.2 Consultation Activities

Noront has responded to enquiries from NGOs. The introduction to Wildlands League was made by Noront after a call from a floatplane operator about a group wishing to land at the lake used by Noront and Cliffs Natural Resources. . Noront contacted Wildlands League to enquire about their plans and offered to provide them helicopter transport from the dock to the camp and provide a tour of Noront's operations. Since then Noront has supplied this NGO and others with copies of reports, and held meetings to review progress on the project, to discuss concerns, and to update on progress of the EA.

In August of 2012 initial introductions were made with the Wildlife Conservation Society Canada (WCS) to outline Noront's project, the environmental study program and results, and to discuss WCS concerns. The notes from the meeting were circulated and adjusted with WCS comments. A conference call on caribou with WCS and Wildlands League, Noront, and Knight Piésold was held on March 26, 2013. As follow up, on May 16, 2013 Noront and Knight Piésold met with Wildlands League and WCS at WCS' offices to discuss caribou habitat and the impact of Noront's planned developments. Noront presented an update on the Project.

9.3.3 Issues Identified

Issues have been raised by NGOs about thoroughness of the EA process for this almost completely undeveloped area which is deemed to be the third largest wetland in the world, and is referred to as "pristine boreal forest". Cumulative effects with other development of mines and infrastructure were of particular concern.

9.3.4 Commitments and Responses

Noront has accommodated many concerns through the selection of alternatives and designs. Examples include the decision to treat process water underground at the mine and reuse it rather than discharge treated water to the wetland, resulting in a "zero discharge" mine water balance where excess water is captured with the underground storage of tailings; also see Volume 4, Section 8 Water Management Plan. The selection of an access corridor (route for roads, power lines, and fibre optic line) from Pickle Lake along areas of poor caribou habitat and avoiding Provincial parks and major rivers is another example of design decisions intended to minimize impacts on the environment.

Volume 3 Cumulative Effects Assessment should be referenced for information on this subject matter.

9.3.5 Outstanding Concerns

Concerns raised by both NGOs have been related to the potential effects of the Project on caribou. Request for detailed assessment including baseline data have been made and are addressed in this report.

9.4 GOVERNMENT CONSULTATION

Noront has a Board, staff and consultants that are experienced in mine development in Canada and elsewhere. This includes an Environmental Advisor, Dr. Neil Westoll, who brings extensive experience on mining projects, including participating in the review of the Comprehensive Study

Report on the Victor Diamond Mine for the First Nation community of Attawapiskat and is quite familiar with the region. Noront hired consultants (Knight Piésold Ltd.) with extensive experience in environmental assessment and who were able to guide Noront through the environmental assessment processes and ensure it was well planned, studied, discussed, and reported. Through these people, Noront has brought in familiarity with the EA/EIS processes and methodologies for conducting the studies, communications and other processes. Each project is unique, as is the blend of people involved from all parties. Acts, regulations and permit requirements undergo changes periodically. Thus it was necessary for Noront to meet with key Government Authorities to discuss the EA/EIS process and other requirements to advance the project.

9.4.1 Identification of Government Review Team

In December 2010 Noront contacted the Acting Executive Director of the CEA Agency to discuss the project and EA process. This was followed that month with a meeting at Noront with representatives from CEA Agency and Ontario Ministries of Northern Development, Mines & Forests (MNDMF; now MNDM), Natural Resources (MNR), and the Environment (MOE) for introductions and discussions around the project, EA processes, and to identify which other departments would be involved in reviews and other permit activities as the project advances. From this meeting and subsequent communications, Noront was informed of the possible participants in the review of Noront's EA work. The possibility of applying both the Provincial and Federal EA Acts was discussed, together with and the associated joint reporting.

9.4.2 Consultation Activities

Noront has had regular communications with the key Government contacts since 2010. Means of communications have included meetings, letters, emails and telephone calls. Meetings have been formal and informal, as at conferences (CIM, PDAC, SME, CAMA) or regional meetings, or during travel (staying at same hotel, seeing contacts at airports). Noront has travelled to the same community meetings as Government representatives (Greenstone in 2011, Attawapiskat in 2013), which provided both formal and informal opportunities to discuss the Project and related matters.

Table C1.1 is the Record of Government Consultation which lists the formal communication activities with Government. It does not list all email and telephone communication or details on the issues brought up during the biweekly conference calls that have taken place since January 2012.

In May 2011 the MNDM hosted a two day kick-off workshop in Thunder Bay attended by Noront, Noront's consultants and other government ministries, agencies and departments. The purpose of the meeting was to discuss the Project and to review the environmental baseline study plan, and information received by government ministries aided the development of the environmental baseline work plan.

Noront participated in a government workshop held in April 2012 in Toronto to discuss baseline studies that were underway and proposed. The meeting included discussion with Federal and Provincial ministries, agencies and departments. During the meeting Noront and its consultants presented the baseline studies being conducted for the EA including the methodologies and scope of the studies. The workshop provided government representatives the opportunity to review and provide feedback on the scope of the work and the methodology for the various baseline studies.

For example, Noront added sampling for methyl-mercury for the water quality baseline study upon the recommendation of government participants.

By early 2011 CEA Agency and MOE had assigned officers to manage their respective work as part of the EIS and EA processes for the Project. Regular discussions and meetings began then. In January of 2012 biweekly conference calls were initiated, hosted by the Ring of Fire Secretariat (MNDM) and involving Noront, MOE and CEA Agency, with MNR joining in mid-2013. The minutes from these biweekly calls track actions and record the main topics of discussion.

In July of 2011 Noront submitted a letter requesting that the Ontario EA Act apply, and the Project be reviewed as an Individual EA. Between then and October 2012, MOE provided guidelines for preparing Terms of Reference. Noront produced two draft Terms of Reference which were reviewed by the public, and feedback was received from Government representatives (and the public and Aboriginal communities) and applied to develop the Amended Terms of Reference submitted to MOE on October 6, 2012.

In 2011 Noront submitted the Project Description, and received public, Aboriginal and Government comments back, and revised it, before submitting the final copy in July 2011. A Notice of Commencement of a Comprehensive Study was issued by CEAA on November 15, 2011. EIS Guidelines were issued by CEAA in January 2012.

9.4.3 Issues Identified

Much of the consultation with Government has been on EIS and EA requirements and what Noront has to achieve to comply with them. Aboriginal consultation has been stressed as a very important aspect of these studies. First Nation treaty rights are to be considered as part of the studies.

Species at risk, especially caribou and wolverine have been discussed. See Volume 2 Section 6 Bio-physical Effects for reference. Valued ecological components have also been discussed in this section.

MNR is leading the community development of Land Use Plans for the Government. Some advancement has been made in some communities, but it remains to be seen how developed the Plans are in 2014.

9.4.4 Commitments and Responses

Noront volunteered to have the Provincial Environmental Assessment Act applied to the Project. A more thorough Individual EA was undertaken rather than applying several Class EAs and having the risk of having the process “bumped up” to an Individual EA. The Canadian Environmental Assessment Agency determined that a Comprehensive Study is appropriate for the Project, with triggers including water crossings and the explosives plant. The Provincial Ministry of the Environment (MOE) and the CEA Agency agreed to a joint EA/EIS process whereby a single report would be prepared by Noront covering the differing requirements of the two EA Acts.

Noront has engaged with local First Nation communities to comply with Federal and Provincial requirements for consultation. This interaction has been reviewed with the Governments. Representatives of the Federal and Provincial Governments attended meetings with Noront (and

Cliffs) in Attawapiskat, Kashechewan and Fort Albany First Nations in 2013. Provincial representatives have attended Open House and community meetings with Noront, in Greenstone (2011) and Eabametoong First Nation (2012/6/26).

Of the identified species at risk in the Project area, Caribou have received the most attention from the MNR. Noront joined MNR and Cliffs Natural Resources in a working group to examine Caribou in the Ring of Fire. The group shared data from their respective studies. Noront also covered wolverine with MNR and had broader discussion on species at risk.

9.4.5 Outstanding Concerns

Land use plans have not advanced as far as required by the Far North Act to allow for the permitting of a mine at Eagle's Nest. Noront has sought information from communities and received some updates on the status of the community- based land use plans, but the land use planning impact on the EA needs to be discussed further with the Province.

The Crown has a Duty to Consult with the First Nation communities to address matters which may impact their treaty rights, culture or traditional ways of life or lands. The Crown delegates some consultation actions to project proponents. The First Nation communities have a duty to respond to requests for their feedback on matters pertaining to impacts of the Project. The capacity and other obligations of community members restricts their ability to respond to all enquiries. Noront has made significant efforts to engage with communities, but not all requests have had responses.

NORONT

Section 10

Environmental Management

Knight Piésold
CONSULTING
www.knightpiesold.com

TABLE OF CONTENTS

PAGE

TABLES

FIGURES

10 – ENVIRONMENTAL MANAGEMENT

10.1 INTRODUCTION

10.1.1 Scope and Objectives

Noront Resources Ltd. (Noront) has developed this Environmental and Social Management Plan (ESMP) as a key instrument for environmental protection for the Eagle's Nest Project (the Project). The ESMP:

- Outlines Noront's commitments to environmental protection
- Details the mitigation and monitoring commitments of the Environmental Assessment/Environmental Impact Statement (EA/EIS) Report
- Identifies who will be responsible for implementing the mitigation and monitoring commitments
- Proposes training for employees and contractors to achieve effective implementation of the System
- Advises how environmental performance and corrective actions are tracked and recorded

The commitments in the ESMP will ensure that the:

- Project is conducted as proposed
- Predicted adverse environmental effects are promptly mitigated at the earliest possible time
- Conditions set at the time of the Project's authorization and the requirements pertaining to the relevant laws and regulations are met

The ESMP is designed based on the principle of continuous improvement through a system of monitoring, reporting, evaluating, reviewing and corrective action. As such, the ESMP is a living document that will be modified and updated over the life of the Project.

The ESMP has a three-tiered hierarchy, as follows:

- **Level 1 - The Environmental Management System (EMS or the System)** - Includes key potential impacts and mitigation, Aboriginal consultation, corporate commitments, roles and responsibilities, and the training and implementation plan. Volume 2, Section 10.0 of the EIS represents the Level 1 part of the EMS.
- **Level 2 - The Environmental Management Plans (EMPs or the Plans)** - The various discipline- or topic-specific management and monitoring plans to be implemented consistent with the Level 1 EMS. Volume 4, Sections 2.0 to 16.0 represent the Level 2 part of the ESMP.
- **Level 3 - Standard Operating Procedures (SOPs or the Procedures)** - These will be developed in the future, as required, to execute specific aspects of the EMPs.

The Level 1 System and Level 2 Plans are presented in the EA, establishing the framework for environmental management. As indicated, the EMPs will be further developed and SOPs prepared or adopted at the conclusion of the EA process to be consistent with the outcome of the EA process and the terms and conditions of permits, licences and authorizations.

10.1.2 Environmental Management Plans (EMPs)

The purpose of the EMPs is to ensure that proper measures and controls are in place to decrease the potential for degradation of the environment over the life of the Project. The EMPs also provide clearly-defined action plans and emergency response procedures to ensure the health and safety of humans and environmental resources.

Each EMP:

- Applicable legislation, standards and guidelines
- Criteria or thresholds to trigger corrective action based on its monitoring results
- Processes by which the mitigation measures will be implemented
- Roles and responsibilities of individuals for implementation and follow-up for each Plan
- Monitoring systems that will be put into place to document the adequacy of each mitigating action in reducing impacts to insignificant levels
- Available contingencies or other adaptive management provisions, including any reporting and documentation requirements
- Methods to review and corrective action to take if impacts and/or mitigation measures do not accurately reflect actual site conditions. This approach is consistent with a strategy of continuous improvement.

Each EMP focuses on a specific Valued Ecosystem Component (VEC), discipline or activity. A VEC refers to an important aspect of the environment that has the potential to interact with the Project. All EMPs are focused on the management of environmental issues through the implementation of mitigation measures. All EMPs have an element of monitoring the implementation of mitigation measures and a portion of the EMPs are dedicated to monitoring environmental media (e.g., water quality). The scope of the EMPs covers all phases of the Project.

The EMPs vary in detail, reflecting the significance and complexity of the issues and information available relative to the current stage of Project development. Proposed mitigation could include additional baseline work, further research and/or development of plans to provide an applicable framework for the implementation of impact-mitigating actions. The EMPs reflect current understanding of the local and regional environmental, socio-economic and heritage conditions. Similar to the over-arching EMS, each individual EMP will be updated as the Project progresses in order to provide timely responses to the issues they address. Task-specific Procedures will be developed to define and detail the relevant safe job practices.

The EMPs include:

- Human Resources Management Plan (Volume 4, Section 2.0)
- Emergency Preparedness and Response Plan (Volume 4, Section 3.0)
- Spill Contingency Plan (Volume 4, Section 4.0)
- Health and Safety Plan (Volume 4, Section 5.0)
- Closure and Reclamation Plan (Volume 4, Section 6.0)
- Consultation Plan (Volume 4, Section 7.0)
- Water Management Plan (Volume 4, Section 8.0)
- Sediment and Erosion Control Plan (Volume 4, Section 9.0)
- Conceptual Fish and Fish Habitat Compensation Plan (Volume 4, Section 10.0)

- Biodiversity Action Plan (Volume 4, Section 11.0)
- Water Quality Monitoring Plan (Volume 4, Section 12.0)
- Road Management Plan (Volume 4, Section 13.0)
- Geochemical Monitoring Action Plan (Volume 4, Section 14.0)
- Aboriginal Traditional Knowledge Study Plan (Volume 4, Section 15.0)
- Cultural Resources Action Plan (Volume 4, Section 16.0)

10.1.3 Standard Operating Procedures (SOPs)

The SOPs will be developed, as required, to define step-by-step procedures for implementing individual Project-, location-, or discipline-specific tasks. Some Plans may specify processes for the development of SOPs, including collaborative arrangements between Noront, contractors and other parties. The Level 2 EMPs will define the need and schedule for developing Level 3 SOPs. The Level 3 SOPs define the “hows,” “whats,” “whens,” “wheres,” and “by whoms” that are involved with a particular job assignment. The development, implementation, training, and continuous improvement of the various SOPs are the responsibility of the manager of the department within which the job assignment will be performed. The Environmental Superintendent is responsible for cataloguing all SOPs in the Project files, as well as interfacing with the Mine Manager to confirm that training records are maintained in the appropriate company training files.

10.1.4 Key Issues and Impacts

Volume 2, Sections 6.0 through 8.0 of the EIS report present an evaluation of the significance of the predicted effects that the Project will have on VECs. A number of the Plans implement the presented mitigation strategies in the effects assessments that will occur during all phases of the Project.

10.1.5 Aboriginal Consultation

Aboriginal consultation is detailed in the Aboriginal Consultation EMP and demonstrates how Noront will consult and engage the First Nations communities. Minimum requirements are outlined for the activities that Noront will undertake as part of the EA process. The specific details are flexible and will be finalized based on ongoing feedback from the communities.

Consultation is a central objective of the EA process and ongoing engagement. The following are elements of a successful consultation plan:

- Clear objectives
- Stakeholder identification
- Consultation methods
- Issue identification
- Integration of input
- Proponent evaluation of consultation
- Activities continue throughout the life of the Project

In carrying out the EA and implementing the EMS (including continuous improvement) Noront will consult residents and organizations in all affected communities and stakeholders.

10.1.6 Corporate Commitments

Noront is committed to meeting best practices regarding environmental and social responsibility. Noront will set its performance standards at a level that is comparable to leading industry practices. To that end, Noront is committed to continuously improving the operational performance of the Project, to enhancing environmental and social benefits, and to limit adverse impacts to the maximum extent practical. Noront commits to the implementation of the EMPs upon finalization in consultation with the Government, First Nations and the public.

Noront has several policies and mechanisms which will apply to the Project, including:

- Aboriginal Policy
- Code of business conduct and ethics
- Environmental Policy
- Workplace Health and Safety Policies

Volume 2, Section 11.0 summarizes the commitments made in the EIS and EMPs.

Noront holds, as a core value, the health and safety of all employees and the integrity of the environment in which they work. Noront is committed to:

- Complying with all existing laws and regulations pertaining to safety, health, and the environment
- Reducing and ultimately eliminating all accidents and incidents of work-related ill health
- Minimizing the impact of the Project's activities on the environment and the communities
- Continuously evaluating the health, safety and environmental risks inherent to the business
- Providing adequate training to employees in order to increase awareness of potential health and safety risks associated with their work and to raise awareness of the potential impact to the environment of their activities
- Ensuring adequate emergency plans are developed and communicated to all employees

Regarding insurance and liability management, Noront will comply with legal requirements and will require contractors to be adequately insured and bonded. Insurance coverage may include, but not necessarily be limited to:

- General Liability
- Commercial Automotive
- Workers Compensation and Employers Liability
- Employee Practice Liability
- General Property Insurance
- Financial Assurance for mine closure, as required by the Ontario *Mining Act* (Ontario, 1990) and outlined in an approved Mine Closure Plan

Noront has been operating exploration activities in the Ring of Fire since 2007 and began environmental baseline data collection in the region in 2009. The company has operated its exploration camp in a manner that ensures the integrity of the environment is maintained.

Noront has been engaging with the First Nation communities in the Project area since 2010. The engagement activities have included community open houses, meetings with Chiefs and Councils, and regular correspondence with the communities. In addition to the engagement activities carried out by Noront, the company has hired a number of First Nation employees for management, camp operations, exploration, and baseline environmental and technical data collection programs. The Company is actively negotiating Memoranda of Understanding (MOUs) with potentially affected First Nation communities. To date MOUs have been signed with the Aroland and Webequie First Nations.

Noront has entered into partnerships with Matawa Tribal Council (through their employment and training services provider KKETS) and Confederation College (in cooperation with Workbay). The objective of both programs is to build a local productive workforce that will enable Aboriginal jobseekers to develop and, ultimately, utilize their skills for future employment opportunities at the Eagle's Nest Mine or businesses supporting the mine. The programs offered through this partnership will benefit all nine Matawa communities and at this time they are aligned with Noront's employee requirements. In March 2013, Noront, KKETS, and Confederation College signed a MOU thereby creating the Ring of Fire Aboriginal Training Alliance. This agreement reinforces the desire and commitment by Noront to work in partnership with the Matawa Communities and Confederation College to develop a highly skilled Aboriginal workforce (Confederation College, 2013).

In 2013, Noront became a member of the Mining Association of Canada (MAC). As a member of MAC, Noront is proud to subscribe to the mandatory requirements of MAC's Towards Sustainable Mining (TSM) initiative. The TSM Guiding Principles outline MAC's and its members' commitment to support advocacy, stewardship, and collaboration on behalf of Canada's mining and mineral-processing industry. Developed together with communities of interest and key stakeholders, these principles are mandated by MAC's members across the industry to help members meet society's needs for minerals, metals and energy products in the most conscientious way possible. This includes conducting all facets of their mining businesses effectively, transparently and accountably. The Guiding Principles of TSM are described on the MAC website (www.mining.ca; MAC, 2004).

TSM Performance Indicators are used to implement the TSM Guiding Principles by setting down specific measurement criteria in six key areas of operational performance:

- Tailings Management
- Energy and Greenhouse Gas Emissions Management
- Aboriginal and Community Outreach
- Crisis Management Planning
- Safety and Health
- Biodiversity Conservation

MAC has also developed a mine closure framework and members are working to develop specific performance indicators to address mine closure.

Members of MAC must measure and report on their performance in these areas annually. Findings are outlined in MAC's yearly Towards Sustainable Mining Progress Report. When measuring performance, MAC employs social, economic and environmental indicators to provide the most in-depth analysis possible. Such indicators demonstrate how the mining industry is responding to concerns, what MAC members are doing successfully, and where members can continue to improve. The TSM initiative has been integrated into Noront's EMS. Additional information on TSM is displayed prominently on MAC's website (MAC, 2004).

10.1.7 Implementation Team

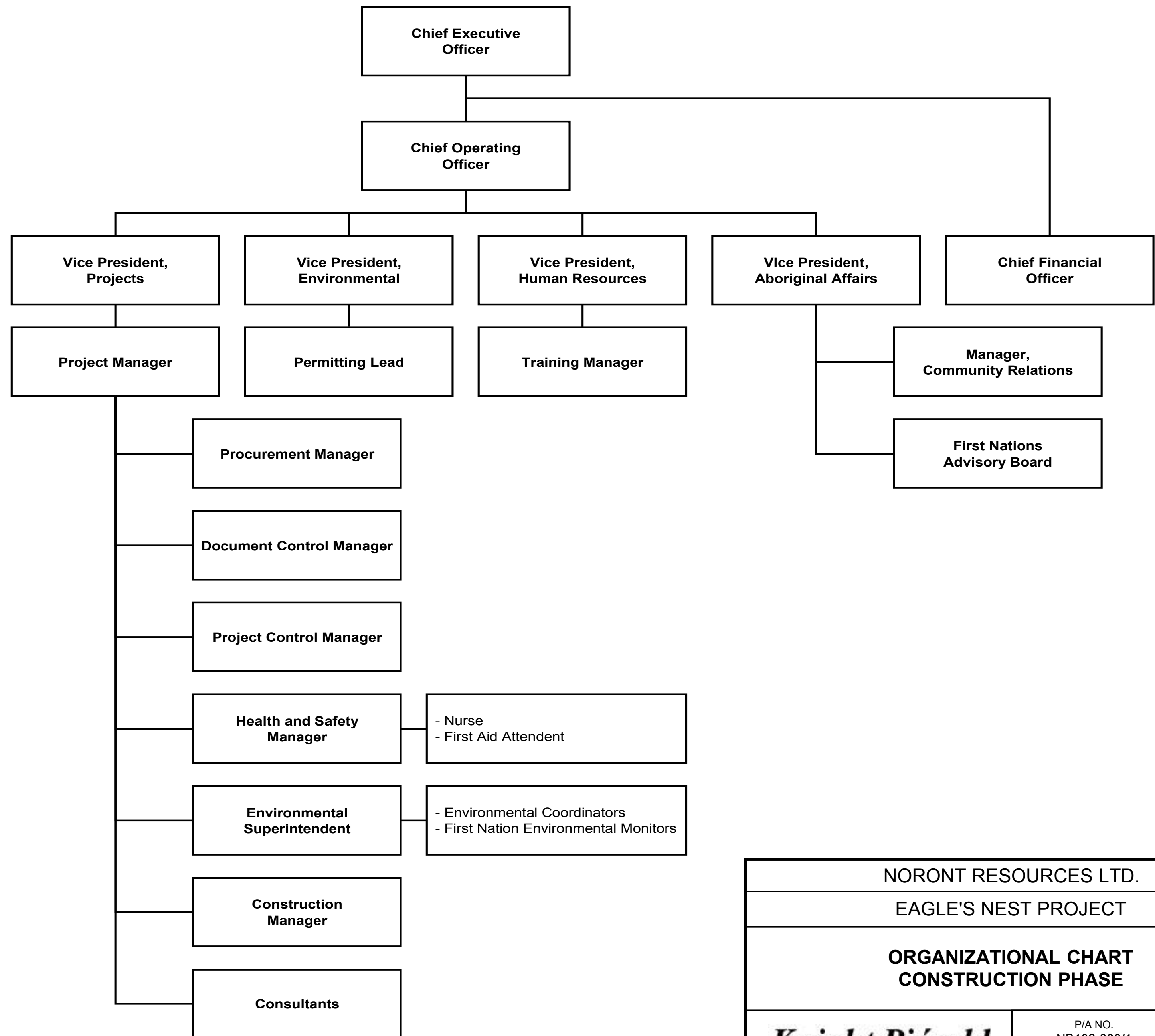
The key personnel involved in environmental management on the Eagle's Nest Project and their respective roles and reports are summarized in Table 10.1-1.

Table 10.1-1 Noront Environmental Management Team

Position	Role	Reports to
President /Chief Executive Officer	Overall corporate responsibility	Noront Board of Directors
Chief Operating Officer	Corporate responsibility for operations	President /Chief Executive Officer
Vice President Human Resources	Corporate responsibility for human resources	President /Chief Operating Officer
Training Manager	Responsible for implementation of the training components of the EMS and EMPs	Vice President Human Resources
Vice-President Aboriginal Affairs	Corporate responsibility for aboriginal affairs and stakeholder relations	Chief Operating Officer
Manager Community Relations	Responsible for implementation of the community relations aspects of the EMS and EMPs	Vice President Aboriginal Affairs
First Nations Advisory Board	Responsible for advising on Aboriginal affairs	Vice President Aboriginal Affairs
Vice President Environment	Corporate responsibility for environmental sustainability	Chief Operating Officer
Permitting Lead	Responsible for coordinating permit applications and addenda, and maintaining regulatory authorizations	Vice President Sustainability
Vice-President & General Manager Eagle's Nest Mine	Responsible for implementation of the Project during the operation and closure phases, including the EMS and EMPs	Chief Operating Officer
Health and Safety Manager	Responsible for implementation of the health and safety components of the EMS and EMPs	Vice-President & General Manager Eagle's Nest Mine
Environmental Superintendent	Responsible for day-to-day implementation of the EMS and EMPs; cataloguing all SOPs in the Project files; ensuring sufficient resources are provided to carry out various environmental duties; reporting of results internally; obtaining and maintaining compliance with applicable permits	Mine Manager
Environmental Coordinator(s)	Responsible for sample collection, ongoing environmental data collection, inspections, and record keeping	Environmental Superintendent
First Nation Environmental Monitor(s)	Responsible for sample collection, ongoing environmental data collection, inspections, and record keeping	Environmental Coordinator(s)
Vice President Projects	Corporate responsibility for projects	Chief Operating Officer

This organizational responsibility applies to the operation and closure phases of the Project. During the construction phase, private contractors will be responsible for the implementation of the construction project. All contractors will be supervised by a contracted Construction Manager, who will assume the responsibilities of the VP & General Manager of Eagle's Nest Mine. Near the end of construction, there will be a transition period wherein the responsibilities of the Construction Manager will be transferred to the VP & General Manager.

The key personnel involved in environmental management and their respective roles on the Project during are summarized in Figure 10.1-1 for the construction phase and Figure 10.1-2 for the operation phase.



NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

ORGANIZATIONAL CHART
CONSTRUCTION PHASE

Knight Piésold CONSULTING

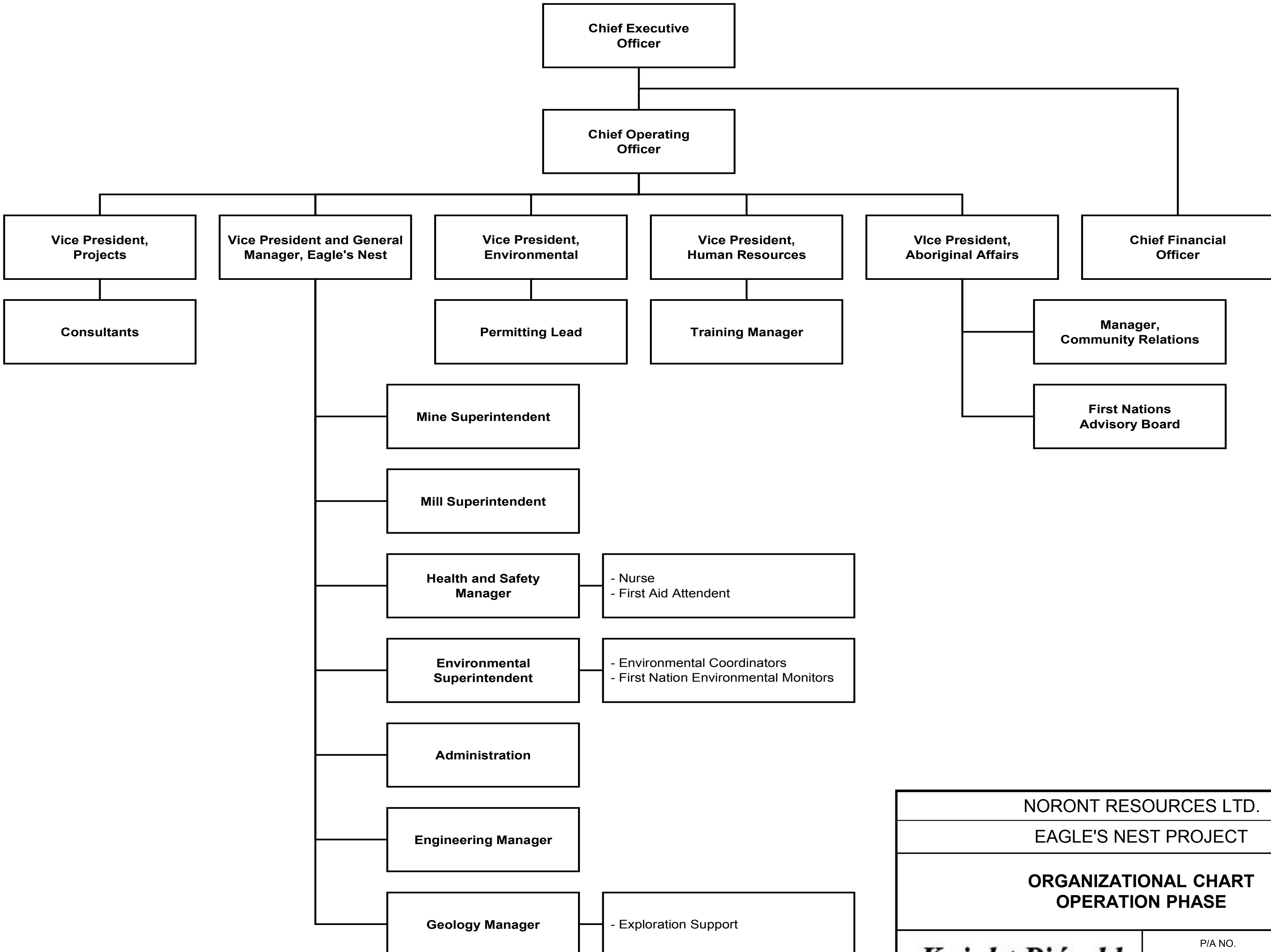
P/A NO. NB102-390/1

REF. NO. 34

FIGURE 10.1-1

REV A

A	20DEC'13	ISSUED WITH REPORT	RDW	RAC	RAM
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D



NORONT RESOURCES LTD.

EAGLE'S NEST PROJECT

ORGANIZATIONAL CHART
OPERATION PHASE

Knight Piésold CONSULTING

P/A NO. NB102-390/1

REF. NO. 34

FIGURE 10.1-2

REV A

A	20DEC'13	ISSUED WITH REPORT	RDW	RAC	RAM
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

10.2 TRAINING

10.2.1 General

Several key training programs will be implemented to ensure effective implementation of the EMS. Select on- or off-site training will be carried out based on a training needs analysis conducted annually by the VP & General Manager in consultation with the Site Management Team. The training analysis will be based on:

- Job description/responsibilities and changes in staff
- Inventories of critical tasks and procedures
- Reports on investigation of undesired events
- Applicable regulations

Training sessions will include testing to ensure a good understanding of the EMS, and certificates of completion will be issued, where applicable. In the case where personnel are reassigned, there will be re-training. A yearly training needs-assessment will be developed and updated each year. Training is covered in the Human Resources Management Plan (Volume 4, Section 2.0).

10.2.2 Employee Orientation / Induction Training

A formal orientation will be provided to all new personnel. It will include at a minimum:

- Expectations of employment
- Site orientation
- Occupational Health and Safety (OHS) training (see Section 10.2.3)
- Noront's corporate commitments, environmental policy and EMS (see Section 10.2.4)
- First Nations and cultural awareness training (see Section 10.2.5)

All orientation will be documented and employees will be required to sign that the training has been received and the corporate commitments are acknowledged.

10.2.3 Occupational Health and Safety (OHS) Training

An Occupational Health and Safety Plan (OHS Plan) has been developed, which provides the framework for addressing OHS risks and preventative measures.

A basic level of Occupational Health and Safety (OHS) training will be provided to all project personnel. This will include a general safety awareness program identifying project specific risks to health and safety, mandatory personnel protection measures, and incident reporting. Annual certification/re-certification of Workplace Hazardous Materials Information System (WHMIS) will be provided to all employees and select personnel will be trained in Standard First Aid and Cardiopulmonary Resuscitation (CPR).

Additional OHS training will be identified and implemented on a job-specific basis, where special risks are associated with a given position. A mine rescue team will be established and receive specialized training.

10.2.4 Environmental Awareness Training

Relevant personnel will receive formal environmental training that will include:

- Review of key environmental regulations and permit conditions
- Environmental sensitivities (i.e., biodiversity issues, heritage resources protection, etc.)
- Spill response reporting requirements
- Employee roles and responsibilities in achieving environmental objectives

10.2.5 Cultural Orientation and Aboriginal Rights Awareness Training

The Project including the transportation corridor is located on the traditional lands of several First Nation communities. Noront is committed to minimizing adverse effects on the First Nation traditional lands and to providing opportunities to engage in the Project. As such, Noront intends to maximize employment of the First Nation and residents of nearby communities.

It will be important to clearly establish amongst the Project's workforce an awareness that the Project is on First Nation traditional lands and a respect for the inherent aboriginal rights afforded to the First Nation peoples, and their unique culture. A cultural orientation and aboriginal rights training program will be established with and delivered by First Nation representatives to all Project and mine staff and contractors. This orientation will be conducted in parallel with the general orientation program described in Section 10.2.2.

10.3 IMPLEMENTATION PLAN

10.3.1 Follow-Up Program

A follow-up program will be implemented to confirm the significance of environmental effects identified in the EIS/EA and to measure the effectiveness of the EMS to continuously improve the System. The program will consist of the measurement and monitoring of the VECs identified in Section 10.1.2 and any additional indicators identified during ongoing consultations. The measurements of each VEC will be compared to the baseline conditions presented in the EIS/EA report and supporting documents.

The follow-up program will compile all reports as set out in the EMP and detailed in the SOPs, and compare the results to the baseline conditions set out in the EIS. If revisions are required, then a formal change request will be submitted internally and necessary updates made.

Noront has not specifically set out to seek funding for follow-up programs. Funding will be allocated internally as the development of the Project progresses.

10.3.2 Sampling and Monitoring

The SOPs will be developed to ensure sample integrity and consistency. Standardized inspection forms will be developed for monitoring and inspection tasks.

10.3.3 Input and Funding from Others

In addition to the roles and responsibilities covered in Section 10.1.7, the follow-up program may include reviews by peers, Aboriginal groups, the public and/or independent researchers. Noront is open to working with researchers, including providing in-kind support (e.g., use of camp to support regional or project-specific research initiatives, etc.).

Monitoring and other follow-up programs may be revised during the EA/permitting review or if parties express an interest in a certain type of project.

Noront will fully fund its EMS and the associated follow-up / implementation programs. External sources of funding are not being sought at the time of publication; however, this may be updated in subsequent revisions of the EMS.

10.3.4 Data Management and Document Control

Effective data management is an important element of the EMS, and it will help maintain data quality and reliability. One or more data management systems will be developed to incorporate, store and retrieve environmental data. This could include, for example, an off-the-shelf software package to manage water quality data. Data management approaches will be developed at the discretion of on-site environmental staff.

Document control is another important aspect that applies to management plans, SOPs and reports. One or more document control SOP(s) will be developed by on-site environmental staff.

10.3.5 Schedule

The EMS will be implemented once the Project has been approved. The System will be finalized in consultation with the Government, First Nations and the public through the EIS/EA report review and overall Project permitting processes. The EMPs will be revised prior to construction to incorporate feedback received from the review and permitting processes.

The EMS is a living document to be updated throughout the Project. Updates will be based on management reviews, incident investigations, regulatory changes, or other Project related changes.

10.3.6 Reporting of Performance

A system for monitoring of performance will be established for internal reporting of environmental sampling, inspection and audit results. Environmental performance will also be reported as required by permits, licences, approvals and authorizations.

Section 11

Commitments

TABLE OF CONTENTS

PAGE

TABLES

11 – COMMITMENTS

Table 11.1-1 provides a summary of all significant commitments made within the EIS/EA Report. The commitments are organized by EIS/EA volume and section numbers. Reference numbers have been assigned to commitments as they appear in the report for future tracking purposes. Legislative requirements have been identified, where applicable.

Sections of the EIS/EA Report may commit to the implementation of a management, action or study plan. Commitments made within these plans are documented and tracked within the Environmental Management System (Volume 4, Section 1.0) of the overall Environmental and Social Management Plan (ESMP).

Knight Piésold CONSULTING

TABLE 11-1

NORONT RESOURCES LTD.
EAGLE'S NEST PROJECT

TABLE OF COMMITMENTS

Print Dec/20/13 23:42:43

Reference Document / Number	Reference Section	Commitment	Applicable Legislation	Frequency or Completion Milestone	Responsibility
EIS/EA Report					
EIS-2-5-1	5.0	Geochemical Sampling and Testing of Quarry and Borrow Materials	N/A	Prior to Development	Noront
EIS-2-6-1	6.5	Monitoring seepage during and after operations underground	N/A	During Operations/Closure and Post-Closure Phases	Noront
EIS-2-6-2	6.6	Additional assesments of fish habitat at the final road alignment transportation corridor water crossings to quantify potential habitat loss and develop a detailed no-net-less Fish Habitat Compensation Plan (FHCP) as part of a *Fisheries Act* Authorization	*Fisheries Act*	Following final road alignment and field investigations (FHCP required prior to road construction)	Noront/KP
EIS-2-7-1	7.1.1	Change of residency of Project employees from the LSA should be included in Project monitoring to act as a quantitative indicator of the level of migration in the LSA as a result of the Project. Qualitative data gathered from the perceptions of community members should also be collected to provide additional context to the quantitative indicator. Education and training attainment rates should be included in early Project planning to ensure a sustainable pool of potential employees is available for the duration of the Project.	N/A	Ongoing	Noront
EIS-2-7-2	7.8	Collect additional ATK data as per ATK Study Plan	*Canadian Environmental Assessment Act*	Ongoing	Noront
EIS-2-7-3	7.10	Upon receipt of additional engineering design, gained during the detailed engineering phase, a revised assessment package will be submitted to TC. The package will include representative width, depth, gradient and flow measurements of each crossing, as well as upstream and downstream photographs. Detailed bridge drawings will be formally submitted to Transport Canada for review for all crossings determined to be navigable. Drawings will include the watercourse name, photographs of the crossing, crossing width, height to the bridge measured from the high water mark, bankfull depth, longitude, and latitude.	*Navigable Waters Protection Act*	Detailed design of Road	Noront
EIS-2-10-1	10.0	Implement Environmental and Social Management Plan	N/A	Ongoing	Noront
Technical Supporting Documents					
TSD-5-17-1	N/A	Installation and Monitoring of Groundwater Monitoring Wells East of the Mine Site	N/A	Prior to Development and then Monitoring Water Levels during Operations, Closure and Post-Closure Phases	Noront

I:\1\02\00390\01\A\Report\Report 34, EA Volume 2 - EA Report\REV A\16 - Section 11 - Commitments\2 - Draft\[Table 11-1 Commitments 2013-12-19 RDW.xlsx]Commitments

NOTES:

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
A	20DEC'13	ISSUED WITH REPORT	RDW	RAC	RAM

Section 12

Other Approvals

Knight Piésold
CONSULTING
www.knightpiesold.com

TABLE OF CONTENTS

PAGE

TABLES

12 – OTHER APPROVALS

Table 12.1 summarizes the federal, provincial and municipal permits/approvals that are expected to be required for the construction and operation of the Project. The list of permits/approvals presented in Table 12.1 is not intended to be a final list of all requirements. Noront will continue to consult with federal, provincial and municipal agencies to refine this list of permits/approvals as additional studies and design details become available.

Table 12.1 Preliminary List of Permits/Approvals

Permit/Approval	Agency	Act	Regulations	Trigger/Activity
Provincial Permits –MNR				
Work Permit	MNR	Public Lands Act	O.Reg. 975/90 Work Permits - road or building construction on public lands. O.Reg. 453/96 Work Permit - for construction of road facility to enable crossing of a water body	Any work on water crossings. (culvert installations, construction of a bridge, seasonal ice bridges, etc.)
Work Permit	MNR	Public Lands Act	O.Reg. 975/90 Work Permits - for road or building construction on Public Land (Crown Land)	Any work that involves upgrading of existing roads, building new roads or building trails on Crown Land
Authorization	MNR	Fish and Wildlife Conservation Act	N/A	Beaver dam removal, collection of fish for scientific purposes, trapping of nuisance beavers
Forest Resource Licence	MNR	Crown Forest Sustainability Act	N/A	Removal of merchantable timber on Crown Land
Approval	MNR	Lakes and Rivers Improvement Act	N/A	Installation/construction of water retaining structures

Permit/Approval	Agency	Act	Regulations	Trigger/Activity
Land Use Permit	MNR	Public Lands Act	Public Lands Act O.Reg. 973/90 land use permits	When land tenure is required to use Crown land for building
Work Permit	MNR	Public Lands Act	O.Reg. 453/96 - Work Permit - Construction - for construction of buildings on public land	Construction of buildings on public land (road construction camps)
Burning permit	MNR	Forest Fire Prevention Act	O.Reg. 207/96 Outdoor Fires	Burning of removed vegetation
Aggregate Permit/Licence	MNR	Ontario Aggregate Resources Act (ARA)	O.Reg. 244/97	Removal of aggregate from pit or quarry (road construction)
Authorization	MNR	Endangered Species Act	O.Reg. 242/08, O.Reg. 230/08	Activities that may kill, harm, harass or threaten a species listed under the Act or damages/destroys their habitat
Provincial Permits –MOE				
Environmental Compliance Approval - Air and Noise	MOE	EPA	O.Reg. 419/05 Air pollution - Local Air Quality O.Reg. 337 - Ambient Air Quality Criteria. Guideline A-7 Air Pollution Control, Design and Operation Guidelines for Municipal Waste Thermal Treatment Facilities	Discharge of an airborne contaminant into the natural environment, including noise (milling, ventilation, generators, incinerator, aggregate crushing, screening and stockpiling, etc.)
Generator Registration Report	MOE	EPA	O.Reg. 347/90 part 5. General Waste management	Storage and transportation of hazardous wastes

Permit/Approval	Agency	Act	Regulations	Trigger/Activity
Waste Audit and Reduction Plan	MOE	EPA	O. Reg. 102/95 - Waste Audits and Waste Reduction Work Plans	Requirement for waste audit and waste reduction plan for construction projects
Environmental Compliance Approval	MOE	EPA	N/A	Construction and operation of a waste disposal site (waste processing and transfer)
Environmental Compliance Approval	MOE	Ontario Water Resources Act	O.Reg. 560/94 Effluent Monitoring and Effluent Limits - metal mining sector. O.Reg 561/94 Effluent monitoring and Effluent Limits Industrial Minerals Sector	Industrial Sewage Works Environmental Compliance Approval (ECA) requirement for discharge of mine wastewater and domestic sewage to ground/surface water
Water Well Installation	MOE	Ontario Water Resources Act	O.Reg. 903 Wells	Well drilling for water supply or groundwater monitoring, in accordance with O. Reg. 903 Ontario Water Resources Act
Permit to Take Water (>50,000 L)	MOE	Ontario Water Resources Act	O.Reg. 387/04 Water Taking	Taking more than 50,000 L per day

Permit/Approval	Agency	Act	Regulations	Trigger/Activity
Provincial Permits – Ministry of Transportation				
Entrance Permit	Ministry of Transportation	Public Transportation and Highway Improvement Act	N/A	Requirement for a new or upgraded road entrance onto a provincial highway
Encroachment Permit	Ministry of Transportation	Public Transportation and Highway Improvement Act	N/A	Activities within 45 m of the highway may be controlled for safety considerations
Provincial Permits – MNDM				
Verification of Closure Plan Completion	MNDM	Mining Act	O.Reg 240/00 Mine development and Closure Plan	Mine development
Notice of Project Status	MNDM	Mining Act	O.Reg 240/00	Mine development
Provincial Permits – MOL				
Pre-development review process	MOL	Occupational Health and Safety Act	Occupational Health and Safety O.Reg 854/90 Mines and Mining Plants	Safety and procedures review of Project prior to development
Federal Permits – NrCan				
Permit	NRCan	Explosives Act Section 7	N/A	Explosives use

Permit/Approval	Agency	Act	Regulations	Trigger/Activity
Licence for Explosives Magazine	NRCan	Explosives Act Section 7	N/A	Required for constructing or maintaining an explosives magazine
Federal Permits – DFO				
Fish Habitat Authorization	DFO	Fisheries Act	Fishery (General) Reg. (SOR/93-53)	Work on water crossings or work near fish habitat
Notification	DFO	Fisheries Act	Fishery (General) Reg. (SOR/93-53)	Beaver dam removal
Federal Permits – EC				
Approval of Cycle 1 Study Design	EC	Fisheries Act	Metal Mining Effluent Regulations (SOR/2002-222)	Discharge of mine effluent exceeding 50 m^3 per day.
Permit	EC	Migratory Birds Convention Act	Migratory Birds Regulations	Perform a regulated activity that harms migratory birds or an area frequented by migratory birds
Federal Permits – TC				
Approval	TC	Navigable Waters Protection Act	Navigable Waters Works Regulations	Any work for crossing a navigable water body that may interfere substantially with navigation

NOTES:

1. MNR = MINISTRY OF NATURAL RESOURCES, MOE = MINISTRY OF THE ENVIRONMENT, MNDM = MINISTRY OF NORTHERN DEVELOPMENT AND MINES, MOL = MINISTRY OF LABOUR, NRCAN = NATURAL RESOURCES CANADA, DFO = DEPARTMENT OF FISHERIES AND OCEANS, TC = TRANSPORT CANADA.

Section 13

Benefits to Canadians

Knight Piésold CONSULTING
www.knightpiesold.com

TABLE OF CONTENTS

PAGE

13 – BENEFITS TO CANADIANS

13.1 OVERVIEW

A number of benefits result from the provincial and federal cooperative environmental assessment process for the Project. The qualitative and quantitative benefits presented here are from the perspective of Noront and are intended to satisfy the requirements of the CEA Agency to include a section on benefits of the environmental assessment to Canadians as part of the EIS/EA Report.

Governments, First Nations and the public reviewed and assessed the information brought forward during the environmental assessment process which contributed to improvements in the Project plan and design, particularly with respect to minimizing potential environmental effects. As a result of the environmental assessment process, Noront's selection of the Project design and activities are not based solely on engineering or economic determinants, but rather on a balanced approach that guides the sustainable development, operation and closure of the Project.

This section presents a summary of the modifications of the Project as a result of the environmental assessment process that enhance environmental outcome, yield social, public health and economic benefits. This section is intended to highlight and report on the type of incremental changes and specific benefits that have accrued from the cooperative environmental assessment process and CEA Agency and MOE led technical reviews. Multiple technical reviewers including government representatives, First Nations and the public have been involved in the collaborative environmental assessment process from the date of Noront's notification to the governments of its intention to seek federal and provincial approval for the construction of the Project through to the submission of the EIS/EA Report. Additional information on the environmental assessment process, technical environmental assessment working group, public consultations and First Nations consultations are presented in other sections of the EIS/EA Report.

In each of the following sections, the text is preceded by a quote from the CEAA Guidelines issued to Noront, specifying what the proponent is expected to demonstrate. Each section then describes how the requirements outlined in the quote are being met.

13.2 MAXIMIZING ENVIRONMENTAL BENEFITS AND SUPPORTING SUSTAINABLE DEVELOPMENT

The EA process allows the effects of a project to be identified along with mitigation measures to reduce or avoid potential adverse effects. The EA of the Project has been carried out early in the Project planning and enables mitigation to be incorporated into Project design and procedures, thereby limiting adverse effects. In addition, the EA allows the positive effects of the Project to be identified. Through the EA process, Noront has identified a number of ways to align its Project with the needs and planning initiatives of the region (Section 13.4).

The EA process is also a public process. The process seeks to engage potentially affected people including local Aboriginal and non-Aboriginal communities. The engagement seeks both to inform interested and relevant stakeholders about the Project, and to seek feedback on the Project. A project that considers stakeholder interests, aspirations and concerns is a better project. Through the conduct of the EA and the preparation of this EIS/EA Report, Noront has identified a number of ways that the Project may contribute directly and indirectly to sustainable development in the region:

- Contributing to the economy of northwestern Ontario and most significantly to the economies within the remote First Nation communities within which Noront will establish direct points of hire.
- Establishing needed infrastructure in this remote part of the province, which will reduce the cost of establishing year-round road access to four remote First Nation communities (see Section 13.3). This in turn has the potential to substantially lower the cost of living within the communities and address poverty issues.
- Provide training and employment to an under-employed part of the province (see Section 13.3).

As described in Section 13.3, the Project is aligned with a number of First Nation initiatives in the region and is very timely in this regard.

13.3 ABORIGINAL CONSULTATION AND PUBLIC PARTICIPATION

Aboriginal consultation and public participation leading up to the preparation of this EIS/EA Report influences has influenced the Project design in a number of ways, as follows:

Selection of an East-West Aligned Transportation Corridor that is Congruent with Other First Nation Initiatives in the Region

One important element of the Project is the construction of an all-season road from the Pickle Lake North Road to the mine site, referred to as the “east-west transportation corridor”. The east-west transportation corridor follows an existing winter road and is well-suited for nearby First Nations or the Ontario government to construct connecting all-season roads between the communities and the Project road. This alignment is similar to a route proposed by four Matawa communities - Neskantaga, Nibinamik, Eabametoong and Webequie – as a way to connect their communities to the provincial highway system (Wawatay News, 2013a).

Furthermore, the east-west transportation corridor has not received the negative feedback that First Nations expressed regarding a north-south aligned transportation corridor suggested by other ROF proponents (Wawatay News, 2013b).

In addition, the Ontario Power Authority has drafted a Remote Community Connection Plan (OPA 2012 and 2013). The draft plan suggests that there is an economic case to connect up to 21 remote communities in northwestern Ontario. The remote First Nation communities in the vicinity of the Project would be serviced by upgrading the existing transmission line to Pickle Lake and extending the transmission line into the “Pickle Lake cluster” of communities. Supporting First Nations to get off diesel generation and on to the provincial grid, and more involved in renewable energy is a high priority for the Nishnawbe Aski Nation (NAN, 2012). On March 12, 2009, the Nishnawbe Aski Nation (NAN) was mandated by the NAN Chiefs in Assembly Resolution 09/39 as follows:

“The NAN Chiefs in Assembly mandate the NAN Executive Council to convene a forum with First Nations to formulate a strategy on the development of potential renewable energy sources in

the NAN territory and identify potential transmission system upgrades and expansions as well as Hydro grid connections to remote First Nations."

Noront's east-west transportation corridor is also consistent with, and supportive of, this initiative.

Maximizing Placement of Infrastructure Underground and Minimizing the Surface Footprint

First Nation communities indicated to Noront a desire to minimize the surface footprint of the Project. Therefore, and also taking into account the poor ground conditions at surface, Noront endeavoured to maximize infrastructure underground as a means to minimize the Project`s surface footprint.

The Project will consist of innovative approaches to placing milling infrastructure underground, having no surface tailings pond and the implementation of our underground quarry which will also serve as a training stope school for local workers.

Maximizing Aboriginal Training and Employment

Noront also heard a strong desire from First Nations to participate in the Project and realize training and employment. A key element of the Project, as described in Noront's Human Resources Management Plan (Volume 4, Section 2), is meaningful participation with the Ring of Fire Aboriginal Training Alliance (ROFATA). ROFATA is a joint initiative of the Kiikenomaga Kilenjigewen Employment Training Services (KKETS), Noront and Confederation College of Applied Arts and Technology. The parties are committed to working cooperatively to plan, promote, secure funding, deliver and expand opportunities for the development of a highly skilled Aboriginal workforce for activity associated with the Ring of Fire. The partners acknowledge and understand that the overall development within the Ring of Fire is a multi-year initiative that will apply learner-centred innovative delivery approaches to preparatory programs, academic upgrading, foundations training and semi-skilled, skilled and professional education and training programs.

In August, 2013 the Ring of Fire Aboriginal Training Alliance (ROFATA) was awarded $5.9 million in funding from the Government of Canada's Skills and Partnership Fund to provide employment in the mining sector for the people of Matawa First Nations until March 31, 2015.

ROFATA is an initiative assisting and supporting members of nine (9) Matawa First Nation communities in pursuit of specialized training and making informed career decisions in their transition from training to employment. The objectives are to (1) provide skills development and training to aboriginal participants for long-term meaningful employment, and (2) promote skills development, labour market participation and inclusiveness through the effective and efficient development of training initiatives and supports that are aligned to identified labour market needs for the Ring of Fire.

Training will be conducted in the areas of Mining Essentials, a pre-employment training program, Environmental Monitoring, Line Cutting, Security Guard, Remote Camp Support, Remote Camp Cook, Underground Common Core, Heavy Equipment Operator, Pre-Trades Carpentry/Electrical/Plumber/Welder/Heavy Duty Equipment Mechanic/Construction Craft Worker.

ROFATA trainees will be guided to long-term sustainable career pathways in the mineral and mining sectors or other resource related areas associated with the Ring of Fire.

Ongoing Aboriginal Consultation and Public Participation

Noront looks forward to ongoing and increased Aboriginal consultation and participation in the Project, within and outside of the formal EA review process.

13.4 TECHNOLOGICAL INNOVATION

There are two key technological innovations proposed for the Project:

- Placement of mining infrastructure in the underground
- Use of a specialized road design for road construction on muskeg

A couple of factors have contributed to Noront's decision to place mining infrastructure (process plant, maintenance facilities) underground. Poor ground conditions at surface make surface development expensive. First Nation communities have expressed a desire that surface infrastructure and disturbance be minimized to the extent possible. Noront's plans to source aggregate from underground stopes will create the necessary space to construct the facilities underground. This is a unique approach to mine development that will provide valuable learning and precedent for future mine developments in the James Bay Lowlands and similar environments.

A portion of the all-season road proposed by Noront along the east-west transportation corridor (approximately 100 km) will involve the application of a specialized road technology for constructing roads on muskeg with low bearing capacity. This road technology has been used frequently in Alberta and the United States but has seen limited applications in Ontario to date. At the Eagle`s Nest Project site, Noront has implemented a test section of road over muskeg to learn more about its application. Through the construction of approximately 100 km of floating road on the Project, Noront and contractors will gain important experience using this road construction methodology that can be applied throughout northwestern Ontario.

13.5 INCREASES IN SCIENTIFIC KNOWLEDGE

Field studies, monitoring and other scientific programs carried out within the environmental assessment process can yield new and enhanced scientific information in areas such as fisheries, wildlife and water quality. This knowledge, collected as part of the environmental assessment process, improves provincial and federal decision-making at the conclusion of the environmental assessment and can benefit the assessment of other projects.

As part of the environmental assessment process for the Project, Noront collected information on the physical environment (meteorology, hydrology, soils and terrain) and biological information on the presence and distribution of fish species, vegetation and wildlife. Prior to the baseline studies carried out by Noront and other ROF proponents, limited environmental information was available for this part of the province. Noront participated in caribou studies and analyses as part of the Woodland Caribou Working Group along with the Ontario Ministry of Natural Resources and Golder Associates (on behalf of Cliffs Natural Resources). This information will help government staff better understand the species distribution, and other environmental parameters to guide decisions in the future.

13.6 COMMUNITY AND SOCIAL BENEFITS

The Project is expected to bring a number of benefits to the potentially affected First Nation communities, northwestern Ontario, and Canadians as a whole as follows:

- Creating economic activity within local Aboriginal communities, northwestern Ontario and the province of Ontario
- Providing direct employment to approximately 700 individuals during construction and 750 individuals during operations
- Providing employment and business opportunities for Aboriginal people
- Generating tax revenues for provincial and federal governments
- Providing positive returns to Noront shareholders and lenders
- Creating a better quality of life for the residents by Noront's involvement in improving education, culture and recreation activities in the community
- Participation agreements with local First Nations
- Indirectly supporting regional development initiatives as described in Section 13.3.

Modifications made to project design in order to address potential environmental effects can result in distinct indirect benefits to communities and can maximize social benefits. Such benefits can include employment opportunities, government revenue generation, enhanced access to wilderness areas for recreation, and increased community knowledge, awareness and engagement.

The Project is anticipated to increase federal, provincial and local governments' taxes and revenues through a combination of direct, indirect and induced effects.

Additionally, while the Project itself is relatively modest in scale, development of the Project marks an important new chapter in the story of northwestern Ontario including the remote First Nations communities in the region. Establishment of an active mining operation in the ROF along with year-round access will provide community benefits through increased access and will also reduce the costs of further mineral exploration and development. Both the costs and risks of mineral exploration and development in the region will be lowered.

Section 15

References

15 – REFERENCES

211 Ontario North (211north), 2013. *Atlas of Canada, 2009*. Atlas of Canada, 6th Edition - Annual Mean Total Precipitation. Her Majesty the Queen in Right of Canada. Natural Resources Canada. Retrieved From: http://search.211north.ca/ (accessed November 15, 2013).

Aboriginal Affairs and Northern Development Canada (AANDC), 2013a. First Nation Community Profiles. Retrieved from: http://pse5-esd5.ainc-inac.gc.ca/fnp/Main/Search/SearchFN.aspx?lang=eng (accessed November 5, 2013).

AECOM, 2010. *2009 Baseline Bird and Habitat Survey – McFaulds Lake and the Muketei River (Ring of Fire) Area*. Memo prepared by Derek Parks, AECOM, Guelph, Ontario.

Allan, Sheila, 2012. Personal communication. Environment Canada, Burlington, Ontario.

AMEC, 2009. *Goldcorp Musselwhite Mine, Individual Environmental Assessment for the Main Power Supply for Musselwhite Mine.* Musselwhite, Ontario. Mississauga, ON.

Anon., 1980. *Guidelines for Canadian Drinking Water Quality 1978. Supporting Documentation.* Health and Welfare Canada, Supply and Services, Hull.

Armstrong, R. L., and E. Brun, eds., 2008. *Snow and Climate: Physical Processes, Surface Energy Exchange and Modeling.* Cambridge: Cambridge University Press.

Avery, M. L., 2013. Rusty Blackbird (Euphagus carolinus), The Birds of North America Online (A. Poole, Ed.). Cornell Lab of Ornithology, Ithaca, New York. Retrieved from: the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/200 (accessed October 16, 2013).

BA Consulting Group Ltd., 2013. *Ring of Fire East-West Road Traffic Capacity Analysis*. September 2013.

Banton, Erin, Johnson, J, Lee, H, Racey, G, Uhlig, P & Wester, M., 2009. *Ecosites of Ontario: Boreal Range, Operational Draft*. Ministry of Natural Resources, Sault Ste Marie, Ontario.

Barnett, P.J., Yeung, K.H. and McCallum, J.D., 2013. *Surficial geology of the Lansdowne House Area Northeast, Northern Ontario.* Scale 1:100 000. Ontario Geological Survey. Preliminary Map P.3697, Toronto: Ontario Geological Survey.

Barnett, R., Fearn, J., Sahai, V., Tilleczek, K., Ward, M., and Zmijowskyj, T., 2005. *Child and Adolescent Health in Northern Ontario: A Quantitative Profile for Public Health Planning.* Canadian Journal of Public Health. 96, 287-290.

Bayne, E., Moses, R. & Boutin, S., 2005. *Evaluation of winter tracking protocols as a method for monitoring mammals in the Alberta Biodiversity Monitoring Program.* Integrated Landscape Management Group, University of Alberta.

Bayne, E.M., L. Habib, and S. Boutin. 2008. *Impacts of chronic anthropogenic noise from energy-sector activity on abundance of songbirds in the boreal forest*. Conservation Biology 22:1186-1193.

Beauvais, G.P., and. Buskirk, S.W., 1999. An improved estimate of trail detectability for snow-trail surveys. *Wildlife Society Bulletin* 27(1):32-38.

Bell, Gerald D., Chelliah, Muthuvel, 2006. Leading Tropical Modes Associated with Interannual and Multidecadal Fluctuations in North Atlantic Hurricane Activity. *J. Climate*, 19, 590–612.

Betts, A. K., Ball, J. H., 1997. Albedo over the boreal forest. *Journal of Geophysical Research: Atmospheres*, 102. 28901-28909.

Blancher, P. J., Phoenix, R. D., Badzinski, D. S., Cadman, M. D., Crewe, T. L., Downes, C. M., Fillman, D., Francis, C. M., Huges, J., Hussell, D. J. T., Lepage, D., McCracken, J. D., McNicol, D. K., Pond, B. A., Ross, R. K., Russell, R., Venier, L. A. & Weeber, R. C., 2009. Population trend status of Ontario's forest birds. *Forestry Chronicle* 85:184-201.

Boulanger, J., Poole, K. G., Gunn, A., & Wierzchowski, J., 2012. Estimating the zone of influence of industrial developments on wildlife: a migratory Caribou *Rangifer tarandus groenlanicus* and diamond mine case study. *Wildlife Biology*, 18, 164-179.

Brown, Ross D., Philip W. Mote, 2009: The Response of Northern Hemisphere Snow Cover to a Changing Climate*. *J. Climate*, 22, 2124–2145.

Brzozowski, Jodi-Anne, Andrea Taylor-Butts, Sara Johnson, 2006. *Victimization and Offending Among the Aboriginal Population in Canada*. Statistics Canada Catalogue no. 85-002-XIE, Vol. 26, No. 3

Bullock, A., Acreman, M., 2003. The role of wetlands in the hydrological cycle. *Hydrol. Earth Syst.* Sci. 7, 358 – 389.

Buse, S. & Smar L., 2007. *Geology of the Winisk Lake Area, Northwestern Ontario: A Fresh Look at a Granitoid and Gneissic Terrane*. Ontario Geological Survey Project Unit 07-004.

Buttle, J. M., Metcalfe, R. A., 2000. Boreal forest disturbance and streamflow response, northeastern Ontario. *Canadian Journal of Fisheries and Aquatics Science*. 2, 5-18.

Cadman, M. D., Sutherland, D. A., Beck, G. G., Lepage, D. & Couturier, A. R. (eds.), 2007. *Atlas of the Breeding Birds of Ontario, 2001-2005.* Bird Studies Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources, and Ontario Nature, Toronto. (online at: http://www.birdsontario.org/atlas/index.jsp)

Calvert, A. M., Taylor, P. D. & Walde, S., 2009. Cross-scale environmental influences on migratory stopover behaviour. *Global Change Biology* 15:744–759.

Canada, 1999. Canadian Environmental Protection Act. S.C. 1999, c. 33.

Canada, 2002. *Species at Risk Act*. S.C. 2002, c. 29

Canadian Centre for Climate Modelling and Analysis (CCCMA), 2013. Retrieved from: http://www.cccma.ec.gc.ca/data/crcm423/crcm423.shtml

Canadian Council of Ministers of the Environment (CCME), 1999. *Canadian Water Quality Guidelines for the Protection of Aquatic Life.* Retrieved from: http://st-ts.ccme.ca/. (accessed April 2013).

Canadian Council of Ministers of the Environment (CCME), 2001. *Canada-wide Standards for Dioxins and Furans.* Council of Ministers, Winnipeg, MB.

Canadian Council of Ministers of the Environment (CCME), 2002. *Canadian Environmental Quality Guidelines and Summary Table.* Retrieved from: http://www.ccme.ca/publications/ceqg_rcqe.html

Canadian Council of Ministers of the Environment (CCME), 2011. *Protocol Manual for Water Quality Sampling in Canada.* PN 1461. ISBN 978-1-896997-7 PDF.

Canadian Council of Ministers of the Environment (CCME), 2013. *Canadian Environmental Quality Guidelines and Summary Table*. Retrieved from: http://www.ccme.ca/publications/ceqg_rcqe.html

Canadian Environmental Assessment Act (CEAA), 1992; amended 2010.

Canadian Environmental Assessment Agency (CEA Agency), 1996. *Assessing Environmental Effects on Physical and Cultural Heritage Resources*

Canadian Environmental Assessment Agency (CEA Agency), 1998. *Operational Policy Statement for Addressing the "Need for", "Purpose of", "Alternatives to" and "Alternative Means" under the Canadian Environmental Assessment Act*

Canadian Environmental Assessment Agency (CEA Agency), 1999. *Cumulative Effects Assessment Practitioners Guide*. Prepared by: The Cumulative Effects Assessment Working Group and AXYS Environmental Consulting Ltd.

Canadian Environmental Assessment Agency (CEA Agency), 2003. *Procedural Guide. Incorporating Climate Change Considerations in Environmental Assessment: General Guidance for Practitioners*. Retrieved From: http://www.ceaa-acee.gc.ca/default.asp?lang=En&n=A41F45C5-1. (accessed February 10, 2012).

Canadian Environmental Assessment Agency (CEA Agency), 2004, Canada-Ontario Agreement on Environmental Assessment Cooperation, Ottawa, ON.

Canadian Environmental Assessment Agency (CEA Agency), 2006. *Glossary – Terms Commonly Used in Federal Environmental Assessments*. Her Majesty the Queen in Right of Canada, 2006. Catalogue No.: En106-58/2006E-PDF. ISBN: 0-662-42711-4. Retrieved from: www.ceaa.gc.ca/012/newguidance_e.htm. (accessed August 7, 2013).

Canadian Environmental Assessment Agency (CEA Agency), 2007. *Operational Policy Statement: Addressing Cumulative Environmental Effects under the Canadian Environmental Assessment Act*.

Canadian Environmental Assessment Agency (CEA Agency), 2011. *Operational Policy Statement. Follow-up Programs under the Canadian Environmental Assessment Act*.

Canadian Environmental Assessment Agency (CEA Agency), 2012. Guidelines for the Preparation of an Environmental Impact Statement Pursuant to the Canadian Environmental Assessment Act for the Eagle's Nest Project.

Canadian Environmental Assessment Agency (CEA Agency), 2013. *Addendum to the Environmental Impact Statement (EIS) Guidelines.* CEAR # 62925.

Canadian Mental Health Association (CMHA Ontario), 2009. *Rural and Northern Community Issues in Mental Health*. Retrieved from: http://ontario.cmha.ca/public_policy/rural-and-northern-community-issues-in-mental-health/#.UpjXkmeA0y9. (accessed November 29, 2013).

Canadian System of Soil Classification (CSSC), 1998. *The Canadian System of Soil Classification, 3rd Edition.* Agriculture and Agri-Food Canada. Ottawa: NRC Research Press.

Carlson, M., & Chetkiewicz, C., 2013. *A Fork in the Road: Future Development in Ontario's Far North.* Report, Canadian Boreal Initiative, Wildlife Conservation Society Canada, Toronto, Ontario.

Chapin, F. S., Sturm, M., Serreze, M. C., et al., 2005. Role of land-surface changes in Arctic summer warming. *Science*. 310. 657-660.

City of Thunder Bay, Thunder Bay Community Economic Development Commission and the Fort William First Nation, 2013. *Mining Readiness Strategy: An Integrated Regional Economic Development Plan - Final Report, April 2013*.

Confederation College, 2013. *Ring of Fire Aboriginal Training Alliance Announced Today*. Retrieved from: http://www.confederationc.on.ca/node/10413. (accessed on June 26, 2013).

Contact North. 2013. *About us*. Retrieved from: http://studyonline.ca/about-us (accessed November 30, 2013).

Cornell Laboratory of Ornithology, 2013. *The Birds of North America Online.* Retrieved from: http://bna.birds.cornell.edu/bna/. (accessed September 25, 2013).

COSEWIC, 2007a. COSEWIC assessment and status report on the Common Nighthawk (Chordeiles minor) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC, 2007b. COSEWIC assessment and status report on the Olive-sided Flycatcher (Contopus Cooperi) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC, 2008. COSEWIC assessment and status report on the Canada Warbler (Wilsonia Canadensis) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC, 2010. COSEWIC assessment and status report on the Peregrine Falcon (Falco peregrinus) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

Couturier, A. R., 2011. *Geospatial Modeling of Abundance with Breeding Bird Atlas Data.* In J. V. Wells (editor). Boreal birds of North America: a hemispheric view of their conservation links and significance. Studies in Avian Biology (no. 41), University of California Press, Berkeley, CA. pp 65-71.

Cox, Bernie. 2012. Personal communication.

Crewe, T. L., McCracken, J. D., Taylor, P. D., Lepage, D. & Heagy, A. E., 2008. *The Canadian Migration Monitoring Network - Réseau canadien de surveillance des migrations: Ten-year*

Report on Monitoring Landbird Population Change. CMMN-RCSM Scientific Technical Report #1. Produced by Bird Studies Canada, Port Rowan, Ontario.

Cunderlik, J. M., Ouarda, T. B. M. J., 2009. Trends in the timing and magnitude of floods in Canada, *Journal of Hydrology.* 375, 471–480.

Dalerum, F., Boutin, S. & Dunford, J. S. 2007. Wildfire effects on home range size and fidelity of boreal Caribou in Alberta, Canada. *Canadian Journal of Zoology*, 85, 26-32.

Dawson, N. 2010. (Thunder Bay Wildlife Assessment Unit, Ontario Ministry of Natural Resources.) Personal communication.

Dawson, F. N., Magoun, A. J., Bowman, J. & Ray, J. C., 2010. Wolverine, *Gulo gulo*, home range size and denning habitat in lowland boreal forest in Ontario, Canada. *Canadian Field-Naturalist*, 124, 139-144.

Ding, Y., Yang, D., Ye, B. and Wang, N., 2007. Effects of bias correction on precipitation trend over China. *J. Geophys. Res*. 112, D13116, doi:10.1029/2006JD007938

Dobbyn, J.S., 1994. *Atlas of the Mammals of Ontario*. Federation of Ontario Naturalists, Toronto.

Dungan, P. and Murphy, S., 2007. *Ontario Mining: A Partner in Prosperity-The Economic Impacts of a “Representative Mine” in Ontario*. Report for the Ontario Mining Association.

Dungan, P., & Murphy S., 2012. Mining: Dynamic and Dependable for Ontario’s Future – Final Report – December 2012. Prepared for the Ontario Mining Association.

Dyer, S. J., O`Neill, J. P., Wasel, S. M., & Boutin, S., 2002. Quanitfying barrier effects of roads and seismic lines on movements of female Woodland Caribou in northeastern Alberta. *Canadian Journal of Zoology*, 80, 839-845.

Earle, R.D., 2001. *Furbearer Winter Track Count Survey of 2000*. Michigan Department of Natural Resources. Wildlife Report No. 3331.

Energy Resources Conservation Board (ERCB), 2007. *Directive 38: Noise Control, February 2007, Revised Edition.* Calgary, Alberta.

Environment Canada (EC), 2002, *Sulphur in Diesel Fuel Regulations SOR/2002-254*, Ottawa, ON.

Environment Canada (EC), 2004. *Metal Mining Guidance Manual for Estimating Greenhouse Gas Emissions*, Greenhouse Gas Division, 2004.

Environment Canada (EC), 2011. Environmental Effects Monitoring Technical Guidance Document. National Environmental Effects Monitoring Office.

Environment Canada (EC) 2012a, Off-Road Compression-Ignition Engine Emission Regulations, Transportation Division Environment Canada, Ottawa, ON.

Environment Canada (EC), 2012a. Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal population, in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. xi + 138pp.

Environment Canada (EC), 2012c. Canada’s Emission Trends 2012, ISBN 978-1-100-21063-6, Ottawa, ON. Canada.

Environment Canada (EC), 2013a. Climate Normals 1971-2000, Meteorological Services of Canada, Ottawa, ON. Retrieved from: http://climate.weather.gc.ca/index_e.html.

Environment Canada (EC), 2013b. Daily Data Report for December 2013. Retrieved from: http://climate.weather.gc.ca/climateData/dailydata_e.html?StationID=10244. (accessed December 20, 2013).

Environment Canada (EC), 2013c. Pickle Lake Climate Normals. Retrieved from: http://climate.weather.gc.ca/climate_normals/results_e.html?stnID=3920&prov=&lang=e&dCode=5&dispBack=1&StationName=pickle_lake&SearchType=Contains&province=ALL&provBut=&month1=0&month2=12

Environment Canada (EC), 2013d. Retrieved from: Retrieved from: http://www.ec.gc.ca/ccmac-cccma/default.asp?lang=En&n=4A642EDE-1

Environment Canada (EC), 2013f. Greenhouse Gas Sources and Sinks in Canada (1990-2011), ISSN 1910-7064, Ottawa, ON. Canada.

Essery, R. and Pomeroy, J., 2004. Vegetation and topographic control of wind-blown snow distributions in distributed and aggregated simulations for an Arctic tundra basin. *Journal of Hydrometeorology*. 5. 735-744.

Eyles, N., 2002. *Ontario Rocks: Three Billion Years of Environmental Change*. Markham: Fitzhenry & Whiteside.

Eyles, N., 2006. The role of meltwater in glacial processes. *Sedimentary Geology*. 190. 257-268.

Fahrig, L. and T. Rytwinski. 2009. *Effects of roads on animal abundance: an empirical review and synthesis*. Ecology and Society 14:21. Available at: http://www.ecologyandsociety.org/vol14/iss1/art21/. Accessed: 22 June 2010

Financial Information Return (FIR), 2012. *FIR Data – By Municipality*. Retrieved from: http://csconramp.mah.gov.on.ca/fir/ViewFIR2012.htm (accessed November 30, 2013)

Findlay, S. F., Bourdage, J., 2000. Response time of wetland biodiversity to road construction on adjacent lands. *Conservation Biology.* 14. 86-94.

Fisheries and Oceans Canada (DFO), 2006. *The Lake Sturgeon (Southern Hudson Bay, James Bay) a Species at Risk in the North.* Retrieved from: http://www.dfo-mpo.gc.ca/species-especes/species-especes/sturgeon7-esturgeon-eng.htm.

Fisheries and Oceans Canada (DFO), 2013. *Regional Publications – Some Like It Warm, Others Like It Cool or Cold.* Retrieved from: http://www.qc.dfo-mpo.gc.ca/publications/habitat-poisson-fish-habitat/habitat-temperature-eng.html. (accessed May 23, 2013).

Fisheries and Oceans Canada (DFO), 2013. *About the Act.* Retrieved from: http://dfo-mpo.gc.ca/species-especes/faq/faq-eng.htm. Accessed on: December 11, 2013.

Forestry Civil Engineering, Scottish Natural Heritage (FCE), 2010. Floating Roads on Peat. A Report into Good Practice in Design, Construction and Use of Floating Roads on Peat. Inverness.

Freeze, A. R. & Cherry R. A., 1979. *Groundwater*. Englewood Cliffs. New Jersey: Prentice-Hall

GARD Guide, 2009. *Global Acid Rock Drainage Guide. International Network for Acid Prevention.* ICARD 8, Sweden. Chapter 5 - Prediction.

Geflan, A., N., Pomeroy, J. W., Kuchment, L., S., 2004. Modeling Forest Cover Influences on Snow Accumulation, Sublimation, and Melt. *Journal of Hydrometeorology.* Vol. 5. 785 - 803.

Gerich, N. United States Department of Agriculture Forestry Service. Working with Beavers. Retrieved from http://www.fs.fed.us/outernet/r2/psicc/leadville/Beaver-Document.pdf.

Golder Associates Ltd. (Golder), 2010a. *Technical Report and Resources Estimate.* McFaults Lake Project James Bay Lowlands, Ontario, Canada, April 23, 2010. Report Number 10 1117 0001.

Golder Associates Ltd. (Golder), 2010b. *Granodiorite Aggregate Potential - Geochemical Test Results for Noront Resources Ltd.* Project No. 10-1117-0045 (2000).

Golder Associates Ltd. (Golder), 2010c. *Granodiorite Aggregate Potential - Geochemical Test Results: Drillhole NOT-10-GT01for Noront Resources Ltd*. Project No. 10-1117-0045 (2000).

Golder Associates Ltd. (Golder), 2010d. *Geochemical Test Results - Granodiorite Waste Rock Samples - Noront Resources Ltd.* Project No. 10-1117-0045 (2000).

Golder Associates Ltd. (Golder), 2010e. *Geochemical Test Results - Granodiorite Waste Rock Samples - Noront Resources Ltd.* Project No. 10-1117-0045 (2000).

Golder Associates Ltd. (Golder), 2010f. *Geotechnical Investigation of the Eagle's Nest Deposit. Draft Factual Report*. Ref. No. 10-1117-0045 (3000).

Golder Associates Ltd. (Golder), 2011. *Recovery Strategy for Lake Sturgeon (Acipenser fulvescens) – Northwestern Ontario, Great Lakes-Upper St. Lawrence River and Southern Hudson Bay-James Bay populations in Ontario.* Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. vii + 77 pp.

Golder Associates, 2012. *Resource Selection Functions for Forest-Dwelling Woodland Caribou in the Far North of Ontario*. Saskatoon, Sask. Report No. 10-1118-0015/2000/2700.

Government of Alberta, 2009. *Best Practice for Building and Working Safely on Ice Covers in Alberta*. ISBN 978-0-7785-8738-5.

Government of Canada, 2003. A Framework for the Application of Precaution in Science-based Decision Making About Risk. ISBN 0-662-67486-3. Retrieved from: http://www.pco-bcp.gc.ca/index.asp?lang=eng&page=information&sub=publications&doc=precaution/precaution-eng.htm.

Government of Canada and the Government of the United States. 1995. *Protocol Between the Government of Canada and the Government of the United States of America Amending the 1916 Convention Between the United Kingdom and the United States of America for the Protection of Migratory Birds in Canada and the United States*. **E101589 - CTS 1999 No. 34**

Government of Canada (NWPA), 1985. Navigable Waters Protection Act. Last Amended March 12, 2009.

Government of Canada (TC), 2010. Minor Waters User Guide. TP14838 (03/2010).

Government of Canada (TC), 2009. Minor Works and Waters Order – Navigable Waters Protection Act Order. April 22, 2009

Government of Canada, Ministry of Finance (CMF), 2013. Jobs, Growth and Long-term Prosperity: Economic Action Plan 2013. Retrieved from: http://www.budget.gc.ca/2013/doc/plan/budget2013-eng.pdf. (accessed on June 18, 2013).

Government of Ontario, 2012a. Archived Bulletin: Ontario and Marten Falls First Nation Sign Memorandum of Understanding - McGuinty Government and Marten Falls First Nation Support Responsible Development in the Ring of Fire. Dated September 7, 2012. Retrieved from: http://news.ontario.ca/mndmf/en/2012/09/ontario-and-marten-falls-first-nation-sign-memorandum-of-understanding.html. (accessed on June 19, 2013).

Government of Ontario, 2012b. Archived Bulletin: Ontario and Webequie First Nation Sign Memorandum of Co-operation - McGuinty Government Will Develop Ring of Fire in Strong Partnership with Far North First Nation. Dated June 14, 2012. Retrieved from: http://news.ontario.ca/mndmf/en/2012/06/ontario-and-webequie-first-nation-sign-memorandum-of-co-operation.html. (accessed on June 19, 2013).

Government of Ontario, 2012c. Archived Bulletin: Thousands of Jobs Coming To Northern Ontario - McGuinty Government Supports Responsible Ring Of Fire Mining Development. Dated May 9, 2012. Retrieved from: http://news.ontario.ca/mndmf/en/2012/05/thousands-of-jobs-coming-to-northern-ontario.html. (accessed on June 19, 2013).

Government of Ontario, Ministry of Northern Development and Mines (MNDM), 2013. Exploration and Development in the Ring of Fire, Last modified February 19, 2013. Retrieved from: http://www.mndm.gov.on.ca/en/ring-fire-secretariat/exploration-and-development#simple-table-of-contents-1. (accessed on June 17, 2013).

Government of Ontario, Ministry of Finance (OMF), 2013. A Prosperous & Fair Ontario: 2013 Ontario Budget. Retrieved from: http://www.fin.gov.on.ca/en/budget/ontariobudgets/2013/papers_all.pdf. (accessed on June 18, 2013).

Government of the Northwest Territories, Department of Transportation (GNWT), 2007. *A Field Guide to Ice Construction Safety*.

Haber, E., 1997. Guide to Monitoring Exotic and Invasive Plants. *Ecological Monitoring and Assessment Network*. Environment Canada, Ottawa.

Habib, L., E.M. Bayne, and S. Boutin. 2007. *Chronic industrial noise affects pairing success and age structure of ovenbirds Seiurus aurocapilla*. Journal of Applied Ecology 44: 176-184.

Harper, K. A., Macdonald, E., Burton P. J., et al., 2005. Edge Influence on Forest Structure and Composition in Fragmented Landscapes. *Conservation Biology.* 19. 768-782.

Harrington F.H. and Veitch, A.M. 1992. *Calving success of woodland caribou exposed to low-level jet fighter overflights*. Arctic. vol:45 iss:3 pg:213 -218.

Hawley, V.D. & Newby, F.E., 1957. Marten home ranges and population fluctuations. *Journal of Mammology*, 38:174-184.

Health Canada, 2012. *Guidelines for Canadian Drinking Water Quality*. Retrieved from: http://www.hc-sc.gc.ca. (accessed June 10, 2013).

Health Canada, 2013. *Guidelines for Toluene, Ethylbenzene and Xylenes*. Retrieved from: http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/toluene/index-eng.php. (accessed September 3, 2013).

Hedstrom, N.R. and Pomeroy, J. W., 1998. *Measurements and modelling of snow interception in the boreal forest.* Hydrological Processes, Vol 12. 1611-1625.

Henson, B. L, Wester, M. C, Crins, Uhlig, W. J, P. & Gray, P.A., In Press. *The Ecosystems of Ontario, Part II: Ecodistricts.* Ontario Ministry of Natural Resources, Peterborough, Ontario. Inventory, Monitoring, and Assessment, SIB TER IMA TR-XX.

Henson, B. L, Wester, M. C, Crins, Uhlig, W. J, P. & Gray, P.A., In Press. *The Ecosystems of Ontario, Part II: Ecodistricts.* Ontario Ministry of Natural Resources, Peterborough, Ontario. Inventory, Monitoring, and Assessment, SIB TER IMA TR-XX.

Holm, E., Mandrak, N.E., and Burridge, M.E., 2010. *The ROM field guide to freshwater fishes of Ontario*. Friesens Printers, Altona, Manitoba.

Hvorslev, M.J., 1951. *Time Lag and Soil Permeability in Ground-Water Observations*. Bull. No. 36. Waterways Experiment Station Corporations of Engineers, U.S. Army. Vicksburg, Mississippi. 50 p.

International Standards Organization (ISO), 1996. *Acoustics – Attenuation of sound during propagation outdoors.* Standard 9613-2:1996.

IPCC. 1996. Intergovernmental Policies for Climate Change - Technologies, policies and measures for mitigating climate change, IPCC Technical Paper 1. R. T. Watson, M. C. Zinyowera, and R. H. Moss, ed. Geneva: Intergovernmental Panel on Climate Change.

International Panel on Climate Change (IPCC), 2007. C*limate Change 2007: Synthesis Report*. Retrieved from: http://www.ipcc.ch

Jäger, H., Kowarik, I., Tye, A., 2009. Destruction without extinction: long-term impacts of an invasive tree species on Galápagos highland vegetation. *Journal of Ecology.* 97: 1252-1263

James, A. R. C., 1999. *Effects of industrial development on the predator-prey relationship between wolves and Caribou in northeast Alberta*. Ph.D. Dissertation, University of Alberta.

James, A. R. C. & Stuart-Smith, A. K. 2000. Distribution of caribou and wolves in relation to linear corridors. *The Journal of Wildlife Management*, 64(1), 154-159.

James Bay Winter Road., 2013. *James Bay Winter Road, Operated and Managed by Kimesskanemenow Corporation.* Retrieved from: www.jamesbaywinterroad.com. (accessed July 17, 2013).

Joly, K., Dale, B. W., Collins, W. B. & Adams, L. G., 2003. Winter habitat use by female Caribou in relation to wildland fires in interior Alaska. *Canadian Journal of Zoology*, 81, 1192-1201.

Kendall, M. G., 1975. *Rank Correlation Methods, 4th ed*. Charles Griffin: London.

King, J. C., Pomeroy, J. W., Gray, D. M., Fierz, C., Fohn, P. M. B., Harding, R. J., Jordan, R. E., Martin, E., and Pluss, C., 2008. *Snow – Atmosphere, space, energy and mass balance*. In Snow and Climate: Physical Processes, Surface Energy Exchange and Modeling. R. L. Armstrong, R. L. and E. Brun ed. Cambridge: Cambridge University Press. 70 - 124.

Knight Piésold Ltd. (KP), 2010. Memorandum to: Mark Baker, Noront Resources Ltd. Re: Field Memo – Fall 2010 Fisheries Baseline Study. October 12. North Bay, Ontario. NB10-00497.

Knight Piésold Ltd. (KP), 2011a. *Eagle's Nest Project – Project Description*. North Bay, Ontario. Ref. No. NB102-390/1-2.

Knight Piésold Ltd. (KP), 2011b. Hydrogeology Summary Report. North Bay, Ontario. Ref. No. NB102-390/1-5 Rev 0.

Knight Piésold Ltd. (KP), 2011c. Memorandum to: Mark Baker, Noront Resources Ltd. Re: 2011 Baseline Aquatic Studies along the Proposed Access Corridor, Eagle's Nest Mine Site, Webequie Junction and the Savant Lake Concentrate Rail Facility. October 21. North Bay, Ontario. NB11-00482.

Knight Piésold Ltd. (KP), 2012a. Memorandum to: Mark Baker, Noront Resources Ltd. Re: Summer 2012 Baseline Fisheries Assessment - Muketei River. August 17. North Bay, Ontario. Ref No. NB12-00346.

Knight Piesold Ltd. (KP), 2012b. Memorandum: *Webequie Junction to Esker Camp – All Season Road – Preliminary Comments.* North Bay, Ontario. Ref. No. NB12-00050, dated March 15, 2012.

Knight Piésold Ltd. (KP), 2012c. *Noront Resources Ltd. – Eagle's Nest Project – Terms of Reference*. NB102-390/1-7, Rev. 1.

Knight Piésold Ltd. (KP), 2012d. Savant Lake Hydrogeological SI Report. North Bay, Ontario. Ref. No. NB102-390/1-11 Rev 0.

Knight Piésold Ltd. (KP), 2012d. Webequie Junction Hydrogeology Field Program Summary. North Bay, Ontario. Ref. No. NB102-390/1-10 Rev 0.

Knight Piésold Ltd. (KP), 2013a. 2012 Monitoring Well Installation Program. North Bay, Ontario. Ref. No. NB1-2-390/1-42 Rev 0.

Knight Piesold Ltd. (KP), 2013b. *Baseline Geochemistry Report.* North Bay, Ontario. Ref. No. NB102-390/1-17.

Knight Piésold Ltd. (KP), 2013c. *Baseline Hydrology and Climate Report*. North Bay, Ontario. Ref. No. NB102-390/1-18.

Knight Piesold Ltd. (KP), 2013d. Vegetation Baseline Studies, Eagle's Nest Project. Knight Piesold Ltd., North Bay, Ontario.

Knight Piésold Ltd. (KP), 2013e. 2012 Site Investigation of Proposed Portal and Decline Areas. North Bay, Ontario. Ref. No. NB102-390/1-41.

Knight Piésold Ltd. (KP), 2013f. 2012 Site Infrastructure Investigastion Summary. North Bay, Ontario. Ref. No. NB102-390/1-33.

Konze, K. & McLaren, M., 1997. *Wildlife Monitoring Programs and Inventory Techniques for Ontario*. Technical Manual TM-009, Ontario Ministry of Natural Resources, Northeast Science and Technology Unit, Timmins, Ontario.

Krebs, J., E. Lofroth, J. Copeland, V. Banci, D. Cooley, H. Golden, A. Magoun, R. Mulders and B. Shults, 2004. Synthesis of survival rates and causes of mortality in North American Wolverine. *Journal of Wildlife Management*, 68, 493-502.

Krebs, J., Lofroth, E.,C. & Parfitt, I., 2007. Multiscale habitat use by Wolverine in British Columbia, Canada. *Journal of Wildlife Management*, 71, 2180-2192.

Kunkel, K. E., & Pletscher, D. H. 2000. Habitat factors affecting vulnerability of moose to predation by wolves in southeastern British Columbia. Canadian Journal of Zoology, 78(1), 150-157.

Kutas, B. F., 2004. *Forest fires, Woodland Caribou and land use policies in northwestern Ontario* (Rangifer tarandus). Masters Thesis, Wilfrid Laurier University, Waterloo, Ontario.Jones, N.E., and Yunker, G., 2009. *Riverine Index Netting Manual of Instructions V.2*. Ontario Ministry of Natural Resources, River and Stream Ecology Laboratory. 36 pp.

Kyle, C. J. & Strobeck, C., 2002. Connectivity of peripheral and core populations of North American Wolverine. *Journal of Mammalogy*, 83, 1141-1150.

Landriault, L.J., Obbard, M.E. and Rettie, W.J. (2000). *Nuisance Black Bears and What to do With Them*. NEST Technical Note TN-017, Ontario Ministry of Natural Resources, December.

Laurian, C., Dussault, C., Ouellet, J.-P., Courtois, R., Poulin, M., Breton, L. 2008. Behavior of moose relative to a road network. Journal of Wildlife Management 72(7): 1550-1557

Lichvar, R. W., Melvin, N. C., Butterwick, M. L., & Kirchner, W. N., 2012. *National Wetland Plant List Indicator Rating Definitions*. Wetland Regulatory Assistance Program, Engineer Research and Development Center, U.S. Army Corps of Engineers. Report ERDC/CRREL TN-12-1, Washington, D.C.

Liston, G. E. and Sturm ,M., 2002. Winter Precipitation Patterns in Arctic Alaska Determined from a Blowing-Snow Model and Snow-Depth Observations. *Journal of Hydrometeorology*. 3: 646-659.

Litvinov, A., 2013. *State of Water Quality of Attawapiskat River Prior to Development "Ring of Fire*". Prepared for the Mushkegowuk Environmental Resources Centre (MERC).

Lugeon, M., 1933. *Barrage et Géologie*. Dunod. Paris

Lundberg, A., Yuichiro, N., Thunehed, H. and Halldin, S., 2004. Snow Accumulation in Forests from Ground and Remote Sensing Data. *Hydrological Processes*. 18. 1941-1955.

Mack, R. N., Simberloff, D., Lonsdale, M. D., Evans, H., Clout, H. M., Bazzaz., F., 2000. Biotic invasions: causes, epidemiology, global consequences, and control. *Ecological Applications.* 10. 689–710.

Manifold Data Mining Inc., 2013. *SuperDemographics for Township of Pickle Lake, Township of Ignace and Municipality of Greenstone*.

Mann, H. B., 1945. Non-parametric test against trend. *Econometrica*. 13, 245-259.

Mahoney, S. P., Mawhinney, K., McCarthy, C., Anions, D. & Taylor, S., 2001. Caribou reactions to provocations by snowmachines in Newfoundland. *Rangifer*, 21, 35-43.

Marshall T.R., and Jones, N.E., 2011. *Aquatic ecosystems of the far north of Ontario: state of knowledge.* Queen's Printer for Ontario. ISBN 978-1-4435-6512-7 (PDF).

May, R., 2007. Spatial Ecology of Wolverine in Scandinavia. Ph.D. Thesis, Norweigian University of Science and Technology, Trondheim, Norway.

McCafferty W.P., 1998. *Aquatic Entomology The Fisherman's and Ecologists' Illustrated Guide to Insects and Their Relatives*. Jones and Bartlett Publishers. 448 pp.

Mekis, É and Vincent, L.A., 2011: An overview of the second generation adjusted daily precipitation dataset for trend analysis in Canada. *Atmosphere-Ocean*, 49 (2), 163-177.

Mekis, É. and Hogg, W.D., 1999. Rehabilitation and analysis of Canadian daily precipitation time series. *Atmosphere-Ocean*, 37 (1): 53–85.

MEND, 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geological Materials. MEND Report 1.20.1.

Metal Mining Effluent Regulations, Canada (MMER) 2002. P.C. 2002-987, 10 December, 2012, SOR/2002-222

Metal Mining Effluent Regulations (MMER), 2012. P.C. 2002-987, 10 December, 2012, SOR/2002-222.

Metcalfe, J.R., Routledge, B. and Devine, K., 1997. Rainfall measurement in Canada: Changing observational methods and archive adjustment procedures. J. Climate, 10: 92–101.

Metsaranta R.T., 2010. *Project Unit 10-004: McFaulds Lake Area Regional Compilation and Bedrock Geology Mapping Project.* In Summary of Field Work and Other Activities 2010, Ontario Geological Survey, Open File Report 6260, p. 17-1 to 17-5.

Metsaranta, R. T. & Houlé M. G., 2012. *Progress on the McFaulds Lake ("Ring of Fire") Region Data Compilation and Bedrock Geology Mapping Project*. Ontario Geological Survey (OGS) Project Unit 10-004.

Metsaranta, R.T., and Houlé, M.G., 2011. *Project Unit 10-004: McFaulds Lake Area Regional Compilation and Bedrock Mapping Project Update*. In Summary of Field Work and Other Activities 2011, Ontario Geological Survey, Open File Report 6270, p. 12-1 to 12-12.

Micon International Limited (Micon), 2012. Technical Report on the Feasibility Study, McFauld's Lake Property, Eagle's Nest Project. James Bay Lowlands, Ontario, Canada. October 2012.

Mine Environment Neutral Drainage Program (MEND), 2006. *Paste Backfill Geochemistry - Environmental Effects of Leaching and Weathering*. MEND Report 10.2.

Mining Association of Canada (MAC), 2004. Towards Sustainable Mining – Guideline Principles – December 2004. Retrieved from: http://www.mining.ca/www/media_lib/TSM_Documents/principleseng.pdf. (accessed June 25, 2013).

Mining Association of Canada (MAC), 2012. *F & F 2012: Facts and Figures of the Canadian Mining Industry*. Retrieved from: http://www.mining.ca/www/media_lib/MAC_Documents/Publications/2013/Facts%20and%20Figures/FactsandFigures2012Eng.pdf.

Mining Industry Human Resources Council and Northwest Training and Adjustment Board, 2012. *2013 Kenora and Rainy River Districts Mining Hiring Requirements Forecasts*.

Mining Industry Human Resources Council, 2011. *Canadian Mining Industry Employment and Hiring Forecasts - A Mining Industry Workforce Information Network Report.* Retrieved from: http://www.mihr.ca/en/publications/resources/Employment_HiringForecasts2011_FINALAug4_ENG.pdf

Ministry of Natural Resources (MNR), 1990. *Environmental Guidelines for Access Roads and Water Crossings*. Queen's Printer for Ontario.

Ministry of Natural Resources (MNR), 2003. *A Class EA for MNR Resource Stewardship and Facility Development Projects*. Policy and Planning Coordination Branch. ISBN 0-7794-3846-9.

Ministry of Natural Resources (MNR), 2008. *Forest Management Plan Summary*. Caribou Forest 2008 – 2018. Forest Management Plan.

Ministry of Natural Resources (MNR), 2009. *Forest Management Plan Summary*. 2009-19 Forest Management Plan for the English River Forest.

Ministry of Natural Resources (MNR), 2013a. *Parks and Protected Areas – Approved Management Direction for Ontario's Provincial Parks*. Retrieved from: http://www.mnr.gov.on.ca/en/Business/Parks/2ColumnSubPage/STDU_138198.html (accessed November 15, 2013).

Ministry of Natural Resources (MNR), 2013b. *Land Use and Environmental Planning – The Crown Land Use Policy Atlas.* Retrieved from: http://www.giscoeapp.lrc.gov.on.ca/web/MNR/NHLUPS/CLUPA/Viewer/Viewer.html. (accessed November 1, 2013).

Ministry of Northern Development and Mines (MNDM), 2012. *Single Master Gravity and Aeromagnetic Data for Ontario.* Date modified: July 31, 2013. Retrieved from: http://www.mci.mndm.gov.on.ca/mines/data/google/web_kml/magnetics.kml. (accessed August 1, 2013).

Ministry of the Environment (MOE), 1994. *Procedure F-5-1, Determination of Treatment Requirements for Municipal and Private Sewage Treatment Works Discharging to Surface Waters*. Legislative Authority, *Water Resources Act RSO 1990* Section 53.

Ministry of the Environment (MOE), 1995. Publication NPC-232 - Sound Level Limits for Stationary Sources in Class 3 Areas (Rural). ISBN 0-7778-4921-6. Toronto, Ontario: Queen's Printer for Ontario.

Ministry of the Environment (MOE), 1999. Water Management Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of Environment and Energy. July 1994, Reprinted February 1999. ISBN 0-7778-8473-9. PIBS 3303E.

Ministry of the Environment (MOE), 2008. Design Guidelines for Sewage Treatment Works. PIBS 6879.

Ministry of the Environment (MOE), 2011. Guide to Environmental Assessment Requirements for Electricity Projects. Legislative Authority, *Environmental Assessment Act* (O. Reg. 116/01). Revised January 2011. PIBS 4021e01.

Ministry of the Environment (MOE), 2012a. Noront Eagle's Nest Multi-metal Mine – Voluntary Agreement. Last Updated: January 8, 2012. Retrieved from: http://www.ene.gov.on.ca/environment/en/industry/assessment_and_approvals/environmental_assessments/projects/STDPROD_089608.html?page=2. (accessed June 15, 2013).

Ministry of the Environment (MOE), 2012b. Ontario's Ambient Air Quality Criteria, April 2012. Retrieved from: http://www.ene.gov.on.ca/environment/en/resources/STDPROD_096586.html. (accessed May 28, 2013).

Ministry of the Environment (MOE), 2013. Eagle's Nest Project Terms of Reference.

Ministry of the Environment and Energy (MOEE), 1994. *Policies, Guidelines, Provincial Water Quality Objectives. Queens Printer for Ontario.* Reprinted February 1999.

Ministry of the Environment and Energy (MOEE), 1996. *Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario, Version 1.1*. Standards Development Branch.

Ministry of the Environment, British Columbia (BCMOE), 2011. *Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators.* Version 1.

Ministry of Training, Colleges and Universities, 2013. Literacy and Basic Skills Snapshot – Fiscal Year 2012-13 – As of March 31, 2013 – Kenora.

Ministry of Transportation (MTO), 2012. *Ontario Provincial Highway Traffic Volumes on Demand – Provincial Highways Traffic Volumes 2010 AADT Only*. Retrieved from: http://www.raqsa.mto.gov.on.ca/techpubs/TrafficVolumes.nsf/tvweb (accessed November 6, 2013).

Mitchell, C.P.J., Branfireun B.A. and Kolka, R.K., 2007. Spatial Characteristics of Net Methylmercury Production Hot Spots in Peatlands. *Environmental Science and Technology*. Vol. 42, No. 4.

Mungall, J.E., Harvey, J.D., Balch, S.J, Azar, B., Atkinson, J., and Hamilton, M.A., 2010. *Eagle's Nest: a magmatic Ni-sulfide deposit in the James Bay Lowlands, Ontario, Canada*. In The challenge of finding new mineral resources: global metallogeny, innovative exploration, and new discoveries. Volume II: Zinc-lead, nickel-copper-PGE, and uranium, Society of Economic Geologists, Special Publication 15, p.539-557.

Moffat, S. (2012). Thesis University of Guelph. Time to Event Modelling: Wolf Search Efficiency in Northern Ontario.

Music, B., and Caya, D., 2007. Evaluation of the Hydrological Cycle over the Mississippi River Basin as Simulated by the Canadian Regional Climate Model (CRCM). *J. Hydromet.*, 8(5), 969-988.

National Aboriginal Health Organization (NAHO), 2011. *Addressing Mental Illness.* Retrieved from: http://www.naho.ca/documents/naho/english/factSheets/mental_Health.pdf. (accessed November 30, 2013).

Natural Resources Canada (NRC), 2007. Aboriginal Participation in Mining – Information Bulletin. Available at: https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/mineralsmetals/pdf/mms-smm/abor-auto/pdf/mus-07-eng.pdf. Accessed on December 18, 2013.

Natural Resources Canada (NRCan), 2013. *Atlas of Canada. 6th ed. Earth Sciences Sector*. Ottawa, Ontario.

Nellemann, C., Jørdhoy, P., Støen, O-G., & Strand, O., 2000. Cumulative impacts of tourist resorts on wild reindeer (*Rangifer tarandus tarandus*) during winter. *Arctic*, 53, 9-17.

Nelleman, C., Vistnes, I., Jørdhoy, P., Støen, O-G., Kaltenborn, B.P., Hanssen, F. & Helgensen, R., 2010. Effects of Recreational Cabins, Trails and Their Removal for Restoration of Reindeer Winter Ranges. *Restoration Ecology*, 18, 873-881.

Nielsen, S.E., Bayne, E.M., Schieck, J., Herbers, J., and Boutin, S., 2007. A new method to estimate species and biodiversity intactness using empirically derived reference conditions. *Biological Conservation* 137: 403-414.

Nishnawbe Aski Nation (NAN), 2012. Undated. *Key Considerations for Resource Development in NAN Territory Focusing on Mining – A Discussion Paper.* Prepared by Deputy Grand Chief Les Louttit. Retrieved from: http://www.nan.on.ca/upload/documents/ecdev-mining-discussion-paper.pdf. (accessed on December 3, 2013).

Nishnawbe-Aski Police Service (NAPS), 2012. *Annual Report 2011-2012*. Retrieved from: http://www.naps.ca/media/NAPS_2011_2012_Annual_Report.pdf. (accessed November 30, 2013).

Noront Resources Ltd., 2013. Eagle's Nest and Blackbird Reserve and Resource – March 2011. Retrieved from: http://www.norontresources.com/?investors#resources (accessed June 19, 2013).

North Superior Workforce Planning Board and Mining Industry Human Resources Council, 2012. *Custom Labour Market Report - Thunder Bay District*.

North Superior Workforce Planning Board (NSWPB) and Mining Industry Human Resources Council (MiHR), 2013. *Addendum – Custom Labour Market Reprot – Thunder Bay District Mining Industry*.

North West LHIN, 2012. *Population Health Profile.* Retrieved from: http://www.nwlhin.on.ca/uploadedFiles/Home_Page/Report_and_Publications/Population%20Report%202012%20English.pdf. (accessed November 30, 2013).

Northwest Training and Adjustment Board (NTAB), 2013. *Local Labour Market Plan Report: Kenora and Rainy River Districts*.

Northwestern Health Unit, 2013. *Sexually Transmitted Infections*. Retrieved from: http://www.nwhu.on.ca/programs/health-protection-stis.php (accessed November 30, 2013).

Ontario, 1990a. *Environmental Protection Act*. R.S.O. 1990, Chapter E.19.

Ontario. 1990b. *Mining Act*. R.S.O. 1990, Chapter M.14.

Ontario, 1990c. *Occupational Health and Safety Act*. R.S.O. 1990, Chapter O.1.

Ontario, 1990d. *Ontario Heritage Act.* R.S.O. 1990, Chapter O.18

Ontario, 2010. Far North Act, 2010. S.O. 2010, Chapter 18.

Ontario Geological Survey (OGS), 1997. *Quaternary Geology, Seamless Coverage of the Province of Ontario*. Data Set 14.

Ontario Geological Survey (OGS), 2006. *1:250,000 Scale Bedrock Geology of Ontario*. Ontario Geological Survey, Miscellaneous. Release - Data 126 - Revised

Ontario Geological Survey (OGS), 2013. *Surficial Geology of the Lansdowne House Area Northeast*. By P.J. Barnett, K.H. Yeung and J.D. McCallum. Scale 1:100 000.

Ontario Mining Association (OMA). 2012. *De Beers Canada Victor Mine Continues to Add Sparkle to Ontario`s Economy.* Retrieved From: http://www.oma.on.ca/en/News/index.aspx?newsId=d67198fd-61e3-498b-9341-9bc244238a9a. Dated July 5, 2012. (Accessed on December 19, 2013).

Ontario Ministry of the Environment (MOE), 2006. *Ontario Drinking Water Standards, Objectives and Guidelines*. June 2003. Revised June 2006.

Ontario Ministry of Environment (MOE), 2010a. *Guideline A-7: Air Pollution Control, Design and Operation Guidelines for Municipal Waste Thermal Treatment Facilities.*

Ontario Ministry of the Environment (MOE), 2010b. *Incinerator Guideline*. Environmental Protection Act Guideline A-7 R.R.O. 1990, Regulation 347

Ontario Ministry of Environment (MOE), 2009. *Air Dispersion Modelling Guide for Ontario, Version 2.0*. Toronto, ON.

Ontario Ministry of Environment (MOE), 2012. *Ontario's Ambient Air Quality Criteria*, Toronto, ON.

Ontario Ministry of Environment and Energy (OMEE), 1996. *Guidance on Sampling and Analytical Methods for Sue at Contaminated Sites in Ontario*. Standards Development Branch. Version 1.1.

Ontario Ministry of Environment and Energy (OMOEE), 1994. *Deriving receiving-water based, point-source effluent requirements for Ontario waters*. PROCEDURE B-1-5, PIBS# 3302, Queens Printer, Ontario.

Ontario Ministry of Natural Resources (MNR), 2006. *Guiding Principles on Rehabilitation – General*. Aggregate and Petroleum Resources. Policy No: A.R. 6.00.00.

Ontario Ministry of Natural Resources (MNR), 2009a. The Ecosystems of Ontario, Part 1: Ecozones and Ecoregions. Science and Information Branch. Technical Report SIB TER IMA TR-01.

Ontario Ministry of Natural Resources (MNR), 2009b. *Backgrounder on Black Bears in Ontario*.

Ontario Ministry of Natural Resources (MNR), 2012. INVASIVE SPECIES

Ontario Ministry of Natural Resources (MNR), 2013. *Moose Resource Report, Wildlife Management* Unit *01D*. Queen's Printer for Ontario.

Ontario Ministry of Natural Resources (OMNR), 1988. *Timber Management Guidelines for the Protection of Fish Habitat.* Ontario Ministry of Natural Resources, Toronto, Ontario.

Ontario Ministry of Natural Resources (OMNR), 1991. *Code of Practice for Timber Management Operations in Riparian Areas.* Ontario Ministry of Natural Resources, Toronto, Ontario.

Ontario Ministry of Natural Resources (OMNR), 2000. *Significant Wildlife Habitat Technical Guide*. Ontario Ministry of Natural Resources, Fish and Wildlife Branch, Wildlife Section, Peterborough, Ontario.

Ontario Ministry of Natural Resources (OMNR), 2013. *Winter observations of Wolverine (2003-2012) in Ontario`s Far North*. Data obtained from the Ontario Ministry of Natural Resources, Peterborough, Ontario.

Ontario Ministry of Natural Resources (OMNR), 2009. *Woodland Caribou Conservation Plan.*

Ontario Ministry of Natural Resources (OMNR), 2012a. *Woodland Caribou Probability of Occurrence in Ontario's Far North*. Data obtained from the Ontario Ministry of Natural Resources, Northwest Science and Information, Thunder Bay, Ontario.

Ontario Ministry of Natural Resources (OMNR), 2012b. *Woodland Caribou Nursery Areas in Ontario's Far North*. Data obtained from the Ontario Ministry of Natural Resources, Northwest Science and Information, Thunder Bay, Ontario.

Ontario Ministry of Natural Resources (OMNR), 2012c. Ontario Invasive Species Strategic Plan. Toronto: Queen`s Printer for Ontario. 55 pp.

Ontario Ministry of Natural Resources (OMNR), 2013. *Ministry of Natural Resources Species at Risk List*. Retrieved from: http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/MNR SAR LK STRGN EN.html

Ontario Parks, 2002. *Otoskwin – Attawapiskat River – Park Management Plan*. Retrieved from: http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@parks/documents/document/mnr_bpp0204.pdf (accessed December 10, 2013)

Ontario Power Authority (OPA), 2012. Technical Report for the Connection of Remote First Nation Communities in Northwestern Ontario. Prepared by the OPA for the Northwest Ontario First Nation Transmission Planning Committee. Undated. Retrieved from: http://www.powerauthority.on.ca/sites/default/files/planning/2012-Draft-Remote-Community-Connection-Plan.pdf. (accessed on December 3, 2013).

Ontario Power Authority (OPA), 2013a. Retrieved from: Power System Planning – Northwestern Ontario. Retrieved from: http://www.powerauthority.on.ca/power-planning/regional-planning/northwest-ontario#Area 5. (accessed on December 3, 2013).

Ontario Power Authority (OPA), 2013b. Presentation: Discussion on Remote Community Connection Concepts. Retrieved from: http://www.nan.on.ca/upload/documents/energy2012-pr-tonneguzzo----remote-connection-2012-update-final.pdf. Presentation dated February 1, 2013. (accessed on December 3, 2013).

Ontario Wolverine Recovery Team (OWRT), 2011. *DRAFT Recovery Strategy for the Wolverine* (Gulo gulo) *in Ontario*. Ontario Recovery Strategy Series, prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario.

Ouranos, 2010. *Climate change scenario over Ontario based on the Canadian Regional Climate Model (CRCM4.2)*. Consortium on Regional Climatology and Adaptation to Climate Change. Ouranos.ca.

Parks, S. A, & Harcourt, A. H., 2002. Reserve Size, Local Human Density, and Mammalian Extinctions in U.S. Protected Areas. *Conservation Biology* 16, 800-808.

Peckarsky, B.L., P.R. Fraissinet, M.A. Penton, and D.J. Conklin Jr., 1990. *Freshwater Macroinvertebrates of Northeastern North America*. Cornell University Press, Ithaca, New York. 442 pp.

Pellikka, J.; Rita, H.; Linden, H., 2005. Monitoring wildlife richness: Finnish applications based on wildlife triangle censuses. *Ann. Zoo. Fennici* 42: 123-134

Percival J.A., Breaks F.W., Brown J.L., Corkery M.T., Devaney J., Dubé B., McNicoll V., Parker JR., Rogers N., Sanborn-Barrie M., Sasseville C., Skulski T., Stone D., Stott G.M., Syme E.C., Thurston P.C., Tomlinson K.Y., and Whalen J.B., 1999. Project 95034. *Evolution of Archean continental and oceanic domains in the Western Superior Province: 1999 NATMAP results*. Ontario Geological Survey Open File Report 6000, Summary of Field Work and Other Activities 1999, 17-1 to 17-16.

Percival J.A., Sanborn-Barrie M., Skulski T., Stott G.M., Helmstaedt H., and White D.J., 2006. Tectonic evolution of the western Superior Province from NATMAP and Lithoprobe studies. *Canadian Journal of Earth Science* 43, 1085-1117.

Peterson, R.L., 1966. *Mammals of Eastern Canada*. Oxford University Press. 465 pp.

Phoenix, D, Abraham, K, Dawson, N, Mills, S, Holborn, G, Lalonde, R, Potvin, D, & Downing, K. 2010. *Far North Information and Knowledge Management Plan Terrestrial Biodiversity Project: Project Description.* Ontario Ministry of Natural Resources, Science and Information Branch, Peterborough, Ontario.

Phoenix, D. 2010. *FNTB_2010_Presentation*. Ontario Ministry of Natural Resources. South Porcupine Wildlife Assessment Unit.

Phoenix, Dean, 2013. Personal communication. Ministry of Natural Resources, Northeast Science and Information Section, Timmins, Ontario.

Poley, L. G., 2012. *Woodland Caribou, moose, and Wolves: Occupancy and Habitat Relationships of Three Ecologically Linked Large Mammals in the Boreal Forest of Ontario*. Masters Thesis, Trent University, Peterborough, Ontario.

Poley, L. G., Pond, B. A., Schaefer, J. A., Brown, G. S., Ray, J. C. & Johnson, D. S., 2013. Occupancy patterns of large mammals in the Far North of Ontario under imperfect detection and spatial autocorrelation. *Journal of Biogeography*, article first published online: 28 AUG 2013. DOI: 10.1111/jbi.12200.

Polfus, J. L., Hebblewhite, M. & Heinemeyer, K., 2011. Identifying indirect habitat loss and avoidance of human infrastructure by northern mountain Woodland Caribou. *Biological Conservation*, 144, 2637-2646.

Polster, D. F., 2005. The role of invasive plant species management in mined land reclamation. *Canadian Reclamation*. Summer/Fall 2005: 24-32.

Pomeroy, J. W., Marsh, P., and Gray, D. M., 1997. Application of a distributed blowing snow model to the Arctic*. Hydrological Processes*. 11. 1451-1464.

Prest, V. K., 1963. *Red Lake – Lansdowne House Area, Northwestern Ontario: surficial geology*. Geological Survey of Canada. Paper 63-6.

Prest, V.K., 1970. *Quaternary geology of Canada*. In: Douglas, R.J.W. (Ed.), Geology and Economic Minerals of Canada Geological Survey of Canada Economic Geology Series, fifth ed., vol. 1.

Price, W.A., 1997. *Draft Guidelines and Recommend Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia*. Energy and Minerals Division, Ministry of Employment and Investment, British Columbia.

Provincial Water Quality Monitoring Network (PWQMN), 2009. *Summarized 2009 dataset*. Retrieved from http://www.ene.gov.on.ca/environment/en/resources/collection/data_downloads/index.htm. (accessed May 21, 2013).

Pulliainen, E. 1981. A transect survey of small land carnivore and red fox populations on a subarctic fell in Finnish forest Lapland over 13 winters. *Annales Zoologici Fennici* 18:270-278.

Quinton, W. L., Roulet, N. T., 1998. Spring and summer runoff hydrology of a subarctic patterned wetland. *Arctic, Antarctic and Alpine Research*. 30, 285–294.

Racey, G. D., 2004. *Preparing for Change: Climate Change and Resource Management in Northwest Region.* Ontario Ministry of Natural Resources, Northwest Science and Information, NWSI Technical Workshop Report, TWR-04.

Racey, G. D., 1997. *Estimating the normal high water mark using the Northwestern Ontario wetland ecosystem classification.* TN-039, Ontario Ministry of Natural Resources, Northwest Science & Technology, Thunder Bay, Ontario.

Raisanen, J., 2007, Warmer climate: Less or more snow? *Climate Dyn.,* 30, 307–319, doi:10.1007/s00382-007-0289-y.

Rayner N., and Stott G.M., 2005. *Discrimination of Archean domains in the Sachigo Subprovince: a progress report on the geochronology*. In Summary of Field Work and Other Activities 2005, Ontario Geological Survey, Open File Report 6172, p 10-1 to 10-21.

Rees, A., English, M., Derksen, C., Toose, P., and Silis, A., 2013. Observations of late Winter Canadian Tundra Snow Cover Properties. *Hydrological Processes*. HYP-12-0037.

Reimers, E., Eftestol, S. & Colman, J. E., 2003. Behavior responses of wild reindeer to direct provocation by a snowmobile or skier. *Journal of Wildlife Management*, 67, 747-754.

Riley, J. L., 2011. *Wetlands of the Hudson Bay Lowlands: A Regional Overview. Nature Conservancy of Canada.* Toronto, ON.

Ruggiero, L., McKelvey, K., Aubry, K., Copeland, J., Pletscher, D. & Hornocker, M., 2007. Wolverine Conservation and Management. *Journal of Wildlife Management*, 71, 2145-2146.

Salmo Consulting Inc. and Diversified Environmental Services, 2003. *Volume 2 Cumulative Effects Indicators, Thresholds, and Case Studies.* In association with GAIA Consultants Inc., Forem Technologies Ltd., and Axys Environmental Consulting Ltd.

Sandstrom, S, Rawson, M., and Lester, N., 2010. *Manual of Instructions for Broad-scale Fish Community Monitoring; using Large Mesh Gillnets and Small Mesh Gillnets*. Ontario Ministry of Natural Resources. Peterborough, Ontario. Version 2010.1 34 pp. + appendices.

Saskatchewan Ministry of Highways and Infrastructure., 2010. *Winter Roads Handbook.* Developed by the Safe Operating Procedures for Winter Roads Committee. December.

Schaefer, J. A. & Pruitt, W. O., Jr., 1991. Fire and Woodland Caribou in Southeastern Manitoba. *Wildlife Monographs*, 116, 3-39.

Schiff, S., Aravena, R. et al., 1998. Precambrian Shield Wetlands: Hydrologic Control of the Sources and Export of Dissolved Organic Matter. *Climatic Change*. 40. 167-188.

Schindler, D. W., Walker, D., Davis, T. & Westwood, R., 2007. Determining effects of an all weather logging road on winter Woodland Caribou habitat use in south-eastern Manitoba. *Rangifer*, Special Issue, 17, 1-9.

Scott, J. S., 1976. *Geology of Canadian Tills*. In R.F. Legget, ed., Glacial Till. Royal Society of Canada Special Publication 12: 50-66.

Seip, D. R., Johnson, C. J. & Watts, G. S., 2007. Displacement of Mountain Caribou from Winter Habitat by Snowmobiles. *Journal of Wildlife Management,* 71, 1539-1544.

Sen, P.K. 1968. Estimates of the regression coefficient based on Kendall's tau*. J. Am. Stat. Assoc*. 63: 1379–1389.

SGS Mineral Services (SGS), 2012.*The Recovery of Nickel, Copper and PGMs from Samples of the Eagle's Nest Deposit, Ontario.* Project 12055-003 Final Report. June 2012.

Shepherd, L., Schmiegelow, F. & Macdonald, E., 2007. Managing fire for Woodland Caribou in Jasper and Banff National Parks. *Rangifer*, 17, 129-140.

Sims, R. A, Towill, W. D, Baldwin, K. A, Uhlig, P. & Wickware, G. M. , 1997. *Field Guide to the Forest Ecosystem Classification for Northwestern Ontario*. Ontario Ministry of Natural Resources, Northwest Science and Technology, Thunder Bay, Ontario. Field Guide FG-03.

Singer, S. N. & Cheng C. K., 2002. *An Assessment of the Groundwater Resources of Northern Ontario: Areas Draining into Hudson Bay, James Bay and Upper Ottawa River*. Hydrogeology of Ontario Series (Report 2). Ministry of the Environment. Toronto, Ontario.

Spatt, P.D., Miller, M. C., 1981. Growth conditions and vitality of Sphagnum in a tundra community along the Alaska pipeline haul road. *Arctic*. 34: 48–54.

Spectranalysis, 2004. *Introduction to the Ontario Land Cover Database, Second Edition (2000): Outline of Production Methodology and Description of 27 Land Cover Classes*. Prepared by Spectranalysis Inc. for the Ontario Ministry of Natural Resources. Oakville, Ontario .

Spence, Roy, 2011. Personal communication. First Nation Guide from Webequie, Ontario.

Spence, Roy, 2012. Personal communication. First Nation Guide from Webequie, Ontario.

Stainton, R. T., 2010. *Evaluation of Hydrological Models in the Ontario Flow Assessment Techniques (OFAT) Software Tool: Assessment of Model Suitability for Ontario's Far North*. Institute for Watershed Science. Trent University. Version 1.1.

Stanfield L., 2010. *Ontario Stream Assessment Protocol*. Version 8.0. Fisheries Policy Section. Ontario Ministry of Natural Resources. Peterborough, Ontario. 376 pp.

Stanley Associates Engineering Ltd. and Sentar Consultants Ltd., 1993. *Environmental Guidelines for the Construction, Maintenance and Closure of Winter Roads in the Northwest Territories*. Prepared for the Department of Transportation, Government of the Northwest Territories. October 8, 1993.

Statistics Canada, 2002. *2001 Census of Population*. Retrieved from: http://www12.statcan.gc.ca/english/census01/index.cfm. (accessed November 2013).

Statistics Canada, 2007. *2006 Census of Population.* Retrieved from: http://www12.statcan.gc.ca/census-recensement/2006/index-eng.cfm. (accessed November 2013).

Statistics Canada, 2012. *2011 Census*. Retrieved from: http://www12.statcan.gc.ca/census-recensement/index-eng.cfm?HPA. (accessed November 2013).

Statistics Canada, 2013. *Population projections by Aboriginal Identify in Canada*. Retrieved from: http://www.statcan.gc.ca/daily-quotidien/111207/dq111207a-eng.htm (accessed November 22, 2013).

Stevenson, B., and Wolfers J., 2013. *Subjective Well-Being and Income: Is There Any Evidence of Satiation?* Dated April, 16, 2013. Retrieved From: http://www.brookings.edu/~/media/research/files/papers/2013/04/subjective%20well%20being%20income/subjective%20well%20being%20income

Stott G.M., 2007. *Precambrian Geology of the Hudson Bay Lowland Interpreted from Aeromagnetic Data, poster.* Ontario Exploration and Geoscience Symposium, Sudbury Ontario, December 11-12, 2007.

Stott G.M., 2008. *Precambrian geology of the Hudson Bay and James Bay lowlands region interpreted from aeromagnetic data – east sheet*. Ontario Geological Survey, Preliminary Map P.3598-Revised, scale 1:500,000.

Stott G.M., 2011. *A revised terrane subdivision of the Superior Province in Ontario.* Ontario Geological Survey, Miscellaneous Release—Data 278.

Stott G.M., Corkery M.T., Percival J.A., Simard M., and Goutier J., 2010. *Project Units 98-006 and 98-007: A Revised Terrane Subdivision of the Superior Province*. In Summary of Field Work and Other Activities 2010, Ontario Geological Survey, Open File Report 6260, p. 20-1 to 20-10.

Stratton, C., 2012. *Far North Ecosystem Calibration Project, Ring of Fire, 2010*. Ministry of Natural Resources, Northwest Science and Information, Distribution Version 1.1.

Sturm, M. and Liston G., 2003. The snow cover on lakes of the Arctic coastal plain of Alaska, U.S.A. *Journal of Glaciology*. 49. 370-380.

Suffling, R., V. Crichton, J.C. Ray, J.A. Schaefer, and I. D.Thompson, 2008. *Report of the Ontario Woodland Caribou Science Review Panel: The Path Forward. Report to Hon. D. Cansfield, Ontario Minister of Natural Resources*. Waterloo, Ontario, Canada. 19 pp.

Szuba, K. & Naylor, B., 1998. *Forest raptors: Their nests in Central Ontario; A guide to stick nests and their users*. Ontario Ministry of Natural Resources, Southcentral Sciences Section, North Bay, Ontario. FG-03.

Terres, J.K., 1982, The Audubon Society Encyclopedia of North American Birds, New York: Alfred A. Knopf.

The Climate Registry. 2013. General Reporting Protocol Version 2.0, March 2013, California, USA.

Thompson, I.D., Davidson, I.J., O'Donnel,l S. and Brazeau, F., 1989. Use of track transects to measure the relative occurrence of some boreal mammals in uncut forest and regeneration stands. *Canadian Journal of Zoology*. 67: 1816-1823.

Thorne, G.A. & Gascoyne, M., 1993. Groundwater recharge and discharge characteristics in granitic terrains of the Canadian Shield; Memories of XXIV Congress of International Association of Hydrogeologists, Oslo. *Hydrogeology of Hard Rocks*. P. 368-374.

Thunder Bay Community Economic Development Commission (Thunder Bay CEDC), 2013. *Mining Readiness Strategy: An Integrated Regional Economic Development Plan*. Final Report. April, 2013.

Thunder Bay Regional Health Sciences Network (TBRHSC), 2013. Retrieved from: http://www.tbrhsc.net/about_TBRHSC/site_search.asp (accessed November 30, 2013).

Thurston P.C., Osmani I.A., and Stone D., 1991. *Northwestern Superior Province: Review and terrane analysis*. In Geology of Ontario. Edited by P.C. Thurston, H.R. Williams, R.H. Sutcliffe, and G.M. Stott. Ontario Geological Survey, Special Vol 4, Part 1, pp. 81-144.

Trenhaile, A. S., 2010. *Geomorphology: A Canadian Perspective*. Oxford: Oxford University Press.

US Environmental Protection Agency (US EPA), 1995. *Emissions Factors & AP 42, Compilation of Air Pollutant Emission Factors,* Baltimore, Maryland, USA.

van der Kamp, G., 1976. *Determining Aquifer Transmissivity by Means of Well Response Tests: The Underdamped Case.* Water Resources Research. Vol 12. No 1. 71 p.

van der Valk, A. G., 2009. *The Biology of Freshwater Wetlands*. Oxford: Oxford University Press.

Vásárhelyi, C, Thomas, V. G, & Nudds, T. D., 2002. *Capacity of Ontario's parks to sustain large carnivores*. In: Proceedings of the 2001 Parks Research Forum of Ontario, Porter, J, & Nelson, J. G. Heritage Resources Centre, University of Waterloo, Waterloo, Ontario. 267 279.

Vásárhelyi, C., V. G .Thomas & T. D. Nudds, 2002. *Capacity of Ontario's parks to sustain large carnivores*. In: Proceedings of the 2001 Parks Research Forum of Ontario, edited by J. Porter and J. G. Nelson. Heritage Resources Centre, University of Waterloo, Waterloo, Ontario. pp. 267-279.

VASCAN-University of Montreal, 2013. *Database of Vascular Plants of Canada*. Retrieved from: http://data.canadensys.net/vascan/about.

Verry, E. S., Kolka, R. K., 2003. *Importance of wetlands to streamflow generation, paper presented at First Interagency Conference on Research in the Watersheds*. U.S. Dep. of Agric., Benson, Ariz., 27– 30 Oct.

Vincent, L. A., Wang, X. L., Milewska, E. J., Wan, H., Yang, F., and Swail, V., 2012. A second generation of homogenized Canadian monthly surface air temperature for climate trend analysis, *J. Geophys. Res.,* 117, D18110, doi:10.1029/2012JD017859.

Vors, L. S., Schaefer, J. A., Pond, B. A., Rodgers, A. R. & Patterson, B. R., 2007. Woodland Caribou extirpation and anthropogenic landscape disturbance in Ontario. *Journal of Wildlife Management*, 71, 1249-1256.

Walker, D.A., Everett, K.R., 1987. Road dust and its environmental impact on Alaskan tiga and tundra , Arctic and Alpine Research, 19(4):479-489. Wasser, S. K., Keim, J. L, Taper, M. L. & Subhash R. L., 2011. The influences of wolf predation, habitat loss, and human activity on Caribou and moose in the Alberta oil sands. *Frontiers in Ecology and the Environment*, 9(10), 546-551.

Wasser, S. K., Keim, J. L, Taper, M. L. & Subhash R. L., 2011. The influences of wolf predation, habitat loss, and human activity on Caribou and moose in the Alberta oil sands. *Frontiers in Ecology and the Environment*, 9(10), 546-551.

Wawatay News., 2013a. Noront Pushing East-West Road Corridor Again. Volume 40, No. 24, June 23, 2013. Retrieved from: http://www.wawataynews.ca/archive/all/2013/6/22/noront-pushing-east-west-road-corridor-again_24634

Wawatay News., 2013b. Ontario Negotiating to Build Ring of Fire Toll Road. Volume 39, No. 29, September 13, 2013. Retrieved from: http://www.wawataynews.ca/archive/all/2012/9/13/ontario-negotiating-build-ring-fire-toll-road_23458

Whittington, J., ST Clair, C. C., & Mercer, G. 2005. Spatial responses of wolves to roads and trails in mountain valleys. Ecological Applications, 15(2), 543-553.

Winterhalder, B., 1981. Foraging strategies in the boreal forest: An analysis of Cree hunting and gathering. In: *Hunter-Gatherer Foraging Strategies: Ethnographic and Archaeological Analyses*. Winterhalder B, and Smith EA, eds. Chicago: University of Chicago Press. Pp. 66-98.

Wells, J. V. & Blancher, P. J., 2011. *Global role for sustaining bird populations*. In J. V. Wells (editor), Boreal birds of North America: a hemispheric view of their conservation links and significance. Studies in Avian Biology (no. 41), University of California Press, Berkeley, CA. pp 7-22.

Weir, J. N., Mahoney, S. P., Mclaren, B. & Ferguson, S. H., 2007. Effects of mine development on Woodland Caribou *Rangifer tarandus* distribution. *Wildlife Biology*, 13, 66-74.

Woo, M. and K., Waylen, P. R., 1986. Probability studies of floods. *Applied Geography*. 6, 185-195.

Yang, D., Kane, D., Zhang, Z., Legates, D., and Goodison, B., 2005. *Bias corrections of long-term (1973–2004) daily precipitation data over the northern regions*. Geophys. Res. Lett. 32: L19501, doi:10.1029/2005GL024057

Zinck, J. and Griffith, W., 2013. *Review of Mine Drainage Treatment and Sludge Management Operations.* MEND Report 3.43.1