GILLIS LAKE QUARRY EXPANSION PROJECT

ENVIRONMENTAL ASSESSMENT REGISTRATION DOCUMENT

Proponent:
Zutphen Resources Inc.
10442 Route 19,
Southwest Mabou, Nova Scotia, Canada
B0E 1X0

Report Prepared by:
McCallum Environmental Ltd.

January 2020

Environmental Assessment Registration Document

Name of Project:

Gillis Lake Quarry Expansion Project

Location: Gillis Lake, Cape Breton County, Nova Scotia

Proponent: Zutphen Resources Inc.

10442 Route 19

Southwest Mabou, Nova Scotia, Canada

BoE 1X0

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Date: January 2020

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EXECUTIVE SUMMARY

Zutphen Resources Inc. (Zutphen) currently owns and operates the Gillis Lake Quarry, operating under the Nova Scotia Environment (NSE) Industrial Approval (NSE Approval #2010-075178-01). The quarry which extends across two properties (PID's 15212947 and 15853146) was originally owned by Malcolm S. MacDonald Company who also utilized it for quarrying activity prior to Zutphen's ownership. Zutphen purchased the properties from Malcolm S. MacDonald Company in 2013 and have been continuing quarry activities in northern portions of PID 15853146 since this time.

Historical quarrying by Malcolm S. MacDonald Company occurred in the southern portion of PID 15212947 adjacent to Coxheath Road, and extended northwest. Restoration of the former quarry in PID 15212947 was completed by Malcolm S. MacDonald Company including stabilization of sidewalls and spoil piles, and integration of water management ponds and ditches prior to purchase by Zutphen.

Zutphen plans to expand the quarry beyond the current 4 ha area within the northern extent of both properties. This activity requires a Provincial EA registration (Class I undertaking). The purpose of the proposed quarry expansion is to continue to have quarry reserves available to serve the local market.

Expansion of the Gillis Lake Quarry is required to access desirable aggregate in the future. There are no anticipated changes to the current operations within the quarry including the amount and frequency of blasting, quarry hours of operation, and number and frequency of haul trucks collecting aggregate from the site.

The EA planning process allows for the prediction of environmental effects of a proposed Project and identifies measures to minimize and then mitigate potential adverse environmental effects. The EA predicts significant residual adverse environmental effects once mitigation measures are implemented.

The EA focusses on specific environmental components called valued environmental components (VECs). VECs are specific components of the biophysical, socioeconomic, human health, and cultural environments. As part of this EA, an evaluation of potential VEC interactions with Project activities was completed to identify environmental effects (if any), for each VEC; and identification of thresholds to determine the significance of residual environmental effects.

Baseline field evaluations were completed for each biophysical VEC's listed below over the course of a four-season survey period.

- Surface water;
- Fish and fish habitat;
- Wetlands;
- Habitat, vascular plants, and lichens;

- Fauna (herpetofauna and mammals);
- Avifauna; and
- Species of Conservation Interest (SOCI) and Species at Risk (SAR).

Additional baseline information was obtained in support evaluating the following physical VEC's:

- Noise;
- Air quality;
- Topography, surficial and bedrock geology;
- Groundwater; and
- Archaeological and Heritage Resources.

Evaluation of the above VEC's was completed within the Project Study Area (i.e. the Zutphen owned properties which the Gillis Lake Quarry is situated), and the Quarry Development Area (QDA). The QDA refers to the proposed expansion area of the quarry.

<u>Surface Water and Fish Habitat</u>
Surface water on site is currently directed southeastward through the Study Area through a series of drainage ditches and settling ponds which initiate in the current quarry area, and drain through the former Malcolm S. MacDonald quarry into a settling pond system alongside Coxheath Road (in the former quarry area). Water drains from the settling pond adjacent to Coxheath Road via a culvert into the receiving watercourse; Portage Brook south of the Study Area. As quarry expansion progresses, surface water will continue to be directed through existing ditches and settling ponds. Modifications to water management infrastructure will be made throughout the lifetime of the Project as necessary.

Five watercourses were identified within the Study Area (WC1 – WC5) as well as two off-site watercourses (Portage Brook to the south of the quarry, and MacDonalds Brook to the east of the quarry). WC4 and WC5 exist within the Quarry Development Area (QDA) and drain water to MacDonalds Brook, while WC's 1, 2 and 3 are located in central portions of the Study Area. WC1 intercepts water sourced from up gradient quarry activities via ditching and settling ponds, which subsequently drains into Portage Brook adjacent to Coxheath Road. Portage Brook and MacDonalds Brook act as the down-stream receiving watercourses from the Study Area, and were assessed within a Fish Habitat Assessment Area defined for the EA. The following general characteristics for identified watercourses are presented:

- WC1 originates as an accumulation of drainage from roadside ditching and natural, overland surface flow that channelizes about midway up the Study Area along the current quarry access road. There were two barriers to fish passage documented on WC1, however, multiple brook trout were captured during field studies above and below the barriers. As such, fish upstream of the barrier are believed to be resident (stranded) fish. WC1 is connected to Portage Brook via a culvert beneath Coxheath Road.

- WC2 and WC3 are both short and intermittent, high gradient streams that form in forested upland habitat north of WC1 as groundwater seepage. Fish habitat within both streams is limited by seasonal dryness, channel gradient, and high velocities.
- WC4 is a first-order, intermittent stream that originates from pockets of standing water along an offsite wetland north of the QDA. Initially, WC4 drains through the QDA as a channelized feature prior to becoming unchannelized and lacking any surface water flow (observed during high and low flow conditions). Due to these conditions, and a permanent barrier to fish passage located downstream on MacDonalds Brook, WC4 does not provide direct fish habitat.
- WC5 is a short, ephemeral watercourse that develops at the eastern extent of the QDA. The channel disappears entirely into upland forest approximately 10 m south of MacDonalds Brook. Due to these conditions, and a permanent barrier to fish passage located downstream on MacDonalds Brook, WC5 does not provide direct fish habitat.
- MacDonalds Brook is thought to originate from a wetland complex approximately 1 km north of the Study Area and drains southeast, eventually discharging into Portage Brook upstream of Blacketts Lake. A permanent barrier to fish passage (waterfall) exists on MacDonalds Brook downgradient (east) of the QDA. Brook trout were captured downgradient of the fish barrier; however, no fish were captured upstream of it. MacDonalds Brook is partially sourced water from the QDA via WC4 and WC5, as well as surface water run-off.
- Portage Brook is thought to originate in an open water wetland complex approximately 1 km west of the Study Area which is fed by two NSTDB mapped headwater streams. Portage Brook receives water from WC1, as well as MacDonalds Brook and drains water into Blackett's Lake located approximately 4.6 km east of the Study Area. Brook trout were captured in Portage Brook during field studies.

Two watercourses (WC4 and WC5) identified within the QDA will be directly impacted by future quarry development. Apart from American eel (*Anguilla rostrate,* COSEWIC Threatened; S2), which can effectively navigate fish barriers, neither watercourse provides access for fish. Fish habitat provision within WC1, MacDonalds Brook and Portage Brook have been evaluated as part of this EA, and habitat is present for various fish species that are likely to occur in the area (based on their contiguity with Blacketts Lake). As well as the observed brook trout, potential species include alewife (*Alosa pseudoharengus,* S3), American eel, brown bullhead (*Ameiurus nebulosus*), white sucker (*Catostomus commersonii*), white perch (*Morone americana*), chain pickerel (*Esox niger*) and smallmouth bass *(Micropterus dolomieu)*.

Surface water quantity to receiving aquatic receptors (watercourses) is expected to be affected by the proposed activity as a result of quarry expansion and site water management. A Water Balance was completed as part of the EA process to predict potential changes in discharge flow to downstream surface water features. During operations, two quarry floor infiltration scenarios were modelled as part of the analysis: existing infiltration (most likely infiltration) and 100% impervious. The analysis concluded that there will be surface water volume changes are predicted to WC1 (an increase in surface water volume), Portage Brook (an increase in surface water volume) and MacDonalds Brook (a decrease in surface water volume). Based on the range of resulting predicted changes, and upon implementation of the proposed mitigation discussed in this document, significant residual effects are not expected to fish and or the watercourses themselves (physical adjustment).

Wetlands

No wetlands exist within the Study Area. Therefore, the Project is not expected to have any direct, or indirect effects to wetland habitat or function.

Habitat

Habitat across the Study Area has been largely disturbed through historical quarrying. Remaining forested habitat within the Study Area comprises mature tolerant hardwood and mixedwood forests types in the central and northern regions of the Study Area. The southern portion of the Study Area comprises of historical quarry activities and are ‘reclaimed’ consisting of poorly drained soils with admixing and a vegetation community reflective of a disturbance. Expansion of the Gillis Lake Quarry will directly disturb 4.6 ha of hardwood forested habitat within the QDA as the quarry expands over its 20-25 year operational life.

Flora

A total of 190 flora species were identified within the Study Area. Three SOCI were observed, variegated horsetail (*Equisteum variegatum*; S3), marsh mermaidweed (*Proserpinaca plaustris var. creba*; S3) and Loesel’s twayblade (*Liparis loeselii*; S3S4). These species were identified outside of the QDA in the former (reclaimed) quarry. Thirty-four (34) lichen species were observed in the Study Area. One species was determined to be a SAR: blue felt lichen (*Pectenia plumbea;* SARA & COSEWIC Special Concern; NSESA Vulnerable; ACCDC S3) and one species was determined to be a SOCI: tree pelt lichen (*Peltigera collina;* S2?). Both species (comprising multiple individuals each) were identified within the QDA and will therefore be lost as a result of quarry expansion. At a regional level, the habitat and flora losses expected in the QDA are small, and reclamation of the quarry will re-introduce habitat in the future; therefore, the predicted residual environmental effects are assessed to be not significant.

Fauna

Wildlife surveys found signs of Eastern coyote (*Canis latrans*), snowshoe hare (*Lepus americanus*), short-tailed weasel (*Mustela ermina*), white tailed deer (*Odocoileus virginianus*), American red squirrel (*Tamiasciursus hudsonicus*), and white-footed deermouse (*Peromyscus leucopus*). No SAR/SOCI fauna (including wood turtle or snapping turtle) were observed on within the Study Area. The QDA is located in the Cape Breton Lynx Range. Canada lynx (NSESA Endangered; ACCDC S1) is considered a SAR and the ACCDC report have outlined 196 recordings of Canada lynx within 10.0 ± 0.0 km of the Study Area. However, habitat evaluation within the QDA has determined that the habitat present is not ideal for either key prey species of the lynx. In addition, the QDA is well below the ideal range for Canada lynx (250-500 masl). This, together with the presence of the adjacent active quarry is expected to act as a deterrent to current Canada lynx use of the area and as such, the Canada lynx, nor its habitat is expected to be affected by the Project.

Avifauna

Bird surveys completed during spring, breeding and fall identified 53 species of birds utilizing on-site habitat. Across all survey seasons, a total of 14 Priority Species (two SAR and twelve SOCI) were observed. The SAR observed included one common nighthawk (*Chordeiles minor)*, and seven evening grosbeak (*Coccothraustes vespertinus).* Habitat is present for all birds observed during surveys within the Study Area. Physical loss of bird habitat within the QDA, and the likely displacement of birds as a result of quarry development are small scale and not expected to impact birds on a regional scale. Therefore, after mitigation measures discussed in this document have been implemented, the predicted residual environmental effects are assessed to be not significant.

Noise

Noise is currently regulated at the Gillis Lake Quarry under the Nova Scotia Pit and Quarry Guidelines. As per this guideline, noise thresholds are required to be met at the property boundary of the quarry, as well as within 7 m of the nearest residential structures during blasting events. To date there have been no instances of official noise complaints originating from the quarry. Future quarry operations and methods are proposed to remain consistent with current operations, therefore noise levels are also expected to remain consistent. Information passed on to Zutphen from some local residents indicated that a blast was heard in 2019, and that truck traffic can be noisy at times on the Coxheath and Gillis Lake Roads. Zutphen have made commitments within this document to minimize the potential effects of noise as a result of the Project. After these commitments and mitigation measures are implemented, and the Nova Scotia Pit and Quarry Guidelines are adhered to, the predicted residual environmental effects for noise are assessed to be not significant.

Air Quality

Air quality (dust) is currently regulated at the Gillis Lake Quarry under the Nova Scotia Pit and Quarry Guidelines. As per this guideline, particulate emission limits are required to be met at the Project property boundaries. Future quarry operations and methods are proposed to remain consistent with current operations, therefore air particulate (dust) levels are also expected to remain consistent. Although no known complaints or air particulate exceedances have been recorded to date in association with quarrying activities, local residents have communicated to Zutphen dust issues associated with trucks travelling along the Coxheath and Gillis Lake Road. Although dust created along these roads is outside the scope of the Project (i.e. the quarry activity), Zutphen have made commitments within this document to minimize the potential effects of dust as a result of trucks visiting the quarry. After these commitments and mitigation measures are implemented, and the Nova Scotia Pit and Quarry Guidelines are adhered to, the predicted residual environmental effects for air quality are assessed to be not significant.

Surficial and Bedrock Geology

The surficial geology of the Study Area consists of three different geologic units: bedrock in the north, stony till plain in the centre, and silty till plain in the south. The Study Area overlies Coxheath Hills Group in the west and the Neoproterzoic Granodiorite Group in the east. Disturbances to surficial and bedrock geology have the potential to effect surface water quality through destabilization of soils (erosion and sedimentation), mineralisation of rock (including Acid Rock Drainage) and changes in surface water volume discharged downstream. Acid Rock Drainage (ARD) testing was completed and it was determined that there is negligible potential for ARD based on low sulphur concentrations. Water quality is currently regulated at the Gillis Lake Quarry under the Nova Scotia Pit and Quarry Guidelines. As per this guideline, Total Suspended Solids (TSS) and pH levels are required to be met in surface water discharging from the Project. An on-going commitment to adhering to these guidelines, as well as implementing the mitigation methods discussed in this document will ensure environmental effects for water quality are not significant.

Groundwater

In relation to potential effects to groundwater quality and quantity, a desktop review for adjacent water wells was conducted. Based on a review of the NS Well Logs Database and field confirmation, the closest known residential well is approximately 815 m away from the QDA. Groundwater is currently regulated at the Gillis Lake Quarry under the Industrial Approval (IA) Conditions and will continue to be so as the quarry expands. To date there have been no known issues with neighbouring groundwater wells as a result of quarrying activity, and since quarry operations and methods are not planned to change, the expectation is that this will remain consistent in the future. Zutphen are committed to ensuring blasting activities are monitored as per IA conditions, as well as notifying residents prior to planned blasts.

To date, the Gillis Lake Quarry has not been observed to interact with the groundwater table (no observed seepages through the exposed rock face of build up of water on the quarry floor) and the intention is to remain above groundwater throughout the expansion process. A groundwater monitoring program adhering to NSE requirements will be implemented to gain an understanding of potential groundwater interactions throughout the life of the quarry. Implementation of these commitments, along with other mitigation and monitoring discussed in this document will ensure residual environmental effects to groundwater (and adjacent wells) is not significant.

Archeological and Heritage Resources

No significant archaeological features were identified within the Study Area during the field reconnaissance study. The Study Area was determined to be of low potential for archeological resources of either First Nations or European-descended origin and therefore, no direct or indirect impacts to archaeological or heritage resources are expected as a result of the Gillis Lake Quarry expansion.

Summary

The Project will allow for continued employment at the quarry, as well as in related industries where the aggregate material is used (e.g. construction, hauling). Therefore, the Gillis Lake Quarry will continue to support the local economy.

The field data, regulatory consultation, and subsequent conclusions of this assessment indicate that there are no significant environmental concerns and no significant impacts expected that cannot be effectively mitigated through well established and acceptable practices, or ongoing monitoring and response. Residual environmental effects have been determined to be not significant for all identified VECs.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ACRONYMS

ACCDC	Atlantic Canadian Conservation Data Centre
AMO	Abandoned mine opening
AQHI	Air Quality Health Index
ARD	Acid Rock Drainage
ASL	Above Sea Level
ATV	All-terrain vehicle
CEAA	Canadian Environmental Assessment Act
CCME	Canadian Council of Ministers of the Environment
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
DEM	Digital Elevation Model
EA	Environmental Assessment
EC	Environment Canada
ECCC	Environment and Climate Change Canada
EMF	Ecological Maintenance Flow
EOQ	End of Quarry
EPP	Environmental Protection Plan
FEC	Forest Ecosystem Classification for Nova Scotia
FHAA	Fish Habitat Assessment Area
FWAL	Protection of Aquatic Life for Freshwater Guidelines
GPS	Global Positioning System
HA	Hectares
HADD	Harmful Alteration, Disruption or Destruction of fish habitat
HAP	Habitat Assessment Point
IBA	Important Bird Area
IA	Industrial Approval
KM	Kilometer
KMKNO	Kwilmu'ku Maw-klusuaqn Negotiation Office
LCA	Local Catchment Area
Ltd	Limited
M	Meters
MBBA	Maritime Breeding Bird Atlas
MBS	Migratory Bird Sanctuary
MEL	McCallum Environmental Ltd.
MW	Mixed Wood
NO_2	Nitrogen dioxide
NS	Nova Scotia
NSCCH	Nova Scotia Communities, Culture & Heritage
NSDEL	Nova Scotia Department of Environment and Labour
NSDNR	Nova Scotia Department of Natural Resources

NSE	Nova Scotia Environment
NSESA	Nova Scotia Endangered Species Act
NSDL&F	Nova Scotia Department of Lands and Forestry
NSTDB	Nova Scotia Topographic Database
O_3	Ozone
OAA	Office of Aboriginal Affairs
PC	Point Counts
PID	Property Identification Number
QDA	Quarry Development Area
SAR	Species at Risk
SARA	Species at Risk Act
SOCI	Species of Conservation Interest
SPC	Specific Conductivity
SRank	Status rank
TH	Tolerant Hardwood
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UTM	Universal Transform Mercator
VEC	Valued Environmental Components
VT	Vegetation Type
WESP-AC	Wetland Ecosystem Services Protocol – Atlantic Canada
WC	Watercourse
WL	Wetland

1 GENERAL INFORMATION

The Project summary is provided below.

Table 1-1 Project Summary

General Project Information	Zutphen Resources Inc. (Company # 2549778) intends to expand the existing Gillis Lake Quarry (NSE Industrial Approval #2010-075178-01), currently located on Property Identification Numbers (PID's) 15212947 and 15853146.
Project Name	Gillis Lake Quarry Expansion Project (the "Project")
Proponent Name	Zutphen Resources Inc. ("Zutphen")
Proponent Contact Information	10442 Route 19, Southwest Mabou, Nova Scotia, Canada B0E 1X0 Business: (902) 945-2300 Facsimile: (902) 945-2087 email: peter@zutphen.ca
Proponent Project Directors	M. Campbell Dec 20, 2019 Martha Campbell Date CEO Zutphen Resources Inc.
Project Location	• The Study Area is located within the boundaries of PID's 15212947 and 15853146. • The Study Area is located approximately 17 km southwest of Sydney in between the communities of Portage and Gillis Lake, Nova Scotia. • The approximate centre of the Study Area is located at 702925.25m E and 5102955.15m N.
Landowner(s)	The Study Area is located on private land owned by Zutphen Resources Inc.
Closest distance from the proposed quarry to a residence	The closest residential building is located approximately 815 m west of the Quarry Development Area (along Gillis Lake East Road). There is an archery/shooting club building located approximately 305 m east of the Quarry Development Area.

Federal Involvement, Permits and Authorizations	No federal departments or public sources of funding provided. No Canadian Impact Assessment triggers occur or are expected. The following federal legislation may occur during the lifetime of the Project. 1. Species at Risk Act 2. Migratory Bird Conventions Act
Provincial Authorities issuing Approvals	Nova Scotia Environment (NSE)
Required Provincial Permits & Authorizations	The following permits, authorizations and/or approvals may be required for this Project which will allow for the construction and operation of the Project: 1. *Environmental Assessment Approval.* Approved pursuant to Section 40 of the *Environment Act* and Section 13 (1)(b) of the *Environmental Assessment Regulations* in Nova Scotia, Canada; 2. *Industrial Approval* pursuant to Activities Designation Regulations, Division V, Section 13(f) 3. *Watercourse Alteration Approval* Pursuant to Activities Designation Regulations, Division I, Section 5A (2)
Provincial Regulatory Authorities Consulted during EA and Project Development Process	Nova Scotia Environment (NSE), Environmental Assessment Branch: • Bridget Tutty, Environmental Assessment Officer Nova Scotia Environment Compliance Division: • Malcolm MacNeil Nova Scotia Department of Lands and Forestry (NSDL&F): • Terry Power, Regional Biologist Nova Scotia Office of Aboriginal Affairs (OAA): • Gill Fielding, Consultation Advisor
Municipal Authorities	Cape Breton County
Required Municipal Permits & Authorizations	None for the proposed expansion.

Environmental Assessment Document Completed By:	Andy Walter, B.Sc. Emma Posluns, M.Sc. Amber Stoffer, MREM John Gallop, B.Sc. **McCallum Environmental Ltd.** Suite 115, 2 Bluewater Road Bedford, NS. B4B 1G7

2 PROJECT INFORMATION

The following sections outline the proponent profile, the environmental assessment team, a description of the Project location, and the current quarry operations and proposed future operations.

2.1 Project Overview

Zutphen Resources Inc. (Zutphen) currently owns and operates the Gillis Lake Quarry, operating under the Nova Scotia Environment (NSE) Industrial Approval (NSE Approval #2010-075178-01). The quarry which extends across two properties (PID's 15212947 and 15853146) was originally owned by Malcolm S. MacDonald Company who also utilized it for quarrying activity prior to Zutphen's ownership. Zutphen purchased the properties from Malcolm S. MacDonald Company in 2013 and have been continuing quarry activities in northern portions of PID 15853146 since this time.

Historical quarrying by Malcolm S. MacDonald Company occurred in the southern portion of PID 15212947 adjacent to Coxheath Road, and extended northwest. Restoration of the former quarry in PID 15212947 was completed by Malcolm S. MacDonald Company including stabilization of sidewalls and spoil piles, and integration of water management ponds and ditches prior to purchase by Zutphen. (see Section 2.4.3 for details).

Zutphen plans to expand the quarry beyond the current 4 ha area within the northern extent of both properties. This activity requires a Provincial EA registration (Class I undertaking). The purpose of the proposed quarry expansion is to continue to have quarry reserves available to serve the local market.

2.2 Proponent Profile

Zutphen Resources Inc. is a family owned Nova Scotian heavy civil and marine construction contractor located in Cape Breton, Nova Scotia. Zutphen who have been in operation since 1964, own and operate several aggregate quarries in Cape Breton to manufacture aggregate for their own construction projects, and for supply to other contractors.

Zutphen Resources Inc. Executive Management Team consists of:

Leonard van Zutphen, President
Martha Campbell, Chief Executive Officer (CEO)
Peter Archibald, B. Eng, CSS, Project Manager

The Environmental Assessment Project Team consists of:

- Andy Walter, B.Sc., McCallum Environmental Ltd.;
- Emma Posluns, M.Sc., McCallum Environmental Ltd;
- John Gallop, B.Sc., McCallum Environmental Ltd;
- Amber Stoffer, MREM, McCallum Environmental Ltd;
- Chris Pepper, Avifauna Surveys; and,
- Courtney Glen, Vanessa McKillop, and April MacIntyre, Davis McIntyre & Associates.

CVs are provided in Appendix B.

2.3 Project Location and Characteristics

Gillis Lake Quarry is located in a rural setting between the communities of Gillis Lake, approximately 2.0 km northwest of the Study Area and Portage, approximately 2.3 km southeast of the Study Area (Figure 1, Appendix A). The quarry entrance is located at the civic address of 2918 Coxheath Road and the approximate centre of the Study Area is located at UTM 20N 702925.25m E and 5102955.15m N.

Gillis Lake Quarry is located immediately north of the former Malcom S. MacDonald Co. Ltd. Quarry, which was reclaimed in March 2002. The majority of the Study Area comprises a high degree of disturbance including the former (now reclaimed) quarry, and the active Gillis Lake Quarry footprint (approximately 4 ha in size) (Figure 2, Appendix A). A network of access roads exists including the main quarry access road along the western Study Area boundary, former access roads within the reclaimed quarry area, and current quarry access roads for the active quarry area.

Of the 41.7 ha Study Area, a total of 16.8 ha exists as natural forested habitat (as determined using Google Earth aerial imagery, 2019). One forested area (~ 3.7 ha in land area) exists in the central portion of the Study Area adjacent to a watercourse, and the other larger portion is located in the northeastern corner of the Study Area which is the area proposed for quarry expansion. This forested area is approximately 6.8 ha in land area size. The remaining forested area is in smaller portions or along the edge of the Study Area. An unnamed NSE mapped watercourse initiates along the west-central boundary of the Study Area and flows south through the block of 3.7 ha natural forested land, eventually draining beneath Coxheath Road. This watercourse is a tributary to Portage Brook, which empties into Blacketts Lake approximately 3.8 km east of the Study Area (Figure 1, attached). A network of drainage ditches and water storage ponds exist within the former quarry and existing quarry as described in Section 2.4.3 of this document.

Access to the Gillis Lake Quarry is via the Coxheath Road and into the main site entrance where there is a weigh scale situated.

There are 12 residences within a 1 km radius of the outer edge of the Quarry Development Area (QDA) and zero (0) residences within 800 m. The QDA refers to the land area in which quarry expansion is proposed over the next 20-25 years. An archery club (Breton Traditional Archers) is located approximately 305 m east of the QDA. More detail is provided regarding neighbouring residences in Section 2.4.1.

2.4 Existing Quarry Operations

The Gillis Lake Quarry generates aggregate material for its own projects, as well as to supply external contractors. The current production rate in recent years has averaged approximately 40,000-50,000 tonnes of aggregate per year, during active periods which tends to be the summer and fall months.

Existing quarry infrastructure includes one processing line (crushers and screener), a scale, and a scale house (at the intersection with Coxheath Road). All infrastructure is mobile and will be relocated within the quarry during expansion; however, the scale house and scale are planned to remain at their current location. No washing processes currently take place on site, nor is fuel stored on site. This will continue to be the case during quarry expansion. Fuelling only occurs (and will continue to occur) in specified locations that are fully equipped with spill kits and containment drums.

Surface water runoff and drainage occurring on site is currently controlled by a network of ditches, culverts, and three settling ponds. A full description of current site drainage is presented in Section 2.4.3. Environmental controls (such as the settling ponds, sediment fencing, rock check dams) will be repaired and replaced as needed as the quarry expands. Additional settling ponds will be added as required during the life of the quarry.

As the quarry expands, the quarry floor will be used for dedicated stockpiles of different aggregate types. Aggregate types produced include; Type I, Type II, Crusher Run, 4-8" clear stone, concrete stone, oversize armour stone, and shot rock.

The following sections provide additional information related to the operations and best management practices which are currently followed at the Gillis Lake Quarry.

2.4.1 Drilling and Blasting

Blasting typically occurs twice per year at the Gillis Lake Quarry but could occur up to four times per year during some years. No residential structures are located within 800 m of the QDA; however, the Breton Traditional Archers Club is located approximately 305 m east of the QDA. The archery club has no water supply provided to it. Two residential buildings (collectively known as Receptor #1) are located 815 and 835 m west of the QDA on Gillis Lake East Road. Two residential buildings (known as Receptors #2 and #3) are located 840 and 880 m southeast and southwest (respectively) from the QDA on Coxheath Road. Under the *Pit and Quarry Guidelines* (NSDEL, 1999), a separation distance of 800 m is required between the working face of the quarry and the base of a structure unless permission is obtained from the property owner to perform the blast. Zutphen currently monitors all blasts for concussion and ground vibration at the scale house. An independent qualified blasting subcontractor undertakes the blasting operations in accordance with the *General Blasting Regulations* contained in the *Nova Scotia Occupational Health and Safety Act* (1996). Monitoring of the blasts is conducted to ensured that concussion and ground vibration levels do not exceed the limits stated within the Industrial Approval (IA).

The qualified blasting company will be responsible for blast design, methods, monitoring and activities consistent with the Nova Scotia Department of Environment and Labour (NSDEL) *Pit and Quarry Guidelines* (NSDEL, 1999) which includes the requirement to complete pre-blast surveys at the two nearest structures (NSE, 1993).

Weather conditions, including high humidity or cloud cover, can cause the levels of overpressure and noise to appear more severe for surrounding residents than on a day when the humidity is low and there is lack of cloud cover. When possible, Zutphen and its sub-contractors will avoid blasting when weather conditions include significant temperature inversions, strong winds, foggy, hazy or smoky conditions with little or no wind, or still, cloudy days with a low cloud ceiling.

2.4.2 Processing Activities

Specific processing activities including crushing and screening will be determined based on need. There is currently one processing line at the Gillis Lake Quarry comprising up to two crushers and a screener. No washing process takes place on the site. Various aggregate products including Type I, Type II, Crusher Run, 4-8" clear stone, concrete stone, oversize armour stone, and shot rock are produced based on need and stockpiled in designated areas within the quarry. Aggregate stockpiles, topsoil and overburden piles are located in designated areas within the quarry. Stockpiles are built, and material hauled and moved within the quarry with a front-end loader. An excavator is also used for material handling.

2.4.3 Water Management

Generally, all surface water runoff and drainage occurring on site drains southeastward toward a series of settling ponds located adjacent to Coxheath Road (Figure 3, Appendix A). Drainage occurs through a series of drainage ditches initiating in the current quarry area, and additional settling ponds which are located in the active quarry area and within northern portions of the former Malcolm S. MacDonald Company quarry. Information provided by local residents at the Public Information Session (see Section 8) indicated that during wet, high flow periods of the year, the southeastern settling ponds overflow and water is sometimes observed upon Coxheath Road. All of the settling ponds are currently vegetated.

There is one NSE mapped watercourse present within the southern half of the Study Area. It initiates on the western Study Area boundary (collecting run-off from the access road ditches) and drains through the forested area within central portions of the Study Area. Historically, all of the drainage from the settling ponds located in the active quarry area and within the northern portions of the former Malcolm S. MacDonald Company quarry would continue southeast into the larger settlings pond north of Coxheath Road; however, runoff from the settling ponds located within the former quarry area has carved out a channel which directs the majority of drainage west, directly into this on-site watercourse (herein referenced as WC1). Surface water that is captured within the settling ponds adjacent to Coxheath Road drains passively from these settling ponds via overflow culverts into WC1. WC1 converges with Portage Brook approximately 75 m southeast of the Study Area.

Drainage along the western Study Area boundary (west side of the active quarry access road) is diverted southwest, away from the Study Area via roadside ditching.

As part of a future IA amendment process, settling ponds and/or water management methods will be added and modified as needed during quarry expansion to ensure water discharge meets water quality and water volume discharge criteria, prior to release into the receiving environment.

2.4.4 Waste Management

Quarry operations do not result in large quantities of waste material. Overburden is currently stored along the exhausted quarry face and will be re-used during rehabilitation and reclamation during the life of the quarry at the end of its operational phase.

Other typical small-scale waste will be disposed of off-site via local waste handling facilities operated by the local municipalities. As appropriate, materials suitable for recycling will be separated, reused and/or recycled.

In the case that excess topsoil is prevalent during quarrying, topsoil will be stored at a suitable location within the active quarry area and occasionally used on Zutphen construction projects. Left over topsoil will be used for future reclamation purposes. Prior to future blasting, tree clearing activities will be completed and merchantable timber removed from the quarry site.

2.4.5 Hazardous Waste Management

No fuel tanks currently exist at the Gillis Lake Quarry and there are no future plans to store additional hazardous materials, chemicals or petroleum products at the quarry site.

Regular, small-scale maintenance of the equipment (loaders, excavators and crushing equipment) is conducted at the quarry site. Used oil and filters are removed from the quarry site once maintenance is complete and this practice will continue with the proposed expansion. Re-fueling of equipment and maintenance will continue to be conducted via a contracted fuel truck. Re-fuelling on site will occur on a regular basis at distances greater than 30 m from any surface water feature and the operators will remain with the equipment at all time when re-fueling activities are taking place. Disposal of hazardous material and refuelling procedures will be conducted in line with best management practices described in the Project Contingency Plan (which follows the EA registration and approval) and regulatory requirements. All larger scale maintenance is completed off-site at a designated location.

2.4.6 Transportation and Production

Haul trucks leaving the Gillis Lake Quarry with aggregate comprise a combination of Zutphen owned vehicles and third-party customer owned trucks. Once leaving the quarry access road, haul truck traffic either travels west on Coxheath Road and then to Gillis Lake Road or east onto Coxheath Road towards Blacketts Lake. At Blacketts Lake trucks can either travel east to access Highway 4 or continue towards Coxheath. Concern was expressed by members of the public during the Public Information Session about truck routes, volume of truck traffic and safety and conditions of the Coxheath and Gillis Lake Road. This is discussed in more detail in Section 8.

The production rate (i.e. 0.5 ha per year, 40,000 – 50,000 tonnes of aggregate per year) and truck traffic expectations are planned to be consistent with current quarry operations but will be market driven.
The quarry will operate for 6 days per week (Monday through Saturday), from 6 a.m. to 6 p.m. No blasting will occur on Sunday's or holidays.

2.4.7 Noise Management

Sound levels within the quarry are monitored as requested by NSE at the property boundaries of the quarry, in accordance with the NSDEL *Pit and Quarry Guidelines* (NSDEL, 1999). Blasting accounts for the predominant source of noise from the quarry. As previously discussed, blasting is monitored and will be planned to occur on days where weather conditions are less likely to cause excessive sound levels, nor will it occur on Sundays or holidays.

Noise from haul truck traffic accessing the quarry will occur during quarry operation. This is consistent with current quarry operations. Noise effects of the Project are discussed in more detail in 9.2.1.

2.4.8 Dust Control

Dust emission and particulate matter will be monitored at property boundaries adjacent to the quarry, at the request of NSE, in accordance with the NSDEL *Pit and Quarry Guidelines* (NSDEL, 1999). All haul truck loads likely to present a higher likelihood to create dust will be covered to minimize dust and to contain aggregate material. Should it be required, dust emissions from the quarry will be controlled with the application of water. Air Quality effects of the Project are discussed in more detail in 9.2.2.

2.4.9 Viewscape

The Gillis Lake Quarry is located in a rural location. The former Malcolm S. Company quarry, which lies adjacent to Coxheath Road is visible from Coxheath Road. However, the active quarry, which is located approximately 600 m from Coxheath Road is not visible from Coxheath Road. It is possible that from high ground, further from the quarry, the expansion area will be visible.

2.4.10 Risk Management

A contingency plan for the Gillis Lake Quarry and its proposed expansion is the responsibility of Zutphen. The Project Contingency Plan will cover identification of owner team leaders and contacts, spill prevention, spill procedures, sediment and erosion control, fire management, and incident reporting procedures. This plan will be provided to NSE as part of the IA application process.

2.5 Future Quarry Operations

In order to continue production and supply aggregate to the local market, Zutphen plans to expand the existing Gillis Lake Quarry. **The proposed quarry expansion is proposed to increase reserves, not increase production.** The timing and rate of quarry expansion and development is based on market demand for local aggregate; however, current production rates are expected to remain consistent as the quarry expands. If the local demand for aggregate changes, the proposed development plans could vary.

Presently, there are no anticipated changes to the current operations within the quarry including the amount and frequency of blasting, quarry hours of operation, and number and frequency of haul trucks collecting aggregate from the site.

2.5.1 Development Plan

The predicted expansion timeline of the Gillis Lake Quarry has been proposed over a 20 -25 year time period (Figure 4, Appendix A). Quarry expansion will occur within the QDA and will include a combination of quarrying activities, and components that support the quarrying activity (i.e. access roads, stockpile and overburden areas among others).

The following items were considered when determining the extent and location of the QDA:

- QDA not encroaching within 30 m of a public road;
- QDA not encroaching within 30 m of an adjacent property boundary;
- QDA not encroaching within 30 m of a watercourse (unless approval provided to do so from NSE); and,
- QDA not encroaching within 800 m of an offsite structure (without consent of the structure owner).

The current working face of the Gillis Lake Quarry is located in the northeastern extent of the IA Approved Area (Figure 4, attached). Expansion of the quarry will move north from its current face to access the desirable aggregate. The current elevation of the quarry floor is 110 m above sea level (ASL) and rises to the natural elevation of 122 m ASL in the forested landscape above the active quarry face (elevations based on a review of Google Earth Imagery).

The height of the quarry face is currently approximately 12 m. Topography beyond the existing quarry face rises upward to the northern extent of the Study Area. A gentle upgradient slope will be maintained during expansion to control runoff, and no excavation will occur within the existing quarry floor. Proposed quarry activities will not result in excavation deeper than the existing quarry floor (i.e. a pit), rather, additional carving of the existing quarry face into the side of the incline will occur, thus limiting groundwater interaction. The potential for interaction with groundwater within the QDA is discussed in more detail in Section 5.3.4.

The rate of expansion has been designed based on Zutphen's expectation of local aggregate need over the next 20-25 years. As such, the specific rate of expansion is estimated, and could vary from those defined in this document. The estimated size of the QDA (i.e. the expansion area) within the 20-25 year period is 9.3 ha.

Approximately half of the QDA has been historically cleared of vegetation, with the remaining half comprising mature hardwood forested habitat. As the quarry expands, grubbing in forested areas will be completed as necessary, and will be limited to minimize exposed soil and potential for erosion. Apart from where land is already cleared, clearing of vegetation at the top of the existing quarry face will be limited to areas planned for imminent quarrying (i.e. the following 2 years). Topsoil and overburden removed during this process will be added to existing stockpiles present in the existing quarry.

2.5.2 Quarry Components

Existing quarry infrastructure will remain in place during expansion within the QDA and no new quarry infrastructure is anticipated. Existing aggregate piles, topsoil piles, and overburden piles that currently exist may be relocated within the quarry floor as expansion progresses. The scale and the scale house are and will continue to be located on the western quarry access road at the intersection with Coxheath Road.

2.6 Decommissioning and Reclamation

Decommissioning will involve the removal of all garbage, equipment and all structures from the quarry property.

Reclamation at the Gillis Lake Quarry will aim to control erosion and sedimentation, restore soil capability, contour, and revegetate. The end land use objectives are based on pre-development site conditions to the extent possible, and the reclaimed site will plan to support the land uses that were present prior to quarrying occurring (i.e. undeveloped, forested land). The management of surface water will be part of the reclamation plan, including potential removal of drainage systems and encouragement of naturalized surface water flows upon vegetated land. A determination as to whether settling ponds will remain, and/or be modified to naturalize into the reclaimed landscape will be made during reclamation planning.

Progressive reclamation will occur where practical, to areas where aggregate resources are exhausted. However, the majority of reclamation is planned to occur in conjunction with decommissioning, towards and at the end of the operational window. Reclamation will involve identification of short and long-term goals and options for the site including, but not limited to the spreading of grubbing piles, sloping, surface contouring, establishing drainage, and revegetation. Reclamation will be completed in accordance with the Nova Scotia Pit and Quarry Guidelines (NSDEL, 2009) to the satisfaction of NSE and other regulatory departments.

Interim reclamation plans will be completed at the request of NSE as per IA requirements.

2.7 Anticipated Schedule of Activities

The following milestone schedule (see Table 2-1) outlines the Project schedule.

Table 2-1. Schedule of Project Activities

Task	Anticipated Completion Date
Environmental Studies	Fall 2018, Spring and Summer 2019.

Task	Anticipated Completion Date
Public Engagement	November 5, 2019 (Information Session). On-going throughout the Project to inform Project design and activities.
Environmental Assessment Registration	December 2019
Expected EA Decision	Spring 2020
Provincial Permitting (Industrial Approval)	Current IA (Approval # 2010-075178-01) for PIDs 45155058, will require amending upon issuance of EA Approval.
Quarry Expansion Window	2020 - 2045 (25 years)
Reclamation	Progressive with quarry operations and during decommissioning

2.8 Purpose and Need for the Undertaking

The purpose and need of the undertaking is to allow Zutphen to expand their existing quarry and to supply the local market with aggregate for a wide variety of construction projects in Cape Breton.

The Project will allow for continued employment at the quarry and will continue to be an important addition to Nova Scotia's natural resource sector.

2.9 Consideration of Alternatives

The consideration of alternatives analyzes different ways in which the Project can be carried out. These include alternate sites, alternate extraction methods, alternative transportation modes and routes etc.

The proposed expansion is located at the existing Gillis Lake Quarry which abuts a former aggregate quarry immediately to the south. Therefore, Zutphen has complete confidence that the site provides suitable aggregate for its purpose. The proposed expansion area is restricted to impacting only a small area (~9.3 ha) of which 4.6 ha are natural forested land, with the remaining area characterized as disturbed. The expansion will take place over a 20—25 year time period, and apart from one unhabituated cabin (archery club), the QDA is setback from residential dwellings (815 m is the closest from the QDA). Gillis Lake Quarry has a proven track record for successfully operating a quarry at this location which reduces the uncertainty of ongoing future quarrying activities and site management.

Few alternatives exist for the methods related to aggregate extraction and crushing. The rock type found within the Study Area requires drilling and blasting to make it available for processing, and these techniques have not presented issues environmentally, or to the public to date (*Note: some public*

comments were made at the Public Information Session regarding audible blasts in the past, but no issues related to groundwater supply or impacts to adjacent structures have been received to date).
As discussed in Section 2.4.6, the Gillis Lake Quarry is located on Coxheath Road. As understood from members of the public at the Public Information Session (Section 8.1), haul trucks either travel east towards Blackett's Lake, or west and then south along Gillis Lake Road towards Highway 4. There is no reason to believe that the quarry expansion will alter the routes that haul trucks currently travel.

The proposed expansion of the Gillis Lake Quarry lies within the remaining area of unquarried property owned by Zutphen. As discussed in this document, it has been determined that the remaining portion of the property does not comprise any significant constraints related to the expansion plans. Therefore, alternative options (i.e. development of a new quarry on undeveloped land) are not considered viable in comparison to the one presented in this document. The Project represents the best option in regard to minimizing environmental impact balanced with the economics of the Project.

3 ENVIRONMENTAL ASSESSMENT SCOPE

The Nova Scotia *Environment Act* and Environmental Assessment Regulations regulate provincial environmental assessments. The Gillis Lake Quarry Expansion Project requires a provincial environmental assessment registration as it is considered a *Class I* undertaking under Section 9(1) of the Nova Scotia Environmental Assessment Regulations.

3.1 Site Sensitivity

The Study Area is not located in any protected or conservation areas within federal, provincial, or municipal jurisdiction. Figure 5 (Appendix A) shows the Study Area and surrounding significant habitats and conservation areas. The Nova Scotia Provincial Landscape Viewer (NSDNR, 2016a) and desktop review identified the following:

- A mapped Significant Habitat for nesting common loon (CB213) is located in Gillis Lake, 1 km northwest of the Study Area. Common loon (*Gavia immer*) is listed as S4B,S4N by the Atlantic Canadian Conservation Data Centre (ACCDC) and is therefor not a priority species.
- A mapped Significant Habitat for wintering white-tailed deer (CB18) is located 1.6 km northeast of the Study Area. White-tailed deer (*Odocoileus virginianus*) is listed as S5 by the ACCDC and is therefore not a priority species.
- A mapped Significant Habitat for nesting bald eagle (CB41) is located 2 km southwest of the Study Area. Bald eagles (*Haliaeetus leucocephalus*) are listed as S5 by the ACCDC and are therefore not priority species.
- A mapped Significant Habitat for a bat (CB821) is located in Sydney Forks, 2.3 km east of the Study Area. Observations from 2014 and 2015 indicate that a bat was seen exiting the roof trim of a house. The type of bat species is unknown.

- The closest NSE Wetland of Special Significance is located 2.1 km southwest and 2.2 km southeast of the Study Area along the shore of the Bras D'Or Lake.
- Barachois Provincial Park is located approximately 9 km northwest of the Study Area.
- Ben Eoin Provincial Park is located approximately 11 km southwest of the Study Area.
- Stillwaters Wildnerness Area is located approximately 24 km southeast of the Study Area.
- The Study Area is within the Cape Breton Island lynx range and a lynx buffer is located approximately 0.6 km north.
- The Big Glace Bay Lake Migratory Bird Sanctuary and Big Glace Bay Important Bird Area are located 36 km northeast of the Study Area.
- The Central Cape Breton Highlands Important Bird Area (NS061) is 21 km northwest of the Study Area.
- The Harbour Rocks Important Bird Area (NS049) is 26 km southeast of the Study Area.
- The Rocks of Fourchu Head Important Bird Area (NS047) is 37 km south of the Study Area.
- The Northern Head and South Head Important Bird Area (NS053) is 37 km east of the Study Area.
- The Scatarie Island Important Bird Area (NS052) is 43 km east of the Study Area.
- The Portnova Island Important Bird Area (NS006) is 46 km southeast of the Study Area.

3.2 Priority Species

Assessment of wildlife, vegetation, and habitat was completed based on the requirements outlined in the Nova Scotia Environment (NSE) *Guide to Addressing Wildlife Species and Habitat in an EA Registration Document,* (NSE, 2009). A Priority Species List was created in accordance with this guide as outlined below (NSE, 2009). The purpose of the Priority Species List is to identify a broad list of species which have the potential to be present within the Study Area, and to inform the field programs. The desktop priority list was based on general species habitat requirements and the broad geographic area that individual species are known to occur. The Priority Species List can be found in Appendix C.

Development of a priority list of species for each taxonomic group was completed based on a compilation of listed species from the following sources:

1) Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the *Federal Species-at Risk Act* (SARA). All species listed as Endangered, Threatened, or of Special Concern;
2) *Nova Scotia Endangered Species Act* (NSESA). All species listed as Endangered, Threatened, or Vulnerable; and,
3) Conservation Rank: All species designated as S1, S2 or S3 or any combination thereof (i.e. S3S4 is considered a Priority Species) as defined by the ACCDC.

Collectively, this group of species is known as priority species. This umbrella grouping includes species of conservation interest (SOCI) that are not listed species under provincial or federal legislation (i.e.

COSEWIC species and ACCDC S1, S2 and S3 species or any combination thereof (i.e. S3S4 is considered a Priority Species)), and Species at Risk (SAR) which are listed on SARA or NSESA.
To determine if a bird is a priority species, breeding bird status qualifiers (as defined by the Maritime Breeding Bird Atlas [MBBA]) were used to determine whether a species is a priority species, based on the time of year in which the species was observed. For instance, a bird with a status rank (S-Rank) of S2S3B,S5N is considered a priority species if observed during the breeding season. If observed outside of breeding season, this species would not be considered a priority species. However, if the species was observed outside of the breeding season, but ample breeding evidence was concurrently observed, it would then be considered as a priority species.

The Priority Species List is referenced across the various biophysical assessments and is provided in Appendix C. See Table 3-1 for S-Rank definitions.

Table 3-1. Provincial status ranks definition

S-rank	Definition
SX	**Presumed Extirpated** - Species or community is believed to be extirpated from the province. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.
S1	**Critically Imperiled** - Critically imperiled in the province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.
S2	**Imperiled** - Imperiled in the province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.
S3	**Vulnerable** - Vulnerable in the province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
S4	**Apparently Secure** - Uncommon but not rare; some cause for long-term concern due to declines or other factors.
S5	**Secure** - Common, widespread, and abundant in the province.
SNR	**Unranked** - Nation or state/province conservation status not yet assessed.
SU	**Unrankable** - Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
SNA	**Not Applicable** - A conservation status rank is not applicable because the species is not a suitable target for conservation activities.

S#S#	**Range Rank** - A numeric range rank (e.g., S2S3) is used to indicate any range of uncertainty about the status of the species or community. Ranges cannot skip more than one rank (e.g., SU is used rather than S1S4).
Not Provided	Species is not known to occur in the province.
Breeding Status Qualifiers	
Qualifier	**Definition**
B	Breeding - Conservation status refers to the breeding population of the species in the province.
N	Nonbreeding - Conservation status refers to the non-breeding population of the species in the province.
M	Migrant - Migrant species occurring regularly on migration at particular staging areas or concentration spots where the species might warrant conservation attention. Conservation status refers to the aggregating transient population of the species in the province.

The Priority Species List is referenced across the various biophysical assessments and is provided in Appendix C. More information on the Priority Species List is provided in Section 4.1.9.

In-text short lists for each of the species categories (vascular plants, lichens, mammals, etc.) were created using the Priority Species List and the ACCDC report to outline those SAR with the highest potential of occurring within the Study Area, based on habitat. These species are described in Section 5.6**.** below.

Databases provided by the Mersey Tobeatic Research Institute (MTRI) were assessed to identify the potential for priority lichen species including vole ears (*Erioderma mollissimum*) and boreal felt lichen. Additionally, the provincial government records of abandoned mine openings (AMOs) were reviewed as AMOs that are uncapped and unflooded may provide bat hibernacula. Lastly, the Nova Scotia Lands and Forestry significant species and habitats database was reviewed.

3.3 **Boundaries of the Assessment- Spatial and Temporal**

Spatial boundaries of the EA are defined by the Gillis Lake Quarry Expansion Study Area (Study Area) (Figures 2, Appendix A). The Study Area covers the entirety of PIDs 15853146 and 15212947 and was designed to buffer and surround the QDA for Gillis Lake Quarry. All assessments used this Study Area as the spatial boundary for assessment with the exception of the following, expanded area evaluations:

1. Local Catchment Areas (LCAs): These spatial boundaries were developed in support of the Water Balance analysis and include outfall locations that may sustain indirect hydrological effects as a result of the proposed Project (Figure 12, Appendix A, and Sections 4.1.8.3 and 5.5.3.3);
2. A Fish Habitat Assessment Area (FHAA) was developed to assess fish habitat within the downstream receiving aquatic environments (Figure 7, Appendix A), which includes the following surveys:
    a. Fish habitat assessments;
    b. Electrofishing and trapping; and,
    c. Water quality sampling;
3. The Cape Breton Regional Municipality was considered for the purpose of data collection relating to existing socioeconomic conditions and evaluation;
4. Potable wells located within a 1.0 km buffer of the QDA (Figure 10, Appendix A) were assessed as potential receptors to evaluate groundwater interaction. No residential buildings or potable wells exist within 800 m of the QDA.

The temporal boundaries of the EA include the construction (expansion), operation and maintenance, and decommissioning/reclamation phases of the Project, and associated activities.

3.4 Assessment Scope

The EA planning process allows for the prediction of environmental effects of a proposed Project and identifies measures to minimize and then mitigate potential adverse environmental effects. The EA attempts to predict significant residual adverse environmental effects once mitigation measures are implemented.

The EA focusses on specific environmental components called valued environmental components (VECs). VECs are specific components of the biophysical, socioeconomic, human health, and cultural environments. VECs are important to a local human population and can have a national or even international profile. VECs are important for the evaluation of environmental impacts of a proposed undertaking. The scope of the assessment for this Project included: the selection and assessment of potential VECs; evaluation of the potential VEC interactions with Project activities, identification of environmental effects, if any, for each VEC; and identification of thresholds to determine the significance of residual environmental effects.

3.4.1.1 *Standards or Thresholds for Characterizing and Determining Significance of Effects*

Criteria or established thresholds for determining the significance of residual effects from Project activities are described for each VEC in their corresponding subsection within Section 9.2. These criteria or thresholds were developed though using available information on the status and characteristic of each VEC, using applicable regulatory documents, environmental standards, guidelines, and/or objectives (i.e. IA approval requirements, and using professional judgement of the EA Study Team.

These criteria or thresholds establish a level beyond which a residual effect would be considered significant. Thresholds may be based on regulations, standards, resource management objectives, scientific literature, and/or ecological processes. Significance criteria has been defined quantitatively where possible and are measurable, and qualitatively with supporting justifications where no standards exist.

4 ENVIRONMENTAL ASSESSMENT METHODOLOGIES

The EA registration document for the Project describes the biophysical, social, and economic environment. All VECs were identified, and the potential for interaction between individual VECs and Project activities were determined. Methods to minimize and mitigate environmental effects resulting from the Project are provided in this document.

The Project team, through an evaluation of the VECs, identified Project environmental effects that, post-mitigation, have the potential for a residual effect on the environment. The significance of these residual effects was then determined and evaluated (Section 9.2).

This chapter details the following key aspects of the EA methodologies:

1. Biophysical: habitat, vegetation, lichen, wildlife, bats, birds, wetlands, surface water, fish habitat, and species at risk.
2. Archaeological Resource Assessment.

The social and economic environment was evaluated by reviewing background literature as well as communicating with local residents at the Public Information Session.

4.1 Biophysical Assessments

In March of 2018, field components of the biophysical EA were initiated. These field components continued through until November 2019 complying with the requirements for a *Class I* undertaking under Section 9(1) of the Nova Scotia Environmental Assessment Regulations. The field studies were focused on highlighting the ecological linkages within the Study Area, as well as with the habitats surrounding the Study Area. The field components included:

1. Avian baseline surveys: fall bird migration, spring bird migration, breeding bird, and common nighthawk surveys;
2. Botanical surveys (late and early) for Priority Species (including lichens);
3. Opportunistic herpetofauna, mammal and other taxonomic group surveys for Priority Species;
4. Wetland and watercourse identification and evaluation;
5. Fish habitat assessments, electrofishing, trapping;
6. Surface water sampling;
7. Habitat surveys; and,
8. Archaeological assessments- Phase I (Desktop) and Phase II (Field).

4.1.1 Habitat

The following are the desktop and field survey methodologies used during the habitat survey program.

4.1.1.1 *Desktop Review*
During September 2019, a desktop review was conducted using the available GIS forestry (NSDNR, 2016b) and wetland inventory layers (NSE, 2017). An approximate survey route (transect) was then determined by desktop review to cover all major forestry polygons present within the Study Area. To understand the community types that may be found in the Study Area during the field surveys, a desktop review of the Ecological Land Classification database was assessed to determine the ecodistrict and ecoregion the Study Area is within (NSDNR, 2015).

4.1.1.2 *Field Survey*
On September 25th, 2019, habitat assessments were completed within the Study Area by Ms. Amber Stoffer. Meandering transects within the Study Area were traveled by foot and habitat types were surveyed whenever noticeable habitat changes occurred. The surveyed locations are referred to as habitat assessment points (HAP) within this report. All wetland habitats within the Study Area were surveyed in detail during the wetland assessments and information regarding stand type and vegetative community structure in these features was documented. Therefore, the habitat assessment surveys only consisted of assessing upland habitat types. Vegetation Types (VT) and ecosite types were recorded at each survey location as per the Forest Ecosystem Classification for Nova Scotia (FEC) guide (Neily, 2010).

During the assessments, the following information was documented:

- VTs were determined using Part 1 of the FEC guide (Neily, 2010). Each stand was classified by overall forest group code and VT using the keys provided in the guidebook. Forest groups are general groupings of VTs. Within each forest group (e.g. open woodland), there are several specific VTs. VTs are recurring and identifiable plant communities that reflect differences in site conditions, natural disturbance regimes and successional stage. For example, TH4 is a tolerant hardwood forest group dominated by sugar maple (*Acer saccharum*) and white ash (*Fraxinus americana*) VT, while TH6 is a tolerant hardwood forest group dominated by red oak (*Quercus rubra*) and yellow birch (*Betula alleghaniensis*) VT.
- Ecosite was determined using Part 3 of the FEC Guide (Neily, 2010). This guide provides keys to identify ecosite using an edatopic grid, which is a two-dimensional diagram used to plot ecosystems and ecosites based on their relative moisture and nutrient regimes. Ecosites are units representing ecosystems that have developed under a particular nutrient and moisture regime. A finite range of VTs will naturally grow in any given ecosite.
- Approximate stand age was determined through qualitative observations of multiple factors such as level of canopy coverage, microtopography and species composition of the understory herb and shrub layers
- Natural or anthropogenic disturbance is recorded in each site. The level and type of disturbance is identified. Examples of anthropogenic disturbances include timber harvesting or road

development. Natural disturbance regimes include fire, pests, wind throw and natural senescence.

- Representative photos were taken of each site.

It is also important to note that during the surveys there are some biases. The habitat survey methods and results are presented with the acknowledgment of three inherent biases found below:

- One bias is towards upland habitat. This bias was purposefully built into the survey methods with the understanding that all wetlands within the Study Area were delineated and described in detail and their function as habitats within the landscape of the Study Area would be captured in the wetland program.
- The second bias is towards forested landscape as opposed to non-forested landscapes. In this context, clear cut lands, or those that have experienced timber harvesting of any sort, are still considered forested because the removal of timber is only a temporary disturbance. Non-forested portions of the landscape, such as roads or extensive gravel areas, often associated with historic mine workings, were not assessed during the habitat survey simply because they lack forest cover to be described and their capability for supporting forest cover in the foreseeable future is low based on the level of disturbance.
- The third bias in this survey is that habitat surveys were completed at discrete points and no effort was made to delineate the extent of that habitat type around those points. As such, the ability to extrapolate habitat survey results across the entire Study Area is limited. These habitat survey points are meant to describe habitat in 'snapshots' of specific locations and are completed to provide a summary of habitats present within the Study Area. They also inform specific biophysical field surveys. The results of the habitat survey are meant to describe the diversity of habitat types present throughout the Study Area and the relative abundance thereof, rather than absolute percent cover of each habitat type throughout the Study Area.

4.1.2 Vascular Plants

The following desktop and field survey methodologies were implemented during the vascular plant survey program and are discussed below.

4.1.2.1 *Desktop Review*

Prior to undertaking the field assessment, a detailed desktop review of known vascular plant observations and potential habitat for rare plants within the Study Area was conducted. The desktop review process involved three components: a review of the ACCDC database results, a review of mapped wetland habitat and a review of the Priority Species List.

4.1.2.2 *Field Survey*

The dedicated vascular plant surveys involved two surveys, one early (June 25, 2019) and late (September 4-5, 2019) to capture plant species with different flowering periods. Incidental observations, particularly priority species, were recorded during the suite of the biophysical surveys conducted in 2018 and 2019. Surveys were conducted by Mr. John R. Gallop.

Meandering transects were completed on foot and all major habitat types were assessed to create a species list of the general vascular species and communities present within the Study Area. The Priority Species List was referenced during the surveys and species on that list were targeted. Survey efforts were focused on wetlands and floodplain habitats often have an increased potential for rarities. The edges of the quarry clearings were also assessed with detail as priority species such as the variegated horsetail (*Equisetum variegatum*) are often associated with these habitats.

All priority species observed were georeferenced, counted (when possible), photographed, and their habitat was recorded. When specimens were present in tufts or in large numbers and counting the individuals became a challenge, the areas of these clumps were measured (e.g. 10 m x 10 m). The following literature are the primary references used during the field surveys and identification process:

- Roland's Flora of Nova Scotia (Zinck, 1998)*;*
- Nova Scotia Plants (Munro, Newell, & Hill, 2014); and
- Flora of New Brunswick (Hinds, 2000).

4.1.3 <u>Lichens</u>

The following are the desktop and field survey methodologies implemented during the lichen survey program.

4.1.3.1 *Desktop Review*

Prior to undertaking the field assessment, a detailed desktop review of known lichen observations and potential habitat for rare lichens within the Study Area was conducted. The desktop review process involved a review of the following: the ACCDC database results; the Nova Scotia Department of Natural Resources (NSDNR) predictive habitat mapping for boreal felt lichen (*Erioderma pedicellatum*); the MTRI Vole Ears and Extant boreal felt lichen (BFL) GIS databases; and the Priority Species List.

4.1.3.2 *Field Survey*

While the specific habitat requirements for each priority lichen species varies, many require mature to over-mature forests; stand age is one of the greatest determinants of the presence of many rare epiphytic lichens (McMullin *et al.*, 2008). Lichen surveys throughout the Study Area were focused on mature stands, which are located primarily in a central patch, along the Study Area boundaries, and in the north.

All suitable habitats within the Study Area were surveyed on September 4th – 5th, 2018 and June 25th, 2019 John R. Gallop. Mature trees appropriate for hosting priority lichen species were visually inspected by focusing on tree trunks, branches and twigs. The following information was collected for any priority lichen species identified during field surveys: site location, date, scientific name, count, size, habitat (host tree and general habitat), location (waypoint in UTM NAD83), height of the specimen, direction that the specimen was facing, along with a photograph and any relevant comments. A general list of common lichens was also recorded with focus on macrolichens (i.e. foiliose, fruticose, squamulose).

In the event that a lichen specimen could not be readily identified in the field, photos and/or specimens were collected and identified at a later date. If necessary, collected samples were inspected with microscopy and standard chemical spot tests in accordance with Brodo *et al*. (2001) to identify the species. The following literature was referenced during the surveys and identification process:

- The Macrolichens of New England (Hinds & Hinds, 2007);
- Lichens of North America (Brodo, I.M., Sharnoff, S.D., & Sharnoff, S., 2001);
- Keys to Lichens of North American – Revised and Expanded (Brodo, Sharnoff, & Sharnoff, 2016);
- Microlichens of the Pacific Northwest – Volume 1 – Key to The Genera (McCune, 2009a);
- Microlichens of the Pacific Northwest – Volume 2 – Key to the Species (McCune, 2009b); and
- Common Lichens of Northeastern North America (McMullin & Anderson, 2014).

4.1.4 Wildlife

The following desktop and field survey methodologies were implemented during the wildlife survey program and are discussed below.

4.1.4.1 *Desktop Review*

A desktop review was conducted using the available GIS forestry database (NSDNR, 2016b) to determine the forest cover types within and surrounding the Study Area. In addition, the Canada lynx range and the lynx buffer Special Management Practice (SMP) zone layers were used on the Nova Scotia Provincial Landscape Viewer to determine if Canada lynx (*Lynx canadensis*) predictive buffers were within and/or in close proximity to the Study Area.

4.1.4.2 *Field Surveys*

Based on the desktop review of Canada lynx habitat and elevation within the Study Area, it was decided that species-specific surveys were not required (see Section 5.6.4 for more detail). Desktop review indicated limited habitat potential for priority herpetofaunal species, therefore, no targeted herpetofauna surveys were undertaken. Incidental observations of all wildlife across the Study Area were documented during all field surveys completed through 2018 and 2019.

4.1.5 Avifauna

The following desktop and field survey methodologies were implemented during the avifauna survey program and are discussed below.

4.1.5.1 *Desktop Review*

A review of the Canada Important Bird Areas database, ACCDC, Maritime Breeding Bird Atlas (MBBA) square 20QS00, and Canada Wildlife Service Migratory Bird Sanctuary (MBS) was completed to support bird survey design and methodology.

4.1.5.2 *Field Surveys*

Avian field monitoring programs were completed by MEL personnel and professional birder Mr. Chris Pepper and included the following surveys:

- Fall migration (September 5 and September 26, 2018);
- Spring migration (May 6 and May 30, 2019);
- Breeding bird (June 17 and June 25, 2019);
- Common nighthawk (June 16 and 24, 2019); and
- Winter surveys (to be completed during the 2019/2020 season).

Surveys took place at eight point count (PC) locations throughout the Study Area in a variety of habitats including forested, riparian edge, forested trail, and tolerant hardwood forest (Figure 6, Appendix A). Surveys began at, or within, half an hour of sunrise and were completed within four-and-a-half hours or by 10:00 a.m., whichever came first. Ten-minute point counts were completed at each survey location. During each survey, weather conditions (i.e., precipitation and visibility) were monitored and bird observations were recorded at four distance regimes: within a 50m radius, 50 to 100 m radius, outside the 100m radius, and flyovers. At each PC, a handheld Global Positioning System (GPS) unit was used to geo-reference the location. General observations including the temperature, visibility, wind speed, date, start and end time were also recorded. Bearings were taken for priority species observed during dedicated survey periods and incidentally.

Bird species were identified based on functional bird groups to understand how each group of birds is using the Study Area. These functional groups include:

1. **Waterfowl:** Ducks, geese, or other large aquatic birds, especially when regarded as game;
2. **Shorebirds**: Waders, from the Order Charadriiformes;
3. **Other waterbirds**: Includes seabirds (i.e. marine birds), grebes (Order Podicipediformes), loons (Order Gaviiformes), Ciconiiformes (i.e. storks, herons, egrets, ibises, spoonbills, etc.), pelicans (Order Pelicaniformes), flamingos (Order Phoenicopteriformes), Gruiformes (i.e. cranes and rails), kingfishers. gulls and dippers (the only family of passerines considered waterbirds);

4. **Diurnal Raptors**: Birds within the families Accipitridae (i.e. hawks, eagles, buzzards, harriers, kites and old-world vultures), Pandidonidae (i.e. Osprey), Sagittariidae (i.e. Secretary bird), Falconidae (i.e. falcons, caracaras, and forest falcons), Cathartidae (i.e. new world vultures), and one species from the Order Strigiformes (i.e. Hawk Owl);
5. **Nocturnal Raptors**: Birds of the Order Strigiformes (i.e. owls; with exception of the Hawk Owl, which is a diurnal species of owl);
6. **Passerines**: Any bird of the Order Passeriformes, which includes more than half of all bird species. This is with exception of the dippers, which are a passerine considered a waterbird; and,
7. **Other Landbirds**: Birds within the Orders Galliformes (i.e. quail, pheasant, and grouse), Columbiformes (i.e. pigeons and doves), Cuculiformes (i.e. cuckoos), Caprimulgiformes (i.e. nighthawks and whip-poor-wills), Apodiformes (i.e. swifts and hummingbirds), and Piciformes (i.e. woodpeckers, flickers and sapsuckers).

4.1.5.2.1 Breeding Birds

The breeding status of the bird species observed during breeding bird surveys were also recorded. The surveyor noted on bird behavior observed, including distraction display, carrying food, and carrying nesting material. The following are the types of breeding evidence and status (MBBA, 2008) recorded during the breeding bird surveys:

- Observed- species observed in its breeding season;
- Possible- species observed during breeding season in suitable nesting habitat or singing males or breeding calls heard, in suitable nesting habitat during breeding season;
- Probable- agitated behavior observed or the occurrence of an adult bird, at the same place, on at least two days a week during breeding season; and
- Confirmed- adult carrying food or distraction display.

4.1.5.2.2 Common Nighthawk

The common nighthawk (*Chordeiles minor*) prefers to nest in gravelly substrates and is best detected while foraging for insects shortly after sunset (MBBA, 2008). Suitable habitat is available for this species within the Study Area (i.e. existing quarry area, cutblocks, and roadside clearings), therefore dedicated surveys for the common nighthawk were conducted two evenings at the end of June, 2019. Two PCs were surveyed by MEL personnel on June 16 and 24, 2019 (Figure 6, Appendix A). The PCs are situated within the Study Area adjacent to existing quarry habitat. Each PC survey consisted of a three-minute passive surveying period, followed by three minutes of alternating 30-seconds call playback of the conspecific common nighthawk call and 30-seconds of silence (passive surveying) as per survey protocol by Saskatchewan Ministry of Environment (2015).

4.1.5.2.3 Winter Survey

Winter surveys will take place during the 2019/2020 season. All avifauna observed during these surveys will be noted.

4.1.6 Wetlands

The NS Environment Act defines wetlands as:

> *Land referred to as a marsh, swamp, fen, or bog that either periodically or permanently has water table at, near, or above the land surface or that is saturated with water, and sustains aquatic processes as indicated by the presence of poorly drained soils, hydrophytic vegetation, and biological activities adapted to wet conditions.* (Environment Act, 2006)

Wetland functions are the natural processes associated with wetlands and include, but are not limited to water storage, pollutant removal, sediment retention and provision of nesting/breeding habitat. Functions may also include values and benefits associated with these natural processes and include aesthetics/recreation, cultural values, and subsistence production. The discussions of wetlands presented herein primarily uses terminology associated with the Canadian Wetlands Classification System (Warner and Rubec, 1997) or in line with the methodologies adapted by Nova Scotia for wetland delineation and functional assessment.

The following desktop and field survey methodologies were implemented during the wetland survey program and are discussed below.

4.1.6.1 *Desktop Review*

A background desktop review of available topographic maps, appropriate provincial databases and aerial photography was completed to aid in determination of wetland habitat in the Study Area. The Wet Areas database, the Nova Scotia Environment (NSE) Wetlands database, and the NSE Wetlands of Special Significance (WSS) database were all reviewed.

4.1.6.2 *Field survey*

Meandering transects were completed within the Study Area to identify wetland habitat in September, 2019. Wetland boundaries were determined as described by the US Army Corps of Engineers, adapted for the Northcentral and Northeast Regions of the US (US Army Corp of Engineers, 2012) based on topography, soil, hydrology, and vegetation.

In keeping with the Army Corps of Engineers methodologies for wetland delineation, three criteria are required in order for a wetland determination to be made:

- Presence of hydrophytic (water loving) vegetation;

- Presence of hydrologic conditions that result in periods of flooding, ponding, or saturation during the growing season; and
- Presence of hydric soils.

4.1.6.2.1 *Hydrophytic Vegetation Methodology*

Hydrophytic vegetation is defined as the total of macrophytic plant life that occurs in areas where the frequency and duration of inundation or soil saturation produce permanent or periodically saturated soils of sufficient duration to exert a controlling influence on the plant species present (Environmental Laboratory, 1987). Hydrophytic vegetation should be the dominant plant type in wetland habitat (Environmental Laboratory, 1987).

Dominant plant species observed at each data point location were classified according to their indicator status (probability of occurrence in wetlands), in accordance with the Nova Scotia Wetland Indicator Plant List. Further relevant information was reviewed in Flora of Nova Scotia (Roland, 1998; Munro, Newell, and Hill, 2014).

If the majority (greater than 50%) of the dominant vegetation at a data point is classified as obligate (OBL), facultative wetland (FACW), or facultative (FAC) (excluding FAC-), then the location of the data point is considered to be dominated by hydrophytic vegetation.

4.1.6.2.2 *Wetland Hydrology Methodology*

Wetland habitat, by definition, has a water table at, near, or above the land surface or that is saturated with water either periodically or permanently. To be classified as a wetland, a site should have at least one primary indicator or two secondary indicators of wetland hydrology. Examples of primary indicators of wetland hydrology include: water marks, drift lines, sediment deposition, and water stained leaves. Examples of secondary indicators of wetland hydrology include oxidized root channels, dry season water table, and stunted or stressed plants.

4.1.6.2.3 *Hydric Soils Methodology*

A hydric soil is defined as a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (USDA-NRCS, 2003). Indicators that a hydric soil is present include the following: soil colour (gleyed soils and soils with bright mottles and/or low matrix chroma), aquic or preaquic moisture regime, reducing soil conditions, sulfidic material (odour), soils listed on the hydric soils list, iron and manganese concretions, organic soils (histosols), histic epipedon, high organic content in surface layer in sandy soils, and organic streaking in sandy soils.

A soil pit was completed at each data point location. These pits were excavated to a maximum depth of 50 cm or refusal. The soil in each was then examined for hydric soil indicators. The matrix colour and mottle colour (if present) of the soil were determined using the Munsell Soil Colour Charts.

Wetland boundaries and watercourse routes were recorded on a Garmin GPSMAP 64s (capable of sub-5m accuracy) and a SXBlue II GPS receiver unit (capable of sub-1m accuracy) with hand-held SXPad field computer. The delineated wetlands were flagged with pink flagging tape. Data points were completed in and adjacent to wetlands identified within the Study Area to determine wetland/upland boundaries.

4.1.6.2.4 Wetland Functional Assessment

Wetland functional assessment was completed for each wetland identified within the Study Area using the Wetland Ecosystem Services Protocol - Atlantic Canada (WESP-AC) wetland evaluation technique. The WESP-AC process involves the completion of three forms; a desktop review portion that examines the landscape level aerial conditions to which the wetland is situated, and two field forms. The process serves as a rapid method for assessing individual wetland functions and values. WESP-AC addresses 17 specific functions that wetlands may provide. The specific wetland functions are individually allocated into grouped wetland functions and measured for “function” and “benefit” scores. Wetland function relates to what a wetland does naturally (i.e., water storage), whereas wetland benefits are benefits of the function, whether it is ecological, social, or economic. The highest functioning wetlands are those that have both high function and benefit scores for a given function. WESP-AC enables a comparison to be made between individual wetlands within the Province to gain a sense of the importance each has in providing ecosystem services.

4.1.7 Surface Water

The Environment Act (2006) defines a watercourse as:

> “*Any creek, brook, stream, river, lake, pond, spring, lagoon, or any other natural body of water, and includes all the water in it, and also the bed and the shore (whether there is actually any water in it or not)”*.

The following desktop and field survey methodologies were implemented during the surface water survey program and are discussed below.

4.1.7.1 *Desktop Review*

The goal of the surface water desktop evaluation was to identify where watercourses, waterbodies, and drainage features may be located within or in proximity to the Study Area based on mapped systems, topography, and satellite imagery, while also identifying where the Study Area lies within primary and secondary watersheds. Prior to completing the field evaluation, MEL reviewed all Nova Scotia

Topographic Database (NSTDB) mapped watercourses and waterbodies, provincial flow accumulation data, and depth to water table mapping to identify potential surface water features within the Study Area.

4.1.7.2 *Field Surveys*

Watercourse delineation and site drainage characterizations were completed throughout the Study Area in conjunction with wetland delineation and evaluation in September 2018, with follow-up surveys completed in September and November 2019.

During the field evaluations, MEL used NSE guidance on watercourse determinations to identify watercourses (NSE, 2015). The following parameters were used to define watercourses:

- Presence of a mineral soil channel;
- Presence of sand, gravel and/or cobbles evident in a continuous pattern over a continuous length with little to no vegetation;
- Indication that water has flowed in a path or channel for a length of time and rate sufficient to erode a channel or pathway;
- Presence of pools, riffles or rapids;
- Presence of aquatic animals, insects or fish; and,
- Presence of aquatic plants.

According to guidance provided by NSE, any surface feature that meets two of the criteria above meets the definition of a regulated watercourse. Using these criteria, regulated watercourses were mapped in the field using either a Garmin GPSMAP 64s (capable of sub-5m accuracy) or a SXBlue II GPS receiver unit (capable of sub-1m accuracy) with hand-held SXPad field computer. Watercourses were flagged using blue flagging tape, and a watercourse description form was completed for each homogenous reach.

4.1.7.2.1 *Surface Water Quality*

Surface water samples were collected by MEL personnel on September 25, 2019 and November 6, 2019 at five locations as indicated on Figure 7. One sample was collected within WC1, two samples within MacDonalds Brook, and two samples within Portage Brook.

Water samples collected at sampling location WQ2 (Figure 7, Appendix A) is sourced from overland drainage from undeveloped, forested land west of and along the Study Area; however, WC1 also acts as the principal receiver of quarry drainage from the existing quarry footprint, both from the quarry access road along the western study area boundary, and from a the network of on-site drainage ditches and settling ponds as described in Section 2.4.3. This unnamed watercourse drains into Portage Brook which is located south of Coxheath Road. Water sample WQ4 and WQ5 (collected in MacDonalds Brook) are reflective of upstream and downstream conditions from the undeveloped, proposed quarry expansion area located to the west of the stream. The existing quarry footprint extends to within approximately 315 m of sampling location WQ4, and 125 m of sampling location WQ5; however, MacDonalds Brook does not currently receive direct surface water inflow from the existing quarry area. As such WQ4 and WQ5 are considered to represent natural, baseline conditions. Water samples collected in Portage Brook (WQ1 and WQ3 on Figure 7, Appendix A) are reflective of upstream and downstream conditions from the existing quarry footprint but are also expected to reflect upstream and downstream conditions from the proposed QDA.

All water samples were kept cool and were transported to Bureau Veritas Laboratories in Bedford, Nova Scotia for processing. The five surface water samples were analysed for RCAp-MS total metals and RBCA hydrocarbons in water. Table 4-1 provides the locations of the five surface water samples. These samples are considered representative of baseline water quality conditions in water features within or receiving water from the Study Area. Repeat sampling at these locations can occur as part of on-going surface water monitoring programs for the Project during construction and operation. Baseline water quality data is provided in Appendix F. Surface water sample results have been compared to the Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life for Freshwater (FWAL) guidelines.

Table 4-1: Surface Water Samples Locations

Sample ID as per Figure 7	Sample Location Description	Sample Location (UTM, 20T)
WQ1	Portage Brook, downstream (east) of WC1.	703572, 5102552
WQ2	WC1, south of Study Area boundary.	703427, 5102503
WQ3	Portage Brook, upstream (west) of WC1.	703376, 5102427
WQ4	MacDonalds Brook, upstream (northeast) of WC4.	702991, 5103486
WQ5	MacDonalds Brook, downstream (southeast) of WC4/WC5.	703187, 5103168

4.1.7.2.2 Water Quality Measurements

Water quality parameters were measured *in-situ* by MEL personnel using a calibrated YSI Professional Plus Multi-Probe during low-flow water quality sampling on September 25, 2019. Parameters recorded include dissolved oxygen (DO), water temperature, pH, specific water conductivity (SPC), and total dissolved solids (TDS).

4.1.7.3 *Water Balance*

A water balance was completed by GHD to support the determination of predicted effects on surrounding surface waterbodies caused by development within the QDA. The Water Balance Analysis report is provided in Appendix E. General tasks completed as part of this assessment are indicated in Table 4-4.

Utilizing the methodology described below, the water balance assessment can be used to determine the yearly changes to flow composition during an average year for two site conditions: baseline and end of quarry (EOQ). In addition, two infiltration scenarios were modelled: existing infiltration (most likely infiltration) and 100% impervious. The percentage changes in area, runoff and infiltration from existing conditions to EOQ conditions was used to predict potential changes in discharge flow to downstream surface water features (watercourses).

Table 4-2 outlines the tasks that were performed in support of the water balance analysis.

Table 4-2: Water Balance Tasks

Task	Details
1. Quarry Development Assumptions	The following assumptions associated with the expansion/development of the Project were identified in support of the water balance: - Surface water from the QDA will continue to be directed southeastward through the series of existing (and updated where necessary) drainage ditches and settling ponds throughout the lifetime of the Gillis Lake Quarry, and post quarry closure (i.e. post reclamation). - All inflow to the settling pond adjacent to Coxheath Road discharges to Portage Brook at a controlled discharge rate. - Three catchment areas existing and/or potentially affected by the proposed Projecthave been developed within and surrounding the Study Area. Three aquatic features (Portage Brook, WC1, and MacDonalds Brook) which have been identified to directly receive water from each of the catchments, have been assessed as part of the water balance and associated Effects Assessment. - For the purposes of the water balance assessment, the model integrates two land drainage characteristics: o Existing infiltration (most likely infiltration); and o 100% impervious - Changes to surface water discharge volume <u>within the quarry area</u> as a result of the quarry expansion is calculated after infiltration, evaporation and evapotranspiration have occurred.
2. Climate Data Collection	Precipitation totals were obtained from the Environment Canada Sydney A Climate Station (Climate ID 8205700) from 1981-2010 to determine evapotranspiration normals, precipitation and temperature values.

Task	Details
3. Define Catchment Areas	Three catchment areas in lands surrounding the Study Area were delineated using aerial imagery, field investigation and topographical mapping data from the Nova Scotia Topographic Database (NSTDB). Catchment areas were defined based on the two quarry life cycles phases 1) Baseline conditions and 2) EOQ conditions.
4. Determination of Infiltration Factor	Each watershed was individually analyzed to determine the slope, land use and soil type drainage factors in development of the infiltration scenarios used. As discussed in Appendix E, two scenarios were used: an impervious quarry floor where no infiltration occurred through the bed of the quarry; and a pervious quarry floor consisting of similar infiltration capabilities to existing surficial soils (Sandy Loam). EOQ conditions were generally expected to be similar to existing conditions with the exception of integrating the Flat Land and Cultivated Land slope and soil conditions within the water balance model, in the area where the quarry was located.

Data Inputs

Data inputs for the monthly water balance analysis included catchment areas, precipitation data, potential evapotranspiration (PET), topography and soil, and land cover data which was used to calculate monthly infiltration for pervious surfaces:

- Three catchments were delineated;
- 30-year precipitation normals (1981 – 2010) were obtained from the Environment Canada Sydney A Climate Station (Climate ID 8205700);
- Potential evapotranspiration (PET) was calculated using Hamon Equation (1961) as described in *A Monthly Water Balance Model Driven By a Graphical User Interface* (USGS Report No. 2007-1088;
- Soil information was obtained from the Soil Survey of Cape Breton; and,
- Land cover was determined from aerial imagery in Google Earth.

The monthly water balance analysis follows the methodology by Thornthwaite (1948) and Mather (1978). For pervious areas (natural/undisturbed), infiltration and surface runoff depths are calculated as fractions of the 'surplus' of water from the soil storage, while for impervious areas (quarry), direct runoff depth is assumed to be equal to precipitation depth. The calculations are performed at a monthly time step for a unit area, and the final results are multiplied by catchment area to determine infiltration and surface runoff volumes.

The water balance modelling approach does not quantify recharge to the groundwater system, baseflow, or total streamflow, rather it calculates infiltration and surface runoff volumes. The infiltration component combines both interflow (lateral water flow) and groundwater recharge. The results of this analysis are used to assess the monthly change in infiltration and surface runoff volume to the three aquatic features throughout the quarry expansion.

4.1.8 Fish Habitat

4.1.8.1 *Desktop Review*

The Priority Species List, as defined in Section 5.6 was used to identify priority fish species that may occur in the Study Area. Information on confirmed and potential fish presence within the Study Area and surrounding surface water features was collected form the following sources:

- ACCDC Report (as presented in Appendix C);
- NSL&F Significant Species and Habitats database;
- Fisheries and Oceans Stock Status Reports;
- Description of Selected Lake Characteristics and Occurrence of Fish Species in 781 Nova Scotia Lakes (Alexander *et al*., 1986);
- Freshwater Fish Species Distribution Records (NSDFA, 2019); and
- NSDFA Lake Inventory Maps.

4.1.8.2 *Field Surveys*

4.1.8.2.1 Fish Habitat Characterization

Fish habitat characterization was completed by MEL biologists for all delineated watercourses in the Study Area in September 2019. The methods to complete habitat characterization were adopted from the Nova Scotia Fish Habitat Assessment Protocol (NSLC, 2017). Watercourse characterization included a visual assessment of substrate, cover, riparian habitat, and physical channel measurements (depth, wetted and bankfull widths). Observations were made on fish habitat quality for each species documented and fish habitat potential for each identified feature, including a description of any potential barriers to fish access.

A broader Fish Habitat Assessment Area (FHAA) was established to identify the effects of the Project on two additional watercourses: MacDonalds Brook and Portage Brook. Additional detailed surveys were completed in September 2019 that included fish surveys (discussed in Sections 4.1.8.2.2 and 4.1.8.2.3), water quality measurements (discussed in Section 4.1.7.2.2), and fish habitat characterization of these two watercourses, as they currently intercept surface water sourced from within the Study Area.

During the fish habitat characterisation evaluation, a determination of fish passage barriers was also completed. According to Bourne et al. (2011), and Fullerton et al. (2010), barrier passability for fish can be difficult to define and measure, as it combines the physical characteristics of a barrier with fish physiology in a dynamic environment. Much of the literature surrounding barriers to fish passage is related to anthropogenic features such as culverts (i.e. Bourne et al., 2011; Fisheries and Oceans Canada, 2015), or natural barriers such as waterfalls (i.e. Government of British Columbia, 1998), but specific assessments for passability of subterranean watercourses or boulder-fields are limited.

Parameters which affect passability for commonly researched barriers such as waterfalls or culverts can be applied to other types of barriers such as subterranean reaches. Features such as the species of interest and their swimming capability, the variability in stream flow, length of the barrier, slope, drop height and outflow pool are all to be taken into consideration when determining the passability of a barrier. Throughout baseline watercourse mapping and fish habitat surveys, an assessment of potential fish passage barriers was completed. When a potential barrier is encountered, biologists recorded the type of barrier, height and length of the barrier, depth of water, along with an estimate of slope where relevant. The contiguity and spatial relationships of discontinuous pools are described, with the intent of understanding a fish's ability to move from one step-pool or isolated pool to another.

Hydrology indicators are used to identify evidence of flow if an initial assessment occurs during a period of low flow. Some examples of hydrology indicators used include water marks on trees, sediment deposits, drift deposits, algal mats, sparsely vegetated concave surface, water-stained leaves, surface soil cracks, drainage patterns, or moss trim lines. Vegetation communities can provide indication of flow (or absence thereof) as well. The presence of some species provide evidence of flowing water, even if the water level has subsided. These include but are not limited to species such as bur-reed (*Sparganium spp.)*, royal fern (*Osmunda regalis*), and certain species within the genera *Glyceria, Juncus,* and *Carex*, to name a few. Guidance on vegetation species habits was provided by the Wetland indicator Plant List (Reed, 1988). Vegetative growth patterns, including growth and species composition of mosses, can provide evidence of water level fluctuations as well.

If a potential barrier is an anthropogenic in nature (i.e. improperly installed culverts), it was noted as such, but not considered a permanent barrier due to its potential for being removed and reinstating fish passage.

4.1.8.2.2 Fish Collection: Electrofishing

Electrofishing was conducted within two watercourses in the FHAA: WC1 and MacDonalds Brook. Electrofishing was not completed within any other watercourse within the Study Area due to dry channel conditions at the time of assessment. Sampling sites of approximately 100 m in length were selected as representative habitats with potential to support fish along a section of a watercourse. The purpose of the electrofishing surveys was to determine fish species presence within the Study Area and within features that intercept surface water from the Study Area. Fish collection was completed under Fisheries and Oceans Canada Fishing License # 341208.

Standardized data collection forms developed by the New Brunswick (NB) Aquatic Resources Data Warehouse, the NB Department of Natural Resources and Energy, and the NB Wildlife Council (2002, updated 2006) were adapted for use for field data collection during electrofishing surveys. Field data collected included the physical and chemical parameters of the electrofishing site, electrofishing methods and settings, and results of electrofishing surveys.

Fisheries and Oceans Canada's (DFO) Interim Policy for the Use of Backpack Electrofishing Units (2003) was reviewed and followed by all members of the electrofishing crew. This document provides a detailed list of standard equipment, safety, training, and emergency response procedure requirements for electrofishing. Each electrofishing crew consisted of two individuals, one of which (the crew lead) was a qualified person as defined under the DFO Interim Electrofishing Policy. The crew lead is responsible for operating the backpack electrofisher according to their training and the Policy, and for communicating safety policies and electrofishing procedures to the second crew member.
Fish were sampled within open sites (i.e. without the use of barrier nets) using a Halltech Battery Backpack Electrofisher (HT-2000) with unpulsed direct current (DC) and a single pass. The operator waded upstream to eliminate the effects of turbidity caused by bottom sediment and probed the anode into likely fish habitat within the site. A second crew member walked behind the operator to net any stunned fish using a D-frame landing net (1/8" mesh). If fish were captured, they were held in a live well containing ambient stream water, which was kept out of the sun and checked regularly. At the conclusion of each pass, fish in the live well were identified to species and measured for length and weight. After recuperating, all fish were released back into the sampled reach.

Details of the September 2019 electrofishing surveys (locations and survey effort) are presented in Table 4-3, and shown on Figure 7 (Appendix A). Sampling reaches were selected based on potential fish presence, accessibility, habitat representation within the watercourse, and safety of personnel.

Table 4-3. Electrofishing Survey Details

Location	Survey Date	Reach Coordinates (UTM, NAD83)				Survey Effort (sec)
		Upstream		Downstream		
		Easting	Northing	Easting	Northing	
WC1 R1	September 23, 2019	703329	5102609	703108	5102529	379.6
WC1 R2	September 23, 2019	703213	5102748	703247	5102688	379.4
WCA R1	September 24, 2019	703171	5103204	703210	5103171	280.8
WCA R2	September 24, 2019	702943	5103269	703028	5103225	626.6

4.1.8.2.3 Fish collection: Minnow Trapping

Fish trapping was conducted in conjunction with electrofishing surveys to support and complement electrofishing efforts. Minnow traps were used exclusively to capture and record fish presence, as water levels at the time of assessment were insufficient to deploy other trap types (e.g. fyke nets, eel pots). Baited minnow traps were set in fish habitat features with sufficient water depths to cover to the traps, left overnight, and collected the following day. The locations of fish traps deployed within the FHAA are shown on Figure 7. Trapping details (locations and survey effort) are presented in Table 4-4.

Table 4-4. Trapping Details

Location	Survey Date	Trap ID	Trap Coordinates (UTM, NAD83)		Survey Effort
			Easting	Northing	
WCA R2	September 24-25, 2019	Minnow Trap 1	703038	5103224	24h15m
		Minnow Trap 2	703027	5103228	24h15m
		Minnow Trap 3	703018	5103230	24h16m
WCB	September 24-25, 2019	Minnow Trap 1	703559	5102550	18h14m
		Minnow Trap 2	703565	5102551	18h02m
		Minnow Trap 3	703585	5102557	17h51m
		Minnow Trap 4	703615	5102568	17h45m

4.1.9 Priority Species

The following desktop and field survey methodologies were implemented during the priority species survey program and are discussed below.

4.1.9.1 *Desktop Review*

A desktop Priority Species List was created in accordance with the *Guide to Addressing Wildlife Species and Habitat in an EA Registration Document* (NSE, 2009). This broad Priority Species List (provided in Appendix C) informed the biophysical field programs by identifying species that have the potential to be present within the Study Area. The desktop priority list was based on general species habitat requirements and the broad geographic area in which individual species are known to occur. See Section 3.2 for a definition of the following terms: priority species, SOCI, and SAR.

Databases provided by MTRI were assessed to identify the potential for priority lichen species including vole ears and boreal felt lichen. Additionally, the provincial government records of AMOs were reviewed as AMOs that are uncapped and unflooded may provide bat hibernacula. In addition, the Canada lynx range and the lynx buffer Special Management Practice (SMP) zone layers were used on the Nova Scotia Provincial Landscape Viewer to determine if Canada lynx (*Lynx canadensis*) buffers were within and/or in close proximity to the Study Area. Lastly, the Nova Scotia Lands and Forestry significant species and habitats database was reviewed.

A desktop review for known bat hibernaculum nearby and within the Study Area was completed. The NSDL&F records of AMOs (NSDNR, 2017) were reviewed for the Study Area and within 5km of the Study Area, as AMOs potentially provide bat hibernacula. The ACCDC report and the Recovery Strategy for the Little Brown Myotis (*Myotis lucifugus*), Northern Myotis (*Myotis septentrionalis*), and Tri-colored Bat (*Perimyotis subflavus*) in Canada (Environment Canada, 2015) were consulted.

4.1.9.2 *Field Surveys*

SAR and SOCI surveys were completed in conjunction with the other biophysical field surveys in 2018 and 2019. Where a SAR or SOCI was identified during surveys, additional effort was made in the field to understand the habitat at the sighting location and evaluate whether it was critical to the species for survival or life cycle requirements.

During habitat surveys within the Study Area, MEL personnel looked for signs of habitat that could support winter bat hibernation. Given the desktop review, it was determined that bat hibernacula surveys were not appropriate for the Study Area.

4.2 **Archaeological Resource Assessment**

Davis MacIntyre and Associates Limited completed an archaeological resource impact assessment for the Gillis Lake Quarry Expansion Project in 2019. This assessment consisted of two components:

- Phase I archaeological resource impact assessment
- Field reconnaissance Phase II archaeological resource impact assessment

The methodologies of these two components are described below.

4.2.1 Phase I

As part of this assessment, a historic background study was conducted. Historical maps, manuscripts and published literature were consulted. The Maritime Archaeological Resource inventory was searched and the Archaeology research division at Kwilmu’kw Maw-klusuaqn (Mi’kmaq Rights Initiative KMKNO) was contacted.

4.2.2 Phase II

Courtney Glen and Kathleen Forward conducted a field reconnaissance of the Study Area on May 30, 2019. Surveys focused on two treed areas that the quarry plans on expanding into within the QDA.

GPS tracklogs of all reconnaissance areas were retained for records, and any sites determined to have potential for archaeological resources were recorded with photographs and GPS coordinates. The terrain and vegetation were noted in the interest of recording negative evidence for historic cultural activity

5 BIOPHYSICAL ENVIRONMENT CONDITIONS

5.1 General Spatial Setting for Project

The proposed Project is in the Nova Scotia Uplands Ecoregion (300), as defined by the Nova Scotia Department of Natural Resources (Neily *et al*. 2017).

The Nova Scotia Uplands Ecoregion extends from Chignecto Bay to Cape Breton Island. This ecoregion is characterized by rounded summits and plateaus interspersed with uplands and lowlands. The total area of the Nova Scotia Uplands Ecoregion is 10,928 km^2 or approximately 19.8% of the province (Neily *et al*., 2017). The elevation ranges from 0-300m ASL.

Geology of the Nova Scotia Uplands Ecoregion comprises metamorphic, intrusive and volcanic rock remnants of the Cretaceous peneplain surface combined with Paleozoic sedimentary rocks in lowland areas. The geologic diversity and the region's vast area results in a variety of soil parent materials within the ecoregion (Neily *et al.*, 2017). Soil classifications include Orthic Humo-Ferric and Ferro-Humic Podzols in well drained areas over medium to coarse textured material; Gleyed subgroups appear in less well-drained areas and Sombric subgroups in more fertile areas. Gleyed Luvisols are found in areas of finer-textured deposits, and these may transition into Luvic Gleysols where drainage is poor. Slopes with colluvium deposits may result in classifications of Sombric and/or Dystric Brunisols (Neily *et al*., 2017).

Uplands of the ecoregion support shade tolerant hardwood forests with yellow birch, sugar maple and beech (*Fagus grandifolia*) which can thrive in the shorter growing seasons and harsher weather experienced by the uplands. The region also has mixedwood forests including species such as yellow birch, hemlock (*Tsuga canadensis*) and red spruce (*Picea rubens*). Hardwood forests in the Nova Scotia Uplands Ecoregion are not typically affected by natural disturbances at stand-level, so forest stands may exhibit old growth features and characteristics of uneven-aged stand development. On upper slopes and crests, tree growth may be stunted as a result of wind and ice damage. Stands of white spruce (*Picea glauca*) result from settlements abandoned by European colonists of the 18th and 19th centuries (Neily *et al*., 2017).

5.1.1 Natural Subregion

The Nova Scotia Uplands Ecoregion is further subdivided into ecodistricts. The Project exists in the Cape Breton Hills Ecodistrict (310). This ecodistrict is distributed throughout Cape Breton Island and consists of hardwood-forested hills and slopes often descending from plateaus to the valleys of significant rivers such as the Southwest and Northeast Margaree (Neily *et al*., 2017). Geology of this ecodistrict reflects the diversity of the Nova Scotia Uplands Ecoregion and bedrock types including varieties of granite, granodiorite, rhyolite, basalt, gneiss, schist, amphibolite, marble, sandstone, siltstone, conglomerate, shale, limestone and gypsum. The diversity in rock weatherability is reflected in the landscape of the ecoregion as older more erosion-resistant rocks underlie the higher and steeper hills, and more gradually sloped hills are underlain by coarse sandstone, shale, and conglomerate. Lower elevations exhibit areas of karst topography typical of underlying limestone and gypsum (Neily *et al*., 2017).

Hardwood stands of yellow birch, sugar maple and beech extend from crests to lower slopes of hills and are supported by fresh medium to rich soils. These hardwood stands are primarily affected by small patch or individual tree mortality resulting from natural disturbances such as wind and ice storms, as well as impacts of freeze/thaw cycles (Neily *et al*., 2017). Imperfectly drained soils may be present on the tops of larger hill complexes and result in forests of softwood comprised primarily of black spruce (*Picea marianna*) and balsam fir (*Abies balsamea*). Abandoned settlements particularly in upland areas of the region have grown into white spruce forests. Conifer forests in the region are frequently impacted by stand-level mortality such as that resulting from infestations of spruce budworm, tussock moth and spruce bark beetle (Neily *et al*., 2017).

5.1.2 Land Use and Habitat

Table 5-1 below displays the land use types and area (in hectares) within the Study Area. These estimations are based on google earth imagery from November 2019, the forest inventory GIS database (NSDL&F, 2017), and field ground truthing.

Table 5-1. Calculations of Land Use within the Study Area

Land Use/Land Type	Area (ha)	% of Study Area
Wetland Habitat	0	0
Quarry	4.0	9.5%
Disturbed Area	18.9	45.3%
Hardwood Forest Dominant	7.8	18.7%
Softwood Forest Dominant	9.0	21.5%
Roads	2.0	4.7%
TOTAL STUDY AREA	41.7	100%

Land use within the Study Area is dominated by historical and current disturbances, totalling approximately 22.9 ha (54.8%), which includes reclaimed quarry area. The total area of forested habitat accounts for 40.2% of the Study Area land base. Roads account for 2 ha (4.7%) of the Study Area. There are no wetlands within the Study Area boundaries.

Table 5-2 below displays the land use types and area (in hectares) within the QDA. These estimations are based on google earth imagery from November 2019, the forest inventory GIS database (NSDL&F, 2017), and field ground truthing.

Table 5-2. Land Use within the QDA

Land Use/Land Type	Area (ha)	% of Study Area
Wetland Habitat	0	0
Disturbed Area	4.7	51%
Hardwood Forest Dominant	4.6	49%
TOTAL STUDY AREA	9.3	100%

Most of the land within the QDA is disturbed (51%), either by historic or current activity. The remaining area is covered by a rich, mature, tolerant hardwood stand.

5.2 Atmospheric Environment

5.2.1 Weather and Climate

Climate in the Nova Scotia Uplands Ecoregion is characterized by a wide variation in daily and seasonal temperatures, and high precipitation. The upland areas of the Nova Scotia Uplands Ecoregion typically experience more precipitation and shorter growing seasons than surrounding lowlands (Neily *et al*., 2017). The elevation changes resulting from the varied topography of the region drive regional climate; weather in local areas may also vary due to sheltered or exposed conditions resulting from transitions in the landscape. Proximity to large water bodies such as the Bras d'Or Lakes and Gulf of St. Lawrence may reduce the influence of elevation on climate in areas of the ecoregion (Neily *et al*., 2017).

Records taken at St. Andrews Channel, on the south side of the Bras D'Or Lake and 15 km southwest of the Study Area, indicates the average low temperature based on records from 2013-2019 was -8.0°C in February and the average high temperature was 24.8°C in August (Cape Breton Weather, 2019). The total precipitation in 2018 at this weather station was 1336.0 mm (Cape Breton Weather, 2019). While this weather station is within the Nova Scotia Uplands Ecoregion, it is directly adjacent to the Bras D'or Lake, which may influence its results. The Sydney Airport is within 30 km of the Study Area, but outside of the Uplands Ecoregion, however, as it is not directly on the coast or adjacent to a water body, it's climate statistics are presented here to assist in estimating climate averages at the Study Area. The average low temperature (based on statistics from 1981-2010; 30 years) was recorded at -5.9 °C in February and the average high temperature was recorded at 18.0 °C in August (Government of Canada, 2010). Average annual precipitation at the Sydney airport weather station is 1517.2 mm. Average annual rainfall at this location is 1242.4 mm with maximum rainfall levels in November (average 144.0 mm). Average annual snowfall has been measured at 283.0 cm with the maximum average snowfall occurring in January (74.3 cm; Government of Canada, 2010).

5.2.2 Air Quality

Measured air quality parameters across Nova Scotia include ground-level ozone (O_3), particulate matter ($PM_{2.5}/PM_{10}$), and nitrogen dioxide (NO_2), and these values are used to calculate a score in the Air Quality Health Index (AQHI). The AQHI is a scale from 1-10+, representing the following health risk categories: Low (1-3), Moderate (4-6), High (7-10), and Very High (10+) (ECCC, 2019a). The Study Area is located approximately 20 kilometers southwest of Sydney, NS. The AQHI at Sydney, NS is considered low when assessed in October 2019 (ECCC, 2019b).

Average air quality data from the nearest station in Sydney (located at 71 Welton Street) from 2017 (the most recent, publicly available year) is provided by National Air Pollution Surveillance (NAPS) Network and is presented in Table 5-3 below.

Table 5-3: 2018 Air Quality Data

Station	SO_2 (ppb)	NOX (ppb)	NO (ppb)	NO_2 (ppb)	PM2.5 (ug/m^3)	O3 (ppb)
Sydney	0.5	3.8	1.3	2.6	6.0	29.0

As per the current IA, particulate emissions (Total Particulate Matter TSP) must not exceed 70 µg/m³ (annual geometric mean) and 120 µg/m³ (daily average [24 hr.]) at or beyond the site property boundaries. Dust monitoring has not been requested by NSE (nor completed) during quarry operations to date. Further, no issues or complaints related to quarry generated dust have been received by the Proponent to date.

5.2.3 Noise

Quarry operations create noise during periods of blasting, aggregate crushing, equipment use, and haul truck traffic entering and exiting the quarry. The Study Area is located in a rural setting with the closest residential receptor located 815 m to the west (Receptor # 1, Figure 10, Appendix A).

As per the current IA, Zutphen monitors all blasts for concussion (air blast) and ground vibration to ensure that the designated limits are not exceeded. To date, no blasts have exceeded concussion (128 dBL) or ground vibration (12.5 mm/s) levels at the scale house.

Noise level monitoring has not been requested by NSE (nor completed) during quarry operations to date. Further, no issues or complaints related to quarry noise have been received by the Proponent to date, although one resident communicated their concern at the Public Information Session at hearing a loud blast at their residence (Receptor # 1, Figure 10, Appendix A) during 2019.

5.3 Geophysical Environment

5.3.1 Topography

The general topography of the Study Area is relatively flat compared to the ridgelines east of it and north of Blacketts Lake. The Study Area slopes downwards from north to south: its highest elevation is 142 m ASL in the northwest corner, and it’s lowest is 43 m where it abuts Coxheath Road. The topography of the quarry has formed a valley running down the centre of the Study Area.

5.3.2 Surficial Geology

The Study Area straddles three different geologic units: bedrock in the north, stony till plain in the centre, and silty till plain in the south (NSDNR, 2012a). The oldest of these units is the bedrock, likely deposited before the last glaciation period, which is glacially scoured containing basins and knobs and overlain by a thin, discontinuous till veneer. The other two layers were deposited during the Wisconsinan glaciation. The silty till plain is derived from silty material from local and distant sources and provides moderate drainage. The topography of the till plain is described as flat to rolling, with few surface boulders and a thickness of 3-30 m, enough to hide the bedrock undulations. The stony till plain is derived from stony material of local and distant origins and provides rapid drainage and erodibility. The topography of this unit is described as flat to rolling, with many surface boulders and a thickness of 2-20 m (NSDNR, 2012a).

The surficial geology underlying the QDA is bedrock and stony till plain.

5.3.3 Bedrock Geology

The Study Area overlies bedrock formations in the Coxheath Hills Group in the west and the Neoproterzoic Granodiorite Group in the east (NSDNR, 2012a). The Coxheath Hills Group is described as felsic, intermediate and mafic tuff, calcalkaline volcanic arc basalt, andesite, rhyolite, sandstone and siltstone. The Neoproterzoic Granodiorite Group is described as granodiorite, an intrusive igneous rock between granite and diorite in composition (NSDNR, 2012a). Surficial geology and bedrock geology within the Study Area are shown on Figure 8 and Figure 9 (Appendix A).

The QDA overlays a small area of Coxheath Hills Group in the west, with a majority over the Neoproterzoic Granodiorite Group in the east.

5.3.3.1 *Acid Rock Drainage*

Exposing and physically disturbing sulphide-bearing rocks can cause acid rock drainage (ARD) to develop and can negatively impact the environment, human health and infrastructure. Acidic runoff, with pH levels as low as 3, can be harmful for aquatic habitats and can cause fish kills. ARD can contaminate drinking water supplies with increased concentrations of toxic and carcinogenic heavy metals (The Province of Nova Scotia, 2017).

In Nova Scotia, bedrock groups such as the Goldenville Formation and Halifax Formation of the Cambro-Ordovician Meguma Group are more likely to comprise acid producing rock. Based on a higher probability of acid producing bedrock to occur in Southwestern Nova Scotia, NSDL&F has developed an ARD Potential Map for this area. The Study Area does not fall within this mapping layer, furthermore the bedrock underlying the Study Area is not part of the Goldenville or Halifax Formation, and therefore likely does not have potential for ARD. However, to fully understand the potential for ARD to occur, ARD testing was completed in November 2019 by the Minerals Engineering Centre at Dalhousie University (Table 5-4 below, and Appendix J). Two samples were collected at representative locations along the existing quarry face of Gillis Lake Quarry, adjacent to the QDA. These samples were analyzed using an Eltra CS2000 to measure total sulphur. Acid Producing Potential was calculated assuming a conservative estimation that all sulphur measured was sulphide sulphur. For both samples, the total sulfur weight proportion was less than 0.05% and the acid producing potential was less than 1.5 kg/t (Table 5-4).

Table 5-4 Acid Rock Drainage Testing

Sample ID	Location (UTM, NAD		Total Sulfur (Wt. %)	Acid Producing Potential (kg/t)
	Easting	Northing		
Sample #1	702802	5103105	0.048	1.46
Sample #2	702904	5103144	0.045	1.37

The sulphur concentrations in the samples are considered as low sulphur content and do not present potential for ARD (D. Chevalier, pers. comm. November 15, 2019).

5.3.4 Groundwater

While depth to groundwater is challenging to predict at this stage, a number of other variables can be considered to further predict its proximity to the surface. Notably adjacent surface water feature elevations, underlying rock type, hydrologic characterization and information sourced from the Nova Scotia Groundwater Well Network.

As previously mentioned, the Study Area slopes downwards from north to south: its highest elevation is 142 m ASL in the northwest corner, and it’s lowest is 41 m ASL where it abuts Coxheath Road. The Study Area is abutted by two primary mapped watercourse systems which drain water to Portage Brook to its south. The Study Area also contains a system of ditches and a watercourse through its centre that also drains into Portage Brook. Groundwater is anticipated to follow the general drainage trend of northwest to southeast through the Study Area towards Portage Brook.

Hydrogeologic characterization of Nova Scotia's Groundwater Regions indicates that the QDA straddles an area of igneous volcanic rock on the west side and igneous plutonic rock on the east side (Kennedy, Drage, and Fisher, 2008). Five of the residential wells in Table 5-6 fall within the igneous volcanic rock layer, and one falls within the igneous plutonic rock. Eight wells fall within a carbonate rock layer, three fall within a sedimentary rock layer, and two fall in other areas. Hydraulic conductivity in both of the bedrock types underlying the QDA is low due to their low porosity; sedimentary and carbonate rocks have a slightly higher hydraulic conductivity (Heath, 1983). Low hydraulic conductivity is also demonstrated by the relatively low average yield from the 4 closest wells (average 25 L/min).

The Nova Scotia Groundwater Observation Well Network was established in 1965 and includes 40 active well observations across the province. The closest observation site to the Study Area is located in Sydney, approximately 18 km to the northeast, and is named Sydney (050). The aquifer material of this well is sandstone. Groundwater at this site has been monitored since 1984, in that time groundwater level elevations have fluctuated but largely remained within the range of 61 – 65 m ASL. Due to the difference in bedrock underlying the Study Area, the Project Team reviewed the Ingonish (065) well data. The Ingonish well was installed into Early Devonion Granodiorite bedrock material which is more representative of the geology at the Study Area. Water levels have been monitored from the well since 1990, with a break in observations between 2000 and 2005. Groundwater level elevations fluctuated between 1 – 4 m ASL, with most observations around 2 m ASL. The average 2014 water levels were recorded as 2.15 m ASL and groundwater fluctuation during this year was 2.83 m. While it may be difficult to draw conclusions based on the distance from the Ingonish well to the Study Area, the bedrock geology is similar and it is therefore useful to note the natural fluctuation of groundwater elevation at this monitoring well, which may also be the case within the wells surrounding the QDA.

Water supplies for individual homes surrounding the Study Area are provided by drilled potable wells. The NS Well Logs Database provides information on more than 100,000 water wells in the province, including information on well locations, geology and well construction, well depth and yield. General conclusions relating to the groundwater resource in the Study Area were derived from this information. Locations of the wells are provided on Figure 10 (Appendix A). It should be noted that location accuracy of these wells ranges from ± 150 m to 1,130 m. According to the user's manual of the NS Well Logs Database, all of the wells listed in Table 5-5 were based off of the NS Map Book, therefore, the UTM coordinates are approximated based on a central point from the map reference (NSE, 2016). In order to determine a more precise location for adjacent residential wells, the Nova Scotia Topographic Database (NSTB) was reviewed to identify buildings within 500 m, 800 m, 1 km and 2 km of the QDA.

Table 5-5: Surrounding Groundwater Wells from the Well Logs Database (NSE, 2016)

Well Number	Civic Address	Number of Structures	Community	Description
Within 500 meters of QDA				
N/A	N/A	1	Gillis Lake	Breton Traditional Archers Building. No well exists at this location.
Within 800 meters of QDA				
800543 801735 802524 802593 850447	N/A	0	Gillis Lake	Database shows 5 wells in the same location in a cleared area, no structures visible from aerial
901881 912388	N/A	0	Gillis Lake	Database shows 2 wells in the same location in a cleared area, no structures visible from aerial
Within 1 km of QDA				
N/A	N/A	0	N/A	None
Within 2 km of QDA				
902624	142 Gillis Lake East Rd.	1	Howie Centre	Residential structure
792605	985 Gillis Lake Rd.	2	Ben Eoin	Residential structures
811225 811229 811230	N/A	0	East Bay	Database shows 3 wells in the same location in a forested area, no structures visible from aerial
831806	Gillis Lake Rd.	1	East Bay	Residential structures
860744	Gillis Lake Rd.	1	Blacketts Lake	Unknown structure
091538	3105 Coxheath Rd.	2	East Bay	Residential structures
802534 840620 840627	N/A	0	Northside East Bay	Database shows 3 wells in the same location in a forested area, no structures visible from aerial
962529	N/A	0	Portage	Database shows 1 well in a forested area, no structures visible from aerial
760877	2486-2710 Coxheath Rd.	1	Blacketts Lake	Residential structure

Well Number	Civic Address	Number of Structures	Community	Description
061065	2486-2710 Coxheath Rd.	1	Blacketts Lake	Residential structure
750920	2486-2710 Coxheath Rd.	1	Blacketts Lake	Residential structure
760810	2785-2435 Coxheath Rd.	1	Blacketts Lake	Residential structure
730773	2620 Coxheath Rd.	1	Blacketts Lake	Residential structure
940453 952543	N/A	0	Portage	Database shows 2 wells in the same location in a forested area, no structures visible from aerial
850917	N/A	0	Blacketts Lake	Database shows 1 well in a forested area, no structures visible from aerial

As indicated in Table 5-5, there are no wells identified within 500 m of the QDA. Field and aerial surveys, in combination with discussions at the public open house confirm this. There is a structure within 500 m of the QDA, the Breton Traditional Archers Clubhouse, but it does not have well water service (see Figure 10). Within 800 m of the QDA, the well logs database identifies 7 wells at 2 locations, however, aerial surveys and discussions with the public did not confirm the presence of any structure in this area; it is likely these are either outdated entries or inaccurate locations. No well records exist between 800 m and 1 km from the QDA, however aerial, the NSTDB buildings database and conversations with landowners show that residences exist within this buffer. The well log database identifies 20 wells between 1 - 2 km from the QDA, 14 of which are associated with structures (as identified using aerial images and the NSTDB buildings database).

Wells within approximately 2 km of the QDA were selected for further analysis and are presented in Table 5-6. For the purpose of this background review, in cases were multiple well records occurred in the same location, only 1 well record is carried forward. This information includes records of geological conditions observed at each well.

Table 5-6. Well Characteristics closest to the Study Area

Well Number	Distance from the QDA	Date	Depth (m)	Casing (m)	Depth to Bedrock (m)	Static Level (m)	Yield (L/min)	Elevation (m ASL)	Easting	Northing	Accuracy ± (m)	Geology
912388*	525 m	1991-10-28	5.69	6.09	-9999	0.79	63.56	93	702500	5102500	707	0-9 feet: Gravel 9-20 feet: Clay
800543*	500 m	1980-10-16	19.79	12.48	11.27	12.18	113.5	117	702273	5102772	1130	0-15 feet: Clay 15-37 feet: Gravel 37-65 feet: Shale
091538	1.2 km	2009-11-23	31.97	21.32	19.18	-9999	204.3	0	702502	5101877	15	0-3 feet: Clay 3-30 feet: Gravel and Clay 30-32 feet: Gravel 32-63 feet: Gravel and Clay 63-97 feet: Conglomerate 97-015 feet: Granite
811225*	1.3 km	1981-11-25	38.06	6.7	-9999	2.44	27.24	105	700662	5102719	1130	0 to 10 feet: topsoil 10 to 18 feet: Sandstone 18 to 60 feet: Clay and boulders 60 to 110 feet: Limestone 110 to 125 feet:

Well Number	Distance from the QDA	Date	Depth (m)	Casing (m)	Depth to Bedrock (m)	Static Level (m)	Yield (L/min)	Elevation (m ASL)	Easting	Northing	Accuracy ± (m)	Geology
												Conglomerate
730773	1.4 km	1973-05-18	60.9	42.93	28.93	-9999	90.8	2	704427	5103210	150	0 to 95 feet" Gravel, Rock and Clay 95 to 200 feet: Rock
850917	1.4 km	1985-06-12	44.76	6.09	6.09	3.04	27.2	150	703834	5104368	1130	8 to 20 feet: Clay 20 to 147 feet: Sandstone
792605	1.5 km	1979-07-24	53.29	31.67	29.23	8.53	181.6	44	701280	5103210	150	0 to 96 feet: clay 96 to 175 feet: Shale
962529	1.5 km	1996-12-13	3.81	4.57	-9999	1.22	1816.0	22	704500	5102500	707	0 to 4 feet: Till 4 to 5 feet: Peat Moss 5 to 15 feet: Sand/lenses
760810	1.5 km	1976-07-29	38.1	25.9	24.4	10.35	18.2	2	704556	5103248	150	0 to 80 feet: Clay 80 to 115 feet: Shale
750920	1.5 km	1975-06-20	4.57	4.26	-9999	-9999	90.8	2	704634	5103192	150	0 to 14 feet: Clay 14 to 15 feet: Gravel

Well Number	Distance from the QDA	Date	Depth (m)	Casing (m)	Depth to Bedrock (m)	Static Level (m)	Yield (L/min)	Elevation (m ASL)	Easting	Northing	Accuracy ± (m)	Geology
760877	1.6 km	1976-09-23	63.0	50.2	48.1	13.1	22.7	2	704640	5103141	150	0 to 59 feet: Gravel and Clay 59 to 158 feet: Clay 158 to 207 feet: Shale
860744	1.6 km	1986-09-03	38.1	28.9	27.4	12.2	36.3	53	702500	5101500	707	0-90 feet: Clay 90-125 feet: Quartzite
902624	1.6 km	1990-10-22	37.76	18.27	9.44	-9999	90.8	85	701500	5104500	707	0 to 31 feet: Gravel and boulders 31 to 54 feet: Rock 54 to 124 feet: Sandstone and shale
061065	1.6 km	2006-05-24	67.6	48.72	19.79	-9999	15.89	48	704671	5103166	15	0 to 24 feet: Clay and Shale 25 to 29 feet: Clay and Shale 29 to 65 feet: Clay 65 to 80 feet: Mudstone 80 to 151 feet: Sandstone and Mudstone

Well Number	Distance from the QDA	Date	Depth (m)	Casing (m)	Depth to Bedrock (m)	Static Level (m)	Yield (L/min)	Elevation (m ASL)	Easting	Northing	Accuracy ± (m)	Geology
												151 to 158 feet: Shale and Mudstone 158 to 222 feet: Sandstone and Limestone
940453*	1.6 km	1994-01-02	20.1	19.49	-9999	7.61	27.24	66	704500	5103500	707	0 to 58 feet: Clay 58 to 62 feet: Gravel
831806	1.9 km	1983-05-3	30.5	21.3	7.9	9.1	22.7	66	702324	5101229	1130	0-26 feet: Gravel 26 to 100 feet: Granite
802534*	1.9 km	1980-05-20	19.18	13.40	10.66	2.44	9.08	19	703936	5101283	1130	0 to 35 feet: Clay and boulders 35 to 63: Gypsum
811225	1.9 km	1981-11-25	38.06	6.70	-9999	2.44	27.24	105	700662	5102719	1130	0 to 10 feet: Topsoil 10 to 18 feet: Sandstone 18 to 60 feet: Clay and boulders 60 to 110 feet: Limestone 110 to 125 feet: Conglomerate and

Well Number	Distance from the QDA	Date	Depth (m)	Casing (m)	Depth to Bedrock (m)	Static Level (m)	Yield (L/min)	Elevation (m ASL)	Easting	Northing	Accuracy ± (m)	Geology
												gravel
711047	2.0 km	1971-07-12	18.57	14.62	14.62	2.44	68.1	104	700500	5103500	707	0 to 5 feet: Mud 5 to 20 feet: Gravel 20 to 35 feet: Sand 35 to 48 feet: Hardpan 48 to 61 feet: Sandstone
Average		**N/A**	**33.35**	**20.19**	**19.77**	**6.27**	**155.43**	**57**	**N/A**	**N/A**	**534**	**N/A**

*Notes locations with multiple well numbers. For the purpose of this background review, only 1 well record is carried forward

The selected drilled wells presented in Table 5-6 have an average depth to bedrock based on drilling data was 19.77 m. Wells appeared to be drilled to an average depth of 33.35 m below grade and were constructed with an average 20.19 m depth of casing (casing depth ranges from 4.26 m to 50.2 m). The wells had an average static depth to water of 6.27 m. A general review of water yields for these wells indicated an average yield of approximately 155.43 L/min. Although these wells are not accurately spatially defined in all cases, this data provides some background conditions that can be reviewed in the context of groundwater within the Study Area. It appears from the well data that geological conditions surrounding the site are typically comprised of clays, gravels, mudstones and sand within the upper 70-90 feet, followed by shale and rock at depths generally greater than 100 feet. These conditions vary from the Study Area where shallow bedrock is present and utilized for quarrying. It is likely that lateral movement of water occurs within the bedrock layers within the Study Area (i.e. as interflow) and provides some recharge to surface water features prior to contributing to groundwater. However, as discussed earlier in this chapter, the rock types present within the Study Area are expected to have low hydraulic conductivity characteristics and are not expected to interact with groundwater levels providing water to the surrounding offsite wells noted in Table 5-6.

To add context to the general local groundwater discussion, a comparison was made between the elevation of the quarry area, surface water features and adjacent water wells. Water wells at residential properties along Coxheath Road, which are located at the bottom of the hill from the quarry typically record an average elevation of 41 m ASL. A review of an available Digital Elevation Model (DEM) indicates that the current quarry floor is located at 110 m ASL and the QDA is located at 122 m ASL. The elevation profile provided in Figure 5-1 (below) indicates the closest residential property to the QDA on Coxheath Road which is downgradient from the quarry area, and indicates the closest residential structure and assumed water well to the west of the QDA.

Watercourse 1 exists at an approximate elevation of 70 m ASL (based on an available DEM) and surface water within MacDonalds Brook (upgradient of the QDA) was measured at 154 m ASL (based on an available DEM). The QDA is situated between these two-surface water features and has an approximate elevation of 122 m ASL. Water sourced to WC1 (which is located in a steep valley) is from surface water run-off, overland drainage from the northwest of the Study Area, and small amounts of groundwater seepage from WC2 and WC3. MacDonalds Brook water is sourced from upstream wetlands and headwater streams rather than from observable seepage from adjacent upland habitat. Both conditions are indicative of a confining layer in which water is travelling via lateral flow, and as such, is not expected to indicate groundwater elevation. No evidence of water staining within seepage into surface water features was observed within or directly adjacent to the Study Area.

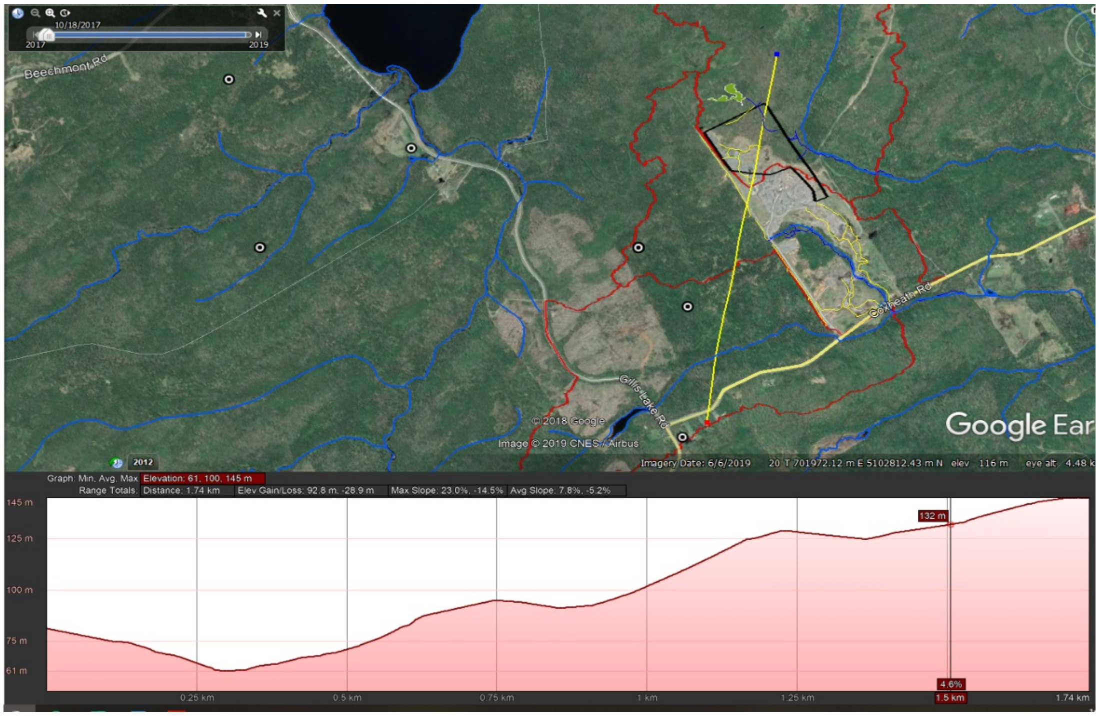

Figure 5-1. Elevation Profile from Downgradient Water Well through Study Area

The perpendicular elevation line indicated on Figure 5-1 (above) indicates the top of the QDA. Topography rises from the water well location on Coxheath Road to the top of the QDA; intermittent plateaus and valleys along the elevation profile are indicative of the surface water features that collect surface water run-off and groundwater seepage from lands surrounding them. The private drilled wells on Coxheath Road are at an average elevation of 41 m ASL with an average static level of 11.7 m. The base of the proposed quarry will approximately match the current quarry floor at 110 m ASL.

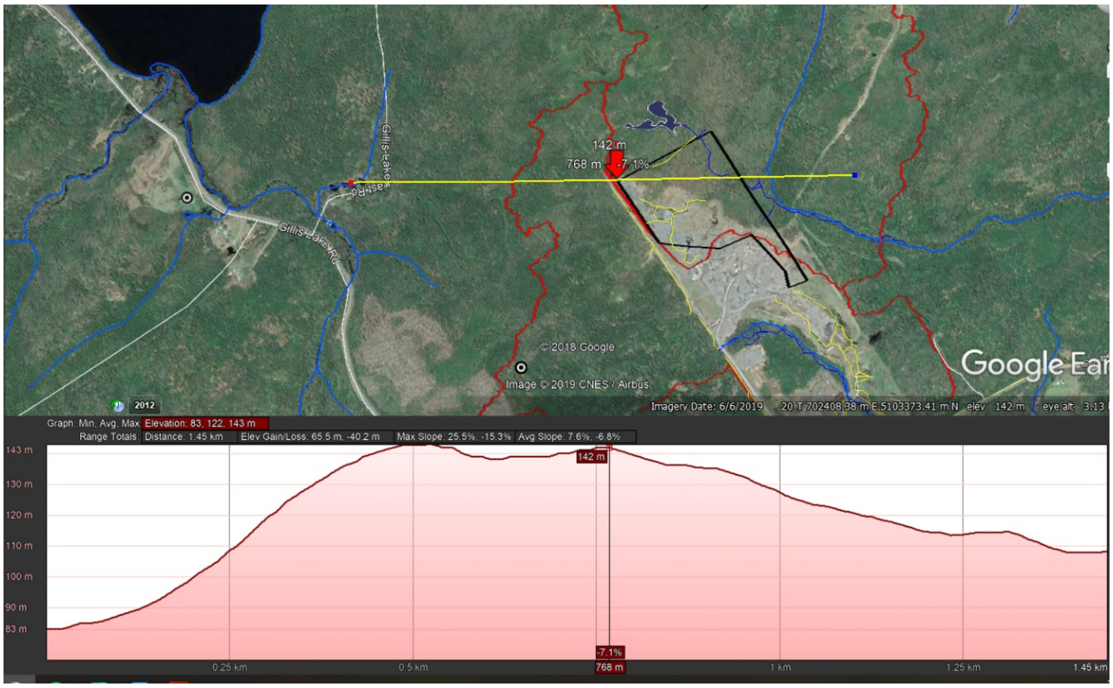

Figure 5-2. Elevation Profile from Downgradient Water Well to the West of the Study Area

The perpendicular line indicated on Figure 5-2 (above) indicates the top of the QDA at its northwestern corner. The topographical conditions indicate that land slopes downgradient (eastward) from this point. Lateral water flow within the bedrock from this point is also expected to generally flow eastward, but then southward toward Coxheath Road. As such, lateral flow in bedrock, is not expected to interact with the water well located to the east of the QDA.

The vertical separation between the proposed quarry and the residential wells along with the evidence of low hydraulic conductivity indicate a limited potential for quarry activities to impact groundwater levels and surrounding wells.

5.4 Terrestrial Environment

This section describes the Study Area habitat, vegetation, lichen, wildlife, bats, birds, wetlands, surface water, fish habitat, and species at risk.

5.4.1 Habitat

Desktop review and field results for habitat assessments completed within the Study Area are provided in the following sections.

5.4.1.1 *Desktop Results*

The Study Area is located in eastern Cape Breton within the Cape Breton Hills ecodistrict within the Nova Scotia Uplands ecoregion (Webb & Marshall, 1999).

The Cape Breton Hills ecodistrict often has steep sloped hills with well drained, moderately coarse textured soils. In relation to the rest of Nova Scotia, this ecodistrict is more elevated: often around 150 – 300 masl (Webb & Marshall, 1999). Low lying areas in this ecodistrict tend to have imperfectly drained, fine textured tills that are often nutrient rich and provide suitable habitat for vascular flora rarities. Karst topography exists within lower elevations in the ecodistrict, which gives rise to calcium rich soil and habitat that supports vascular flora rarities.

As a result of the bedrock and climatic conditions, this ecodistrict primarily consists of tolerant hardwood forests with scattered softwood species (Webb & Marshall, 1999).

5.4.1.2 *Field Results*

During the field surveys it was noted that a large percentage of the Study Area is disturbed by current and historical quarry activities and accounts for approximately 55% (n=22.9 ha) of the Study Area[1]. In areas that remained forested, mature tolerant hardwood and mixedwood forests types were present which are located in the central and northern regions of the Study Area. The southern portion of the Study Area comprised of historical quarry activities and are 'reclaimed' consisting of poorly drained soils with admixing and a vegetation community reflective of a disturbance (See section 5.4.2). A total of 4 HAPs were surveyed consisting of 4 different VTs and two different ecosites. Two of these HAPs were located in the QDA. Habitat within the QDA was also made up of current and historic disturbance, along with mature tolerant hardwood forest. Find below a discussion of the VTs and ecotypes observed within the Study Area and see Figure 11 for HAP survey locations.

5.4.1.2.1 *<u>Ecosites</u>*

Within the Study Area, the ecosites generally consisted of medium to rich nutrient regimes to moderate to imperfectly drained soils that all fall within the Acadian ecosites AC11 and AC13. Rich tolerant hardwood stands were located in the northern portions of the Study Area (HAP2 and HAP3, both within the QDA) while medium nutrient richness was located in the central forested regions of the Study Area and as indicative of the VTs described below. The intact natural forest within the QDA was predominantly rich tolerant hardwoods.

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[1] *Disturbance area is an estimate based on google earth imagery assessed November 21st, 2019. This estimate does not include regenerative forests as these features cannot be accurately delineated by desktop review.*

5.4.1.2.2 Vegetation Types

The Study Area consists of VTs within the mixedwood forest group (n=2; 50%) and the tolerant hardwood group (n=2; 50%). Of the mixedwood forest group (MW) the VTs comprise of red spruce – yellow birch/evergreen wood fern (MW1) and balsam fir – red maple/wood sorrel/ goldthread (MW4) and of the tolerant hardwood group (TH), the VTs comprised of sugar maple – white ash/silvery spleenwort/baneberry (TH4) and red maple – yellow birch/sugar maple (TH8).

In general, the tolerant hardwood groups (TH), which was found within the QDA, are often a vegetative community type with a higher potential to support vascular rarities. These community types roughly account for 11% (4.7 ha) of the Study Area and are located in the northern portion of the Study Area, making up the majority of the forested section of the QDA. The majority of the Study Area (55%) is disturbed by both current quarry activities and historical (reclaimed land in the south), which leaves very little intact vegetation communities within the Study Area. Although the Study Area is disturbed, the presence of calciphiles, plants that thrive in lime rich soils, indicate calcareous soils which provide habitat for vascular flora rarities (Section 5.4.2).

5.4.2 Vascular Plants

The following sections outline the results from the desktop review and the field surveys completed within the Study Area.

5.4.2.1 *Desktop Results*

Six vascular priority plant species was documented within 5 km of the Study Area in the ACCDC report and include: brook lobelia (*Lobelia kalmii*; S2), few-flowered spikerush (*Eloecharis quinqueflora*; S2), richardson's pondweed (*Potamogeton richardsonii*; S2), boreal aster (*Symphyotrichum boreale;S2?*), white-stemmed pondweed (*Potamogeton praelongus*; S3) and common scouring-rush (*Equisetum hyemale var. affine*; S3S4).

5.4.2.2 *Field Results*

A total of 190 vascular plant species were observed within the Study Area, three of which were SOCI: the variegated horsetail (*Equisteum variegatum*; S3), marsh mermaidweed (*Proserpinaca plaustris var. creba*; S3) and Loesel's twayblade (*Liparis loeselii*; S3S4). No priority vascular plant species were observed within the QDA. Within the Study Area 23% of observed vascular plant species (n=44) comprised of exotics. A list of all observed plants can be found in Appendix D.

As described in section 5.4.1, the Study Area largely consists of a disturbed landscaped by both current and historical quarry activities (accounting for approximately 55% of the Study Area). These disturbed areas provided the habitats for all SOCI plant species observed.

Due to the underlying parent rock material that contains siltstone, sandstone, and other calcium rich deposits, the soils in the Study Area are also calcium rich and alkaline, resulting in high soil fertility that can support vascular rarities.

As mentioned above, all the vascular plant rarities were observed outside the QDA, within reclaimed quarry clearings and old trails, and all of the species are an indication of richer soils, with the variegated horsetail and Loesel's twayblade having an affinity for calcium rich soils (Zinck, 1998). Groups of over 3000 stems of variegated horsetail were observed growing in large patches within disturbed, isolated areas. One explanation for the increase in rarities in the disturbed areas can be attributed by the exposed bedrock from the blasting and ultimately the weathering and eroding of the bedrock which enriches the soil.

The southern, previously reclaimed portion of the Study Area consisted of admixed compact soils that resulted in wetland hydrology but lacked wetland soils. As such, species that prefer wetland conditions such as variegated horsetail, Loesel's twayblade and yellow sedge (*Carex flava*) were found in these areas, which are also calciphiles.

Tolerant hardwoods and mixedwood canopies made up the forested sections of the Study Area. These are confined to the north and to a central isolated patch. The Study Area consisted of 23% exotic species that were isolated to the disturbed areas and reflect the high levels of disturbance in the area.

5.4.3 Lichens

The following sections outline the results from the desktop review and the field surveys completed within the Study Area.

5.4.3.1 *Desktop Results*

No priority lichen species were documented within 5 km of the Study Area in the ACCDC report. No predicted BFL polygons are present within the Study Area. According to the MTRI databases, no extant BFL populations are within 26 km and no vole ears lichen are within 173 km of the Study Area.

5.4.3.2 *Field Results*

During the field Surveys, 34 lichen species were observed within the Study Area. Two were determined to be a priority species: blue felt lichen (*Pectenia plumbea;* SARA & COSEWIC Special Concern; NSESA Vulnerable; ACCDC S3) and tree pelt lichen (*Peltigera collina;* S2?). These priority species were only observed in the northern section of the Study Area, within the forested section of the QDA. Additional information regarding the priority lichen species is provided in Section 5.6.3.

As described in section 5.4.1, the Study Area largely consists of a landscape disturbed by both current and historical quarry activities (accounting for approximately 55% of the Study Area). Forested canopies are present in the north and central regions of the Study Area; it is these forested communities that have the highest likelihood for priority lichen species.

No BFL habitat is within the Study Area as the suitable habitat (mature balsam fir swamps) were not present within the Study Area. Due to the richer soils present, the treed portions were dominated by hardwood species suitable for a suite of lichen associated with older hardwood forests.

The other main lichen habitats were on the edges of the Study Area and in the upland reclaimed habitats. These habitats had sparse woody perennials. The majority of the species found in these areas were terricolous and saxicolous lichens including Reindeer lichen (*Cladonia arbuscula*), grey reindeer lichen (*Cladonia rangeriferina*) and pink earth lichen (*Dibaeis baeomyces*). Although these habitats could be suitable for some SOCI species (e.g. *Collema tenax*; S3), they do not provide habitat for any SAR lichen species in the province. See Table 5-7 for the lichens observed within the Study Area.

Table 5-7: Observed Lichen Species

Scientific Name	Common Name	SAR/COSEWIC/NSESA	SRank
Pectenia plumbea	**Blue felt lichen**	**Special Concern/Special Concern/Vulnerable**	**S3**
Peltigera collina	**Tree pelt lichen**	**-**	**S2?**
Bacidia schweinitzii	Surprise lichen	-	-
Biatora vernalis	Crust lichen	-	-
Bryoria sp.	A hose hair lichen	-	-
Cetrelia chicatae	Frothing seastorm lichen	-	S5
Cladonia arbuscula	Reindeer lichen	-	S5
Cladonia coniocraea	Common pixie powderhorn	-	S5
Cladonia rangiferina	Grey reindeer lichen	-	S5
Collema subflaccidum	Tree tarpaper lichen	-	S5
Dibaeis baeomyces	Pink earth lichen	-	S5
Evernia mesomorpha	Boreal oakmoss lichen	-	S5
Hypogymnia physodes	Monk’s hood lichen	-	S5
Hypogymnia incurvoides	Lattice tube lichen	-	S4S5
Leptogium cyanescens	Blue jellyskin lichen	-	S5
Lobaria pulmonaria	Lungwort lichen	-	S5
Lobaria quercizans	Smooth lung lichen	-	S5
Lobaria scrobiculata	Textured lungwort lichen	-	S5
Melanelexia subaurifera	Abrading camouflage lichen	-	S5
Nephroma helveticum	Fringed kidney lichen	-	S4S5
Pannaria rubiginosa	Brown-eyed shingle lichen	-	S4
Parmelia sulcatta	Hammered shield lichen	-	S5
Parmeliella tryptophylla	Black-bordered shingles lichen	-	S5
Peltigera aphthosa	Common freckle pelt lichen	-	S5
Peltigeria canina	Dog lichen	-	S5
Peltigera horizontalis	Flat-fruited pelt lichen	-	S5
Phaeophyscia rubropulchra	Orange-cored shadow lichen	-	S5

Scientific Name	Common Name	SAR/COSEWIC/NSESA	SRank
Platismatia glauca	Varied rag lichen	-	S5
Protopannaria pezizoides	Brown-gray moss-shingle lichen	-	S5
Punctelia rudecta	Rough speckleback lichen	-	S5
Pyxine sorediata	Mustard lichen	-	S5
Ramalina roesleri	Frayed ramalina lichen	-	S5
Ropalospora chlorantha	Comet spored lichen	-	--*
Thelotrema lepadinum	A crust lichen	-	--*

Note: Scientific names used are in accordance to the latest ACCDC species list retrieved in December 2019. Scientific names may no longer be in use, however, for consistency in this report, species names in the ACCDC species list are used.

* Species ranking in the province has yet to be determined by the ACCDC

5.4.4 Wildlife

The following sections outline the results from the desktop review and the field surveys completed within the Study Area.

5.4.4.1 *Desktop Results*

The Study Area is within the Special Management Practice Zones for the Cape Breton Island Canada lynx range and 520 m south of a Canada Lynx buffer Special Management Practice (SMP). The Lynx buffer SMP zones administer 100 meters buffers to all undisturbed, forested bogs (NSDNR, 2012b). Open bogs are reliable producers of cones, a significant food source for American red squirrels, as such, protecting the habitat of red squirrels protects this Canada lynx food source (NSDNR, 2012b).

Although the Study Area is within the SMP zone, habitat for lynx hunting for prey within the Study Area is not present. Canada lynx are typically found in stands with regenerative conifers which they use for hunting, denning and as shelter (MTRI, 2015). These forest types provide suitable foraging habitat for snowshoe hare and American red squirrel which are two important food sources for the lynx. Within the Study Area, forest community types include mature mixedwood and tolerant hardwood forests which do not provide ideal hunting habitat for Canada lynx. Furthermore, the majority of the Study Area comprises of 55% of current and historical quarry disturbances which do not provide any regenerative conifer stands which would provide hunting habitat for Canada lynx. Further information is provided in Section 5.6.5.

5.4.4.2 *Field Results*

5.4.4.2.1 Mammals

Wildlife species, including herpetofaunal and mammal species, were assessed through incidental wildlife observations and recorded within the Study Area during all biophysical surveys. See Table 5-8 for all incidental wildlife observations confirmed either visually or by sign (scat, footprints, etc.).

Table 5-8. Confirmed Mammalian Species within the Study Area

Scientific Name	Common Name	SRank
Canis latrans	Eastern coyote	S5
Lepus americanus	Snowshoe hare	S5
Mustela erminea	Short-tailed weasel	S5
Odocoileus virginianus	White tailed deer	S5
Tamiasciursus hudsonicus	American red squirrel	S5
Peromyscus leucopus	White-footed deermouse	S5

Other species not encountered during field surveys that have the potential to utilize the Study Area habitat include the following.

Table 5-9. Terrestrial Wildlife with Potential Habitat within the Study Area

Scientific Name	Common Name	SRank
Neovison vison	American mink	S5
Ursus americanus	American black bear	S5
Lynx rufus	Bobcat	S5
Tamias striatus	Eastern chipmunk	S5
Blarina brevicauda	Northern short-tailed shrew	S5
Zapus hudsonius	Meadow jumping mouse	S5
Microtus pennsylvanicus	Meadow vole	S5
Alces americanus	Moose	S5 – Cape Breton pop.
Procyon lotor	Northern raccoon	S5
Vulpes vulpes	Red fox	S5
Myodes gapperi	Southern red-backed vole	S5
Mephitis mephitis	Striped skunk	S5

Wildlife species have an equal opportunity to use habitat within the Study Area and QDA, however, in both areas, wildlife likely avoid areas of disturbance which may deter their usage.

5.4.4.2.2 Herpetofauna

No herpetofaunal species were observed during field surveys within the Study Area. However, the Study Area provides potential herpetofaunal habitat notably within WC 1 and the settling ponds, outside of the QDA. A common assemblage of herpetofaunal species likely to inhabit the Study Area are listed in Table 5-10.

Table 5-10. Herpetofaunal Species with an Elevated Potential to Occupy the Study Area.

Scientific Name	Common Name	ACCDC Prov. Rank
Anaxyrus americanus	Eastern American Toad	S5

Scientific Name	Common Name	ACCDC Prov. Rank
Lithobates clamitans	Green Frog	S5
Lithobates palustris	Pickerel Frog	S5
Lithobates pipiens	Northern Leopard Frog	S5
Lithobates septentrionalis	Mink Frog	S5
Lithobates sylvaticus	Wood Frog	S5
Opheodrys vernalis	Eastern Smooth Green Snake	S5
Plethodon cinereus	Eastern Red-backed Salamander	S5
Pseudacris crucifer	Spring Peeper	S5
Thamnophis sirtalis pallidulus	Maritime Garter Snake	S5

5.4.5 Avifauna

The following sections outline the results from the desktop review and the field surveys completed within the Study Area.

5.4.5.1 *Desktop Results*

There are no Important Bird Areas (IBA) within 20 km of the Study Area. (Bird Studies Canada, 2012). The closest IBA, Central Cape Breton Highlands (NS061), is approximately 20 km northwest of the Study Area. The reader is referred to Section 3.1 for all other IBAs in the area.

The Central Cape Breton Highlands (NS061) is located south of the Cape Breton Highlands National Park in northeastern Nova Scotia. The IBA is mountainous with plentiful streams, small lakes, and ponds. It is dominated by balsam fir and spruce, especially in areas of regeneration. Bicknell's thrush (*Catharus bicknelli;* SARA & COSEWIC Threatened; NSESA Vulnerable; ACCDC S1S2B) have been observed in the IBA (Bird Studies Canada, 2012). Bicknell's thrush prefer spruce-fir forests in elevations above 300m, where trees are stunted and dense. Furthermore, this species cannot tolerate even low-level disturbance (MTRI, 2015).

While the forest cover type within the Study Area may be similar to that within IBA NS061, the elevation is well below the elevation requirements for Bicknell's thrush. The QDA sits at approximately 122 m ASL. Furthermore, the Study Area is already subject to a significant amount of disturbance, therefore negating the provision of Bicknell's thrush habitat.

The closest Canada Wildlife Service MBS in Nova Scotia is Big Glace Bay Lake MBS, located approximately 35 km northeast of the Study Area. This MBS is located on a lake containing salt marshes and intertidal flats. The habitats provided within this MBS are not consistent with habitat present within the Study Area.

The MBBA 20QS00 square results are included in Appendix C. The ACCDC database identified eight avian SAR within 5 km of the Study Area. These are discussed further in Section 5.6.6. The ACCDC results are in Appendix C.

5.4.5.2 *Avian Survey Results*

Baseline surveys for birds were completed from September 2018 to June 2019, by MEL personnel and professional birder, Mr. Chris Pepper. A total of 504 minutes (8 hours and 24 mins) of surveys were completed over three seasons including time spent on common nighthawk surveys. These surveys resulted in the observation of 526 individuals, representing 58 species within the Study Area. An additional 22 individuals observed incidentally. Incidental observations include those individuals observed outside of dedicated point count survey locations or survey times. Novel species (i.e. those not yet recorded in standardized point counts) and priority species are recorded if observed incidentally.

Across all survey seasons a total of fourteen priority species were observed during dedicated survey periods: common nighthawk, evening grosbeak (*Coccothraustes vespertinus*), Swainson's thrush (*Catharus ustulatus*), killdeer (*Charadrius vociferus*), red crossbill (*Loxia curvirostra*), purple finch (*Haemorhous purpureus*), yellow-bellied flycatcher (*Empidonax flaviventris*), ruby-crowned kinglet (*Regulus calendula*), red-breasted merganser (*Mergus serrator*), boreal chickadee (*Poecile hudsonicus*), northern harrier (*Circus hudsonius*), spotted sandpiper (*Actitis macularius*), red-breasted nuthatch (*Sitta canadensis*), and pine siskin (*Spinus pinus*). These Priority Species are discussed in Section 5.6.6. Avian survey locations can be found in Figure 6.

The seasonal specific survey results are discussed below.

5.4.5.2.1 *Fall Migration*

The fall bird migration survey consisted of 8 point count stations and dedicated surveys were conducted two times during the fall migration period; September 5 and September 26, 2019. During fall migration, a total of 90 individuals representing 20 species and several individuals unidentifiable at the species level were observed. When incidental observations were removed (i.e. those observed outside of PC locations or survey times), 75 individuals representing 16 species remain (see Table 5-11 below). One avian SOCI was observed during fall migration surveys, all avian priority species are discussed in Section 5.6.6.

Table 5-11. Fall Migration Surveys: Species and Abundance of Birds

Species Code	Common Name	Scientific Name	S-Rank	#	Point Obs.	Group
amcr	American Crow	*Corvus brachyrhynchos*	S5	7	1, 4, 6, 7, 8	6
amgo	American Goldfinch	*Carduelis tristis*	S5	9	1, 5, 7	6
amro	American Robin	*Turdus migratorius*	S5B,S3N	2	3, 4	6
bcch	Black-capped Chickadee	*Poecile atricapilla*	S5	9	1, 4, 6, 7	6
bhvi	Blue-headed Vireo	*Vireo solitarius*	S5B	3	2, 3	6
blja	Blue Jay	*Cyanocitta cristata*	S5	9	1, 3, 4, 6	6

Species Code	Common Name	Scientific Name	S-Rank	#	Point Obs.	Group
boch	Boreal Chickadee	*Poecile hudsonica*	S3	2	1	6
cedw	Cedar Waxwing	*Bobycilla cedrorum*	S5B	10	5	6
colo	Common Loon	*Gavia immer*	S4B,S4N	1	3	3
cora	Common Raven	*Corvus corax*	S5	2	7, 8	6
deju	Dark-eyed Junco	*Junco hyemalis*	S4S5	1	1	6
gcki	Golden-crowned Kinglet	*Regulus satrapa*	S5	6	1, 4, 6	6
hawo	Hairy Woodpecker	*Picoides villosus*	S5	1	5	7
nofl	Northern Flicker	*Colaptes auratus*	S5B	1	3	7
noha	Northern Harrier	*Circus cyaneus*	S3S4B	2	4, 5	4
revi	Red-eyed Vireo	*Vireo olivaceus*	S5B	5	3, 4, 8	
unpa	Unknown Passerine	-	-	3	1	6
unwo	Unknown Bird	-	-	2	3, 4	
	16 Species	**Total Number:**		**75**		

Notes: Incidental observations not included (those observed outside of point count locations). Bird group is coded as: 1 = waterfowl; 2 = shorebirds; 3 = other waterbirds (i.e. that are not waterfowl or shorebirds); 4 = diurnal raptors; 5 = nocturnal raptors; 6 = passerines (excluding dippers) and 7 = other landbirds.

Passerines comprised 91% of all individuals observed, which was to be expected based on the forest habitat. The second most abundant species group was landbirds (i.e. woodpeckers, grouse), which made up 5% of all observed individuals. The four most commonly observed species during fall migration were cedar waxwing (n=10), American goldfinch (n=9), black-capped chickadee (n=9), and blue jay (n=9). No large flocks or obvious migration patterns were observed.

5.4.5.2.2 Spring Migration

Eight (8) point count locations were surveyed during the spring bird migration period. The spring bird migration survey was conducted on May 6 and May 30, 2019. During spring migration, a total of 244 individuals representing 45 species were observed. With incidental observations removed (those outside of PC locations or survey times), 240 individuals, representing 41 species remain (total number of species does not include an unidentifiable woodpecker species, see Table 5-12 below).

One SAR and two SOCI species were observed during the spring migration surveys, all avian priority species are discussed in Section 5.6.6.

Table 5-12. Spring Migration: Species and Abundance of Birds

Species Code	Common Name	Scientific Name	S-Rank	#	Points Obs.	Bird Group
evgr	**Evening Grosbeak**	***Coccothraustes vespertinus***	**S3S4B,S3N**	**7**	**1, 6, 7, 8**	**6**
amcr	American Crow	*Corvus brachyrhynchos*	S5	3	4, 8	6
amgo	American Goldfinch	*Carduelis tristis*	S5	5	6, 8	6

Species Code	Common Name	Scientific Name	S-Rank	#	Points Obs.	Bird Group
amre	American Redstart	*Setophaga ruticilla*	S5B, S3N	3	1, 4	6
amro	American Robin	*Turdus migratorius*	S5B,S3N	21	1, 2, 3, 4, 5, 6, 7, 8	6
baww	Black-and-white Warbler	*Mniotilta varia*	S5B	7	1, 3, 5, 6, 7, 8	6
bcch	Black-capped Chickadee	*Poecile atricapilla*	S5	14	1, 2, 3, 4, 5, 6, 7, 8	6
beki	Belted Kingfisher	*Megaceryle alcyon*	S5B	1	1	3
bhvi	Blue-headed Vireo	*Vireo solitarius*	S5B	4	1, 7, 8	6
blja	Blue Jay	*Cyanocitta cristata*	S5	7	1, 2, 3, 5	6
btnw	Black-throated Green Warbler	*Dendroica virens*	S5B	6	1, 2, 4, 5, 7	6
cago	Canada Goose	*Branta canadensis*	SNAB,S4N	3	8	1
cogr	Common Grackle	*Quiscalus quiscula*	S5B	5	3, 5, 6, 7	6
cora	Common Raven	*Corvus corax*	S5	2	1, 7	6
deju	Dark-eyed Junco	*Junco hyemalis*	S4S5	8	1, 4, 5, 6, 7, 8	6
dowo	Downy Woodpecker	*Picoides pubescens*	S5	3	2, 3, 8	7
hawo	Hairy Woodpecker	*Picoides villosus*	S5	3	3, 8	7
heth	Hermit Thrush	*Catharus guttatus*	S5B	12	1, 3, 5, 6, 7, 8	6
kill	Killdeer	*Charadrius vociferus*	S3B	2	3, 8	2
lefl	Least Flycatcher	*Empidonax minimus*	S4S5B	5	2, 3, 8	6
mawa	Magnolia Warbler	*Dendroica magnolia*	S5B	5	1, 5, 7, 8	6
nofl	Northern Flicker	*Colaptes auratus*	S5B	6	1, 2, 3, 5, 7, 8	7
nopa	Northern Parula	*Parula americana*	S5B	5	5, 7, 8	6
oven	Ovenbird	*Seiurus aurocapilla*	S5B	18	1, 2, 3, 4, 5, 6, 7, 8	6
pigr	Pine Grosbeak	*Pinicola enucleator*	S2S3B,S5N	2	1, 4	6
pisi	Pine Siskin	*Carduelis pinus*	S2S3	3	4, 7, 8	6
piwo	Pileated Woodpecker	*Dryocopus pileatus*	S5	1	4	7
pufi	Purple Finch	*Carpodacus purpureus*	S3S5B,S3S4N	2	1, 3	6

Species Code	Common Name	Scientific Name	S-Rank	#	Points Obs.	Bird Group
rbnu	Red-breasted Nuthatch	*Sitta canadensis*	S3	4	2, 6, 7	6
rcki	Ruby-crowned Kinglet	*Regulus calendula*	S3S4B	7	1, 3, 4, 5, 6, 7, 8	6
recr	Red Crossbill	*Loxia curvirostra*	S3S4	1	1	6
rugr	Ruffed Grouse	*Bonasa umbellus*	S5	7	1, 2, 4, 6, 7	7
rwbl	Red-winged Blackbird	*Agelaius phoeniceus*	S4B	2	1	6
savs	Savannah Sparrow	*Passerculus sandwichensis*	SNA	1	6	6
sosp	Song Sparrow	*Melospiza melodia*	S5B	11	1, 3, 5, 6, 7, 8	6
spsa	Spotted Sandpiper	*Actitis macularius*	S3S4B	1	6	2
swth	Swainson's Thrush	*Catharus ustulatus*	S3S4B	2	7, 8	6
tres	Tree Swallow	*Tachycineta bicolor*	S4B	4	5, 7	6
woodpecker sp	woodpecker sp	*#N/A*	S5B	17	1, 2, 3, 4, 5, 6, 7, 8	1
wtsp	White-throated Sparrow	*Zonotrichia albicollis*	S5B	6	1, 2, 5, 8	6
ybsa	Yellow-bellied Sapsucker	*Sphyrapicus varius*	S4S5B	11	1, 2, 3, 5, 7, 8	7
yrwa	Yellow-rumped Warbler	*Dendroica coronata*	S5B	3	3, 4, 7	6
	Total Species: 41	***Total Number:***		**240**		

Notes: Incidental observations are not included (those observed outside of point count locations). Bird group is coded as: 1 = waterfowl; 2 = shorebirds; 3 = other waterbirds (i.e. that are not waterfowl or shorebirds); 4 = diurnal raptors; 5 = nocturnal raptors; 6 = passerines (excluding dippers) and 7 = other landbirds.

Passerines comprised 77% of all individuals observed, followed by landbirds (13%) and waterfowl (8%). American robin (n=21) was the most abundant species observed, followed by ovenbird (n=18) and unidentifiable woodpecker species (n=17). No large flocks or obvious migration patterns were observed.

5.4.5.2.3 <u>Breeding Season</u>

The breeding bird survey consisted of 8 point count stations that were surveyed twice on June 17 and 25, 2019. A total of 190 individuals representing 43 species were observed, not including an unidentifiable bird. With incidental observations removed (i.e. those outside of PC locations or survey times), 187 individuals representing 42 species were observed, not including an unidentifiable bird. The species observed during dedicated surveys are included in the summary below (see Table 5-13). During dedicated breeding bird point count surveys, six avian priority species were observed, all of which were SOCI. All avian priority species are discussed in Section 5.6.6.

Table 5-13. Breeding Season Surveys: Species and Abundance of Birds

Species Code	Common Name	Scientific Name	S-Rank	#	Points Obs.	Bird Group	Breeding Status
alfl	Alder Flycatcher	*Empidonax alnorum*	S5B	4	6, 7, 8	6	Possible
amcr	American Crow	*Corvus brachyrhynchos*	S5	3	3, 5, 6, 7, 8	6	Possible
amgo	American Goldfinch	*Carduelis tristis*	S5	12	3, 5, 6, 7, 8	6	Probable
amre	American Redstart	*Setophaga ruticilla*	S5B, S3N	4	4, 5	6	Probable
amro	American Robin	*Turdus migratorius*	S5B,S3N	12	2, 3, 5, 7	6	Probable
baea	Bald Eagle	*Haliaeetus leucocephalus*	S5	1	2	4	Possible
baww	Black-and-white Warbler	*Mniotilta varia*	S5B	5	1, 3, 5, 6, 8	6	Possible
bcch	Black-capped Chickadee	*Poecile atricapilla*	S5	2	1, 5	6	Possible
bhvi	Blue-headed Vireo	*Vireo solitarius*	S5B	11	2, 3, 6, 7, 8	6	Probable
blbw	Blackburnian Warbler	*Dendroica fusca*	S4B	2	7, 8	6	Possible
blja	Blue Jay	*Cyanocitta cristata*	S5	2	2, 4	6	Possible
btnw	Black-throated Green Warbler	*Dendroica virens*	S5B	8	2, 3, 4, 5, 6, 7	6	Possible
bwwa	Blue-winged Warbler	*Vermivora pinus*	SNA	2	1, 5	6	Possible
cogr	Common Grackle	*Quiscalus quiscula*	S5B	4	1, 5, 6, 8	6	Possible
colo	Common Loon	*Gavia immer*	S4B,S4N	2	2, 6	3	Possible
cora	Common Raven	*Corvus corax*	S5	1	2	6	Possible
coye	Common Yellowthroat	*Geothlypis trichas*	S5B	7	1, 3, 6, 7, 8	6	Probable
deju	Dark-eyed Junco	*Junco hyemalis*	S4S5	6	1, 7, 8	6	Probable
dowo	Downy Woodpecker	*Picoides pubescens*	S5	1	5	7	Possible
hawo	Hairy Woodpecker	*Picoides villosus*	S5	5	2, 3, 4, 8	7	Possible
heth	Hermit Thrush	*Catharus guttatus*	S5B	10	1, 2, 4, 5, 7, 8	6	Probable
kill	Killdeer	*Charadrius vociferus*	S3B	1	8	2	Possible
lefl	Least Flycatcher	*Empidonax minimus*	S4S5B	5	2, 3, 5	6	Probable
mawa	Magnolia Warbler	*Dendroica magnolia*	S5B	7	1, 3, 5, 7, 8	6	Probable

Species Code	Common Name	Scientific Name	S-Rank	#	Points Obs.	Bird Group	Breeding Status
mowa	Mourning Warbler	*Oporornis philadelphia*	S4B	1	8	6	Possible
nofl	Northern Flicker	*Colaptes auratus*	S5B	2	2, 3	7	Possible
nopa	Northern Parula	*Parula americana*	S5B	3	5	6	Possible
oven	Ovenbird	*Seiurus aurocapilla*	S5B	16	1, 2, 3, 5, 6, 7, 8	6	Probable
piwo	Pileated Woodpecker	*Dryocopus pileatus*	S5	1	4	7	Possible
pufi	Purple Finch	*Carpodacus purpureus*	S3S5B,S3S4N	2	1, 4	6	Possible
rbng	Red-breasted Merganser	*Mergus serrator*	S3S4B,S5N	1	3	2	Possible
recr	Red Crossbill	*Loxia curvirostra*	S3S4	1	1	6	Possible
revi	Red-eyed Vireo	*Vireo olivaceus*	S5B	10	1, 2, 3, 4, 5, 6, 8	6	Probable
rwbl	Red-winged Blackbird	*Agelaius phoeniceus*	S4B	1	5	6	Possible
savs	Savannah Sparrow	*Passerculus sandwichensis*	SNA	1	7	6	Possible
sosp	Song Sparrow	*Melospiza melodia*	S5B	8	3, 5, 6, 7, 8	6	Probable
swth	Swainson's Thrush	*Catharus ustulatus*	S3S4B	7	1, 4, 5, 7, 8	6	Probable
tres	Tree Swallow	*Tachycineta bicolor*	S4B	1	6	6	Possible
unwo	Unknown	*#N/A*	n/a	1	3	7	-
wtsp	White-throated Sparrow	*Zonotrichia albicollis*	S5B	3	1, 5, 8	6	Possible
ybfl	Yellow-bellied Flycatcher	*Empidonax flaviventris*	S3S4B	5	1, 2, 3, 4, 8	6	Possible
ybsa	Yellow-bellied Sapsucker	*Sphyrapicus varius*	S4S5B	5	2, 3, 5, 6	7	Possible
yrwa	Yellow-rumped Warbler	*Dendroica coronata*	S5B	1	5	6	Possible
	Total: 42 Species	**Total Number:**		**187**			

Notes: Incidental observations not included (those observed outside of point count locations). Bird group is coded as: 1 = waterfowl; 2 = shorebirds; 3 = other waterbirds (i.e. that are not waterfowl or shorebirds); 4 = diurnal raptors; 5 = nocturnal raptors; 6 = passerines (excluding dippers) and 7 = other landbirds.

Passerines comprised 89% of all individuals observed, followed by landbirds (8%). The three most commonly observed species during breeding bird surveys were the ovenbird (n=16), American goldfinch (n=12), and American robin (n=12). No large flocks or obvious migration patterns were observed. Those identified as possible breeders were observed during breeding season in suitable nesting habitat (n=29). Since the site surveyed is a relatively small part of the surrounding area, it is not possible to confirm that all species identified were actually nesting within the boundaries of the Study Area. For instance, for an adult bird that was observed singing in suitable nesting habitat (possible breeding evidence), it is reasonable to assume that the bird could be nesting on an adjacent parcel of land. All others were identified as probably breeders (n=13).

All of the species identified are native species in this area of Nova Scotia and the province in general and observed within the typical and common habitat associated with the Study Area and surrounding landscape.

5.4.5.2.1 Common Nighthawk Surveys

Common nighthawk surveys took place on June 16 and 24, 2019. One common nighthawk was observed on June 16, 2019 at PC2 (Figure 6, Appendix A). This individual was heard making a nasal peent call and booming, the sound made during a courtship dive. The call was heard from over 500 m east of the Study Area.

5.4.5.3 *Summary of Bird Surveys*

Four seasonal surveys were completed in the Study Area: fall migration, spring migration, breeding bird, and common nighthawk surveys. A total of 504 minutes (8 hours and 24 minutes) was spent on these dedicated avian surveys, which resulted in the observation of 526 individuals representing 58 species. An additional 22 individuals were observed incidentally, all of which were species observed during dedicated surveys except for a mallard (*Anas platyrhynchos*) and ruby-throated hummingbird (*Archilochus colubris*). All of the species observed are native species in this region; they are typical species commonly found within the Study Area habitat and its surroundings. No obvious concentrations of one particular bird group were observed, nor was an identifiable migratory pathway noted.

5.5 Aquatic Environment

Five watercourses were identified within the Study Area during field surveys (2 watercourses are located within the QDA). No wetlands were identified within the Study Area. The following sections provide details about the surface water features identified, including the results from the surface water sampling program, fish and fish habitat evaluations, and the water balance assessment.
The Study Area lies within the unnamed tertiary watershed 1FJ-10-B (herein referred to as the Blacketts Lake Tertiary Watershed), which is contained within the Sydney River Secondary Watershed (1FJ-101) that discharges into the Sydney River located approximately 11.5 km northeast of the Study Area. The Sydney River Secondary Watershed is located within the Salmon/Mira Primary Watershed (1FJ). The sizes of the tertiary, secondary, and primary watersheds are 3,322 ha, 18,489 ha, and 266,694 ha, respectively.

Three Local Catchment Areas (LCA) have been identified within and adjacent to the Study Area. These are discussed in detail in Section 5.5.2.3.

5.5.1 Wetlands

5.5.1.1 *Desktop Review*

A review of the NSE Wetlands Inventory Database identified no wetlands within the Study Area. The Wet Areas Database identified two areas as having moisture within 0.5 m of the surface: one runs southeast-northwest through the centre of the Study Area exiting on the west side, the second is in the northern third of the Study Area. No WSS are within or adjacent to the Study Area.

5.5.1.2 *Field Surveys*

No wetlands were identified during field surveys within the Study Area. One wetland was observed on an adjacent property north of the Study Area but does not enter or abut the PID boundaries. Observations from the Study Area boundary indicate that WC4 flows out of the wetland and into the Study Area. The off-site wetland exists as a mixedwood, terrene swamp dominated by shrubs and forbs. Vegetation included yellow birch and sugar maple in the tree stratum, red spruce and sugar maple in the shrub stratum, and cinnamon fern and creeping buttercup in the shrub stratum. Hydric soil properties were indicated by histosol, and hydrology indicators included a high-water table, saturation, and water marks.

This wetland is located outside of the Study Area, and as such, functional analysis was not performed.

5.5.2 Surface Water

5.5.2.1 *Desktop Review*

A review of aerial imagery and NSTDB mapping identified no waterbodies within the Study Area. The following mapped watercourses were identified as indicated on Figure 2 (Appendix A):

- One unnamed NSE mapped watercourse was identified in the south-central portion of the Study Area, initiating approximately halfway up the existing quarry access road that runs along the western Study Area boundary. This mapped watercourse drains south to Portage Brook (WCB) and is referred to in this document as WC1.
- MacDonalds Brook is sourced from a wetland complex northeast of the Study Area and flows south. Field mapping confirmed that this watercourse travels slightly west of the NSTDB mapped watercourse line, flowing within the Study Area boundary for approximately 90 m before exiting the Study Area boundary east (see Figure 2, Appendix A). MacDonalds Brook eventually drains into Portage Brook, approximately 3.7 km east of the Study Area.
- Portage Brook (WCB) is located approximately 75 m south of the Study Area and receives inputs from WC1. Portage Brook flows east below the Study Area boundary, eventually discharging into Blacketts Lake approximately 4.7 km east of the Study Area.

The detailed catchment area analysis which was completed to evaluate hydrological effects associated with the Project identified three LCAs and associated outfalls. These catchments define baseline water flow patterns across and in proximity to the Study Area and indicate that due to the undulating nature of the landscape, surface water flows are as follows. LCA and associated outfalls are presented on Figure 12 (Appendix A) as well as in the Water Balance Analysis Report (Appendix E).

- Southeast, from northern portions of the Study Area;
- Southeast, from central portions of the Study Area; and,
- Eastward, from southern portions of the Study Area.

5.5.2.1.1 Predicted Water Discharge

As described in Section 2.4.3, water currently discharges from existing quarry infrastructure via ditching and settling ponds southward into WC1, which eventually discharges into Portage Brook. Desktop resources including topographical mapping, flow accumulation mapping (NSDNR, 2013), and aerial imagery were utilized to predict the flow of water from the current quarry footprint, which was verified during field assessments. Future water flows are proposed to discharge via the same system although upgrades and/or modifications maybe required during the life of the quarry.

5.5.2.1.2 Coxheath/Westmount Municipal Water Supply Area

According to the ACCDC report, the Study Area is located within the Coxheath/Westmount Municipal Water Supply Area, which is considered a natural watershed area upstream of intake. This water supply area covers approximately 18,311 ha in total surface area (close to the entirety of the Sydney River Secondary Watershed).

5.5.2.2 *Field Results*

Five unnamed watercourses were delineated and characterized within the Study Area. Two additional watercourses (MacDonalds Brook and Portage Brook) were partially assessed to capture aquatic features downgradient of the QDA. Combined, these assessments cover all watercourses within the FHAA. The physical characteristics of each watercourse are summarized in Table 5-14.

Table 5-14: Physical Characteristics of Watercourses within the FHAA

WC ID	Reference UTMs (NAD 83)		Reach Length (m)	Stream Order	Flow Regime[1]	V[2]	Gradient	Bankfull Width (cm)	Depth Range (cm)	Bank Height (cm)	Substrate (%)	Cover (%)	Habitat (%)	Barriers
	E	N												
1	Upstream 703089 Downstream 703437	 5102820 5102483	872	1-2	Intermittent - Perennial	H	5.8%	50-200	20-40	30-100	Boulder (15) Cobble (15) Gravel (60) Muck (10)	In-stream vegetation, Woody debris, Boulder (40)	Run (50) Pool (35) Riffle (15)	• Steep gradient/falls • Seasonal debris blockages/sediment wedges • Seasonally dry channel
2	Upstream 702949 Downstream 703984	 5102893 5102871	66	1	Intermittent	No flow	6.1%	30-50	0-30	30-50	Boulder (20) Cobble (10) Gravel (70)	In-stream vegetation, Woody debris, Boulder (20)	Step--pool (100)	• Steep gradient • Seasonally dry channel
3	Upstream 702935 Downstream 702957	 5102838 85102853	74	1	Intermittent	No flow	4.1%	30-100	0-30	30-50	Boulder (30) Cobble (30) Gravel (30)	In-stream vegetation, Boulder (10)	Step-pool (100)	• Steep gradient • Seasonally dry channel
4	Upstream 702702	 5103459	413	1	Intermittent	No flow	7.0%	30	Dry	30-100	Gravel (60) Silt (40	None	Run (100)	• Falls • Dechannelized area

WC ID	Reference UTMs (NAD 83)		Reach Length (m)	Stream Order	Flow Regime[1]	V[2]	Gradient	Bankfull Width (cm)	Depth Range (cm)	Bank Height (cm)	Substrate (%)	Cover (%)	Habitat (%)	Barriers
	E	N												
	Downstream													• Seasonally dry channel
	702887	5103297												
5	Upstream		65	1	Ephemeral	No flow	6.2%	20	Dry	20	Boulder (10) Gravel (20) Silt (70)	In-stream vegetation, Boulder (10)	Run (100)	• Falls • Ephemeral channel
	702942	5103205												
	Downstream													
	702969	5103241												
A*	Upstream		571	2	Perennial	M	7.2%	300	10-40	100	Bedrock (4) Boulder (15) Cobble (15) Gravel (20) Sand (10)	Woody debris, Boulder, Undercut banks (25)	Pool (40) Riffle (35) Riffle (15) Cascade (10)	• Falls
	703037	5103230												
	Downstream													
	703378	5103141												
B*	Upstream		369	3	Perennial	M	1.9%	500-600	10-65	50	Boulder (15) Cobble (30) Gravel (30) Sand (5) Muck (20)	Woody debris, Boulder, Undercut banks (15)	Run (3) Pool (25) Riffle (25) Flat (20)	None
	703443	5102490												
	Downstream													
	703763	5102594												

*Characteristics only reflect those within the length of watercourse assessed (watercourses continue outside of the FHAA)
[1]Perennial = Year-round streams. Water is supplied from smaller upstream waters or groundwater while runoff from rainfall or other precipitation is supplemental. Intermittent = Seasonal streams. Flow during certain times of the year, with runoff from rainfall or other precipitation supplementing flow. Ephemeral = Rain-dependent streams that flow only after precipitation. Runoff from rainfall is the primary source of water.
[2] V=Velocity (L: Low flow rates (<0.15m/s). M: Moderate flow rates (0.15-0.3m/s). H: High flow rates (>0.3m/s))

5.5.2.2.1 *Surface Water Sampling*

Five surface water samples were collected and analyzed as detailed in Section 4.1.7.2.1 to establish a baseline for future surface water quality comparison. RCAp-MS Total Metals in Water and RCBA Hydrocarbons in Water were analysed. This analysis included the testing of many different metals such as arsenic, cadmium, and lead amongst others. Full results are in Appendix F. Unless included in the table below, all other sample results were low to undetectable levels. Additional baseline water quality sampling will be conducted prior to quarry expansion to establish further baseline parameters (i.e. TSS) and seasonal variability in surface water quality parameters. Sample results recorded at WQ1 through WQ5 meet all but three applicable CCME FWAL water quality guidelines. Table 5-15 provides a comparison of the CCME FWAL exceedances at all sample locations (indicated by bolded cells).

Table 5-15: CCME FWAL Guideline Exceedances

Sample Parameter	CCME FWAL Guideline	WQ1		WQ2		WQ3		WQ4		WQ5	
Flow regime*		LF	HF	LF	HF	LF	HF	LF	HW	LF	HW
pH	6.5 to 9.0	7.73	7.67	8.20	7.90	7.86	7.25	6.86	**6.10**	6.89	**6.32**
Total Aluminum	5 ug/L	**16**	**470**	**20**	**110**	**32**	**730**	**220**	**220**	**140**	**190**
Total Iron	300 ug/L	ND	**380**	ND	89	63	**710**	**780**	**430**	230	280

*Flow regime at time of sampling event: LF = Low Flow (September 26, 2019), HF = High Flow (November 6, 2019)

Baseline conditions indicate that aluminum consistently exceeds the CCME FWAL criteria for all samples. This also exceeds the Nova Scotia Environmental Quality Standards (Tier 1 EQS) for surface water criteria for aluminum (5 ug/L). In addition, results from WQ1, WQ3, and WQ4 indicate exceedances of iron during both (WQ4) and high flow (WQ1, WQ3) sampling events. This also exceeds the Tier 1 EQS for surface water criteria for iron (300 ug/L). WQ4 and WQ5 had recorded high flow pH levels slightly below the CCME FWAL guideline of 6.5, but generally, pH across the Study Area fell within the acceptable range for freshwater aquatic life.

Sample resulted recorded at WQ1 through WQ 5 meet all but three applicable Tier 1 EQS guidelines. Table 5-16 provides a comparison of the guidelines at all sample locations. Unless included in the table below, all other sample results were low to undetectable levels.

Table 5-16: Tier 1 EQS Guideline Exceedances

Sample Parameter	Tier 1 EQS Guideline	WQ1		WQ2		WQ3		WQ4		WQ5	
Flow regime*		LF	HF	LF	HF	LF	HF	LF	HW	LF	HW
Total	5 ug/L	**16**	**470**	**20**	**110**	**32**	**730**	**220**	**220**	**140**	**190**

Sample Parameter	Tier 1 EQS Guideline	WQ1		WQ2		WQ3		WQ4		WQ5	
Flow regime*		LF	HF	LF	HF	LF	HF	LF	HW	LF	HW
Aluminum											
Cadmium	0.01 ug/L	ND	ND	ND	ND	ND	ND	**0.018**	**0.019**	ND	ND
Total Iron	300 ug/L	ND	**380**	ND	89	63	**710**	**780**	**430**	230	280

*Flow regime at time of sampling event: LF = Low Flow (September 26, 2019), HF = High Flow (November 6, 2019)

5.5.2.2.2 Water Quality Parameters

Water quality parameters as recorded *in-situ* during the surface water sampling program are presented in Table 5-17.

Table 5-17: In-situ Water Quality Profiles (taken September 25, 2019)

Location	Watercourse ID	Temp (°C)	pH	DO (mg/L)	Sp. Con (µS/cm)	TDS (mg/L)
WQ1	WCB (downstream)	12.2	7.65	10.44	568.0	368.5
WQ2	WC1	12.7	8.06	9.01	471.8	306.8
WQ3	WCB (upstream)	12.9	7.93	10.07	507.8	330.2
WQ4	WCA (upstream)	13.0	6.55	9.12	47.3	36.4
WQ5	WCA (downstream)	13.1	6.85	9.21	48.5	31.2

These results are discussed as they relate to fish habitat quality in Section 5.5.3.2.

5.5.2.3 *Catchment Areas and Outfalls*

Three Local Catchment Areas (LCA) and associated Outfall Locations were identified. Baseline LCA and Outfall Locations are presented on Figure 12 in the Water Balance Analysis Report (Appendix E).

- LCA1/Outfall Location 1 – This LCA and Outfall is the largest catchment (177.5 ha) and includes Sub-Catchment 2/Outfall Location 2. LCA 1 includes the drainage basin of Portage Brook and land to the west of the existing western access road through the Gillis Lake Quarry. Outfall Location 1 is located on Portage Brook and receives water from LCA1 and LCA2 which drains from the existing quarry areas.

- LCA2/Outfall Location 2 – LCA2 is 71.0 ha in size and comprises a large portion of the existing and former quarry, and a very small portion of the QDA. The catchment receives water from undeveloped land to the northwest of the Study Area and drainage of water through the LCA is predominantly through the Study Area via WC1 and the existing drainage channels. Outfall Location 2 is situated at the outflow culvert from WC1 on-site prior to its confluence with Portage Brook.

- LCA 3/Outfall Location 3 – LCA3 is predominantly located outside the Study Area and is 144.8 ha in size. LCA3 encompasses multiple off-site watercourses and is the main contributor of water to the off-site MacDonalds Brook. Outfall Location 3 is situated in MacDonalds Brook and represents the furthest downstream location along MacDonalds Brook that receives water from the QDA.

5.5.2.4 *Water Balance Results*

Utilizing the methodology discussed above and in the Water Balance Analysis Report (Appendix E), the following section outlines the predicted changes that can be expected to each aquatic feature receiving water from the Gillis Lake Quarry. It should be noted that these changes are based on the full expansion of the Gillis Lake Quarry. **Since the calculated changes have been completed at the outfall of each LCA/sub-catchment (i.e. the bottom), potential changes and associated effects to the upper portions (headwaters) of each aquatic feature have been qualitatively discussed. In some cases, this includes an extrapolation of predicted increases and reductions to the upper portions of each aquatic feature.**

Table 5-18 and Table 5-19 below indicate the percentage change in area, runoff and infiltration from existing conditions to EOQ conditions respectively. A negative represents a decrease in the value compared to existing condition, and a positive value represents an increase in the value compared to existing conditions.

Table 5-18: End of Quarry Impervious Conditions Comparison to Existing Conditions

Catchment	% Area Change	% Runoff Change	% Infiltration Change
Outfall 1	5.58%	12.94%	-4.44%
Outfall 2	13.94%	24.94%	2.98%
Outfall 3	-6.77%	-10.65%	-10.65%

Table 5-19: End of Quarry Pervious Conditions Comparison to Existing Conditions

Catchment	% Area Change	% Runoff Change	% Infiltration Change
Outfall 1	5.58%	-0.72%	2.09%
Outfall 2	13.94%	5.67%	10.60%
Outfall 3	-6.77%	-10.65%	-10.65%

Summary

The reader is reminded that the predictions summarized in Table 5-17 and Table 5-18 and discussed further below are based on the two infiltration factors used in the analysis (i.e. 100% infiltration, and existing, most likely infiltration).

Outfall Location 1 – Portage Brook: The expanded quarry footprint increases the catchment's contributing area by 5.58%, which contributes drainage to Outfall Location 1. This surplus water initiating in the quarry area would be drained through water management infrastructure (ditches and settling ponds) to Outfall Location 2. As a result, the following surface water run-off volume changes and changes to infiltration in LCA1, which sources water to Portage Brook can be expected at full quarry development.

- A predicted increase in surface-water volume ranging somewhere between -0.72% and 12.94%.
- A change in infiltration ranging between -4.44% and 2.09%.
- Predicted changes in surface-water volume are anticipated to be less identifiable as Portage Brook extends downstream to the east. The effects are reduced as water is sourced to it from the natural, undeveloped sub-catchment which is unaffected by quarry development.

Outfall Location 2 – Watercourse 1: The expanded quarry footprint increases the catchment's contributing area by 13.94%, which results in an increase of contributing drainage area to the current water management infrastructure (ditches and settling ponds) and WC1. Subsequently, surface water volume discharge and infiltration changes occurring in LCA3 which sources Portage Brook and can be expected at full quarry development.

- A predicted increase in surface-water volume ranging somewhere between 5.67% and 24.94%.
- A change in infiltration ranging between 2.98% and 10.60%.
- Predicted changes in surface-water volume are anticipated to be greater as WC1 extends upstream (northwestward) from Outfall Location 2, to the point at which drainage sourced from the active quarry area flows into it. As such, above this confluence, WC1 is predicted to be unaffected by a change in surface water volume discharge.

Outfall Location 3 – MacDonalds Brook: The quarry expansion removes 6.77% of the contributing drainage area of the LCA, which equates to a 6.77% portion of the contributing drainage area to MacDonalds Brook and diverts it through quarry water management infrastructure towards Outfall Location 2. As discussed in Section 9.2.5, quarry expansion in LCA3 will eliminate the functionality of WC's 4 and 5, which currently act as intermittent/ephemeral streams and drain water towards MacDonalds Brook. As such, due to their expected loss, these watercourses were not analyzed as part of the water balance. The water balance results show that MacDonalds Brook is expected to see a loss of surface water drainage volume at full quarry development.

- A predicted decrease in surface-water volume of 10.65%,
- A decrease in infiltration of 10.65%.
- Predicted changes in surface-water volume are anticipated to be greater as MacDonalds Brook extends upstream (northwestward) from Outfall Location 3, to the point in which it confluences with WC4 and meanders northeastward away from the quarry. As such, above this confluence, MacDonalds Brook is predicted to be unaffected by a change in surface water volume discharge.

5.5.2.4.1 Reclamation

Reclamation at the Gillis Lake Quarry will focus on the re-contouring of quarry areas, and revegetation and stabilization of exposed surfaces. As it relates to hydrological conditions, and the water balance performed above for the active period of the quarry, the following assumptions have been made:

- Re-contouring of lands within the active quarry area, and future quarry areas in the QDA will take place to reduce the steepness of sidewalls, banks and stockpile areas.
- Revegetation will focus on soil stabilization and will include efforts to reclaim natural vegetation and habitat types present in the local area and adjacent lands where possible.
- Some water management infrastructure maybe removed (i.e. ditching, settling ponds) and surface water drainage will be encouraged to flow naturally across a well vegetated surface. Development of the Project reclamation plan throughout quarry operations will define the options available to implement these activities.
- Underlying bedrock and surface soil infiltration capacity is expected to resemble the pervious-infiltration scenario.
- Surface water from within the quarry areas will continue to drain southeastward toward Outfall Location 2 and into Portage Brook.

Based on these assumptions, it is possible water may infiltrate in a more natural way in comparison to how it is predicted to drain under an active quarry scenario. This could result in increased groundwater recharge capacity and drainage characteristics resembling more natural conditions.

However, due to the preliminary nature of reclamation plans at this time, the predicted effects discussed in this document as it relates to surface water discharge volume changes (and associated potential effects to fish and fish habitat) are considered to be permanent and irreversible.

5.5.3 Fish and Fish Habitat

5.5.3.1 *Desktop Review*

The Atlantic Salmon Federation (ASF) considers the Sydney River as presently salmon-bearing (2019). Atlantic salmon (*Salmo salar*) in this system are considered part of the Eastern Cape Breton Atlantic salmon population (COSEWIC Endangered; S1). The Sydney River serves as the outlet of Blacketts Lake, and eventually discharges into the Atlantic Ocean at the South Arm of Sydney Harbour. Atlantic salmon was identified within 5 km of the Study Area by ACCDC.

The Nova Scotia Freshwater Fish Distribution Records document brook trout (*Salvelinus fontinalis,* S3), alewife (*Alosa pseudoharengus,* S3), American eel (*Anguilla rostrata,* COSEWIC Threatened; S2), brown bullhead (*Ameiurus nebulosus*), white sucker (*Catostomus commersonii*), white perch (*Morone americana*), chain pickerel (*Esox niger*) and smallmouth bass in Blacketts Lake (NSDAF, 2019). Blacketts Lake is located east of the Study Area. The lake's primary tributary, Portage Brook, is hydrologically connected to surface water features within the Study Area.

In Nova Scotia, chain pickerel and smallmouth bass are considered both non-native and invasive species. Once introduced, these highly successful predators can significantly reduce native fish populations, particularly salmonids (i.e. trout and salmon), by feeding on smaller fish and outcompeting for food. It is believed that these species were illegally introduced into Blacketts Lake around 2010 and are thought to have caused a significant reduction in the number of brook trout within the lake (Cape Breton Post, 2012).

Details relating to habitat requirements for Priority Species identified through the desktop review (Atlantic salmon, brook trout, alewife, and American eel) are discussed in Section 5.6.8. Fish habitat characterization provided herein is focused on habitat requirements for native fish species.

5.5.3.2 *Field Results*

Field surveys found no lakes or areas of contiguous open water in the Study Area. Five watercourses were confirmed to be present within the Study Area (WC1, WC2, WC3, WC4, and WC5) and two additional watercourses outside of the Study Area were identified (Portage Brook and MacDonalds Brook). The additional watercourses encompass the downstream receiving environment from the Study Area and have been assessed within the FHAA (Figure 7, Appendix A).

As indicated through the desktop review, watercourses drain into the Portage Brook and are sourced water from the Study Area, which subsequently flows east to Blacketts Lake. Blacketts Lake connects directly to the Sydney River, which discharges into the Atlantic Ocean via the South Arm of Sydney Harbour.

Physical characteristics of the watercourses within the FHAA are described in Table 5-13 (Section 5.5.2). A georeferenced photolog was completed during the fish habitat evaluations and is provided in Appendix I.

WC1

WC1 originates as an accumulation of drainage from roadside ditching and natural, overland surface flow that channelizes about midway up the Study Area along the current quarry access road. The channel flows southeast through a natural, forested corridor, receiving inputs from short, first-order streams (WC2 and WC3), and settling ponds associated with the currently active quarry floor. The watercourse passes through two culverts: the first is a buried culvert under an old quarry access road (see P2 in Georeferenced Photolog – Appendix I), and the second directs WC1 under Coxheath Road. WC1 eventually empties into Portage Brook approximately 75 m south of the Study Area.

WC1 had a bankfull range width of 0.5-2 m, with water depths ranging between 0 and 40 cm. Substrate was dominated by gravel-sized rock, with boulder, cobble, and muck present in smaller amounts. Run, riffle, and pool habitats were all documented, with run being the predominant habitat feature. In-stream cover in the form of in-stream vegetation, woody debris, and boulder substrate is present.

Two barriers to fish passage were documented on WC1. The most downstream barrier was observed just above the old quarry access road culvert (see Figure 7 and P3 in Georeferenced Photolog – Appendix I). Here, the channel has carved out an extremely steep gradient, with vertical falls upwards of 1 m and average plunge pools depths of 10 cm. During fish collection surveys conducted above this barrier, brook trout were identified, so this is either an incomplete barrier, or a population of resident fish is present above this barrier. An additional vertical barrier of 2 m was noted approximately 435 m upstream (see Figure 7 and Photo 5). Upstream of this barrier, the channel was completely dry (September 24, 2019), and determined to be inaccessible to fish.

In-situ water quality measurements recorded within WC1 (WQ2) fell within the CCME guidelines and are considered suitable for freshwater fish; however, specific conductance and total dissolved solids measurements were considerably higher for WC1 (WQ2) than for MacDonalds Brook (WQ4 and WQ5). It has been inferred that these parameters are higher for WC1 due to the inflow of active and old quarry drainage into WC1, as opposed to MacDonalds Brook which does not currently receive drainage from the active quarry area. Future on-site water management will involve on-site water detention, sediment and erosion control, best management practices and implementation of the Surface Water Monitoring Program to ensure water quality meets the appropriate guidelines (i.e. no exceedance of CCME FWAL criteria or confirmed background concentrations for TSS, pH and metals).

WC2

WC2 is a short and intermittent, high gradient stream that forms in forested upland habitat north of WC1 as groundwater seepage. Habitat within the watercourse was characterized by step-pools, and substrate dominated by gravel. During the September 2018 assessment, water was confined to residual pools, with no flow observed between pools. Though potentially accessible by resident brook trout in WC1 during high flow, fish habitat within the watercourse is limited by seasonal dryness, channel gradient, and high velocities. The potential for this watercourse to support fish is low.

WC3
Like WC2, WC3 is a short, intermittent stream that forms in forested upland habitat south of WC1 as groundwater seepage. Habitat within the watercourse was characterized by step-pools, and gravel, cobble, and boulder-sized substrate were equally represented. During the September 2018 assessment, water within the channel was confined to residual pools, with no flow observed between pools. Like WC2, fish habitat within the watercourse is limited by seasonal dryness, channel gradient, and high velocities. Though possibly accessible by resident fish from WC1 during higher flows, the potential for this watercourse to support fish is low.

WC4
WC4 is a first-order, intermittent stream that originates from pockets of standing water along an offsite wetland north of the Study Area. During the initial assessment in September 2018, the watercourse was completely dry. In addition, a 55 m linear distance was documented where no channel could be located (see Figure 7). A follow-up assessment conducted in November 2019 to observed conditions during high flow. Despite increased flow within the channelized sections of the watercourse, no defined channel, bed or banks, or contiguous surface flow was identified within the 55 m linear distance (see P11 in Georeferenced Photolog – Appendix I). The channel reforms and splits approximately 45 m upstream of its confluence with MacDonalds Brook. Based on the lack of contiguous, channelized flow within the watercourse and to the barrier to fish passage located downstream on MacDonalds Brook, this watercourse does not provide direct fish habitat.

WC5
WC5 is a short, ephemeral watercourse that develops east of the current active quarry area. At the time of the assessment (September 2018), the watercourse was completely dry. The channel disappears entirely into upland forest approximately 10 m south of MacDonalds Brook (see P15 in Georeferenced Photolog – Appendix I). Based on the lack of connectivity between this watercourse and downstream aquatic features, and the barrier to fish passage located downstream on MacDonalds Brook, this watercourse does not provide direct fish habitat.

MacDonalds Brook
Based on NSTDB mapping and aerial imagery, MacDonalds Brook is thought to originate from a wetland complex approximately 1 km north of the Study Area. The watercourse drains southeast, eventually emptying into Portage Brook just upstream of Blacketts Lake. MacDonalds Brook was assessed over a linear reach of approximately 571 m, commencing just upstream of where the watercourse intercepts surface water from WC4. This high gradient, perennial watercourse reach was characterized by exposed bedrock and relatively equal amounts of boulder, cobble, and gravel substrates. Water depths ranged from 10-40 cm and mean bankfull width within this area was estimated to be 3 m. Step-pools were the dominant habitat type within the assessed reach, with runs and riffles present in flatter areas. In-stream cover was abundant and available in the form of coarse woody debris, boulders, and undercut banks. The riparian area was characterized by mature, hardwood forest. In-situ water quality measurements recorded

within MacDonalds Brook (WQ4 and WQ5) fell within the CCME guidelines and are considered suitable for freshwater fish.

MacDonalds Brook flows through a single, concrete culvert under a gravel access road, which was observed to be approximately 20 cm perched above the downstream watercourse channel. There was a waterfall observed approximately 125 m downstream of this road crossing, which was estimated to have a height of 12 m (see P17 in Georeferenced Photolog – Appendix I). This waterfall has been assessed as a permanent barrier that would prevent fish from accessing the watercourse upstream of the waterfall. No fish were captured upstream of the waterfall through electrofishing and trapping efforts.

Portage Brook

Based on NSTDB mapping and aerial imagery, Portage Brook (WCB) is thought to originate in an open water wetland complex approximately 1 km west of the Study Area which is fed by two NSTDB mapped headwater streams. At its downstream extent, Portage Brook feeds in to Blacketts Lake. WCB was observed over a linear reach of approximately 369 m, commencing at its confluence with WC1.

This third order, perennial watercourse was the lowest gradient stream of all watercourses described within the FHAA with a gradient of approximately 1.9%. Run, riffle, pool, and flat habitat types were present in relatively equal amounts along the reach. Variable rocky substrate types, including boulder, cobble, and gravel-sized substrate were observed. In addition, silt depositions were observed frequently throughout the reach. The bankfull width of the channel had an estimated range of 5-6 m, and depths observed at the time of the assessment ranged from 10-65 cm. A moderate amount of in-stream cover was present in the form of coarse woody debris, boulders, and undercut banks; however, this cover was limited by silt, which had embedded larger substrate and submerged woody debris.

Four brook trout were captured through trapping efforts within the reach. Portage Brook is considered to provide potential spawning, rearing, and overwintering habitat for brook trout. In addition, Portage Brook may serve as a refuge for brook trout from invasive predators present in Blacketts Lake (i.e. chain pickerel, smallmouth bass). In-situ water quality measurements recorded within Portage Brook (WQ1 and WQ3) fell within the CCME guidelines and are considered suitable for freshwater fish; however, like WC1, SPC and TDS measurements were considerably higher than those of MacDonalds Brook. It has been inferred that these parameters are higher for Portage Brook due to the inflow of active and old quarry drainage into WC1, which flows into Portage Brook, but elevated SPC and TSS levels were recorded upstream (WQ3) and downstream (WQ1) of the confluence with WC1 (WQ3 and WQ1). These elevated parameters are therefore also likely being influenced from sources upgradient, and outside of the Study Area.

5.5.3.2.1 *Electrofishing and Trapping Results*

A total of 45 individual brook trout were captured as a result of fishing efforts. No other species were captured through electrofishing or trapping within the FHAA. Catch results are presented in Table 5-20.

Table 5-20: Fish Captured Within the FHAA

Location	Species		Catch		Conservation Rank (ACCDC)
	Common	Scientific	Total #	% of Catch	
WC1 R1	Brook Trout	*Salvelinus fontinalus*	28	100	S3
WC1 R2			10	100	
WCA R1			12	100	
WCB			4	100	
WC A R2	- No catch -				

As noted in Section 5.5.3.2, brook trout were recorded in WC1 both below (WC1R1) and above (WC1R2) the most downstream barrier to fish passage. Brook trout were also in captured in Portage Brook, and MacDonalds Brook below the falls (WCAR1). No fish were captured above the falls in MacDonald Brook (WCAR2) through electrofishing and trapping efforts, which supports the assessment of the falls as a permanent barrier to fish passage.

5.5.3.2.2 *Species Specific Habitat Requirements*

Based on the desktop review completed, the follow species are expected within the FHAA, or watercourses contiguous with those within the FHAA (i.e. Blacketts Lake):

- Atlantic salmon;
- American eel;
- brook trout;
- alewife
- white sucker;
- white perch;
- brown bullhead;
- chain pickerel; and,
- smallmouth bass.

As described above, chain pickerel and smallmouth bass are non-native species, illegally introduced to this system. As such, habitat quality for these species is not being discussed in detail.

Atlantic Salmon

Atlantic Salmon spawn in fresh water, generally in the same river where they were born. Juveniles spend one to eight years in fresh water before migrating to saltwater in the North Atlantic. After remaining within saltwater for one to four years, adult salmon will return to fresh water to spawn. Salmon rivers or streams are generally large, clear and cool, with gravel, cobble and boulder river beds (DFO, 2016a). WC1 drains south to Portage Brook, which flows south of the Study Area, eventually discharging into Blacketts Lake and then into Sydney River. The ASF considers the Sydney River to be salmon-bearing (2019). As such there is the potential for Atlantic salmon to access WC1 and its associated tributaries; however, WC1 is not considered to provide suitable spawning or migratory habitat for Atlantic salmon, nor was any preferred Atlantic salmon habitat identified within the Study Area or FHAA. No Atlantic salmon were observed during field surveys (including electrofishing).

<u>American Eel</u>
American eel is found in the Atlantic Ocean from Iceland to the Caribbean Sea. They spawn in the Sargasso Sea, situated on the West side of the Atlantic Ocean, southeast of Nova Scotia. American Eel can be found in all waters that are connected to the Atlantic Ocean (DFO, 2016c). As Sydney River eventually discharges into the Atlantic Ocean at the South Arm of Sydney Harbour, there is a surficial connection from WC1 to the ocean. There is potential for American eel to access Portage Brook, MacDonalds Brook, WC1 and its associated tributaries within the Study Area. Habitat provision within the FHAA for eel would be limited to elvers, yellow eel, and adult life history stages.

<u>Brook Trout</u>
Brook trout require cool water habitat. In Nova Scotia, mature brook trout migrate to spawn in lakes or streams in the fall of the year. Trout spawning sites are usually near groundwater upwelling or spring seeps and within a lake or stream with gravel substrate (NSDFA, 2005). Optimal spawning conditions for brook trout include clear substrate 3-8 mm in size with limited fines (<5%), and velocities of 25-75 cm/s (Raleigh, 1982). Juvenile rearing areas require cold water, stable flow, and an abundance of cover. Optimal temperature for juvenile growth is 10-16℃, while cover in the form of deep water, overhanging and in-stream vegetation, undercut banks, woody debris, and rocky substrate should account for a minimum of 15% of total stream area (Raleigh, 1982). In winter, brook trout aggregate in pools beneath silt-free rocky substrate and close to point sources of groundwater discharge (Raleigh, 1982; Cunjak and Power, 1986). Brook trout respond negatively to flashy or hydrologically dynamic systems and require stable flow for all life stages (Raleigh, 1982). Brook trout were caught in WC1, MacDonalds Brook (below the waterfall) and Portage Brook.

Brook trout were the only species identified within the FHAA during fish collection surveys. In total, 38 individual brook trout ranging from 3.8 to 16 cm in total length were captured in WC1 through electrofishing efforts, including 28 fish below the most downstream barrier, and 10 fish above the most downstream barrier. Brook trout caught above the barrier are thought to be remnants from historical access; however, habitat provisioning for brook trout spawning, rearing, and overwintering within the watercourse is thought to be sufficient to support a small number of fish.

Within MacDonalds brook, twelve individual brook trout ranging from 6.8 to 17.5 cm in total length were captured downstream of the waterfall through electrofishing efforts. The clear, gravel substrate, abundant in-stream cover, and deeper pools in this area provide potential spawning, rearing, and overwintering habitat for brook trout. None were identified in reach 2 above the barrier.

Four individuals were identified during minnow trapping efforts completed on Portage Brook. Except where permanent barriers to fish passage have been identified, watercourses present within the FHAA are considered to be accessible to brook trout.

Alewife

Like Atlantic salmon, alewife are anadromous fish that travel from the marine environment to freshwater to spawn. In the Maritimes, spawning occurs in lakes or slow-moving portions of rivers in late spring. Alewife are found mostly in larger rivers (DFO, 2016b). Given the surface connection between WC1 and other, larger, fish-bearing streams further down in the watershed, alewife have the potential to access WC1, MacDonalds Brook and Portage Brook. Preferred alewife spawning habitat (slow moving, larger rivers) was not identified within the Study Area or FHAA. As an anadromous species, freshwater habitat use is limited to spawning and migration to spawning grounds, so if alewife were using the FHAA in any capacity, it would likely be for migration to suitable spawning habitat. No alewife were observed during field surveys (including electrofishing), which is expected since Alewife leave their spawning grounds and return to the marine environment after Spring.

White Sucker

White sucker are bottom dwellers found in warm, shallow water areas of lakes and quiet streams. They feed on small aquatic plants and animals filtered out of sand or mud (Gilhen 1974). White Sucker have a preferred temperature of 22.4°C (Spotila et al. 1979) and are most abundant in areas with aquatic vegetation and underwater debris that provide cover.

White sucker are active year-round, spawning in May-June when they migrate into small streams and tributaries with water temperatures of 10-18°C (NSSA 2005). Preferred spawning habitat for white sucker is shallow gravel riffles of moderate water velocity. Lake populations sometimes spawn on gravel shoals where there is wave action (NSSA 2005). The adults leave the spawning ground after a week or two and return to the river or lake they originated from (NL Department of Environment and Climate Change, n.d.). While white sucker have not been observed within the FHAA, suitable habitat for spawning, rearing, juvenile and adult life history stages is available, particularly in Portage Brook. White sucker are generally poorer swimmers (Gardunio, 2014) compared with brook trout, Atlantic salmon or American eel, and are not expected to be able to navigate any of the identified barriers within he FHAA.

White Perch

White perch are found in, lakes, pools, and other quiet-water areas of medium to large rivers (Page and Burr 2011). White perch use both brackish and freshwater, but in Nova Scotia are more commonly seen in freshwater habitats usually over mud substrate (Bigelow and Schroeder 2002). White perch are typically resident species wherever they are found and seem to be most productive in water temperatures of 24°C and above (Scott and Crossman 1973).

Spawning occurs in the spring, in shallow areas of either fresh or brackish water (Gilhen 1974). During spawning, adhesive eggs are expelled over and attach to the bottom substrate, showing no preference for particular substrate types (Scott and Crossman 1973). While white perch have not been observed within the FHAA, suitable habitat for juvenile and adults is available, particularly in Portage Brook.

Brown Bullhead

Brown bullheads are bottom dwellers that prefer sluggish and warm water in slow-moving streams, ponds, and lakes with abundant aquatic vegetation. The species is resistant to increased levels of pollution and is tolerant of low oxygen concentrations and temperatures up to 31.6 °C (Scott and Crossman 1973). Brown bullheads can be found in lakes and rivers with a variety of substrates but are typically associated with muddy bottoms. These fish are omnivorous night-feeders and will forage on all types of plant and animal materials that they locate with their barbels.

Brown bullhead spawning occurs in late spring and summer when water temperatures reach 21°C (Scott and Crossman 1973). Adhesive eggs are deposited into shallow nest that is excavated in mud or sand substrate, covered by at least 15 cm of water (Scott and Crossman 1973). Suitable habitat for brown bullhead (all life history stages) is limited to slower, low-energy streams such as Portage Brook.

5.6 Priority Species

5.6.1 Desktop Review

A review of ACCDC report confirms the presence of several Priority Species in proximity to the Study Area (Figure 13, Appendix A). The ACCDC identified the following records of SAR and SOCI within 5 km of the Study Area including:

- 7 records of 6 vascular flora,
- no records of nonvascular flora,
- 53 records of 25 vertebrate,
- no records of invertebrates, and
- 1 location sensitive bat hibernaculum.

The Department of Natural Resources considers a number of species "location sensitive". Concern about exploitation of location-sensitive species precludes inclusion of precise coordinates in an ACCDC report. A bat hibernacula was identified to be within 5 km of the Study Area however, the exact location of this feature was not provided. For more information regarding bat hibernacula and habitat see Section 5.6.5.1.

Eight of these identified records are SAR, of which two were observed during field surveys (common nighthawk and evening grosbeak):

- Barn swallow (NSESA Endangered, SARA Threatened, COSEWIC Threatened)
- Canada warbler (NSESA Endangered, SARA Threatened, COSEWIC Threatened)
- Bobolink (NSESA Vulnerable, SARA Threatened, COSEWIC Threatened)
- Common Nighthawk (NSESA Threatened, SARA Threatened, COSEWIC Special Concern)
- Eastern Wood Pewee (NSESA Vulnerable, SARA Special Concern, COSEWIC Special Concern)
- Olive-sided Flycatcher (NSESA Threatened, SARA Threatened, COSEWIC Special Concern)
- Rusty Blackbird (NSESA Endangered, SARA Special Concern, COSEWIC Special Concern)
- Evening grosbeak (NSESA Vulnerable, COSEWIC Special Concern)

A summary of priority species identified within 10 km of the Study Area is provided below (Table 5-21). For avifaunal Priority Species, breeding status as documented in the Maritime Breeding Bird Atlas square summary (square 20QS00) is also included. If the species was observed during atlas surveys, with no breeding evidence noted, this is indicated below as well.

Table 5-21. Summary of ACCDC observations of priority species within 10 km of the Study Area.

Scientific Name	Common Name	COSEWIC	SARA	NSESA	S Rank	Distance	MBBA
Flora and Lichens							
Potamogeton praelongus	White-stemmed Pondweed	-	-	-	S3	1.8 ± 5.0	NA
Equisetum hyemale var. affine	Common Scouring-rush	-	-	-	S3S4	2.9 ± 10.0	NA
Eleocharis quinqueflora	Few-flowered Spikerush	-	-	-	S2	2.9 ± 7.0	NA
Potamogeton richardsonii	Richardson's Pondweed	-	-	-	S2	3.1 ± 7.0	NA
Symphyotrichum boreale	Boreal Aster	-	-	-	S2?	3.7 ± 0.0	NA
Lobelia kalmii	Brook Lobelia	-	-	-	S2	4.5 ± 1.0	NA
Hypericum dissimulatum	Disguised St John's-wort	-	-	-	S2S3	5.3 ± 2.0	NA
Megalodonta beckii	Water Beggarticks	-	-	-	S3	5.8 ± 1.0	NA
Proserpinaca palustris	Marsh Mermaidweed	-	-	-	S3	5.8 ± 2.0	NA
Cypripedium parviflorum	Yellow Lady's-slipper	-	-	-	S2S3	6.4 ± 1.0	NA
Rhamnus alnifolia	Alder-leaved Buckthorn	-	-	-	S3	6.5 ± 0.0	NA
Cypripedium reginae	Showy Lady's-Slipper	-	-	-	S2	6.6 ± 0.0	NA
Agrimonia gryposepala	Hooked Agrimony	-	-	-	S3	6.8 ± 0.0	NA
Carex cryptolepis	Hidden-scaled Sedge	-	-	-	S3	6.8 ± 0.0	NA
Platanthera huronensis	Fragrant Green Orchid	-	-	-	S1S2	7.3 ± 100.0	NA
Fraxinus nigra	Black Ash	-	-	Threatened	S1S2	8.1 ± 0.0	NA
Liparis loeselii	Loesel's Twayblade	-	-	-	S3S4	8.9 ± 0.0	NA

Scientific Name	Common Name	COSEWIC	SARA	NSESA	S Rank	Distance	MBBA
Mammals							
Lynx canadensis	Canadian Lynx	Not At Risk	-	Endangered	S1	10.0 ± 1.0	NA
Myotis lucifugus	Little Brown Myotis	Endangered	Endangered	Endangered	S1	4.2 ± 0.0	NA
Avian							
Carduelis pinus	Pine Siskin	-	-	-	S2S3	1.6 ± 0.0	Confirmed
Sitta canadensis	Red-breasted Nuthatch	-	-	-	S3	1.6 ± 0.0	Confirmed
Actitis macularius	Spotted Sandpiper	-	-	-	S3S4B	1.6 ± 0.0	Confirmed
Wilsonia canadensis	Canada Warbler	Threatened	Threatened	Endangered	S3B	1.7 ± 0.0	Probable
Hirundo rustica	Barn Swallow	Threatened	Threatened	Endangered	S2S3B	2.9 ± 7.0	Confirmed
Dolichonyx oryzivorus	Bobolink	Threatened	Threatened	Vulnerable	S3S4B	2.9 ± 7.0	Probable
Euphagus carolinus	Rusty Blackbird	Special Concern	Special Concern	Endangered	S2B	2.9 ± 7.0	Probable
Chordeiles minor	Common Nighthawk	Special Concern	Threatened	Threatened	S2B	2.9 ± 7.0	Possible
Contopus cooperi	Olive-sided Flycatcher	Special Concern	Threatened	Threatened	S2B	2.9 ± 7.0	Possible
Contopus virens	Eastern Wood-Pewee	Special Concern	Special Concern	Vulnerable	S3S4B	2.9 ± 7.0	Confirmed
Coccothraustes vespertinus	Evening Grosbeak	Special Concern	-	Vulnerable	S3S4B,S3N	2.9 ± 7.0	Probable
Circus cyaneus	Northern Harrier	Not At Risk	-	-	S3S4B	2.9 ± 7.0	Possible
Molothrus ater	Brown-headed Cowbird	-	-	-	S2B	2.9 ± 7.0	Probable
Perisoreus canadensis	Gray Jay	-	-	-	S3	2.9 ± 7.0	Confirmed
Poecile hudsonica	Boreal Chickadee	-	-	-	S3	2.9 ± 7.0	Confirmed
Falco sparverius	American Kestrel	-	-	-	S3B	2.9 ± 7.0	Confirmed

Scientific Name	Common Name	COSEWIC	SARA	NSESA	S Rank	Distance	MBBA
Gallinago delicata	Wilson's Snipe	-	-	-	S3B	2.9 ± 7.0	Probable
Tyrannus tyrannus	Eastern Kingbird	-	-	-	S3B	2.9 ± 7.0	Possible
Picoides arcticus	Black-backed Woodpecker	-	-	-	S3S4	2.9 ± 7.0	Confirmed
Anas discors	Blue-winged Teal	-	-	-	S3S4B	2.9 ± 7.0	Probable
Empidonax flaviventris	Yellow-bellied Flycatcher	-	-	-	S3S4B	2.9 ± 7.0	Possible
Regulus calendula	Ruby-crowned Kinglet	-	-	-	S3S4B	2.9 ± 7.0	Possible
Catharus ustulatus	Swainson's Thrush	-	-	-	S3S4B	2.9 ± 7.0	Possible
Mergus serrator	Red-breasted Merganser	-	-	-	S3S4B,S5N	2.9 ± 7.0	Probable
Tringa melanoleuca	Greater Yellowlegs	-	-	-	S3B,S3S4M	6.1 ± 0.0	NA
Chaetura pelagica	Chimney Swift	Threatened	Threatened	Endangered	S2B,S1M	8.0 ± 7.0	NA
Sterna hirundo	Common Tern	Not At Risk	-	-	S3B	8.0 ± 7.0	NA
Vireo philadelphicus	Philadelphia Vireo	-	-	-	S2?B	8.0 ± 7.0	NA
Pinicola enucleator	Pine Grosbeak	-	-	-	S2S3B,S5N	8.0 ± 7.0	Possible
Wilsonia pusilla	Wilson's Warbler	-	-	-	S3B	8.0 ± 7.0	NA
Loxia curvirostra	Red Crossbill	-	-	-	S3S4	8.0 ± 7.0	NA
Vermivora peregrina	Tennessee Warbler	-	-	-	S3S4B	8.0 ± 7.0	NA
Dendroica striata	Blackpoll Warbler	-	-	-	S3S4B	8.0 ± 7.0	NA
Accipiter gentilis	Northern Goshawk	Not At Risk	-	-	S3S4	8.4 ± 7.0	NA
Invertebrates							
Lampsilis cariosa	Yellow Lampmussel	Special Concern	Special Concern	Threatened	S1	5.0 ± 0.0	NA

Scientific Name	Common Name	COSEWIC	SARA	NSESA	S Rank	Distance	MBBA
Lampsilis radiata	Eastern Lampmussel	-	-	-	S3S4	5.0 ± 0.0	NA
Leptodea ochracea	Tidewater Mucket	-	-	-	S1	5.3 ± 1.0	NA
Margaritifera margaritifera	Eastern Pearlshell	-	-	-	S2	5.4 ± 0.0	NA
Fish							
Salmo salar	Atlantic Salmon	-	-	-	S1	4.6 ± 1.0	NA
Alosa pseudoharengus	Alewife	-	-	-	S3	7.4 ± 0.0	NA

5.6.2 Vascular Plants

Six vascular priority plant species were documented within 5 km of the Study Area in the ACCDC report and include: brook lobelia (*Lobelia kalmii*; S2), few-flowered spikerush (*Eloecharis quinqueflora*; S2), richardson's pondweed (*Potamogeton richardsonii*; S2), boreal aster (*Symphyotrichum boreale;S2?*), white-stemmed pondweed (*Potamogeton praelongus*; S3) and common scouring-rush (*Equisetum hyemale var. affine*; S3S4).

Within the Study Area, three SOCI were identified: the variegated horsetail (*Equisteum variegatum*; S3), marsh mermaidweed (*Proserpinaca plaustris var. creba*; S3) and Loesel's twayblade (*Liparis loeselii*; S3S4). None of these species were observed within the QDA. Details regarding these priority vascular plant species, including their general descriptions and habitats are below.

Variegated Horsetail

Variegated horsetail (*Equisetum variegatum*) is a member of the ferns and allies' group (Polyopdiopsida) in the horsetail family (Equisetaceae), which are spore producing vascular plants. This species is listed as vulnerable (S3) by the ACCDC and is one of the more diminutive horestail species in Nova Scotia, with an abruptly pointed strobilus and persistent leaf sheaths (Hinds, 2000). In Nova Scotia this species is often associated with disturbances and found growing in calcareous soils and in some cases, in old mining tailings (Helen *et al*, 1968).

This species was observed at seven locations within the Study Area. Stem density varied between locations with some consisting of a few individuals while others contained large patches of over 2000 stems (approximately 48 m x 20 m). This species was only found in areas disturbed by active and historical quarry activity. The large patches were found in reclaimed areas where compacted, admixed soils were present. These locations contained wetland hydrology but lacked wetland soils. The large patches were primarily monocultures; in general, variegated horsetails were 'weedy' within the Study Area. None of the observations of the variegated horsetail was observed within the QDA.

Marsh Mermaidweed

Marsh mermaidweed (*Proserpinaca plaustris var. creba*) is an aquatic species typically found in still standing water and has morphologically distinct emersed and submersed leaves (Native Plant Trust, 2019). This species is listed as vulnerable (S3) by the ACCDC.

This species was observed within the Study Area and outside the QDA with over 50 individuals. It was found in an old trail with admixed soils, with a high concentration of gravel present. This area was inundated with water for long enough periods to support aquatic plants such as this one, however, hydric soils were not present, and these wetland-like conditions were a result of anthropogenic influences.

Loesel's Twayblade

Loesel's twayblade (*Liparis loeselii*) is a small orchid with two basal leaves and yellow-green petals and often associated with calcareous rich soils (Zinck, Roland's Flora of Nova Scotia, 1998). This species is listed as a vulnerable/apparently secure (S3S4) by the ACCDC.

This species was observed within the Study Area and outside the QDA. This species was found in similar habitats to the variegated horsetail and found in the reclaimed areas of the Study Area. Four individuals were observed.

5.6.3 Lichens

No priority lichen species were documented within 5 km of the Study Area in the ACCDC report. No predicted BFL polygons are present within the Study Area. According to the MTRI databases, no extant BFL populations are within 26 km and no known vole ears lichen are within 173 km of the Study Area.

Given the habitat types and stand age present within the Study Area, certain species had the potential to be found: frosted glass whiskers (*Sclerophora peronella;* SARA Special Concern, NSESA not listed), Shaggy Fringed Lichen (*Anaptychia palmulata*; S3S4) and powdered fringe lichen (*Heterodermia speciosa*; S3). However, after extensive searching, none were observed.

Two priority species were observed within the Study Area during the field visits: blue felt lichen (*Pectenia plumbea;* SARA & COSEWIC Special Concern; NSESA Vulnerable; ACCDC S3) and tree pelt lichen (*Peltigera collina;* S2?). See below on a description of the lichens observed within the Study Area and QDA.

Blue Felt Lichen

Blue felt lichen is a foliose cyanolichen (a lichen with a cyanobacteria as a photobiont) which typically grows on mature red maple on the edge of swamps, lakes and rivers. This species can also be found growing upland and on other hardwood species such as white ash, yellow birch and sugar maple (COSEWIC, 2010). Blue felt lichen is fairly common in Nova Scotia, however, in North America the range is restricted to the north east and only found in Nova Scotia, Newfoundland and Labrador and New Brunswick (COSEWIC, 2010). Blue felt lichen is listed as Vulnerable (S3) by the ACCDC and special concern and vulnerable under SARA and NSESA, respectively.

Three locations are observed within the QDA with approximately 8 thalli observed. All thalli were observed on sugar maple and/or white ash in upland habitat and/or in proximity to watercourses.

Tree pelt lichen

Tree pelt lichen (*Peltigera collina*) is one of the many pelt lichen species found within Nova Scotia. This species, which separates it from the other pelt lichens found in Nova Scotia is the marginal coarse soredia on the thallus lobes (Brodo, I.M., Sharnoff, S.D., Sharnoff, S., 2001). This species is typically found on the bark of hardwood species, often being present mid-way up the tree and in proximity to watercourses and/or wetlands. This species is listed as imperiled (S2?).[2]

Four locations of the tree pelt lichen were observed, three of which are with in the QDA and one location is approximately 8 m north of the QDA. Approximately 28 thalli were observed on sugar and red maple in upland habitat.

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[2] *The "?" in the ranking is referring to the uncertainty to the rank, which often is a result of insufficient data.*

5.6.4 Mammals

No priority mammal species were observed during field surveys. According to the ACCDC report, two SAR were identified within 20 km of the Study Area, the little brown myotis (4.2 km ± 0.0) and a Canada lynx (10 km ± 1.0).

Little Brown Myotis

The ACCDC reported a known bat hibernaculum within 5 km of the Study Area and identified 34 recordings of the little brown myotis (*Myotis lucifugus*) within 4.2 ± 0.0 km of the Study Area. Additionally, critical habitat for the little brown myotis, northern myotis (*Myotis septentrionalis*), and tri-colored bat (*Perimyotis subflavus*) has been identified within a 100 km^2 area within the vicinity of the Study Area (Environment Canada, 2015). Critical habitat is defined by Environment Canada as the habitat necessary for the survival or recovery of the species and is considered location sensitive therefore, for protection and conservation, a 100 km^2 area is provided instead of a specific location (Environment Canada, 2015).

No provincial government records of AMOs were located within the Study Area (NSDNR, 2017). There are 8 records of AMOs within 5 km of the Study Area, the closest of which is approximately 3.3 km northeast. All of these records are northeast of the Study Area, concentrated south of Beechmont Road. Of these features, five are considered to have a shaft opening type, two have an adit opening type, and 1 has a trench opening type. According to the database, five of these AMOs are plugged with rock or rock and vegetation, however, three are "Not Rated".

The little brown myotis require a variety of habitats depending on the season. For overwintering habitat, they need hibernacula provided by caves, abandoned mines, and wells. In the summer they require roosting and foraging habitat, in late summer and early fall they need swarming habitat for mating and socializing. The little brown myotis roosts in buildings and other anthropogenic structures, tree cavities, tree bark, and crevices on cliffs. They feed on insects and spiders and are associated with open habitats, ponds, road, and open canopy forests. Minimal roosting habitat for the little brown myotis is provided within the Study Area, especially in the small, central, forested area and in the northern corner, including forest within the QDA. However, it may be that noise from the current quarry activities make the Study Area unfavourable for bats.

Canada Lynx

The ACCDC report outlined 196 recordings of Canada lynx within 10.0 ± 0.0 km of the Study Area. Lynx (NSESA Endangered; ACCDC S1) require deep snowfalls (>270 cm per year) to create preferred habitat for their key prey: snowshoe hare (ISEC, 2017). Ideal habitat for this prey species is made up of patches of mid-regeneration (15-35 years old) forest dominated by conifers where tree heights are above winter snow levels (NSDNR, 2012b). Less dense understory in mature forests provides higher visibility of hare (Fuller and Harrison, 2010). Lynx also rely on habitat for their alternate prey species, red squirrel, which includes bogs with adjacent mature/over-mature softwood, mixed-wood stands, and a 100 m strip of buffer vegetation containing unharvested forest (NSDNR, 2012b). Additionally, intact mature forest corridors are important for Canada lynx movement (NSDNR, 2012b). Lynx are negatively impacted by logging roads and rural roads that provide access to competitor species such as coyotes and bobcats who are generalist hunters, able to subsist on many different species while out-competing the lynx, a specialist hunter (Aubry, Koehler, and Squires, 2000; O'Donoghue *et al.,* 2001; Parker, G. 2001).

The QDA is characterized by current and historically disturbed areas adjacent to the current quarry area and rich, tolerant, mature hardwood forest to the north. This forest description is not ideal for either key prey species: it is not conifer dominated nor mixed-wood. Additionally, its proximity to the present quarry likely acts as a deterrent to current Canada lynx use of the area. Lastly, researchers have noted the association of lynx to elevations between 250-500 m ASL (Parker, 2001); the QDA has an approximate elevation of 122 m ASL, putting it well below the ideal range. Optimal habitats for lynx do not exist within the Study Area, therefore targeted surveys for lynx were not completed.

5.6.5 Herpetofauna

No priority herpetofauna species were observed during field surveys. According to the ACCDC, two SAR were identified within 20 km of the Study Area. Wood Turtle and Snapping Turtle were identified approximately 14.9 km and 11.3 ± 10.0 km from the Study Area, respectively. No wood turtle buffers exist within or in proximity to the Study Area.

Wood Turtle

Wood turtles are listed as Threatened under SARA, COSEWIC and NSESA. The species live along permanent streams but may roam overland during summer and can be found in a variety of terrestrial habitats. Wood turtles nest on sand or gravel-sand beaches and banks. This species prefers clear rivers, streams or creeks with moderate current and sandy or gravelly substrate. They overwinter in numerous microhabitat types, which include burrowing in mud, under overhanging banks, or in the bottoms of stream pools (Environment Canada, 2016). No overwintering or nesting habitat for the wood turtle was identified within the Study Area. WC1 substrate is co-dominated by small boulders, cobbles, gravel and muck, therefore the potential for the wood turtle to nest in this watercourse is low. However, wood turtles could use the watercourse for passage to other habitats beyond the Study Area limits, furthermore Portage Brook, south of the Study Area may provide wood turtle habitat. All other watercourses were too intermittent to provide suitable wood turtle habitat, including those within the QDA.

Snapping Turtle

Snapping turtles are listed as Vulnerable under the NSESA and Special Concern under SARA and COSEWIC. Snapping turtles use a variety of habitats; however, the preferred habitat is slow-moving water with a soft mud bottom and dense aquatic vegetation. They overwinter in aquatic environments that do not freeze to the bottom (ECCC, 2016). No soft, muddy bottom and dense aquatic vegetation conditions are present in the watercourses within the Study Area therefore suitable overwintering or nesting habitats for the snapping turtle are not present.

5.6.6 Avian

Fourteen (14) priority avifauna species were observed within the Study Area (Table 5-22) during all field surveys. Two of these were SAR and the rest were SOCI.

Table 5-22. SAR and SOCI observed during all survey periods

Common Name	Scientific Name	SARA	COSEWIC	NSESA	SRank	Survey type[1]	Location	Total # Observed
Common nighthawk	***Chordeiles minor***	**SC**	**SC**	**T**	**S2B**	**CONI**	**PC2**	**1**
Evening grosbeak	***Coccothraustes vespertinus***		**SC**	**V**	**S3S4B, S3N**	**Spring**	**PC1, PC6, PC7, PC8**	**7**
Boreal chickadee	*Poecile hudsonica*	-	-	-	S3	Fall	PC1	2
Killdeer	*Charadrius vociferus*	-	-	-	S3B	Spring, BBS	PC3*, PC8	3
Northern harrier	*Circus cyaneus*	-	-	-	S3S4B	Fall	PC4, PC5	2
Pine grosbeak	*Pinicola enucleator*	-	-	-	S2S3B,S5N	Spring	PC1, PC4	2
Pine siskin	*Cardelius pinus*	-	-	-	S2S3	Spring	PC4, PC7, PC8	3
Red-breasted merganser	*Mergus serrator*	-	-	-	S3S4B,S5N	BBS	PC3*	1
Red-breasted Nuthatch	*Sitta canadensis*	-	-	-	S3	Incidental, Spring	PC2, PC6, PC7	5
Red crossbill	*Loxia curvirostra*	-	-	-	S3S4	Spring, BBS	PC1	2
Ruby-crowned Kinglet	*Regulus calendula*	-	-	-	S3S4B	Spring, BBS	PC1, PC3*, PC4, PC5, PC6, PC7, PC8	8
Spotted sandpiper	*Actitis macularius*	-	-	-	S3S4B	Fall, Spring	PC6	11
Swainson's thrush	*Catharus ustulatus*	-	-	-	S3S4B	Spring, BBS, CONI	PC1, PC2, PC4, PC5, PC7, PC8	11
Yellow-bellied Flycatcher	*Empidonax flaviventris*	-	-	-	S3S4B	BBS	PC1, PC2, PC3*, PC4, PC8	5

[1]**Survey Type**: Spring = spring migration survey; BBS = breeding bird survey, Fall = fall migration survey

*PC3 is within the QDA

Bold denotes SAR designation

Point count 3 is within the QDA; four avian SOCI were observed at this location. One of each of the following species was observed at this PC: killdeer (S3B) observed during Spring and BBS; red-breasted merganser (S3S4B, S5N) observed during BBS; ruby-crowned kinglet (S3S4B) observed during Spring and BBS; and yellow-bellied flycatcher (S3S4B) observed during BBS.

Common Nighthawk

Preferred breeding habitats include areas devoid of vegetation, such as sand dunes, beaches, logged areas, burned-over areas, forest clearings, quarries and pastures (COSEWIC, 2007). This habitat exists within the Study Area, especially in the south around the quarry.

Evening Grosbeak

In the winter months, the evening grosbeak range can vary widely depending on the food source available and it is often found at backyard feeders. Breeding habitat is typically in open, mature mixedwood upland forests often dominated by balsam fir and white spruce where their main food source, the spruce budworm (*Choristoneura* spp.) is present (COSEWIC, 2016). This habitat exists within the Study Area, especially in the north, including within the QDA.

Boreal Chickadee

This passerine inhabits mostly mature coniferous forests dominated generally by spruce and balsam fir in the tree stratum (Cornell University, 2019). Mature mixedwood forests exist in the central part of this Study Area, outside the QDA.

Killdeer

Killdeer inhabit and breed in open areas near water including sandbars, mudflats and grazed fields (Cornell University, 2019). Killdeer were observed at PC3 and PC8 during spring migration and a breeding bird survey in habitat not typical for the species. It may be that the individuals were in migration when observed or headed to Gillis Lake located 1.2 km northwest. The preferred habitat of killdeer does not exist within the Study Area, nor within the QDA.

Northern Harrier

Northern harriers are commonly found in large, open, undisturbed areas containing a variety of habitats such as wetlands, low vegetation, and grasslands (Cornell University, 2019). This raptor forages using their sight and hearing, making open areas such as pasturelands, croplands, and old fields particularly important. These types of habitats are not present within the Study Area nor the QDA, however, the openings created by the quarry may provide hunting vantage points.

Pine Grosbeak

This passerine species lives in open, coniferous forests dominated by spruce, pine or fir where their diet consists of buds, seeds, and fruit from various trees (Cornell University, 2019). This habitat exists within the Study Area, especially in the north, including within the QDA.

Pine Siskin
Preferred habitat for the Pine Siskin consists of coniferous or mixed wood forest with open canopies. They nest within conifer trees (Cornell University, 2019). Potential breeding habitat is scattered throughout the Study Area, especially within the southern section of the Study Area, outside the QDA.

Red-breasted Merganser
This diving duck breeds in freshwater or saltwater close to the coast in the boreal forest. They use oceans, lakes and rivers during migration (Cornell University, 2019). One red-breasted merganser was observed during the breeding bird survey at PC3, within the QDA. It may be that the individual was in migration when observed or headed to Gillis Lake located 1.2 km northwest. The preferred habitat of this species does not exist within the Study Area, nor within the QDA.

Red-breasted Nuthatch
Red-breasted Nuthatches preferred habitat is mainly in coniferous forests of spruce, fir, pine, hemlock, and larch (Cornell University, 2019). Potential breeding habitat is scattered throughout the Study Area, especially in the central portion outside of the QDA.

Red Crossbill
Red crossbills are generalists and can inhabit many different habitat types where cone-producing conifers, their major food source, are available (COSEWIC, 2004a). Potential breeding habitat is scattered throughout the Study Area, especially in the central portion outside of the QDA.

Ruby-crowned Kinglet
Ruby-crowned Kinglets build their nests high on a conifer tree within conifer dominant or mixed wood forests. They also use isolated trees in meadows and floodplain forests (Cornell University, 2019). Potential breeding habitat is scattered throughout the Study Area, especially in the central portion outside of the QDA.

Spotted Sandpiper
This shorebird has a broad breeding range throughout North America and can be found breeding in proximity to most types of water bodies including coasts, rocky shores, river tributaries and lakeshores (MBBA, 2008). Eleven individuals were observed at PC6 located on WC1, which likely provides foraging habitat for this species. Habitat for this species does not exist within the QDA.

Swainson’s Thrush
The Swainson’s thrush generally prefers balsam fir and spruce forests with a variety of ages and disturbance levels. This species is most abundant in high elevations (MBBA, 2008). Potential breeding habitat is scattered throughout the Study Area, especially in the central portion outside of the QDA.

Yellow-bellied Flycatcher
Yellow-bellied Flycatchers build their nest on or near the ground in moist coniferous forests, bogs, swamps, and peatlands (Cornell University, 2019). Potential breeding habitat is scattered throughout the Study Area, especially in the central portion outside of the QDA.

5.6.7 Invertebrates

No invertebrate priority species were observed during field surveys. According to the ACCDC report, four species have been observed within 10 km of the Study Area: yellow lampmusel (*Lampsilis cariosa;* SARA & COSEWIC Special Concern; NSESA Threatened; ACCDC S1), eastern lampmussel (*Lampsilis radiata;* ACCDC S3S4), tidewater mucket (*Leptodea ochracea;* ACCDC S1), and eastern pearlshell (*Margaritifera margaritifera;* ACCDC S2).

Yellow Lampmussel
This bivalve mollusc is at its northern range in Cape Breton, where a population is known to be in the Sydney River (COSEWIC, 2004b). The yellow lampussel is generally found in faster flowing sections of larger rivers that typically have sand and gravel bottoms. Movement and dispersal of the yellow lampmussel depends on the movement of yellow and white perch, which hosts the lampmussel's larvae. The Nova Scotia Freshwater Fish Distribution Records document white perch in in Blacketts Lake (NSDAF, 2019). WC1 and Portage Brook may provide habitat but none were observed.

Eastern Lampmussel
The eastern lampmussel can be found in small streams, large rivers, ponds and lakes, and prefers sand or gravel substrates but can be found on many different substrates (Connecticut DEP, 2003; Nedeau, McCollough, Swartz, 2000; Strayer and Jirka, 1997). This bivalve uses white and yellow perch as host fish for reproduction (Nedeau, McCollough, Swartz, 2000). WC1 and Portage Brook may provide habitat but none were observed.

Tidewater Mucket
Often found with the yellow lampmussel, this bivalve prefers coastal lakes, ponds and slow-moving portions of rivers. It can be found in a variety of substrates including silt, sand, gravel, cobble and even clay (Maine Department of Inland Fisheries and Wildlife, 2003). WC1 and Portage Brook may provide habitat but none were observed.

Eastern Pearlshell
Found in streams and small rivers, this bivalve may use trout and/or salmon as a host species for reproduction and larvae movement (DEEP, 2019). Brook trout were found in WC1, which may provide habitat for the eastern pearlshell but none were observed.

5.6.8 Fish

Brook trout (ACCDC S3) were captured during fish surveys within the Study Area, and no other priority fish species were identified during field surveys or electrofishing. ACCDC reported Atlantic salmon within 5 km of the Study Area, and the ASF considers the Sydney River, the outlet of Blacketts Lake, to be salmon-bearing (2019). Portage Brook, into which WC1 flows, has a surface connection to Blacketts Lake. The Nova Scotia Freshwater Fish Distribution Records document brook trout, alewife (ACCDC S3), and American eel (*Anguilla rostrata,* COSEWIC Threatened; S2) in Blacketts Lake (NSDAF, 2019).

While there will be direct impacts to two watercourses (WC4 and WC5) within the QDA, neither watercourse directly supports fish habitat. See Section 9.2.6.1 for more information. However, as described in Section 9.2.6.2, possible indirect effects related to flow of water and water quality may occur. As such, potential effects as a result of this scenario for the species discussed below is further evaluated in Section 9.2.6.

The following describes habitat provision for the priority fish species that either have been observed within the evaluated watercourses or have potential to access watercourses within the Study Area.

<u>Atlantic Salmon</u>
Atlantic Salmon spawn in fresh water, generally in the same river where they were born. Juveniles spend one to eight years in fresh water before migrating to saltwater in the North Atlantic. After remaining within saltwater for one to four years, adult salmon will return to fresh water to spawn. Salmon rivers or streams are generally large, clear and cool, with gravel, cobble and boulder river beds (DFO, 2016a). WC1 drains south to Portage Brook, which flows south of the Study Area, eventually discharging into Blacketts Lake and then into Sydney River. The ASF considers the Sydney River to be salmon-bearing (2019). As such there is the potential for Atlantic salmon to access WC1 and its associated tributaries; however, WC1 is not considered to provide suitable spawning or migratory habitat for Atlantic salmon, nor was any preferred Atlantic salmon habitat identified within the Study Area or FHAA. No Atlantic salmon were observed during field surveys (including electrofishing).

<u>American Eel</u>
American eel is found in the Atlantic Ocean from Iceland to the Caribbean Sea. They spawn in the Sargasso Sea, situated on the West side of the Atlantic Ocean, southeast of Nova Scotia. American Eel can be found in all waters that are connected to the Atlantic Ocean (DFO, 2016c). As Sydney River eventually discharges into the Atlantic Ocean at the South Arm of Sydney Harbour, there is a surficial connection from WC1 to the ocean. There is potential for American eel to access Portage Brook, MacDonalds Brook, WC1 and its associated tributaries within the Study Area. Habitat provision within the FHAA for eel would be limited to elvers, yellow eel, and adult life history stages.

<u>Brook Trout</u>
Brook trout require cool water habitat. In Nova Scotia, mature brook trout migrate to spawn in lakes or streams in the fall of the year. Trout spawning sites are usually near groundwater upwelling or spring seeps and within a lake or stream with gravel substrate (NSDFA, 2005). Optimal spawning conditions for brook trout include clear substrate 3-8 mm in size with limited fines (<5%), and velocities of 25-75 cm/s (Raleigh, 1982). Juvenile rearing areas require cold water, stable flow, and an abundance of cover. Optimal temperature for juvenile growth is 10-16℃, while cover in the form of deep water, overhanging

and in-stream vegetation, undercut banks, woody debris, and rocky substrate should account for a minimum of 15% of total stream area (Raleigh, 1982). In winter, brook trout aggregate in pools beneath silt-free rocky substrate and close to point sources of groundwater discharge (Raleigh, 1982; Cunjak and Power, 1986). Brook trout respond negatively to flashy or hydrologically dynamic systems and require stable flow for all life stages (Raleigh, 1982). Brook trout were caught in WC1, MacDonalds Brook (below the waterfall) and Portage Brook.

Brook trout were the only species identified within the FHAA during fish collection surveys. In total, 38 individual brook trout ranging from 3.8 to 16 cm in total length were captured in WC1 through electrofishing efforts, including 28 fish below the most downstream barrier, and 10 fish above the most downstream barrier. Brook trout caught above the barrier are thought to be remnants from historical access; however, habitat provisioning for brook trout spawning, rearing, and overwintering within the watercourse is thought to be sufficient to support a small number of fish.

Within MacDonalds brook, twelve individual brook trout ranging from 6.8 to 17.5 cm in total length were captured downstream of the waterfall through electrofishing efforts. The clear, gravel substrate, abundant in-stream cover, and deeper pools in this area provide potential spawning, rearing, and overwintering habitat for brook trout. None were identified in reach 2 above the barrier.

Four individuals were identified during minnow trapping efforts completed on Portage Brook. Except where permanent barriers to fish passage have been identified, watercourses present within the FHAA are considered to be accessible to brook trout.

Alewife

Like Atlantic salmon, alewife are anadromous fish that travel from the marine environment to freshwater to spawn. In the Maritimes, spawning occurs in lakes or slow-moving portions of rivers in late spring. Alewife are found mostly in larger rivers (DFO, 2016b). Given the surface connection between WC1 and other, larger, fish-bearing streams further down in the watershed, alewife have the potential to access WC1, MacDonalds Brook and Portage Brook. Preferred alewife spawning habitat (slow moving, larger rivers) was not identified within the Study Area or FHAA. As an anadromous species, freshwater habitat use is limited to spawning and migration to spawning grounds, so if alewife were using the FHAA in any capacity, it would likely be for migration to suitable spawning habitat. No alewife were observed during field surveys (including electrofishing), which is expected since Alewife leave their spawning grounds and return to the marine environment after Spring.

6 SOCIOECONOMIC CONDITIONS

The Project is located in the community of Gillis Lake, approximately 13km southwest of Sydney River in Cape Breton Regional Municipality. Information on the region is summarized below. Background on the regional area including nearby centres are also summarized below.

6.1 Mi'kmaq

The Study Area is located within the Mi'kmaq district of Unama'kik which means "land of fog" and encompasses the entire island of Cape Breton. Gillis Lake is known to the Mi'kmaq as Kelpikatek which means "at the two waters joined (tied) together," and Mi'kmaq and their ancestors are believed to have inhabited the area around Gillis Lake and East Bay for thousands of years (Davis MacIntyre & Associates Limited, 2019). First Nations archaeological potential in the region was increased by the fact that a well-established First Nations portage route existed from the head of East Bay to Blackett's Lake which then leads to Sydney River; this region is still known as "Portage" (Davis MacIntyre & Associates Limited, 2019). Current First Nations communities located near the Study Area include Membertou (approximately 16 km northeast) and Eskasoni (approximately 20 km southwest).

There are 12 traditional land use sites within a 1 km radius of the Study Area. These sites include nine hunting areas, two encampment areas and one fishing or aquatic harvesting area (Davis MacIntyre & Associates Limited, 2019 [KMKNO-ARD, pers. comm., 2019]). The nearest recorded archaeological site listed in the Maritime Archaeological Resource Inventory is 4 km from the Study Area in East Bay. Two more recorded sites are located within 10 km of the Study Area. It is noted that the relative absence of recorded archaeological sites near the Study Area may result from a lack of previous archaeological research conducted in the area rather than from a true absence of archaeological sites (Davis MacIntyre & Associates Limited, 2019).

Despite desktop review indicating the potential for archaeological sites in the Gillis Lake region, archaeological field reconnaissance indicated that the Study Area was of low potential for archeological resources, and none were observed during field reconnaissance (Davis MacIntyre & Associates Limited, 2019). This can be partly explained by the fact that the watercourses in the Study Area are small and do not have useful connections to other bodies of water in the region such as East Bay or Gillis Brook, which means they were not likely to have been used historically for travel and accessing resources (Davis MacIntyre & Associates Limited, 2019).

6.2 Population and Demographics

Gillis Lake is located in Cape Breton County, Nova Scotia. According to the 2016 census, the population of Cape Breton County was 98,722 which is approximately 10.7 percent of the population of Nova Scotia. From 2011 to 2016, the county population decreased 2.9 percent while the provincial population increased by 0.2 percent. Table 6-1 presents population and demographics statistics for Cape Breton County. The largest population centre in Cape Breton County is the community of Sydney. Other population centres near the Study Area include Sydney River and North Sydney.

Table 6-1 Population and Demographics for Cape Breton County and Nova Scotia (Statistics Canada, 2016)

	Cape Breton County	Nova Scotia
Population in 2016	98,722	923,598
Population in 2011	101,619	921,727
2011-2016 Population Change (%)	-2.9	0.2
Total private dwellings (2016)	47,205	458,568
Total number of households (2016)	43,081	401,990
Population density per square km (2016)	40.0	17.4
Land area (square km) (2016)	2,467.7	52,942.3
Median Age of the Population (2016)	48.9	45.5

The population of Cape Breton County has a median age of 48.9 years, over three years older than that of the entire province, which has a median age of 45.5. The population by age cohort in Cape Breton County is presented in Figure 6-1 (below).

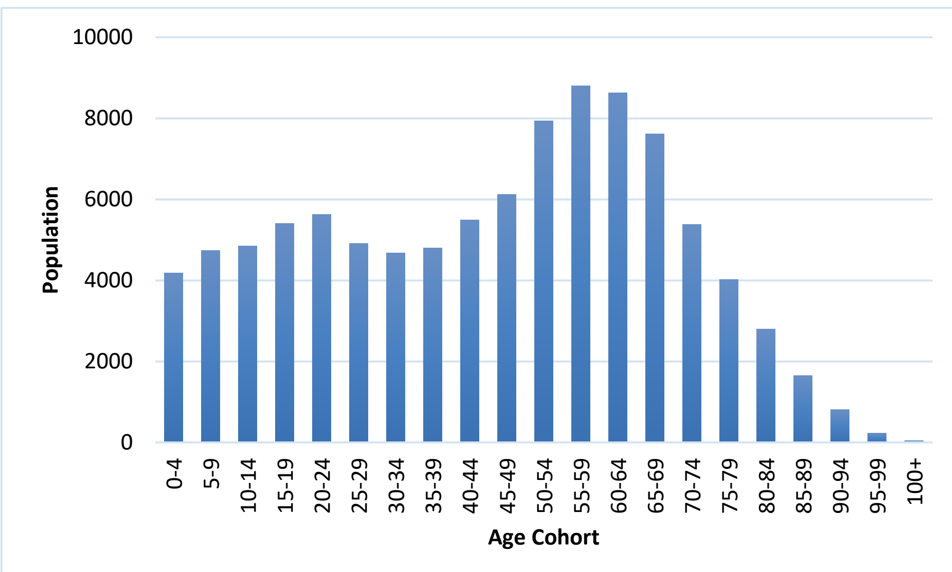

Figure 6-1 Population by Age Cohort, Cape Breton County

Source: Statistics Canada, 2016

Median income in Cape Breton County in 2015 for residents aged 15 years and older with income was $28,457. Employment income accounted for 61.4 percent of income, and 23.9 percent was from government transfers.

6.3 Economy

The economy of Cape Breton County was greatly impacted by increased development of coal mining in the 1880's, and subsequent construction of the first and largest integrated steel plant in Canada, which was built in Sydney in 1889 (Nova Scotia Archives, 2019). These industries created thousands of jobs, and the region experienced rapid population growth from immigration during this period (Nova Scotia Archives, 2019). However, profitability of coal mining and steel manufacturing industries declined after the Second World War, and the economy of the region struggled as a result of its dependence on these industries (Frank, 1977).

Today, the economy of Cape Breton County is driven by health care and social assistance (17.76 percent of labour force), followed by retail trade, and construction (13.87 and 8.37 percent of labour force, respectively). Table 6-2 outlines the percentages of industries which makes up the labour force of Cape Breton County, based on the Statistics Canada Census Profile of Cape Breton County in the 2016 Census.

Table 6-2 Labour Force by Industry, Cape Breton County (Statistics Canada, 2016)

Industry	Total	Percentage
Health care and social assistance	7,545	17.76
Retail trade	5,895	13.87
Construction	3,555	8.37
Educational services	3,500	8.24
Accommodation and food services	3,465	8.15
Public administration	3,425	8.06
Administrative and support; waste management and remediation services	2,785	6.55
Transportation and warehousing	1,740	4.10
Other services (except public administration)	1,715	4.04
Manufacturing	1,665	3.92
Professional, scientific and technical services	1,310	3.08
Agriculture, forestry, fishing and hunting	1,240	2.92
Mining, quarrying, and oil and gas extraction	975	2.29
Arts, entertainment and recreation	940	2.21
Finance and insurance	715	1.68
Wholesale trade	660	1.55
Information and cultural industries	565	1.33
Real estate, rentals and leasing	415	0.98
Utilities	370	0.87
Management of companies and enterprises	10	0.02

Source: Statistics Canada 2016 National Household Survey

According to the Statistics Canada 2016 Census, the labour force in Cape Breton County is divided approximately evenly between women (50.1 percent) and men (49.9 percent). The participation rate in the county's labour force is 52.8%, compared to a provincial average of 61.3%. Cape Breton County's unemployment rate is 17.6%, compared to 10.0 % in the province of Nova Scotia.

Economic activity within 5 km of the Study Area includes a seasonal archery club located on private land directly adjacent to the Study Area (Breton Traditional Archers, 2019). Forestry activity in the vicinity of the quarry is visible on satellite imagery of the area. A landscaping and nursery business which also produces grass sod is located approximately 2.2 km southwest of the Study Area (Sydney Landscaping & Nurseries Ltd., 2019). A farm and equestrian center are located approximately 2.6 km northeast of the Study Area (MacVicar, 2009). A Canada Post office is located approximately 4.4 km east of the Study Area (Canada Post, 2019). A fire hall is located approximately 1.7 km due south of the Study Area. MEL employees noted a gas station and fish 'n' chips stand approximately 2.2 km southeast of the Study Area.

6.4 Recreation and Tourism

Residents of Cape Breton County have access to a wide variety of recreational facilities which include baseball fields, multi purpose fields, playgrounds, walking tracks, hiking trails, as well as facilities for skateparks, golf, tennis and skiing (Cape Breton Regional Municipality, 2019). Since many areas of the county are rural, residents may also participate in fishing, hunting, and driving in all-terrain vehicles (ATVs).

Two hiking trails are located near the Study Area. The trailhead for Coxheath Hills hiking trail is located approximately 6.5 km northeast of the Study Area at the intersection of Blacketts Lake Road and Coxheath Road. The Coxheath Hills trail is over 9 km long and divided into three main trails with two secondary additional trails (Hike Cape Breton, 2019). The East Bay Hills trailhead is located approximately 4.5 km southwest of the Study Area (Hike Cape Breton, 2019). The Sydney Forks Recreation Centre is located approximately 4.5 km east of the Study Area (Sydney Forks Recreation Centre, 2019).

The nearest provincial park is Ben Eoin Provincial Park which is located approximately 11.5 km southwest of the Study Area. Ben Eoin Provincial Park is approximately 90 ha in size and is comprised of an old farm property bordered by a hardwood-forested hillside to the southeast. It is a day-use park and has a walking trail which leads to a scenic lookoff (Nova Scotia Provincial Parks, 2019).

The province of Nova Scotia relies on tourism as an industry. According to a news release from Tourism Nova Scotia, tourism revenues increased 28 percent between 2010 and 2016, and reached an estimated $2.61 billion in 2018 (Tourism Nova Scotia, 2019). Cape Breton Island is considered its own tourism region within the province. Cape Breton is known for its rugged scenery and unique culture resulting from its varied Mi'kmaq, Scottish and French heritage among others (Cape Breton Island, 2019). Additionally, the deep saltwater 'inland sea' known as the Bras d'Or Lakes draws sailing enthusiasts to the region; it was designated a UNESCO Biosphere Reserve in 2011 (UNESCO, 2015).

Tourist destinations near the Study Area include a golf club and resort called The Lakes at Ben Eoin (https://www.lakesresort.ca/), which is located approximately 9 km southwest. The Lakes offers an 18-hole golf course with resort facility including on-site restaurant. Directly adjacent to the golf club and resort is a ski hill called Ski Ben Eoin (http://www.skibeneoin.com/), which offers downhill and cross-country ski and snowshoe trails as well as a chalet, pub, equipment shop plus repair/rental shop, and ski school. Across from the ski and golf facilities is the 75-berth Ben Eoin Yacht Club & Marina (https://www.beneoinmarina.com/about/), which was completed in 2012 and is the largest marina on the Bras d'Or Lakes.

Other tourist attractions in the region include the Fortress of Louisbourg National Historic Site, which is located approximately 35 km southeast. This site was a vital center for historic French trade and military operations in the 18th century and is now run by Parks Canada. The site is staffed with historic interpreters who provide an insight into daily life during this time period (Parks Canada, 2017). Additional tourist draws include numerous parks, museums and attractions in the Sydney region.

The Study Area does not include any known recreational uses other than hunting which was indicated by the discovery of a hunting blind in the northern wooded portion of the Study Area (Davis MacIntyre & Associates Limited, 2019). There are no known ATV or walking trails on the property. One access road from an adjoining private property could be used to access the Study Area, but the access has been blocked by boulders and appears unused. No fishing is known to occur within the Study Area, but MEL employees spoke with several residents of the local area who fish in nearby Blacketts Lake.

7 ARCHAEOLOGICAL RESOURCES

Two phases of the archaeological resource impact assessment were completed for the Project. The first, Phase I, was a historical assessment of the potential for archaeological resources to be present within the Study Area. The second, Phase II, was the field reconnaissance program within the Study Area. The results described below are taken directly from the assessment completed by Davis McIntyre & Associates Ltd. (Appendix G).

7.1 Phase I

A historic background study was conducted in April 2019, which included consultation of historic maps and manuscripts and published literature. The Maritime Archaeological Resource Inventory, a database of known archaeological resources in the Maritime region, was searched in an effort to understand prior archaeological research and known archaeological resources neighbouring the Study Area. No archaeological sites were identified less than 4 km from the Study Area through this process. The nearest site is located 4 km from the Study Area in East Bay, where a lithic scatter was found. The next closest records are within a 10-km radius, representing domestic activities from the 19th century. Davis McIntyre & Associates Ltd. believe the relatively limited archaeological sites is likely due to a lack of research in the area and does not necessary reflect a true absence of archaeological sites.

Staff at the Archaeology Research Division of Kwilmu'kw Maw-klusuaqn (KMKNO-ARD) were contacted in April 2019 to inquire whether their records contained any information regarding past or traditional land use in or near the Study Area. They indicated 12 traditional use sites within a 1-km radius of the Study Area, representing 9 hunting areas, 2 encampment areas, and one for fishing and aquatic harvest. Additionally, their database shows one precontact site within a 5-km radius of the Study Area. Gillis Lake, as described in an interview with Elders, was used by at least one Mi'kmaw family as a lucrative trapping area (Davis McIntyre & Associates Ltd., 2019 [Kaitlin MacLean pers. comm., 2019]).

Euro-Canadian settlement in the Gillis Lake area was first done by Donald Gillis in 1834. The present-day Study Area occupies land granted to Donald Gillis in the north, and Alexander O'Handley in the south. The first map of the Study Area is Ambrose Church's 1877 map of East Bay. Historical farming and logging activities have taken place on the landscape (Davis McIntyre & Associates Ltd., 2019).

7.2 Phase II

An archaeological field reconnaissance was conducted in May 30, 2019 within the Study Area. The assessment was directed by Courtney Glen and Kathleen Forward of Davis MacIntyre & Associates Limited.

The field reconnaissance of the Study Area has revealed no evidence of historic cultural landscape alteration and areas of low archeological potential. Overall the Study Area has been determined to be of low potential for archaeological resources, of either First Nations or European-descended origin. There were no recommendations for further mitigation.

The 2019 report is provided in Appendix G. The report was provided to Nova Scotia Communities, Culture and Heritage (NSCCH), as documented in Appendix C.

8 ENGAGEMENT SUMMARY

In support of this EA registration document the Project Team have implemented the following engagement efforts for the Gillis Lake Expansion Project.

8.1 Public Engagement

Public engagement was completed for the Project via an information session. In addition, a Project Description letter was developed and sent to stakeholders and Mi'kmaq representatives.

One community information session was held for the Project in November 2019.

On October 18, 2019 and in advance of the information session, 2,000 flyers were distributed via Canada Post to residents within four different rural routes encompassing the Study Area, which included the communities of Gillis Lake, East Bay, Portage and Blacketts Lake (Appendix H). The flyers announced the information session date and location, a general description of the quarry location, as well as opened the line of communication directly with Zutphen. If people had questions, comments or concerns about the Project, the flyer provided contact information for the local Zutphen representative.

In addition to the flyers, a notice providing the same information was advertised in Cape Breton Post on October 23, 2019 (Appendix H).

Project Description letters, along with an invitation to the information session were also sent to local representatives, including:

- Gilliam Fielding, NS Office of Aboriginal Affairs (NS OAA);
- Chief Gerald Gloade, Millbrook First Nation;
- Chief Michael Sack, Sipekne'katik First Nation;
- Twila Gaudet, KMKNO;
- Maxine Stevens, Eskasoni First Nation;
- Chief Terry Paul, Membertou First Nation;
- Keith Bain, MLA, Victoria-The Lakes;
- Mark Eyking, MP;
- Terrance Power, NSDL&F;
- Bridget Tutty, NSE; and
- Malcolm MacNeil, NSE.

On November 5, 2019, Zutphen hosted the Information Session at the East Bay Northside Fire Hall in East Bay Northside, NS (5:00-8:00 pm). This provided residents, community members and other interested parties an opportunity to view and discuss with the Zutphen Project Manager information on the Project. The Project was introduced to the community through a series of poster boards and two consultants from MEL (Andy Walter and Amber Stoffer) who were present to describe the Project, the EA process, and proposed and expected timelines.

- Nineteen (19) people attended the Information Session (according to signatures on the sign in sheet provided at the front door). It is anticipated that an additional 5-10 people attended who did not sign in.
- Attendees were encouraged to fill out comment cards. Nine (9) comment cards were received.

The Sign in Sheet and Comment Cards are provided in Appendix H. Poster boards presented at the Information Session is also provided in Appendix H.

During the information session event, Zutphen and the consultants discussed the Project with local residents and members of the public. The following concerns were relayed to the Project team regarding the Project:

- Questions from residents regarding blasting were asked, including one resident (receptor # 1, Figure 10, Appendix A) that noted a blast which shook their house during 2019. Although no direct concerns were noted from residents about property damage, frequency of blasting, or impacts to water wells, multiple attendees requested that they be included on a blasting notification list prior to blasting occurring. The adjacent archery club (Figure 10, Appendix A) noted in a separate phone call correspondence with MEL that they would like notification as they often hold archery club events in the forested lands beside the quarry. The Project Team advised these individuals that the frequency of blasting will not increase above current levels, that monitoring of blasting activity will occur to ensure compliance with IA requirements, and that future blasting associated with the expansion will remain beyond 800 m from their property unless permission to be closer is obtained. Zutphen have committed to notifying this residence prior to planned blasting. Effects and mitigation related to Project noise is provided in Section 9.2.1.
- The greatest concern raised by multiple local residents was in relation to existing and future truck traffic in the neighbourhood. The following concerns were raised:
  - Increase in truck traffic as a result of quarry expansion;
  - Impact to the current community use of the Coxheath Road, especially since it does not have a sidewalk. Concerns include multiple bus service route, use of Coxheath Road by the Coxheath Wilderness Hills Recreation Association, use of the Coxheath Road by bikers.
  - Concern for the potential effects related to truck traffic including dust and noise from trucks.
  - Deterioration of the road through truck traffic use (i.e. potholes and erosion).
  - Accountability of truck use and identification of trucks so that speed and rock flying from truck loads can be traceable.

  The Project team explained to the residents that quarry production is not proposed to increase from current rates and as such, increases in truck traffic are not expected. Truck traffic potential effects and mitigation are discussed further in Section 9.2.1 and outline methods by which Zutphen can improve truck use of the local roads when visiting the Gillis Lake Quarry. Zutphen have committed to the following measures to reduce the potential for the above issues to occur:
  - Zutphen owned trucks will be required to cover loads for materials which is susceptible to create dust during transportation (i.e. fines).
  - Signage will be installed at the scale house to remind customers to adhere to speed limits on local roads.
  - Zutphen will maintain an open line of communication with residents so that concerns, issues or questions related to truck traffic from the quarry can be considered.
- A few residents expressed concern regarding the potential effects to groundwater wells as a result of blasting at the quarry. The Project Team advised these individuals that the frequency of blasting will not increase above current levels, that monitoring of blasting activity will occur to ensure compliance with IA requirements, and that future blasting associated with the expansion will remain at minimum 800 m from their property unless permission to be closer is obtained. In

the unlikely event that blasting is proven to affect a resident's groundwater well, the Proponent has committed to re-drilling or re-digging their well. In addition, Zutphen committed to performing pre quarry expansion water quality sampling of resident's domestic wells which exist in close proximity to the QDA (i.e.1 km) Potential effects as a result of blasting are discussed further in Sections 9.2.4 and 9.2.1.

8.2 Mi'kmaq Engagement & Traditional Use

The Project Description letter and an invitation to the November 5, 2019 information session were submitted to the KMKNO, Millbrook First Nation, Sipekne'katik First Nation, Eskasoni First Nation and the NS OAA on May 10, 2019 and October 21, 2019, respectively. To date, confirmation of receipt was provided by the OAA, however no other responses have been received and no representatives were present at the information session.

Zutphen acknowledge that consultation with the Mi'kmaq should follow the Six Step process as outlined in the "Proponents' Guide: The Role of Proponents in Crown Consultation with the Mi'kmaq of Nova Scotia" (Office of Aboriginal Affairs, 2012). Although early engagement was initiated (through provision of the Project Description and an invite to the Information Session), meetings with the Mi'kmaq Community have not yet occurred.

Due to the limited size of the expansion (i.e. a 9.3 ha QDA adjacent to the existing quarry), it being located on private land with no major waterways used historically as travel routes within or adjacent to the site, and lack of high archaeological or cultural significance potential within the Study Area, the Project Team determined that a Mi'kmaq Ecological Knowledge Study (MEKS) was not required.

9 DISCUSSION OF IMPACTS

9.1 Valued Environmental Component (VEC) Selection

The scope, methodology and baseline environmental conditions for the Project have been described in detail in Sections 3 through 8 in this registration document. Each potential VEC, as identified and defined in the NSE *Guide to Preparing an Environmental Assessment Registration Document for Pit and Quarry Developments in Nova Scotia*, revised September 2009, has been described and baseline environmental work has been completed to evaluate each VEC based on the site-specific conditions relating to the Gillis Lake Quarry Expansion Project.

Based on the environmental baseline work completed for each VEC over the course of a four-season survey period, and the expertise of the various members of the EA Project Team, an evaluation has been completed to determine the significance of residual effects for each VEC from Project activities once planned mitigation has been completed. Potential effects, mitigation and residual effect for each VEC is provided in Section 9.2.

The thresholds for determination of significant of adverse residual environmental effects for each VEC are defined in Table 9-1 below. Where they apply, regulatory guidelines and limits associated with IA approval requirements have been used as the threshold. Where IA guidelines or limits are not applicable to the VEC being addressed, appropriate thresholds have been identified based on environmental standards and professional opinion of the Project Team.

Table 9-1. VECs Threshold for Determination of Significance

<table>
<tr><th>Valued Environmental Components (VECs)</th><th colspan="3">Threshold for Determination of Significance</th></tr>
<tr><td rowspan="6">Noise</td><td colspan="3">A significant adverse effect from the Project includes an exceedance of the maximum allowable noise limits as described under the Nova Scotia Pit and Quarry Guidelines that remains after mitigation is put into place as indicated below:</td></tr>
<tr><td>Spatial Boundary</td><td>Temporal Boundary</td><td>Leq Threshold (dBA)</td></tr>
<tr><td>Property Boundary</td><td>Daytime (0700 to 1900)</td><td>65</td></tr>
<tr><td>Property Boundary</td><td>Evening (1900 to 2300)</td><td>60</td></tr>
<tr><td>Property Boundary</td><td>Nighttime (2300 to 0700) and
All day Sunday and statutory holidays</td><td>55</td></tr>
<tr><td>7 m from the nearest structure not located in the property boundary</td><td>During blasting events</td><td>128</td></tr>
</table>

Valued Environmental Components (VECs)	Threshold for Determination of Significance
Air Quality	A significant adverse effect from the Project includes an exceedance of the parameters defined by NSE in the current IA that remains after mitigation is put into place as indicated below: *Particulate emissions shall not exceed the following limits at or beyond the Site property boundaries: Annual Geometric Mean 70 µg/m3 Daily Average (24 hr.) 120 µg/m3.*
Topography, Surficial and Bedrock Geology	There are no regulated or proposed thresholds for geology/topography for the Project but processing of aggregate and disturbance to surficial geology can impact water quality (i.e. total suspended solids [TSS], metals, and sediments). Refer to the threshold for determination of significance for surface water.
Groundwater	GROUNDWATER QUALITY A significant adverse effect from the Project includes a proven negative change (as defined below) in the groundwater quality due to the Project activity. This is an effect that remains after mitigation is put into place (i.e., a residual effect). A sustained exceedance of the following parameters: • Standard water quality variables and trace metals as determined by the RCAp MS water sample analysis method. • Benzene, Toluene, Ethylbenzene and Xylene (BTEX) as well as Total Petroleum Hydrocarbons (TPH).
	GROUNDWATER QUANTITY A significant adverse effect from the project includes a proven change in the groundwater quantity such that it has a negative effect on a groundwater receptor such as drinking water wells after mitigation has been put into place. A negative effect has been defined as a reduction in water yield of 20%.

<table>
<tr><th>Valued Environmental Components (VECs)</th><th>Threshold for Determination of Significance</th></tr>
<tr><td rowspan="2">Surface Water</td><td>WATER QUALITY
A significant adverse effect from the Project includes regular exceedance (i.e. more than two per year) of the parameters defined by NSE in the current IA after mitigation has been put into place as indicated below:

<u>Total Suspended Solids</u>
Clear Flows (Normal Background Conditions):
1) Maximum increase of 25 mg/l from background levels for any short term exposure (24 hour or less)
2) Maximum average increase of 5 mg/l from background levels for longer term exposure (inputs lasting between 24 hours and 30 days)
High Flow (Spring Freshets and Storm Events):
1) Maximum increase of 25 mg/l from background levels at any time when background levels are between 25 mg/l and 250 mg/l
2) Shall not increase more than 10% over background levels when background is > 250 mg/l
<u>pH</u>
1) Maximum 5 to 9 in grab sample
2) Maximum 6 to 9 as a Monthly Arithmetic Mean</td></tr>
<tr><td>WATER QUANTITY
Predicted surface water discharge flows that are beyond the existing natural variability in the studied watersheds were considered as at greater risk for changes to the physical properties of the waterways, primarily through changes in the potential for erosion, sedimentation or water feature morphological changes. For the purposes of this threshold, a 25% increase change is considered a significant adverse effect.</td></tr>
<tr><td>Fish and Fish Habitat</td><td>A significant adverse effect from the Project to fish is an effect that is likely to cause harmful alteration, disruption or destruction of fish habitat (HADD) as defined by the Fisheries Act after mitigation has been put into place without consideration of appropriate offsetting measures.</td></tr>
<tr><td>Wetlands</td><td>A significant adverse effect from the Project on wetland habitat is defined as an effect that results in an unmitigated or uncompensated net loss of wetland habitat as defined under the NSE Wetland Conservation Policy, and its associated no-net loss policy.</td></tr>
<tr><td>Habitat, Vascular Plants and Lichens</td><td>A significant adverse effect from the Project includes an effect that is likely to cause a permanent alteration to any flora species distribution, abundance or habitat, where similar habitat is not currently available at the local/regional level.</td></tr>
</table>

Valued Environmental Components (VECs)	Threshold for Determination of Significance
Fauna (Herpetofauna Species and Mammals)	A significant adverse effect from the Project includes an effect that is likely to cause a permanent alteration to any fauna species distribution or abundance, or alteration of core habitat.
Birds (Avifauna)	A significant adverse effect from the Project includes an effect that is likely to cause a permanent alteration to any bird species distribution or abundance, or alteration of defined core habitat.
Species of Conservation Interest (SOCI) and Species at Risk (SAR)	A significant adverse effect from the Project includes an effect that is likely to cause a permanent alteration to a priority species' distribution or abundance, or alteration of critical habitat. Sedentary species such as flora and lichens do not have the opportunity to move to avoid direct or indirect impact. For these taxa, the loss of a population of SAR, is considered significant.
Archaeological and Heritage Resources	A significant adverse effect from the Project includes any disturbance to or destruction of any archaeological or heritage resource of importance in context of the *Special Places Act* after mitigation has been put into place.

9.2 Effects Assessment

The detailed effects assessment involves the following steps:

1. Identification of potential Project interactions on selected VEC;
2. Identification of potential effects;
3. Description of recommended mitigation and monitoring;
4. Identification of expected residual effects (post mitigation); and,
5. Identification of the significance of residual effects.

Results of the detailed effects assessment process listed above is presented for each identified VEC where residual effects are expected in the following sections.

9.2.1 Noise

Table 9-2 provides a summary of the potential Project interactions and environmental effects resulting from the Project-VEC Noise. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Decommissioning as well as Accidents, Malfunctions, and Unplanned Events). The discussion following the table provides an analysis of key Project-VEC interactions. Interaction and potential effects to noise levels as a result of quarrying, and residential receptors surrounding the QDA has been analysed as part of the review.

Table 9-2. Project- VEC Interactions by Project Phase on Noise

Project Activities and Physical Works	Potential Project Interactions with Noise Levels
Construction	
Site preparation/clearing	X
Grubbing	X
Watercourse/wetland alteration	
Removal of overburden	X
Waste management	
Expansion of storage areas for grubbings and overburden soils	X
Operation and Maintenance	
Rock Blasting	X
Rock Transfer	X
Sorting and Crushing	X
Management of surface water	
Trucking/Transport of product	X
Decommissioning	
Re-grading of rock face	X
Reclamation/re-vegetation	X
Accidents, Malfunctions and Unplanned Events	
Erosion and sediment control failure	
Fuel spill from machinery/trucks	X
Fire	

As outlined above, noise can be created as a result of quarry operations as a result of multiple sources. The use of heavy equipment, hauling of material by trucks, quarry processing equipment and disposal of quarry rock are examples. Blasting using explosives is a primary source of noise and vibration and can act as a nuisance for adjacent residents, and changes to ambient noise levels and the presence of periodic vibrations have the potential to adversely affect fauna and birds by potentially influencing migration and behavioral patterns. Additional detail related to effects of noise and wildlife is provided in Section 9.2.9.

Noise and vibration are provincially regulated via the *Occupational Health and Safety Act* (OSHA, 1996) and the Pit and Quarry Guidelines (NSEDL, 1999), which protects the health of site workers and the general public at the property boundaries of the Project, respectively.

As part of this effects assessment it is worthy to note that to date, there have been no known complaints of noise issues made to NSE or Zutphen for the Gillis Lake Quarry. The lack of known noise related issues is likely due to the distance between surrounding residences and the QDA (i.e. 815 m being the closest distance of a residence from QDA). Furthermore, an undulating landscape and forested lands in-between the residences and QDA are expected to muffle noise being produced. The quarry operations are not planned to change; therefore, noise levels are expected to remain consistent with current conditions. At the Public Information Session held in November 2019 (Section 8), a neighbouring resident (receptor # 1,

Figure 10, Appendix A) mentioned that they heard blasting for the first time during one event that occurred in 2019. In addition, an owner of the adjacent Breton Traditional Archery Club (Figure 10, Appendix A), noted that blasting occurred on a day that the archery club members were using the adjacent forested lands, and that they were concerned by it from a health and safety perspective. The blasting communication commitments discussed in the mitigation section below will address these instances.

9.2.1.1 *Mitigation*

The following mitigation measures will be included in the design of the Project to minimize the effects of Noise:

- Blasting will be monitored and will be planned to occur on days where weather conditions are less likely to cause excessive sound levels;
- The quarry will operate during daylight hours only to prevent nighttime disturbance;
- Blasting will not occur on Sundays or holidays;
- Regular maintenance of site vehicles will be completed to ensure they are in working order and not a source of excessive noise;
- Neighboring residents who requested notification at the information session will be included on a blasting notification list; and,
- A Project Contingency Plan will be developed and will include site specific measures to reduce and mitigate noise levels during operations if and as required.

9.2.1.2 *Monitoring*

- Noise levels will be monitored in accordance with NSE IA Conditions.

9.2.1.3 *Residual Effects and Significance*

Residual environmental effects of the Project related to noise production are likely (i.e. audible blasting at residential receptors or truck traffic along the Coxheath Road). However, after mitigation measures have been implemented, and IA regulations have been met, the predicted residual environmental effects are assessed to be not significant.

9.2.2 Air Quality

Table 9-3 provides a summary of the potential Project interactions and environmental effects resulting from the Project-VEC Air Quality. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Decommissioning as well as Accidents, Malfunctions, and Unplanned Events). The discussion following the table provides an analysis of key Project-VEC interactions. Interaction and potential effects to air quality levels as a result of quarrying, and residential receptors surrounding the QDA has been analysed as part of the review.

Table 9-3. Project- VEC Interactions by Project Phase on Air Quality

Project Activities and Physical Works	Potential Project Interactions with Air Quality Levels
Construction	
Site preparation/clearing	X
Grubbing	X
Watercourse/wetland alteration	X
Removal of overburden	X
Waste management	X
Expansion of storage areas for grubbings and overburden soils	X
Operation and Maintenance	
Rock Blasting	X
Rock Transfer	X
Sorting and Crushing	X
Management of surface water	
Trucking/Transport of product	X
Decommissioning	
Re-grading of rock face	X
Reclamation/re-vegetation	X
Accidents, Malfunctions and Unplanned Events	
Erosion and sediment control failure	
Fuel spill from machinery/trucks	
Fire	X

Quarrying has the potential to have an effect to Air Quality in the following ways:

- Climate Change: Production of Greenhouse Gasses (GHG) as a result of fuel combustion during quarry operation, blasting and vehicle use can contribute to the effect of Climate Change. Although there are no province wide standards for GHG use, it is considered here as an effect of the Gillis Lake Quarry Expansion Project.

- Air Pollutants: There are federal and provincial regulations as it relates to levels of Nitrogen Oxides (NO_x), Sulphur Dioxide (SO_2), Carbon Monoxide (CO), and Particulate Matter. NO_x, SO_2, and CO are generated through the operation of internal combustion engines associated with Project activities as well as other compounds, such as Polycyclic Aromatic Hydrocarbons (PAHs) and Volatile Organic Compounds (VOCs). Air pollutants have been identified as a potential risk to human health if found at certain ground level concentrations, typically prescribed under provincial and federal regulatory regimes, although not always (in the case of $PM_{2.5}$).

- Particulate Levels: Dust and particulate levels (known as Total Particulate Suspended Matter), can be emitted from quarrying activities such as blasting, crushing, stockpiling material and travel of trucks on unpaved roads, and can act as a cause of nuisance to local residents or people in proximity of the quarry.

For the purposes of this effect's assessment, potential effects to air quality are compared to the regulatory requirements set out in the Pit and Quarry Guidelines (NSEDL, 1999), which regulates particulate levels at the property boundaries of the Project.

Similar to the effects of noise, quarry operations have the potential to effect air quality in the above described ways, which can have a subsequent effect to the public and residential receptors surrounding the QDA. For similar reasons discussed for noise however (Section 2.4.7), air quality conditions are not expected to change from current conditions as a result of the quarry operations remaining consistent. Based on feedback provided from residents at the Public Information Session held in October 2019, air quality was raised as a concern as it relates to dust being produced on the unpaved Coxheath Road during dry conditions. Zutphen acknowledge that use of Coxheath Road by haul trucks visiting the Gillis Lake Quarry will continue, however, truck volumes are not expected to increase as a result of its expansion discussed herein.

9.2.2.1 *Mitigation*

The following mitigation measures will be included in the design of the Project to minimize effects to Air Quality:

- Should it be required, dust emissions sourced from the quarry site will be controlled with the application of water.
- Slopes on inactive stockpiles will be stabilized with mulching and/or vegetation, where appropriate. Waste rock piles will be sprayed with water as necessary to minimize fugitive dust.
- Zutphen owned trucks will be required to cover loads for materials which is susceptible to create dust during transportation (i.e. fines).
- A Project Contingency Plan will be developed and will include site specific measures to reduce and mitigate dust levels during operations.

9.2.2.2 *Monitoring*

- Dust emission and particulate matter will be monitored at the property boundary of the quarry at the request of NSE and as per IA regulations.

9.2.2.3 *Residual Effects and Significance*

Residual environmental effects of the Project related to air quality are likely (i.e. contribution to Climate Change, Air pollutant levels and dust along the Coxheath Road from haul trucks). To date, there have been no known complaints related to air quality and dust production from the Gillis Lake Quarry property, nor have high dust levels from the quarrying activities been reported. Quarrying production is not expected to increase, and operation methods will remain consistent with current processes; therefore, dust emissions are not expected to be significant and are expected to meet the IA monitoring requirements. Should dust be generated from quarry operations within the property, standard mitigation (discussed above) can be applied to ensure IA compliance and ensure environmental effects are not significant.

Zutphen acknowledges that dust can be created on the Coxheath Road as a result of truck traffic visiting the quarry. This effect is outside of the scope of this Project (i.e. non-quarry related), however, as discussed in Section 8.1, as part of their ongoing environmental commitments, Zutphen will ensure that Zutphen owned trucks carrying dust producing loads are covered, that speed limit signage is installed at the quarry, and that an open line of communication with residents is maintained so that public concerns can be considered.

9.2.3 Surficial and Bedrock Geology and Topography

Table 9-4 provides a summary of the potential Project interactions and environmental effects resulting from the Project-VEC Surficial and Bedrock Geology and Topography. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Decommissioning as well as Accidents, Malfunctions, and Unplanned Events). The discussion following the table provides an analysis of key Project-VEC interactions. Interaction and potential effects to Surficial and Bedrock Geology and Topography has been analysed as part of the review.

Table 9-4. Project- VEC Interactions by Project Phase on Surficial and Bedrock Geology and Topography

Project Activities and Physical Works	Potential Project Interactions with Surficial and Bedrock Geology and Topography
Construction	
Site preparation/clearing	X
Grubbing	X
Watercourse/wetland alteration	X
Removal of overburden	X
Waste management	
Expansion of storage areas for grubbings and overburden soils	X
Operation and Maintenance	
Rock Blasting	X
Rock Transfer	
Sorting and Crushing	
Management of surface water	
Trucking/Transport of product	
Decommissioning	
Re-grading of rock face	X
Reclamation/re-vegetation	X
Accidents, Malfunctions and Unplanned Events	

Project Activities and Physical Works	Potential Project Interactions with Surficial and Bedrock Geology and Topography
Erosion and sediment control failure	
Fuel spill from machinery/trucks	
Fire	X

Quarrying has the potential to have an effect on the following Surficial and Bedrock Geology and Topography variables:

- Soil Destabilization: Clearing and disturbance of lands has the potential to cause soil erosion and sedimentation in receiving surface water systems (i.e. watercourses, on-site drainage ditches and wetlands). Increases in sediment loads can degrade water quality conditions (See Section 9.2.6).

- Soil Quality: Disturbance of surficial soils, and adjacent quarrying activities has the potential to degrade the quality of soils, notably its ability to act as a growth medium for vegetation. Soil quality could be affected through compaction or contamination from quarry related dust or mixing with quarry spoils.

- Rock Mineralisation: Upon exposure to oxygen and water, blasted or otherwise disturbed rock has potential to mineralize and leach soluble metals into surface and groundwater systems. The production of Acid Rock Drainage (ARD) is also a possibility in areas which comprise rock containing high levels of iron-sulphides. As discussed in Section 9.2.6.2, the potential for ARD at the Gillis Lake Quarry is considered low.

- Topography: Topography (land elevations) will be altered as the quarry expands including presence of the active quarry, sidewalls, spoil and aggregate piles etc. Potential impacts to surface water run-off characteristics could occur including volumes of discharge water being sourced to surface water features, and water quality conditions. These effects have been evaluated in Section 9.2.6.

Potential effects to Surficial and Bedrock Geology and Topography are compared to the regulatory requirements set out for surface water quality (i.e. no exceedance of CCME FWAL criteria or confirmed background concentrations for TSS, pH and metals to meet the NS Pit and Quarry Guidelines) (NSEDL, 1999).

9.2.3.1 *Mitigation*

The following mitigation measures will be included in the design of the Project to minimize effects to Surficial and Bedrock Geology and Topography and resulting potential effects to surface water:

- Construction of sediment control measures (i.e. settlement pond/s, sediment fencing) and erosion control (e.g. check dams in ditching) will be implemented.

- Topsoil and organic soil material removed during construction will be saved and used during reclamation in order to restore the local seed bank.
- Soil material will be replaced during reclamation when weather is optimal (i.e. minimal precipitation).
- Areas of soil that do become compacted may be aerated to aid in reclamation of soil quality.
- Implement interim reclamation as the quarry expands to stabilize and revegetate side slopes and exposed surfaces.
- A Project Contingency Plan will be developed and will include site specific measures to prevent sedimentation and erosion and reduce and mitigation dust levels during operations.

9.2.3.2 *Monitoring*

Monitoring will be implemented as described in Section 9.2.5 (Surface Water)

9.2.3.3 *Residual Effects and Significance*

Zutphen are required to meet the IA requirements associated with water quality conditions leaving the site, and reclamation commitments mean that changes to topography and surficial characteristics will be remediated to a stable, vegetated landscape. Furthermore, the regulatory monitoring requirements for the expansion of the quarry will improve the general conditions across the entire Study Area (including the former quarry located adjacent to Coxheath Road). Predicted residual environmental effects are assessed in Section 9.2.5.4 (Surface Water).

9.2.4 Groundwater

Table 9-5 provides a summary of the potential Project interactions and environmental effects resulting from the Project-VEC interactions with groundwater. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Decommissioning as well as Accidents, Malfunctions, and Unplanned Events). The discussion following the table provides an analysis of key Project-VEC interactions. Interaction and potential effects to groundwater as a result of quarrying, and potable wells surrounding the QDA has been analysed as part of the review.

Table 9-5. Project- VEC Interactions by Project Phase on Groundwater

Project Activities and Physical Works	Potential Project Interactions and Environmental Effect	
	Interaction with Localized Groundwater	Adjacent Potable Water Resources
Construction		
Site preparation/clearing	X	
Grubbing	X	
Watercourse/wetland alteration		
Removal of overburden	X	

Project Activities and Physical Works	Potential Project Interactions and Environmental Effect	
	Interaction with Localized Groundwater	Adjacent Potable Water Resources
Waste management		
Expansion of storage areas for grubbings and overburden soils		
Operation and Maintenance		
Rock Blasting	X	X
Rock Transfer		
Sorting and Crushing		
Management of surface water		
Trucking/Transport of product		
Decommissioning		
Re-grading of rock face		
Reclamation/re-vegetation	X	
Accidents, Malfunctions and Unplanned Events		
Erosion and sediment control failure		
Fuel spill from machinery/trucks	X	X
Fire		

Groundwater impacts as a result of quarrying can be variable and depend on conditions such as underlying geological conditions, natural groundwater characteristics and the quarrying activities taking place. These interactions are based upon a potential change in groundwater quantity and quality from baseline conditions as outlined below.

9.2.4.1 *Quantity*

- Recharge Capacity: Changes to the natural surface conditions within the QDA have the potential to alter groundwater recharge and could cause temporary lowering or rising of the water table relative to baseline conditions. Hardened surfaces (i.e. new roads, compacted surfaces) will likely reduce recharge, whereas clearing of vegetation and exposure to fractured bedrock on the quarry floor could increase local groundwater levels. The type and integrity of the underlying bedrock would influence the infiltration rates (and subsequent recharge) that could be expected.

  For the Gillis Lake Quarry, changes in natural surface conditions are only expected within the QDA (~ 9.3 ha of which 4.6 ha are natural forested land and the remainder is disturbed landscape) through conversion to quarry floor. As discussed in Section 5.5.2, the water balance completed for the Project indicates that infiltration characteristics could change. Water management practices that are currently in place (ditches and settling ponds), which will be updated as the quarry continues to operate, will collect surface water from the quarry that does not infiltrate quickly. In a natural environment this water would have more time to infiltrate and recharge groundwater, whereas in a developed scenario is drained at surface from the landscape quicker.

Future reclamation of the Gillis Lake Quarry could include removal of some of the surface water drainage features (i.e. ditches), and revegetation of the quarry surface will occur. It is possible that the infiltration characteristics at the surface will change post reclamation (i.e. more groundwater recharge), but the predominant flow of water will still be via surface towards the onsite settling ponds adjacent to Coxheath Road and as such, localized groundwater levels are likely to resemble active quarry conditions on a permanent basis.

- Groundwater Flow: Changes in local groundwater recharge as a result of the expanding quarry, has the ability to change localized interflow of groundwater and potential flow of water to wells or surface water features.

- Blasting: Blasting can increase bedrock fracture frequency and change the direction of groundwater interflow, potentially impacting flow to wells or surface water features.

9.2.4.2 *Quality*

- Blasting: Use of ammonium nitrate in the blasting process has the potential to leave residual nitrogen that can leach into groundwater which could potentially make its way to water wells or surface water features.

- Rock-Water Interaction: Precipitation or surface water that comes into contact with rock could affect surface water runoff quality or leach into the groundwater. Processing of aggregate and rock at a quarry (notably crushing and exposure of rock to water and oxygen), can create dissolved solids and metals which could potentially make its way to water wells or surface water features.

Effects to groundwater quantity and quality (and surrounding wells) is unlikely as a result of the proposed expansion due to the limited size of landscape alteration proposed (9.3 ha conversion to quarry floor). No additional hard landscaped areas are proposed in the expansion area (i.e. impermeable, compacted areas such as roads or other constructed infrastructure), and the rock type and associated infiltration rates of the future quarry floor is expected to remain consistent with current conditions.

The Gillis Lake Quarry is an existing quarry that has had no issues regarding interactions with residents drilled wells to date. Quarry practices are expected to remain consistent (i.e. blasting frequency), therefore impacts are not expected at the closest residences associated with this expansion. The closest residential wells are located approximately 815 and 835 m and from the QDA, and expansion is extending farther away from them which further reduces the likelihood that issues may arise.

No interaction with groundwater has occurred to date at the Gillis Lake quarry (including seepages through exposed rock quarry face or build up of water on the quarry floor) based on visual observations. Therefore, since the quarry floor will continue to slope upwards as it expands, future interaction with groundwater is not expected.

Due to the lack of natural aquatic features present within the Study Area, and level of current disturbance in lands downgradient from the current quarry, interactions (i.e. increases or decreases in groundwater supply) between groundwater and wetlands and watercourses is not expected.

9.2.4.3 *Mitigation*

The following mitigation measures will be included in the design of the Project:

- The quarry floor will be sloped upwards within the QDA in order to control runoff and ensure the potential for interaction with groundwater is limited.
- Zutphen will develop a blasting notification list to advise neighbouring residents of future blasting events.
- Zutphen will monitor neighboring residential structures during blasting events. This will be detailed in the IA Amendment application process.
- Potential effects to groundwater quality as a result of blasting will be reduced by using an emulsion compound which is insoluble in water. This will prevent contaminants such as Ammonium Nitrate Fuel Oil entering surface water bodies and groundwater during blasting activities.
- Fuel is currently not stored on site and will not be stored on site in the future. A Contingency Plan including best management practices and spill release practices will be developed to reduce the potential of groundwater contamination.

9.2.4.4 *Monitoring*

- A groundwater monitoring program in line with NSE standards will be implemented to assess the water table location and groundwater flow conditions and for comparison to future conditions.
- As part of the groundwater monitoring program, the Proponent will perform baseline water chemistry sampling in order for future results to be compared to. This will be completed to ensure the quarry is not causing adverse effects to groundwater quality conditions as a result of dissolved solids and metals or other deleterious substances.

9.2.4.5 *Residual Effects and Significance*

Due to the small area of quarry expansion proposed and no known interactions with groundwater from operations at the existing quarry to date, no negative effect to surrounding water supplies (i.e. drilled or dug residential wells) is expected. Therefore, after mitigation measures have been implemented and IA requirements have been met, the predicted residual environmental effects to groundwater are assessed to be not significant.

9.2.5 Surface Water

Table 9-6 provides a summary of the potential Project interactions and environmental effects resulting from the Project-VEC interactions with surface water. As discussed in Sections 3.1 and 4.1.2.4, potential effects to surface water have been evaluated within the Study Area as well as within off-site watercourses (MacDonalds Brook, Portage Brook). The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Decommissioning as well as Accidents, Malfunctions, and Unplanned Events). The discussion following the table provides an analysis of key Project-VEC interactions.

Interaction and potential effects to water quantity and water quality as a result of quarrying are presented.

Table 9-6. Project- VEC Interactions by Project Phase on Surface Water

Project Activities and Physical Works	Potential Project Interactions and Environmental Effect	
	Changes in Water Quality	Changes in Water Quantity
Construction		
Site preparation/clearing	X	
Grubbing	X	
Watercourse/wetland alteration	X	X
Removal of overburden	X	
Waste management	X	
Expansion of storage areas for grubbings and overburden soils	X	
Operation and Maintenance		
Rock Blasting	X	X
Rock Transfer		
Sorting and Crushing	X	
Management of surface water	X	X
Trucking/Transport of product		
Decommissioning		
Re-grading of rock face	X	
Reclamation/re-vegetation	X	X
Accidents, Malfunctions and Unplanned Events		
Erosion and sediment control failure	X	

Project Activities and Physical Works	Potential Project Interactions and Environmental Effect	
	Changes in Water Quality	Changes in Water Quantity
Fuel spill from machinery/trucks	X	
Fire		

Potential surface water effects can be divided into direct impacts and indirect impacts. Indirect impacts can be further divided into two components (i) water quantity effects and (ii) water quality effects. These effects are discussed below. It should be noted that the Project interactions described below relate to the physical effects that could occur to a surface water component as a result of direct Project development and/or indirect changes in water quantity or water quality conditions. **Subsequent effects to fish and fish habitat as a result of indirect effects to surface water features are discussed separately in Section 9.2.6**.

9.2.5.1 *Direct Effects*

Direct alteration to surface water systems as a result of the quarry expansion at Gillis Lake Quarry will occur to WC4 and WC5 which are located within the QDA. As detailed in 5.5.3, WC4 is an intermittently channelized, first-order stream and facilitates the drainage of water from the off-site wetland to the north towards MacDonalds Brook, located east of the Study Area. WC5 is an ephemeral stream that directs surface flow towards MacDonalds Brook; however, the watercourse channel does not extend into MacDonalds Brook. A watercourse alteration approval will be required from NSE to extend quarry development through these features. An evaluation of potential water quantity effects to MacDonalds Brook as a result of this alteration is discussed in Section 9.2.5.2 below.

9.2.5.2 *Indirect Effects*

Indirect effects associated with quarry development include surface water quantity and quality to downstream aquatic receivers, as discussed below.

Water Quantity

As per the results of the Water Balance Analysis (Section 5.5.3.4) predicted reductions and increases of surface water to receiving surface water systems as a result of the quarry expansion has been completed. Results of the analysis predict the following potential increases and reductions of surface water discharge flow to the modelled outfalls.

Outfall 1: 12.94% increase in surface water discharge under impervious conditions, or 0.72% reduction in surface water discharge under pervious conditions.

Outfall 2: 24.94% increase in surface water discharge under impervious conditions, or 5.67% increase in surface water discharge under pervious conditions.

Outfall 3: 10.65% reduction in surface water discharge under impervious and pervious conditions.

The reader is reminded that it is anticipated that actual losses and reductions in discharge flow are expected to fall somewhere between the ranges presented for each outfall above based on the infiltration that occurs on the surface of the quarry floor.

It is evident that throughout the expansion of the Gillis Lake Quarry, water will continue to be drained through current ditches and settling ponds towards the receiving Portage Brook. However, as indicated above, increased surface water flow volumes could occur within Portage Brook (Outfall 1) and is expected to occur within WC1 (Outfall 2). As a result, impacts to the morphological characteristics of WC1, or Portage Brook itself are possible, if mitigation measures were not applied. These indirect effects could constitute a watercourse alteration activity. Effects to fish and fish habitat as a result of these potential increases in discharge flow are discussed separately in Section 9.2.6.2.

Reduced flow volumes anticipated to occur in MacDonalds Brook (Outfall 3) also have the potential to impact fish and fish habitat which are also discussed in Section 9.2.6.2.

Water Quality

Similar to some of the effects discussed for Groundwater, quarrying has the ability to impact surface water quality as follows:

- Rock-Water Interaction: The physical processing of aggregate and rock and contact with surface water and oxygen has the potential to create dissolved solids and metals which could flow to downstream surface water receivers. This includes the potential for ARD (see Section 9.2.3).
- Erosion and Sedimentation: earth moving, excavation, vegetation clearing, and blasting are activities that can lead to increased erosion and sedimentation and turbidity issues in surface water.
- Malfunctions and Accidents: Oil spills or loss of a hazardous or deleterious substance within the quarry has the potential to release into surface water systems via the quarry ditching system currently in place.

As discussed in Section 4.1.7.2.1, baseline water quality samples for total metals in water and hydrocarbons in water have been obtained at five locations during high and low flow conditions within watercourses within and surrounding the FHAA. Water quality analysis indicates that for the most part CCME Environmental Quality Guidelines for Freshwater Aquatic Life are met, however all samples indicated exceedances for Total Aluminum, three locations exhibit exceedances for Total Iron and two locations exhibit exceedances of pH.

Furthermore, samples were collected to determine potential for ARD. For both samples, the total sulfur weight proportion was less than 0.05% and the acid producing potential was less than 1.46 kg/t (Table 5.3-1, Section 5.3.3.1). A sulphur concentration of 0.001% is considered as low sulphur content and therefore does not present a potential for ARD.

9.2.5.3 *Mitigation*

The following mitigation measures will be included in the design of the Project:

- Design and implementation of a surface water management strategy will be completed for the Gillis Lake Quarry. This will include:
  - Design of new and/or updates to existing settling ponds to manage and ensure peak discharge rates from the quarry site are equal to pre-quarry expansion conditions to negate the predicted increases in surface flow discharge to Outfalls 1 and 2 (Portage Brook and WC1.
  - Redirection of surface water (through ditching) around the northern extent of the QDA in order to i) reduce discharge flow into the active quarry and downstream aquatic receivers and ii) maintain the natural drainage direction from the off-site wetland to the north of the QDA toward MacDonalds Brook;
- Zutphen will implement and update existing erosion and sediment control structures (e.g. sediment fence, rip rap, check dams etc.) as needed to minimize the potential for sediment release into surface water. All erosion and sediment control structures will be regularly inspected and repaired.
- Stockpiles of material with a potential to cause sedimentation issues will be setback from surface water systems and will be stabilized to reduce the likelihood of erosion and sedimentation.
- Potential effects to water quality as a result of blasting will be reduced by using an emulsion compound which is insoluble in water. This will prevent contaminants such as Ammonium Nitrate Fuel Oil entering surface water bodies and groundwater during blasting activities.
- Zutphen will not store fuel on site in the future. Refueling and maintenance of vehicles and equipment will occur in areas 100 m from a watercourse or off-site completely.
- A Project Contingency Plan will be developed for the Project to outline the prevention and response methods regarding spills and/or substance loss.

Additional mitigation measures related to water quantity effects associated with fish habitat (receiving watercourses) are provided in Section 9.2.6.3.

9.2.5.4 *Monitoring*

- To implement a surface water monitoring program (including sample locations from the outflow/downstream environment of the settling pond), to ensure water quality entering the downstream environment meets regulatory requirements and that potential impacts to aquatic life is not occurring. Details of the water quality program will be outlined in a Surface Water Monitoring Program as part of the IA Amendment Application process.

- The Surface Water Monitoring Program will also be designed to evaluate the effects of increased and decreased discharge flows to watercourses discussed in this document.

9.2.5.5 *Residual Effects and Significance*

On site water management will ensure impacts as a result of changes in discharge flow to downstream watercourses (i.e. Portage Brook at Outfall Location 1 and WC1 at Outfall Location 2) during quarry expansion does not occur, and surface water quality will be managed through on-site water detention, sediment and erosion control, best management practices and implementation of the Surface Water Monitoring Program to ensure water quality meets the appropriate guidelines (i.e. no exceedance of CCME FWAL criteria or confirmed background concentrations for TSS, pH and metals).

Therefore, although residual effects associated with surface water quality and quantity are possible, after mitigation measures have been implemented and monitoring performed, the predicted residual environmental effects of the Project on surface water quantity are assessed to be not significant.

9.2.6 Fish and Fish Habitat

Quarry development can affect fish and fish habitat through direct and indirect activities associated with quarrying practices. Activities such as clearing, grubbing, blasting and expansion of the quarry can lead to a direct loss of a watercourse from the landscape, or access of equipment across watercourses would require installation of drainage structures such as culverts or bridges. Indirect effects to fish and fish habitat include potential changes in water quality conditions draining from the QDA into aquatic receivers, and water quantity changes due to quarry development, and associated potential loss of drainage area and re-direction of surface water flows.

Table 9-7 provides a summary of the potential Project interactions and environmental effects resulting from the Project-VEC interactions with fish and fish habitat. As discussed in Sections 9.2.5.1 and 9.2.5.2, potential effects to surface water have been evaluated within the Study Area as well as within off-site watercourses (MacDonalds Brook, Portage Brook). The table below is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Decommissioning as well as Accidents, Malfunctions, and Unplanned Events). Potential effects to fish and fish habitat have been divided into water quality and water quantity effects. The discussion following the table provides an analysis of key Project-VEC interactions.

Table 9-7. Project- VEC Interactions by Project Phase on Fish and Fish Habitat

Project Activities and Physical Works	Potential Project Interactions and Environmental Effect	
	Change in Water Quality	Change in Water Quantity
Construction		
Site preparation/clearing	X	
Grubbing	X	
Watercourse/Wetland Alteration	X	X
Removal of overburden	X	
Waste management	X	
Expansion of storage areas for grubbings and overburden soils	X	
Operation and Maintenance		
Rock Blasting	X	
Rock Transfer		
Sorting and Crushing	X	
Management of surface water	X	X
Trucking/Transport of product		
Decommissioning		
Re-grading of rock face		
Reclamation/re-vegetation	X	X
Accidents, Malfunctions and Unplanned Events		
Erosion and sediment control failure	X	
Fuel spill from machinery/trucks	X	
Fire		

Similar to Surface Water effects (Section 9.2.5), potential effects to fish and fish habitat can be divided into direct impacts and indirect impacts. Indirect impacts can be further divided into two components (i) water quantity effects and (ii) water quality effects. These effects are discussed below. It should be noted that the Project interactions described below relate to the potential effects to fish and fish habitat as a result of direct Project development and/or indirect changes in water quantity or water quality conditions. **Physical effects to watercourses (including morphological characteristics, direct alteration and water quality) are discussed separately in Section 9.2.5**.

9.2.6.1 *Direct Impacts*

Field surveys identified two watercourses (WC4 and WC5) within the QDA, both of which are proposed to be directly impacted by future quarry development. Approximately 225 m of WC4 and 15 m of WC5 are predicted to be removed by quarry development. As discussed in Section 5.5.3.2, both WC4 and WC5 do not directly support fish habitat due to a permanent down stream barrier to fish passage (falls) present on MacDonalds Brook.

Alteration of these watercourses requires a provincial permit through NSE regional offices. A watercourse alteration permit application will be submitted to NSE and approval granted prior to commencement of alteration of watercourses to support quarry expansion. Due to the lack of viable fish habitat in WC4 and WC5, and the inability for fish to access these watercourses, no residual effects are expected to fish and fish habitat.

9.2.6.2 *Indirect Effects*

Indirect effects associated with quarry development include surface water quantity and quality to downstream aquatic receivers and associated fish and fish habitat. These are discussed below.

<u>Water Quantity</u>

In support of the discussion below, the reader is referred to the Water Balance Analysis (Section 5.5.3.4) and results presented in Surface Water Effects Assessment (Section 9.2.5).

The results of the Water Balance Analysis are based on the entire Gillis Lake QDA. It is noteworthy to remind the reader that the analysis completed assesses the change in infiltration and surface runoff volume at three Outfalls downstream of the QDA. As such, the predicted reductions and increases in water quantity have been completed at various locations along the aquatic features receiving water from the QDA. These are identified on Figure 12 (Appendix A) as Outfall Locations.

The predicted changes in water being sourced to each downstream aquatic feature can have implications to the viability of fish habitat or habitat conditions within them. The reader is reminded that it is anticipated that <u>actual</u> losses and reductions in discharge flow are expected to fall somewhere between the ranges presented in Section 5.5.3.4. However, for the purposes of this effects assessment, the <u>largest</u> reduction or increase in discharge flow to each outfall (and corresponding watercourse) has been used, to be conservative as to the maximum potential impact to fish and fish habitat.

A reduction in flow can reduce the availability of suitable fish habitat by altering the water characteristics (e.g. water temperature) and changing habitat types (e.g. runs, pool depth, or riffles). Furthermore, managing the local drainage of surface water flows across the landscape (i.e. through use of settling ponds) has the potential to alter natural flow regimes entering downstream aquatic resources. Quantifying potential effects as a result of altered flow is challenging; however, a literature review was completed by the Faculty of Environmental Sciences, Griffith University, Queensland, Australia in 2002 to identify potential threats to aquatic biodiversity as a result of altered flows (Bunn and Arthington, 2002). The study identified four potential effects to aquatic biodiversity which can interrelate resulting in varying levels of effect. These include:

1. Physical stream habitat effects (i.e. riffles, pools, substrate, vegetation cover), flooding, scouring, changes in velocity and frequency of flow, pulsing of flow etc.;
2. Effects to aquatic species (i.e. changes in flow regime have the ability to alter aquatic species (i.e. recruitment, growth, and establishment of aquatic vegetation, and critical life cycle events for fish and insects including emergence and populations);

3. Changes in longitudinal and lateral connectivity (i.e. barriers for movement of aquatic life into adjacent floodplain wetlands should they become drier or wetter); and
4. Introduction of exotic and introduced species (i.e. modified flow could introduce invading fish and/or exotic plants).

For the purposes of evaluating potential effects to fish and fish habitat related to the Gillis Lake QDA, the reduction or increase in discharge flow to each outfall (and associated watercourse) is described for both pervious and impervious conditions below. The reader is reminded that the water balance presented is also a predictive tool, based upon assumptions and does not incorporate field data (i.e. flow volume measurements).

Outfall Location 1 / Portage Brook

- A 12.94% predicted increase in surface water discharge volume under impervious conditions.
- A 0.72% predicted decrease in in surface water discharge volume under pervious conditions.

Since the actual changes in discharge volume is expected to fall within the range presented above it is likely Portage Brook will experience an increase in discharge flow. A predicted increase in water quantity within this system could generate net benefits to fish and fish habitat (i.e. improve fish passage and accessibility or decrease low flow stranding). Conversely, increased flows and discharge rates could interrupt fish passage by reducing the frequency of resting areas and increases velocities could cause fish fatigue. Erosion and scour could increase turbidity and have a negative effect on fish species. However, as per commitments made in the mitigation section (Section 9.2.6.3), the on-site water management strategy will balance peak flows and the increases in discharge flow expected to mitigate these effects.

Outfall Location 2 / Watercourse 1

- A 24.94% predicted increase in surface water discharge volume under impervious conditions.
- A 5.67% predicted increase in in surface water discharge volume under pervious conditions.

Since the actual changes in discharge volume is expected to fall within the range presented above, WC1 is expected to experience an increase in discharge flow to some degree. However, it is important to note that the location at which this increase is likely to be experienced is upstream of Outfall Location 2, at the confluence with the quarry drainage ditch system (Figure 12, Appendix A).

The predicted increase in water quantity within this system could generate net benefits, or potential negative effects to fish and fish habitat as discussed above, however as per commitments made in the mitigation section (Section 9.2.6.3), the on-site water management strategy will balance peak flows and the increases in discharge flow expected to this watercourse to mitigate these effects.

Outfall Location 3 / MacDonalds Brook

- A 10.65% predicted reduction in surface water discharge volume under impervious and pervious conditions.

As discussed in the mitigation sections below (Section 9.2.6.3), redirection of surface water will occur to the north of the QDA in order to continue flow towards MacDonalds Brook. Taking this into consideration, at the location of Outfall Location 3 it is possible that the predicted decrease in water discharge volume could affect the aquatic biodiversity and fish habitat within MacDonalds Brook as described by Bunn and Arthington (2002). Outfall Location 3 is located 175 m below the field identified fish passage barrier, therefore potential effects to habitat present for the fish identified in MacDonalds Brook is possible for this short section of stream.

Due to the stream characteristics currently present and described during low flow conditions (perennial stream with frequent, deeper pools providing refuge), stranding of fish, reduction in accessible habitat, and fish mortality is not expected based on a predicted discharge volume reduction of ~10%. The reduction in surface water discharge volume is not expected to result in a significant reduction in water levels within the stream. As such, the viability of habitats for the species likely to utilize MacDonalds Brook (i.e. spawning, rearing, and overwintering habitat for brook trout, adult life history for American eel, spawning, rearing, juvenile and adult life history stages for white sucker, juvenile and adult habitat for white perch) is not expected to be affected by the relatively small change in surface water volume. As well, the rate of quarry expansion and associated predicted loss of water quantity to MacDonalds Brook is not expected to influence natural, temporal variability in flow regimes. As discussed in Section 5.5.3.4, predicted changes in surface-water volume are anticipated to be greater as MacDonalds Brook extends upstream (northwestward) from Outfall Location 3, to the point in which it confluences with WC4 and meanders northeastward away from the quarry. However, the falls present on MacDonalds Brook negates any effects to fish habitat from the falls to the confluence with WC4, as fish cannot access the watercourse upstream of this permanent barrier. This amounts to approximately 278 m (or 61%) of the 453 m of watercourse with a predicted reduction in surface water discharge volume.

It is important to note that the rate of quarry expansion within LCA3 (which sources water to MacDonalds Brook) is planned over a long timeline (20-25 years) and the predictions made are based on a range of surface water discharge flow and infiltration losses. It is also important to highlight the inherent unpredictability and error associated with hydrological analyses. This effects assessment has been based on results of a water balance which utilized loss of catchment area and infiltration to the receiving aquatic system, in comparison to the use of stream flow data in downstream features (which one would expect to produce more predictable effects). However, potential errors exist in the alternative process of stream flow measurement techniques as well. Based on evidence from the literature, a reasonable error for streamflow measurement and discharge calculations is 10% (Harmel et al., 2006; Dibaldassarre and Montanari, 2009) which is consistent with the loss of water predicted within the 175 m reach of MacDonalds Brook which provides fish access and habitat. As such, this predicted loss is consistent with natural variability of the system and measurability of such a change is not feasible.

Indirect impacts to fish and fish habitat is also possible as a result of water quality changes sourced from upgradient quarrying activities. These effects are the same as those described in Surface Water Effects (Section 9.2.5.2) and include unplanned events and release of deleterious substances, oil spills and erosion and sediment control failure (and associated siltation). In addition, water quality issues associated with the blasting and quarrying practices (i.e. chemical composition of water, increase in dissolved metals etc.) is also a threat to fish and fish habitats. Regarding ARD, samples were collected, and it was determined that they do not hold a potential for ARD (see Section 5.3.3.1). Mitigation and monitoring, as described below, will ensure discharge is within the parameters outlined in the Project IA.

It should be noted that baseline water quality results (Table 5-13) highlights exceedances in some of the CCME FWAL guidelines, notably total aluminum, and on occasion total iron and pH.

9.2.6.3 *Mitigation*

The following mitigation measures will be included in the design of the Project:

- Design and implementation of a surface water management strategy will be completed for the Gillis Lake Quarry. This will include:
    - Design of new and/or updates to existing settling ponds to manage and ensure peak discharge rates from the quarry site are equal to pre-quarry expansion conditions. This will negate the predicted increases in surface flow discharge to Outfalls 1 and 2 (Portage Brook and WC1).
    - Redirection of surface water (through ditching) around the northern extent of the QDA in order to i) reduce discharge flow into the active quarry and downstream aquatic receivers and ii) maintain the natural drainage direction from the off-site wetland to the north of the QDA toward MacDonalds Brook. This will ensure that reduction in surface flow volume to Outfall Location 3 is minimized to the extent possible, subsequently reducing potential fish habitat effects.
    - Design of on-site settling ponds and drainage ditches in consideration of thermal charging of water, to reduce the potential effects of higher water temperatures being discharged into fish habitats.
- Zutphen will implement and update existing erosion and sediment control structures (e.g. sediment fence, rip rap, check dams etc.) as needed to minimize the potential for sediment release into surface water. All erosion and sediment control structures will be regularly inspected and repaired.
- Stockpiles of material with a potential to cause sedimentation issues will be setback from surface water systems and will be stabilized to reduce the likelihood of erosion and sedimentation.
- Potential effects to water quality as a result of blasting will be reduced by using an emulsion compound which is insoluble in water. This will prevent contaminants such as Ammonium Nitrate Fuel Oil entering surface water bodies and groundwater during blasting activities.
- Zutphen will not store fuel on site. Refueling and maintenance of vehicles and equipment will occur in areas 100 m from a watercourse or off-site completely.
- A Project Contingency Plan will be developed for the Project to outline the prevention and response methods regarding spills and/or substance loss.

9.2.6.4 *Monitoring*

- Implement a Surface Water Monitoring Program (including water sample locations from the outflow/downstream environment of the settling pond), to ensure water quality entering the downstream environment meets regulatory requirements and that potential impacts to aquatic life is not occurring. Details of the water quality program will be outlined in a Surface Water Monitoring Program as part of the IA Amendment Application process.
- The Surface Water Monitoring Program will also be designed to evaluate the effects of increased and decreased discharge flows to watercourses and fish and fish habitat discussed in this document.

9.2.6.5 *Residual Effects and Significance*

Should they occur at all, potential effects to fish and fish habitat as a result of water quantity and quality changes will occur over a long period of time concurrent with quarry development (20-25 years). As such, monitoring and associated adjustments to mitigation and Project design (should it be necessary) can occur pre-emptively prior to any significant effects occurring.

As a result, expansion of the Gillis Lake Quarry and alteration to discharge flow to WC1 and Portage Brook is not expected to meet the threshold of triggering a harmful alteration, disruption, or destruction to fish habitat, and the predicted residual environmental effects of the Project on fish and fish habitat are considered not significant after mitigation measures have been implemented. For MacDonalds Brook, a loss of 10.65% discharge flow was predicted. However, this value is consistent with natural variability of a stream system and is not considered a significant indirect effect to fish and fish habitat. The threshold of triggering a harmful alteration, disruption, or destruction to fish habitat in MacDonalds Brook is not expected.

9.2.7 Wetlands

Due to a lack of wetlands within the Study Area, no direct or indirect impacts to wetlands are expected as a result of the Gillis Lake Quarry expansion.

9.2.8 Habitat, Vascular Plants and Lichens

Table 9-8 provides a summary of the potential Project interactions and environmental effects resulting from the Project-VEC Habitat, Vascular Plants and Lichens. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Decommissioning as well as Accidents, Malfunctions, and Unplanned Events). The discussion following the table provides an analysis of key Project-VEC interactions. Interaction and potential effects to Habitat, Vascular Plants and Lichens has been analysed as part of the review.

Table 9-8. Project- VEC Interactions by Project Phase on Habitat, Vascular Plants and Lichens

Project Activities and Physical Works	Potential Project Interactions with Habitat, Vascular Plants and Lichens
Construction	
Site preparation/clearing	X
Grubbing	X
Watercourse/wetland alteration	X
Removal of overburden	X
Waste management	X
Expansion of storage areas for grubbings and overburden soils	X
Operation and Maintenance	
Rock Blasting	X
Rock Transfer	
Sorting and Crushing	
Management of surface water	X
Trucking/Transport of product	
Decommissioning	
Re-grading of rock face	X
Reclamation/re-vegetation	X
Accidents, Malfunctions and Unplanned Events	
Erosion and sediment control failure	X
Fuel spill from machinery/trucks	X
Fire	X

Quarrying has the potential to have an effect on the VEC Habitat, Vascular Plants and Lichens in the following ways:

- Vegetative Composition: The Gillis Lake Quarry expansion will result in direct impacts to vascular and non-vascular individuals and to flora communities. These impacts are specific to upland habitats, as no wetlands are present within the Study Area. Clearing, grubbing and quarrying within the QDA accounts for the most notable impact, whereby the approximate 4.6 ha area of mature hardwood dominated forest will be slowly removed from the landscape as the quarry expands. As discussed in Section 5.4.2, flora communities across the remainder of the Study Area are predominantly comprised of reclaimed areas consisting of poorly drained soils herbaceous species, exotics and species which prefer the standing water conditions which intermittently occur in these areas. A smaller (3.7 ha) area of forested land located adjacent to WC1 exists and intersects the southern half of the Study Area. No direct impacts are expected to flora and habitats outside of the QDA.

Additional indirect impacts to native plant communities include the potential for introduction of invasive species. Seeds and roots of invasive species can be transferred from construction equipment, transportation vehicles, or workers (footwear and clothing) into adjacent habitat during construction and operational activities. Introduction of invasive species can occur when equipment or people enter vascular plant communities, or indirectly via runoff or dust from the roads. Invasive species, such as purple loosestrife (*Lythrum salicaria*), can severely degrade habitat quality and outcompete many native species, particularly along roadsides. No purple loosestrife was noted during field surveys.

Adjacent blasting has the potential to destabilize land surfaces and the root zone of vegetative areas.

Active interim and final reclamation aim to restore floral communities and habitats as the quarry expands and at the point of its closure.

- Contamination: Blasting, crushing, and hauling aggregate may result in deposition of dust on vegetation within close proximity of the QDA, especially when conditions are dry. This affects flora through the deposition of dust on leaves, which temporarily reduces evapotranspiration and photosynthesis. Over time this may reduce overall growth rates.

  Contamination from spills and wastes from materials such as fuels and hydraulic fluids has the potential to migrate into naturally vegetated areas, and impact them negatively through growth inhibition or cessation.

- Priority Species: One SAR and one SOCI lichens; blue felt lichen (*Pectenia plumbea;* SARA & COSEWIC Special Concern; NSESA Vulnerable; ACCDC S3) and tree pelt lichen (*Peltigera collina*) (S2?) respectively were identified within the QDA. No Priority Species vascular flora are present within the QDA. Both of the identified priority lichen species are expected to be lost due to quarry expansion. Aside from these priority species, the vegetation identified within the QDA was determined to be locally and regionally common.

Decommissioning of the quarry will result in a positive effect on the Project, involving the reclamation of land, regrading of the quarry face, and re-establishment of vegetation across the Study Area.

There are no regulatory thresholds to compare to for this VEC; as such, for the purposes of this effect's assessment, potential effects to Habitat, Vascular Plants and Lichens have been done so based on evaluating what is expected to be lost, in comparison with the distribution and abundance of similar species and habitat in the region.

9.2.8.1 *Mitigation*

The following mitigation measures will be included in the design of the Project to minimize effects to Habitat, Vascular Plants and Lichens:

- Grubbings and topsoil will be salvaged and stored for use in site restoration.
- Develop and implement erosion and sediment control plan.
- Regularly inspect and repair erosion and sediment control devices.
- Avoid travel across erosion prone areas.
- Manage vegetation by cutting rather than herbicide use.
- Dust suppressants (e.g. water trucks) will be used when normal precipitation levels are not effective in controlling dust.
- Equipment will be equipped with spill kits and site personnel will be instructed on their use.
- Employ measures to reduce the spread of invasive species (such as cleaning and inspecting vehicles).
- Implement reclamation program to re-establish native vegetation communities.
- A Project Contingency Plan will be developed and will include site specific measures to prevent sedimentation and erosion, dust level management and vegetation management during operations.

9.2.8.2 *Residual Effects and Significance*

Although the above described mitigation measures will be implemented, residual environmental effects of the Project related to Habitat, Vascular Plants and Lichens are expected (i.e. loss of SAR and SOCI lichens, and vegetative communities). However, at a regional level, the losses described are small scale (9.3 ha in QDA) and reclamation will re-introduce habitat in the future; therefore, the predicted residual environmental effects are assessed to be not significant.

9.2.9 Fauna

Table 9-9 provides a summary of the potential Project interactions and environmental effects resulting from the Project-VEC interactions with Fauna. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Decommissioning as well as Accidents, Malfunctions, and Unplanned Events). Interaction and potential effects have been divided into direct mortality to fauna, habitat alteration, and sensory disturbance. The discussion following the table provides an analysis of key Project-VEC interactions.

Table 9-9. Project- VEC Interactions by Project Phase on Fauna

Project Activities and Physical Works	Potential Project Interactions and Environmental Effect		
	Direct Mortality	**Habitat Alteration**	**Sensory Disturbance**
Construction			
Site preparation/clearing	X	X	X
Grubbing	X	X	X
Watercourse/Wetland Alteration	X	X	X
Removal of overburden		X	X
Waste management	X		X
Expansion of storage areas for grubbings and overburden soils		X	X
Operation and Maintenance			
Rock Blasting	X		X
Rock Transfer	X		X
Sorting and Crushing			X
Management of surface water		X	
Trucking/Transport of product	X		X
Decommissioning			
Re-grading of rock face		X	X
Reclamation/re-vegetation		X	X
Accidents, Malfunctions and Unplanned Events			
Erosion and sediment control failure		X	
Fuel spill from machinery/trucks	X	X	
Fire	X	X	X

Quarrying has the potential to have an effect on the VEC Fauna in the following ways:

- Direct Habitat Alteration: The Gillis Lake Quarry expansion development will cause direct impacts to habitat used by terrestrial fauna, which includes the hardwood upland forested habitat present in the QDA. As discussed in Section 5.4.4, low levels of wildlife were identified within the Study Area during field surveys, likely as a result of the current quarry and fragmentation that exists.

  Most effects to fauna are expected during the construction phase which will occur gradually and as the quarry expands (~20-25 years) through grubbing, clearing and eventual blasting of the area. Quarry expansion will result in increased habitat fragmentation and a decrease in habitat quality for fauna. Typically, removal of habitat increases fragmentation and restricts animal movements and connectivity to additional habitats. However, the presence of the existing quarry currently restricts wildlife movement, and the additional area of quarrying within the QDA (9.3 ha) is not expected to exacerbate this effect significantly. Furthermore, the presence of the current quarry, access roads and adjacent clear-cut landscapes indicates that the QDA does not provide valuable interior forest habitat for species that rely on it (i.e. fisher), therefore, effect to this habitat and types of species is not expected. The habitat present in the QDA is common to the regional area and alternate habitat for wildlife exists on adjacent undeveloped lands, therefore, QDA level changes in abundance and distribution could be expected, but overall fauna population changes is not expected as a result of the quarry expansion.

As discussed in Section 5.4.4, the Study Area is located within the southern extent of the Cape Breton Lynx Range (NSDNR, 2012b). Potential for this species to utilize habitat within the QDA is discussed further in Section 9.2.11.

Decommissioning of the quarry will result in a positive effect on the Project, involving the reclamation of land, regrading of the quarry face, and re-establishment of vegetation across the Study Area.

- Sensory Disturbances: Sensory disturbance to fauna is expected to occur throughout all Project phases and would result from activities such as rock blasting, clearing and grubbing, and the sorting and crushing of aggregate. This will likely result in the localized wildlife avoidance of the Study Area. Overall, Project activities will likely cause a change in usage of the QDA by wildlife, however, as discussed above, the existing quarry likely already deters wildlife. Some species may tend to avoid the area, while others may be attracted to the increased activity, including opportunistic species such as Eastern Coyote, Northern Raccoon, Striped Skunk, or American Black Bear (*Ursus americanus*).

  Noise is the type of sensory disturbance that is most likely to affect fauna within the Study Area. Although the auditory capabilities of fauna species vary (Shannon *et al*., 2016) and fauna behavior in response to noise is largely related to perceived threats not noise intensity (Bowles, 1995) changes to ambient noise levels and the presence of periodic vibrations from blasting have the potential to adversely affect fauna. Noise can affect behavioral patterns (Patthey *et al*., 2008), stress fauna (Knight and Swaddle, 2011), cause avoidance behavior (Ware *et al*., 2015), and reduce the ability for communication and hunting success (Barber *et al*., 2009). Combined, these effects can negatively impact the overall population health of a particular species (Ware *et al*., 2015). Blasting will not occur in close proximity to any fish bearing streams, therefore potential impacts to fish populations are not expected as a result of noise.

  Light is another sensory disturbance that can impact fauna by potentially causing disorientation or by causing attraction or avoidance behaviour (Longcore and Rich, 2004). In turn, these behavioral changes can affect the success of foraging, reproduction, and communication of wildlife (Longcore and Rich, 2004) and can disrupt habitat connectivity (Bliss-Ketchum *et al*., 2016). The current quarry comprises one spotlight (located at the scale house) which remains on during the night for safety purposes. This will remain the only source of light throughout the proposed expansion of the quarry.

- Direct Mortality: Direct mortality of fauna species could result from Project activities, particularly from wildlife vehicle collisions. There is no expected increase in traffic as a result of quarry expansion, therefore, wildlife vehicle collisions remain unlikely. The risk of collisions with wildlife will vary depending on the season and the species. For instance, during winters with deep snow conditions, white-tailed deer are more likely to use roads and trails, putting them at an elevated risk of collisions. During spring and summer, porcupine and skunk forage on roadside vegetation at dawn and dusk, increasing the risk of collisions with those species, and turtles are drawn to the roadside to nest in the gravelly shoulders in June. As such, the risk of wildlife collisions is present at any time of year.

  Accidents such as fuel spills have the potential to cause indirect mortality to fauna due to exposure of contaminants.

9.2.9.1 *Mitigation*

The following mitigation measures will be included in the design of the Project to minimize effects to Fauna:

- Implementation of wildlife best management practices.
- Provide wildlife awareness training to site personnel.
- Quarry staff will be made aware of wildlife potential on roads especially for Project traffic.
- Install signage where specific wildlife concerns have been identified.
- Follow Pit and Quarry Guidelines to reduce impact of noise and vibration on wildlife.
- Limit the use of lighting to the current spotlight located at the scale house and shine it downward to reduce attraction to birds.
- Grubbings and topsoil will be salvaged and stored for use in site restoration.
- Implement erosion and sediment control plan.
- Regularly inspect and repair erosion and sediment control devices.
- Dust suppressants (e.g. water trucks) will be used when normal precipitation levels are not effective in controlling dust.
- Equipment will be equipped with spill kits and site personnel will be instructed on their use.
- Implement reclamation program to re-establish habitat to support fauna habitat.
- Waste management to reduce attractants to opportunistic wildlife species.
- Vegetation management will be conducted by cutting (i.e., no use of herbicides).

- A Project Contingency Plan will be developed and will include site specific best management practices and mitigation methods associated with vegetation removal, dust suppression, progressive reclamation and re-vegetation of the quarry and a Wildlife Management Plan. The Project Contingency Plan will include methods by which the Project can take place while minimizing interactions with wildlife.

9.2.9.2 *Residual Effect and Significance*

Effects to fauna and a result of expanding the Gillis Lake Quarry is limited due to the presence of the current quarry, and the limited habitat disturbance associated with the QDA (9.13 ha) proposed over the next ~25 years. The above described mitigation measures will be implemented to reduce potential effects, therefore, residual environmental effects of the Project related to fauna is predicted to be not significant.

9.2.10 Avifauna

Table 9-10 provides a summary of the potential environmental effects resulting from the Project-VEC interactions with birds. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Decommissioning as well as Accidents, Malfunctions, and Unplanned Events). Interaction and potential effects have been divided into direct mortality of birds, alteration to habitat, and sensory disturbance. The discussion following the table provides an analysis of key Project-VEC interactions.

Table 9-10. Project- VEC Interactions by Project Phase on Birds

Project Activities and Physical Works	Potential Project Interactions and Environmental Effect		
	Direct Mortality	**Habitat Alteration**	**Sensory Disturbance**
Construction			
Site preparation/clearing	X	X	X
Grubbing	X	X	X
Watercourse/Wetland Alteration		X	X
Removal of overburden	X	X	X
Waste management	X		X
Expansion of storage areas for grubbings and overburden soils	X	X	X
Operation and Maintenance			
Rock Blasting	X		X
Rock Transfer	X		X
Sorting and Crushing			X
Management of surface water		X	
Trucking/Transport of product	X		X
Decommissioning			
Re-grading of rock face		X	X

Project Activities and Physical Works	Potential Project Interactions and Environmental Effect		
	Direct Mortality	Habitat Alteration	Sensory Disturbance
Reclamation/re-vegetation		X	X
Accidents, Malfunctions and Unplanned Events			
Erosion and sediment control failure		X	
Fuel spill from machinery/trucks	X	X	
Fire	X	X	X

Quarrying has the potential to have an effect on the VEC Birds in the following ways:

- Direct Habitat Alteration: The Gillis Lake Quarry expansion will cause direct impacts to bird habitat within the QDA. Similar to the discussion for fauna (Section 9.2.9) habitat will be eliminated gradually over the expansion timeframe. Clearing and grubbing for site preparation will remove vegetation, reducing the quantity of avifauna habitat, and will affect the quality of hardwood forested habitat that currently exists on the QDA. The Project will result in an increase in edge area which could increase predation on birds, but also has potential benefits related to habitat creation (edge nesting birds), and food availability (near edge and ditches).

  Habitat fragmentation can adversely affect local populations of avifauna living adjacent to the Study Area. However, due to the small area of quarry expansion (9.3 ha), and the current level of disturbance from the existing quarry, impacts as a result of fragmentation would be low. Furthermore, the QDA does not comprise interior forest habitat or any Old Forest polygons which means that species relying on these types of habitat will not be adversely affected. No areas of wetland habitat are present in the QDA meaning that effects to species that prefer wetlands will also be limited (i.e. Canada warbler, rusty blackbird).

  Bird species that currently use the habitat within the QDA will be displaced during the initial stages of construction. This could potentially cause direct mortality of species if individuals are unable to relocate to alternate suitable habitat. However, as previously noted, there are areas of suitable nesting habitat in adjacent lands and the regional area in general.

  Construction, in particular site preparation, during the breeding season for birds has the potential to cause direct mortality, abandonment of nests, the destruction of nest contents, which could include species designated as SAR or SOCI (see Section 9.2.11). However, adjacent suitable habitat is available, which indicates that birds which have been displaced will utilize it, instead of the habitat present in the QDA. The environmental effects of clearing and grubbing are most severe when these activities are conducted during the period when most bird species are breeding

(May to end of August). Clearing and grubbing at this time could result in the direct mortality of eggs and unfledged nestlings. The killing of birds or the destruction of their nests, eggs, or young is an offence under the Migratory Birds Convention Act. The construction phase (i.e. clearing, grubbing, vegetation removal) of the Project will be planned to take place outside of the nesting season for most birds (May-August), where practicable. If this is not possible, pre-nest surveys will be completed to prevent disturbance to nesting birds. Similarly, stockpiles of soil within the quarry area can attract the nesting of some birds (i.e. Bank Swallows). Utilization of nesting birds within stockpiles typically occurs until chicks can fly.

Decommissioning of the quarry will result in a positive effect for birds, involving the reclamation of land, regrading of the quarry face, and re-establishment of vegetation across the Study Area.

- Sensory Disturbances: Sensory disturbance to birds is expected to occur throughout all Project phases and would result from activities such as rock blasting, clearing and grubbing, and the sorting and crushing of aggregate. Overall, Project activities will likely cause a change in usage of the QDA by birds, with some species tending to avoid the area, while others may be attracted to the increased activity. It is likely however that current quarry operations are deterring bird use of the QDA, especially in habitat adjacent to the active quarry faces.

  Ambient noise will continue to deter bird use of the area, especially blasting activities which can influence breeding and migratory patterns. Operation of equipment including crushers, excavators and haul trucks would contribute to the potential effects, although where quarry production is not planned to increase from current rates, these effects are unlikely to increase bird displacement significantly.

  Light is another sensory disturbance that can impact birds by potentially causing disorientation or by causing attraction or avoidance behaviour (Longcore and Rich, 2004). In turn, these behavioral changes can affect the success of foraging, reproduction, and communication of wildlife (Longcore and Rich, 2004) and can disrupt habitat connectivity (Bliss-Ketchum *et al*., 2016). The current and future quarry expansion area does not comprise quarry lighting apart from the one spotlight (located at the scale house) which remains on during the night for safety purposes. This will remain the only source of light throughout the proposed expansion of the quarry.

- Direct Mortality: Direct mortality of birds is possible at the quarry as a result from Project activities, particularly from wildlife vehicle collisions. There is no expected increase in traffic as a result of quarry expansion, therefore, bird vehicle collisions remain unlikely.

  There is potential that birds can be affected through exposure to poor surface water quality as a result of quarry operations (i.e. accidents such as fuel spills or other quarry derived contaminants).

9.2.10.1 *Mitigation*

The following mitigation measures will be included in the design of the Project to minimize effects to Birds:

- Avoid construction/disturbances on native vegetation during the breeding bird season for migratory birds, where practicable.
- Discourage ground-nesting species (e.g. Common Nighthawk, Bank Swallow) by limiting large piles or patches of bare soil during the breeding season, where practicable.
- Should any ground- or burrow-nesting species initiate breeding activities within stockpiles or exposed areas, the Proponent will avoid disturbance to these areas until chicks can fly and the nesting areas are no longer being utilized.
- Implement dust suppressants (e.g. water trucks) when normal precipitation levels are not effective in controlling dust.
- Limit lighting to the one spotlight at the weigh scale, where practicable.
- Install downward-facing lights on site infrastructure to reduce attraction to birds.
- Implement wildlife best management plans.
- Provide wildlife awareness training to site personnel.
- Vehicles will yield to wildlife on roads.
- Install signage where specific wildlife concerns have been identified.
- Follow Pit and Quarry Guidelines to reduce impact of noise and vibration on birds.
- Grubbings and topsoil will be salvaged and stored for use in site restoration.
- Implement erosion and sediment control plan.
- Regularly inspect and repair erosion and sediment control devices.
- Equipment will be equipped with spill kits and site personnel will be instructed on their use.
- Implement reclamation program to re-establish habitat to support reintroduction of birds post quarry life.
- Should site activities during active nesting periods be unavoidable, additional mitigative measures such as pre-disturbance nest searches and avoidance and setbacks from active nests will be applied. These will be developed in consultation with Environment and Climate Change Canada (ECC).

- Clearing of vegetation associated with quarrying will be limited to areas where quarrying is imminent (i.e. within the next two years) in order to maintain intact habitat elsewhere across the unquarried portions of the QDA.

9.2.10.2 *Residual Effect and Significance*

Effects to birds and a result of expanding the Gillis Lake Quarry is limited due to the presence of the current quarry, and the limited habitat disturbance within the QDA (9.13 ha) proposed over the next ~20-25 years. The above described mitigation measures will be also be implemented to reduce potential effects, including adherence to the Migratory Birds Convention Act. Therefore, residual environmental effects of the Project related to birds is predicted to be not significant.

9.2.11 Species of Conservation Interest and Species at Risk

The following SAR/SOCI (and/or their habitat) were identified within the QDA:

- One SAR lichen (blue felt lichen *[Pectenia plumbea])* and one SOCI lichen (tree pelt lichen [*Peltigera collina])* exist within the QDA. Three locations and 8 blue felt lichen thalli were observed in the QDA, and four locations and 28 tree pelt thalli were observed within the Study Area (three locations in QDA).
- No priority herpetofauna species, nor their potential habitat were observed within the QDA.
- No priority mammals were observed, but the QDA is located in the Cape Breton Lynx Range (habitat provision discussed below).
- Four SOCI birds were identified within the QDA as follows:
  - red-breasted merganser (S3S4B, S5N) during breeding season;
  - ruby-crowned kinglet (S3S4B) during spring and breeding bird seasons;
  - killdeer (S3B) during spring and breeding bird seasons; and,
  - yellow-bellied flycatcher (S3S4B) were observed during the breeding bird season.
- No priority invertebrates were observed; and
- Although not within the QDA, brook trout, a SOCI, (ACCDC S3) was captured during fishing surveys within WC1, MacDonalds Brook and Portage Brook. These watercourses receive surface water from the QDA and are therefore potentially affected by upstream quarry expansion. Potential access for Atlantic salmon (ACCDC S1), American eel (S2), brook trout (S3) and alewife (ACCDC S3) is provided within WC1, and its associated tributaries.

A number of SOCI flora species were also identified within the Study Area in the southern former (and reclaimed) quarry. For the purposes of this effect's assessment, SAR/SOCI located beyond the QDA are not discussed as they are not expected to be impacted by the quarry expansion.

Potential effects to SAR and SOCI are similar to those discussed for habitat and flora (Section 9.2.8), fauna (Section 9.2.9) and birds (Section 9.2.10) including:

- Sensory disturbance resulting in area avoidance or behaviour changes; and,
- Alteration or loss of habitat/habitat fragmentation.

Table 9-11 provides a summary of the potential environmental effects resulting from the Project-VEC interactions on SOCI and SAR. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Decommissioning as well as Accidents, Malfunctions, and Unplanned Events). Interaction and potential effects have been divided into direct mortality, alteration to habitat and sensory disturbance. The discussion following the table provides an analysis of key Project-VEC interactions.

Table 9-11. Project- VEC Interactions by Project Phase on Potential SAR/SOCI

Project Activities and Physical Works	Potential Project Interactions and Environmental Effect		
	Direct Mortality	Habitat Alteration	Sensory Disturbance
Construction			
Site preparation/clearing	X	X	X
Grubbing	X	X	X
Watercourse Alteration	X	X	X
Removal of overburden		X	X
Waste management	X	X	X
Expansion of storage areas for grubbings and overburden soils		X	X
Operation and Maintenance			
Rock Blasting	X		X
Rock Transfer	X		X
Sorting and Crushing			X
Management of surface water	X	X	
Trucking/Transport of product	X		X
Decommissioning			
Re-grading of rock face		X	X
Reclamation/re-vegetation		X	X
Accidents, Malfunctions and Unplanned Events			
Erosion and sediment control failure		X	
Fuel spill from machinery/trucks	X	X	
Fire	X	X	X

Potential effects to SAR/SOCI are consistent with those discussed for habitat and flora, fauna and birds.

The SOCI species identified within the QDA during field evaluations are dominated by birds (4 species). Suitable habitat for these species was identified within the Study Area, as well as within surrounding lands and the region in general.

Multiple occurrences of the one species of SAR lichen (blue felt lichen) and one occurrence of SOCI lichen (tree pelt lichen) were observed within the QDA. It is anticipated that quarry development will cause the direct removal/destruction of all individuals.

As discussed in Section 5.6, the QDA is located within the Cape Breton Lynx Range, however, ideal habitat, nor ideal land elevation for Canada lynx are present within the QDA. The QDA is characterized by current and historically disturbed areas adjacent to the current quarry area and rich, tolerant, mature hardwood forest to the north. This forest description is not ideal for either key prey species: it is not conifer dominated nor mixed-wood. Additionally, its proximity to the present quarry likely acts as a deterrent to current Canada lynx use of the area. Lastly, researchers have noted the association of lynx to elevations between 250-500 m ASL (Parker, 2001); the QDA has an approximate elevation of 122 m ASL, putting it well below the ideal range. Optimal habitats for lynx do not exist within the Study Area. Therefore, expansion of the Gillis Lake Quarry is not expected to impact the Canada lynx, nor its habitat. As is the same for all wildlife species (See Section 9.2.9), sensory disturbance is possible to the Canada lynx (throughout the lifetime of the Project.

No unique habitat was identified within the Study Area for mammalian and herpetofauna SAR and SOCI that have been observed in the local region, and alternate habitat resource for these species is available during the construction and operational phase of this Project in surrounding areas.

Progressive decommissioning of the quarried areas will result in a positive effect on the habitat available for SAR/SOCI, involving the re-grading of the rock face, reclamation of land and vegetation across the Study Area, and reduction in overall habitat fragmentation associated with the Project.

Fire events, fuel losses, or erosion/sediment control failure during any phase of the Project could remove/destroy/flood significant amounts of vegetation, thereby having an environmental effect on habitat for wildlife including SAR and SOCI and potentially result in their displacement or mortality.

9.2.11.1 *Mitigation*

Mitigation of effects to SAR/SOCI are consistent with habitat and flora, fauna and birds (Sections 9.2.8, 9.2.9, and 9.2.10). The Project Contingency Plan (and associated Wildlife Management Plan) will raise awareness of the specific SAR/SOCI identified and potential SAR that could be present to site personnel and provide recommendations for protective measures to be in place.

9.2.11.2 *Residual Effects and Significance*

Due to the presence of blue felt lichen (a SAR), a tree pelt lichen (SOCI) and four SOCI birds within the QDA, residual effects as a result of the Gillis Lake Quarry expansion are expected. However, on a regional scale, the physical loss of these species, and the likely displacement of SOCI birds to alternate available habitat are small scale, therefore, after mitigation measures have been implemented, the predicted residual environmental effects are assessed to be not significant.

9.2.12 Archaeological and Heritage Resources

Due to a low potential for archaeological resources, of either First Nations or European-descended origin within the Study Area, no direct or indirect impacts to Archaeological and Heritage Resources are expected as a result of the Gillis Lake Quarry expansion.

10 CONCLUSIONS

Zutphen Resources Inc. (Zutphen) currently owns and operates the Gillis Lake Quarry, operating under the Nova Scotia Environment (NSE) Industrial Approval (NSE Approval #2010-075178-01). The quarry which extends across two properties (PID's 15212947 and 15853146) was originally owned by Malcolm S. MacDonald Company who also utilized it for quarrying activity prior to Zutphen's ownership. Zutphen purchased the properties from Malcolm S. MacDonald Company in 2013 and have been continuing quarry activities in northern portions of PID 15853146 since this time.

Historical quarrying by Malcolm S. MacDonald Company occurred in the southern portion of PID 15212947 adjacent to Coxheath Road, and extended northwest. Restoration of the former quarry in PID 15212947 was completed by Malcolm S. MacDonald Company including stabilization of sidewalls and spoil piles, and integration of water management ponds and ditches prior to purchase by Zutphen.

Zutphen plans to expand the quarry beyond the current 4 ha area within the northern extent of both properties. This activity requires a Provincial EA registration (Class I undertaking). The purpose of the proposed quarry expansion is to continue to have quarry reserves available to serve the local market.

Expansion of the Gillis Lake Quarry is required to access desirable aggregate in the future. There are no anticipated changes to the current operations within the quarry including the amount and frequency of blasting, quarry hours of operation, and number and frequency of haul trucks collecting aggregate from the site.

The EA planning process allows for the prediction of environmental effects of a proposed Project and identifies measures to minimize and then mitigate potential adverse environmental effects. The EA predicts significant residual adverse environmental effects once mitigation measures are implemented.

The EA focusses on specific environmental components called valued environmental components (VECs). VECs are specific components of the biophysical, socioeconomic, human health, and cultural environments. As part of this EA, an evaluation of potential VEC interactions with Project activities was completed to identify environmental effects (if any), for each VEC; and identification of thresholds to determine the significance of residual environmental effects.

Baseline field evaluations were completed for each biophysical VEC's listed below over the course of a four-season survey period.

- Surface water;
- Fish and fish habitat;
- Wetlands;
- Habitat, vascular plants, and lichens;
- Fauna (herpetofauna and mammals);

- Avifauna; and
- Species of Conservation Interest (SOCI) and Species at Risk (SAR).

Additional baseline information was obtained in support evaluating the following physical VEC's:

- Noise;
- Air quality;
- Topography, surficial and bedrock geology;
- Groundwater; and
- Archaeological and Heritage Resources.

Evaluation of the above VEC's was completed within the Project Study Area (i.e. the Zutphen owned properties which the Gillis Lake Quarry is situated), and the Quarry Development Area (QDA). The QDA refers to the proposed expansion area of the quarry.

Surface Water and Fish Habitat

Surface water on site is currently directed southeastward through the Study Area through a series of drainage ditches and settling ponds which initiate in the current quarry area, and drain through the former Malcolm S. MacDonald quarry into a settling pond system alongside Coxheath Road (in the former quarry area). Water drains from the settling pond adjacent to Coxheath Road via a culvert into the receiving watercourse; Portage Brook south of the Study Area. As quarry expansion progresses, surface water will continue to be directed through existing ditches and settling ponds. Modifications to water management infrastructure will be made throughout the lifetime of the Project as necessary.

Five watercourses were identified within the Study Area (WC1 – WC5) as well as two off-site watercourses (Portage Brook to the south of the quarry, and MacDonalds Brook to the east of the quarry). WC4 and WC5 exist within the Quarry Development Area (QDA) and drain water to MacDonalds Brook, while WC's 1, 2 and 3 are located in central portions of the Study Area. WC1 intercepts water sourced from up gradient quarry activities via ditching and settling ponds, which subsequently drains into Portage Brook adjacent to Coxheath Road. Portage Brook and MacDonalds Brook act as the down-stream receiving watercourses from the Study Area, and were assessed within a Fish Habitat Assessment Area defined for the EA. The following general characteristics for identified watercourses are presented:

- WC1 originates as an accumulation of drainage from roadside ditching and natural, overland surface flow that channelizes about midway up the Study Area along the current quarry access road. There were two barriers to fish passage documented on WC1, however, multiple brook trout were captured during field studies above and below the barriers. As such, fish upstream of the barrier are believed to be resident (stranded) fish. WC1 is connected to Portage Brook via a culvert beneath Coxheath Road.
- WC2 and WC3 are both short and intermittent, high gradient streams that form in forested upland habitat north of WC1 as groundwater seepage. Fish habitat within both streams is limited by seasonal dryness, channel gradient, and high velocities.

- WC4 is a first-order, intermittent stream that originates from pockets of standing water along an offsite wetland north of the QDA. Initially, WC4 drains through the QDA as a channelized feature prior to becoming unchannelized and lacking any surface water flow (observed during high and low flow conditions). Due to these conditions, and a permanent barrier to fish passage located downstream on MacDonalds Brook, WC4 does not provide direct fish habitat.
- WC5 is a short, ephemeral watercourse that develops at the eastern extent of the QDA. The channel disappears entirely into upland forest approximately 10 m south of MacDonalds Brook. Due to these conditions, and a permanent barrier to fish passage located downstream on MacDonalds Brook, WC5 does not provide direct fish habitat.
- MacDonalds Brook is thought to originate from a wetland complex approximately 1 km north of the Study Area and drains southeast, eventually discharging into Portage Brook upstream of Blacketts Lake. A permanent barrier to fish passage (waterfall) exists on MacDonalds Brook downgradient (east) of the QDA. Brook trout were captured downgradient of the fish barrier; however, no fish were captured upstream of it. MacDonalds Brook is partially sourced water from the QDA via WC4 and WC5, as well as surface water run-off.
- Portage Brook is thought to originate in an open water wetland complex approximately 1 km west of the Study Area which is fed by two NSTDB mapped headwater streams. Portage Brook receives water from WC1, as well as MacDonalds Brook and drains water into Blackett's Lake located approximately 4.6 km east of the Study Area. Brook trout were captured in Portage Brook during field studies.

Two watercourses (WC4 and WC5) identified within the QDA will be directly impacted by future quarry development. Apart from American eel (*Anguilla rostrate,* COSEWIC Threatened; S2), which can effectively navigate fish barriers, neither watercourse provides access for fish. Fish habitat provision within WC1, MacDonalds Brook and Portage Brook have been evaluated as part of this EA, and habitat is present for various fish species that are likely to occur in the area (based on their contiguity with Blacketts Lake). As well as the observed brook trout, potential species include alewife (*Alosa pseudoharengus,* S3), American eel, brown bullhead (*Ameiurus nebulosus*), white sucker (*Catostomus commersonii*), white perch (*Morone americana*), chain pickerel (*Esox niger*) and smallmouth bass *(Micropterus dolomieu)*.

Surface water quantity to receiving aquatic receptors (watercourses) is expected to be affected by the proposed activity as a result of quarry expansion and site water management. A Water Balance was completed as part of the EA process to predict potential changes in discharge flow to downstream surface water features. During operations, two quarry floor infiltration scenarios were modelled as part of the analysis: existing infiltration (most likely infiltration) and 100% impervious. The analysis concluded that there will be surface water volume changes are predicted to WC1 (an increase in surface water volume), Portage Brook (an increase in surface water volume) and MacDonalds Brook (a decrease in surface water volume). Based on the range of resulting predicted changes, and upon implementation of the proposed mitigation discussed in this document, significant residual effects are not expected to fish and or the watercourses themselves (physical adjustment).

Wetlands

No wetlands exist within the Study Area. Therefore, the Project is not expected to have any direct, or indirect effects to wetland habitat or function.

Habitat

Habitat across the Study Area has been largely disturbed through historical quarrying. Remaining forested habitat within the Study Area comprises mature tolerant hardwood and mixedwood forests types in the central and northern regions of the Study Area. The southern portion of the Study Area comprises of historical quarry activities and are 'reclaimed' consisting of poorly drained soils with admixing and a vegetation community reflective of a disturbance. Expansion of the Gillis Lake Quarry will directly disturb 4.6 ha of hardwood forested habitat within the QDA as the quarry expands over its 20-25 year operational life.

Flora

A total of 190 flora species were identified within the Study Area. Three SOCI were observed, variegated horsetail (*Equisteum variegatum*; S3), marsh mermaidweed (*Proserpinaca plaustris var. creba*; S3) and Loesel's twayblade (*Liparis loeselii*; S3S4). These species were identified outside of the QDA in the former (reclaimed) quarry. Thirty-four (34) lichen species were observed in the Study Area. One species was determined to be a SAR: blue felt lichen (*Pectenia plumbea;* SARA & COSEWIC Special Concern; NSESA Vulnerable; ACCDC S3) and one species was determined to be a SOCI: tree pelt lichen (*Peltigera collina;* S2?). Both species (comprising multiple individuals each) were identified within the QDA and will therefore be lost as a result of quarry expansion. At a regional level, the habitat and flora losses expected in the QDA are small, and reclamation of the quarry will re-introduce habitat in the future; therefore, the predicted residual environmental effects are assessed to be not significant.

Fauna

Wildlife surveys found signs of Eastern coyote (*Canis latrans*), snowshoe hare (*Lepus americanus*), short-tailed weasel (*Mustela ermina*), white tailed deer (*Odocoileus virginianus*), American red squirrel (*Tamiasciursus hudsonicus*), and white-footed deermouse (*Peromyscus leucopus*). No SAR/SOCI fauna (including wood turtle or snapping turtle) were observed on within the Study Area. The QDA is located in the Cape Breton Lynx Range. Canada lynx (NSESA Endangered; ACCDC S1) is considered a SAR and the ACCDC report have outlined 196 recordings of Canada lynx within 10.0 ± 0.0 km of the Study Area. However, habitat evaluation within the QDA has determined that the habitat present is not ideal for either key prey species of the lynx. In addition, the QDA is well below the ideal range for Canada lynx (250-500 masl). This, together with the presence of the adjacent active quarry is expected to act as a deterrent to current Canada lynx use of the area and as such, the Canada lynx, nor its habitat is expected to be affected by the Project.

Avifauna

Bird surveys completed during spring, breeding and fall identified 53 species of birds utilizing on-site habitat. Across all survey seasons, a total of 14 Priority Species (two SAR and twelve SOCI) were observed. The SAR observed included one common nighthawk (*Chordeiles minor)*, and seven evening grosbeak (*Coccothraustes vespertinus).* Habitat is present for all birds observed during surveys within the Study Area. Physical loss of bird habitat within the QDA, and the likely displacement of birds as a result of quarry development are small scale and not expected to impact birds on a regional scale. Therefore, after mitigation measures discussed in this document have been implemented, the predicted residual environmental effects are assessed to be not significant.

Noise

Noise is currently regulated at the Gillis Lake Quarry under the Nova Scotia Pit and Quarry Guidelines. As per this guideline, noise thresholds are required to be met at the property boundary of the quarry, as well as within 7 m of the nearest residential structures during blasting events. To date there have been no instances of official noise complaints originating from the quarry. Future quarry operations and methods are proposed to remain consistent with current operations, therefore noise levels are also expected to remain consistent. Information passed on to Zutphen from some local residents indicated that a blast was heard in 2019, and that truck traffic can be noisy at times on the Coxheath and Gillis Lake Roads. Zutphen have made commitments within this document to minimize the potential effects of noise as a result of the Project. After these commitments and mitigation measures are implemented, and the Nova Scotia Pit and Quarry Guidelines are adhered to, the predicted residual environmental effects for noise are assessed to be not significant.

Air Quality

Air quality (dust) is currently regulated at the Gillis Lake Quarry under the Nova Scotia Pit and Quarry Guidelines. As per this guideline, particulate emission limits are required to be met at the Project property boundaries. Future quarry operations and methods are proposed to remain consistent with current operations, therefore air particulate (dust) levels are also expected to remain consistent. Although no known complaints or air particulate exceedances have been recorded to date in association with quarrying activities, local residents have communicated to Zutphen dust issues associated with trucks travelling along the Coxheath and Gillis Lake Road. Although dust created along these roads is outside the scope of the Project (i.e. the quarry activity), Zutphen have made commitments within this document to minimize the potential effects of dust as a result of trucks visiting the quarry. After these commitments and mitigation measures are implemented, and the Nova Scotia Pit and Quarry Guidelines are adhered to, the predicted residual environmental effects for air quality are assessed to be not significant.

Surficial and Bedrock Geology

The surficial geology of the Study Area consists of three different geologic units: bedrock in the north, stony till plain in the centre, and silty till plain in the south. The Study Area overlies Coxheath Hills Group in the west and the Neoproterzoic Granodiorite Group in the east. Disturbances to surficial and bedrock geology have the potential to effect surface water quality through destabilization of soils (erosion and sedimentation), mineralisation of rock (including Acid Rock Drainage) and changes in surface water volume discharged downstream. Acid Rock Drainage (ARD) testing was completed and it was determined that there is negligible potential for ARD based on low sulphur concentrations. Water quality is currently regulated at the Gillis Lake Quarry under the Nova Scotia Pit and Quarry Guidelines. As per this guideline, Total Suspended Solids (TSS) and pH levels are required to be met in surface water discharging from the Project. An on-going commitment to adhering to these guidelines, as well as implementing the mitigation methods discussed in this document will ensure environmental effects for water quality are not significant.

Groundwater

In relation to potential effects to groundwater quality and quantity, a desktop review for adjacent water wells was conducted. Based on a review of the NS Well Logs Database and field confirmation, the closest known residential well is approximately 815 m away from the QDA. Groundwater is currently regulated at the Gillis Lake Quarry under the Industrial Approval (IA) Conditions and will continue to be so as the quarry expands. To date there have been no known issues with neighbouring groundwater wells as a result of quarrying activity, and since quarry operations and methods are not planned to change, the expectation is that this will remain consistent in the future. Zutphen are committed to ensuring blasting activities are monitored as per IA conditions, as well as notifying residents prior to planned blasts.

To date, the Gillis Lake Quarry has not been observed to interact with the groundwater table (no observed seepages through the exposed rock face of build up of water on the quarry floor) and the intention is to remain above groundwater throughout the expansion process. A groundwater monitoring program adhering to NSE requirements will be implemented to gain an understanding of potential groundwater interactions throughout the life of the quarry. Implementation of these commitments, along with other mitigation and monitoring discussed in this document will ensure residual environmental effects to groundwater (and adjacent wells) is not significant.

Archeological and Heritage Resources

No significant archaeological features were identified within the Study Area during the field reconnaissance study. The Study Area was determined to be of low potential for archeological resources of either First Nations or European-descended origin and therefore, no direct or indirect impacts to archaeological or heritage resources are expected as a result of the Gillis Lake Quarry expansion.

Summary

The Project will allow for continued employment at the quarry, as well as in related industries where the aggregate material is used (e.g. construction, hauling). Therefore, the Gillis Lake Quarry will continue to support the local economy.

The field data, regulatory consultation, and subsequent conclusions of this assessment indicate that there are no significant environmental concerns and no significant impacts expected that cannot be effectively mitigated through well established and acceptable practices, or ongoing monitoring and response. Residual environmental effects have been determined to be not significant for all identified VECs.

11 LIMITATIONS

Constraints Analysis

- On some maps, land use or land cover is defined everywhere to form a complete mosaic of polygons. On topographic maps landuse/landcover is depicted only in certain areas. The source data in some cases may need to be conditioned to allow the second type of depiction if it is a mosaic, and certain constraints will operate differently in each case, and,
- Conflicts that might exist between objects in a database are typically of a logical nature, such as topological inconsistencies or duplicate identifiers. We attempted to ensure that our database has addressed any potential inconsistencies, however inconsistencies may still occur. In map generalization, the vast majority of conflicts are physical, spatial consequences of reducing map scale. The greater the degree of scale change, the more cluttered an un-generalized map will be, and this signals the extents of potential conflicts in presentation of the data.

Limitations incurred at the time of the assessment include:

- McCallum Environmental Ltd. has relied in good faith upon the evaluation and conclusions in all third-party assessments. MEL relies upon these representations and information provided but can make no warranty as to accuracy of information provided;
- There are a potentially infinite number of methods in which human activity can influence wildlife behaviors and populations and merely demonstrating that one factor is not operative does not negate the influence of the remainder of possible factors;
- The EA provides an inventory based on acceptable industry methodologies. A single assessment may not define the absolute status of site conditions;
- Effects of impacts separated in time and space that may affect the areas in question, have not been included in this assessment; and
- Limitations associated with the seasonality of Habitat Surveys are described in Section 4.1

General Limitations incurred include:

- Classification and identification of soils, vegetation, wildlife, and general environmental characteristics (*i.e.,* vegetation concentrations, and wildlife usage) have been based upon commonly accepted practices in environmental consulting. Classification and identification of these factors are judgmental and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may not identify all factors; and
- All reasonable assessment programs will involve an inherent risk that some conditions will not be detected and all reports summarizing such investigations will be based on assumptions of what characteristics may exist between the sample points.

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13 CERTIFICATION

This Report has considered relevant factors and influences pertinent within the scope of the assessment and has completed and provided relevant information in accordance with the methodologies described.

The undersigned has considered relevant factors and influences pertinent within the scope of the assessment and written, combined, and referenced the report accordingly.

Andy Walter, B.Sc.
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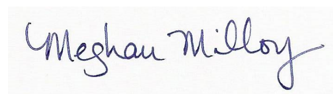

Meghan Milloy
Vice President
McCallum Environmental Ltd.

APPENDIX A. FIGURES

APPENDIX B. PROJECTTEAM MEMBERS' CVS

APPENDIX C. PRIORITY SPECIES, ACCDC, MBBA AND NSCCH REPORT

APPENDIX D. VEGETATION LIST

APPENDIX E. WATER BALANCE

APPENDIX F. WATER QUALITY RESULTS

APPENDIX G: ARCHAEOLOGICAL REPORT

APPENDIX H: ENGAGEMENT DOCUMENTATION

APPENDIX I: PHOTOLOGS

APPENDIX J: ACID ROCK DRAINAGE (ARD) REPORT