REPORT

Environmental Assessment Registration Document

Scotian Materials Limited Goffs Quarry

Submitted to:

Nova Scotia Environment - Environmental Assessment Branch
1903 Barrington Street, Suite 2085
Halifax, Nova Scotia
B3J 2P8

Submitted by:

Golder Associates Ltd.
201 Brownlow Avenue, Suite 26
Dartmouth, Nova Scotia,
B3B 1W2

+1 902 466 1668

1777778

July 2018

Distribution List

1 e-copy - Nova Scotia Environment - Environmental Assessment Branch

1 e-copy - Golder

Executive Summary

Scotian Materials Limited (Scotian) is proposing to undertake an expansion of the existing 3.99 ha aggregate quarry located in Goffs, Nova Scotia (NS) (herein referred to as the Project). The total area of the proposed Project is 41 ha. The scope of the Project includes the construction, operation, decommissioning and reclamation of the expanded quarry. The quarry will be developed in four phases and depending on market demand, operation of the quarry will take place over a period of 25 to 50 years. Where the Project is an extension of the existing 3.99 ha quarry, the production rates, days/hours of operation, traffic, blasting etc., will be consistent with the current operations.

The Project is located on private land owned by Scotian (PID 00505941) within Halifax Regional Municipality and approximately 2.86 km south and west of the Halifax Stanfield International Airport and immediately adjacent to the Aerotech Industrial Park, located northeast of the Project. Based on the NS Well Data Base and aerial photos, the closest domestic use well located 1.1 m from the Project boundary.

Based on the work completed as part of this Environmental Assessment Registration Document for a Class I Environmental Assessment, assuming the mitigative measures specified in this report are implemented, and the quarry is operated according to existing provincial guidelines and approvals, no significant adverse residual environmental effects are likely to occur. Monitoring will be conducted in accordance with all approvals and permits. If monitoring indicates additional mitigation is required, necessary mitigation measures will be implemented.

In accordance with the NS Pit and Quarry Guidelines and the Industrial Approval for the Project, Scotian will develop any required monitoring program to be approved by NSE prior to the start of Project activities. The program will be designed to monitor for changes to groundwater levels and quality, changes to surface water features such as streams, wetlands and fish and fish habitat. Monitoring of dust and noise will be conducted as per the NS Pit and Quarry Guidelines and at the request of NSE.

Numerous studies were completed to establish the existing environment and to evaluate the potential impacts of the Project on the Valued Components (VC). The following summaries the findings associated with the VCs.

Groundwater

A hydrogeological investigation was completed including 21 on-site monitoring well points to provide Project-specific groundwater levels and quality data. This was completed to provide an understanding of the existing groundwater resources in the area of the Project and evaluate the potential impacts of the quarry development on potentially groundwater dependent features (wetlands and streams) located within the predicted groundwater radius of influence. Based on the elevation of the fully extracted quarry of 88 masl (Phases 1, 2 and 3) and to 99 masl (Phase 4), the calculated groundwater radius of influence was calculated to be 431 m from extraction areas in Phases 1, 2 and 3 and 284 m from extraction areas in Phase 4. Impacts related to Project activities on nearby water wells are not anticipated where these wells are located beyond the radius of influence of groundwater level drawdown.

Based on the results of analysis done on rock samples collected from the existing quarry, lithologies at the Goffs Quarry are not expected to generate acidic drainage.

Streams and Fish Habitat

A series of hydrological field and desktop studies were conducted for the purpose of characterizing existing conditions and potential impacts on four un-named watercourses located on the Property (Streams 3, 4, 5, and 6), and one downgradient watercourse (Holland Brook).

The potential loss in groundwater contribution in Stream 3 is expected to be minimal as a small percentage of the drainage area is within the groundwater radius of influence. Because no measurable decrease in the flows to Stream 3 are expected, it is anticipated that there will be no impact to fish or fish habitat in Stream 3.

Stream 4 is located west of the Project, originating in a wetland on the south side of Highway 102. Flows in Stream 4 are anticipated to decrease following full quarry extraction as it is expected that only runoff will contribute to the flow in Stream 4 within the property boundary. If, through monitoring, it is determined that the water levels in Stream 4 become too low to provide the current amount or quality of fish habitat, or if water temperature exceeds levels appropriate for the species in Stream 4, authorizations from DFO including fisheries offset (compensation) and / or NSE will be obtained and all conditions of any permits will be implemented. With the implementation of these monitoring and mitigation (i.e. authorization) measures, no net loss of fish habitat in Stream 4 is anticipated.

Stream 5 is within the Project footprint and will be removed as a part of the Project operations. Stream 5 was assessed to have low potential to provide fish habitat given the lack of suitable habitat features, as well as barriers to fish migration, and lack of surface connectivity with other streams.

In the full quarry extraction condition, the flow in Stream 6 within the property boundary will be minimized due to the reduction in catchment area and loss of groundwater contribution to the stream. Appropriate authorizations will be obtained, if deemed necessary though consultation with DFO and/or NSE, including establishing compensation habitat elsewhere if required, and all other conditions of permits will be implemented.

Holland Brook flows southwest from Preeper's Pond south of the property. Although runoff contributing to the southern Property Boundary near the outlet to Holland Brook is expected to increase due to addition of the quarry discharge, the estimated increase in flow is minimal compared to observed flows in Holland Brook. Therefore, no effects on Holland Brook are anticipated as a result of the Project.

Vegetation

The proposed extraction will remove areas of Red Spruce – Yellow Birch Mixed Forest (9.6 ha) and Regenerating Forest (25.8 ha) forest types, which are common in the general vicinity and in the province. A total of 35.4 ha (40%) of upland vegetation will be removed. However, these communities appear to be abundant within the region, and the removal is not expected to effect the overall availability or habitat quality available in the region.

Wetlands

Six wetlands (i.e., Wetlands 3, 4, 5, 6, 8 and 9) are located within the Project footprint and will be directly or indirectly impacted as part of the Project. A functional assessment carried out on all of the wetlands impacted by the Project indicated that none of the six wetlands were determined to be significant. A Wetland Alteration Approval will be obtained and compensation provided for all wetlands expected to be impacted as a result of the Project and all conditions of that permit will be fulfilled, thereby addressing any adverse effects to wetlands.

Wildlife

Implementation of standard best management practices, such as avoidance of Project preparation/clearing activities during the breeding bird nesting and bat maternity roost season and managing light pollution (quarry will only operate ten to twelve hours a day), will prevent adverse impacts to wildlife on the Property Boundary. A total of 35.4 ha of upland habitat will be removed, habitat within the Project Boundary is not unique, and large areas of similar habitat appear to occur in the region. The removal of these areas is not likely to have a negative impact on the overall wildlife habitat available in the region.

Species at Risk

A black ash is located within Wetland 7 which is located along the northern property boundary, but outside of the proposed extraction area of the Project. There will be no direct impacts to this individual sapling as a result of the proposed extraction. Furthermore, since black ash have a shallow root system and where Wetland 7 is primarily surface water fed based, no indirect impacts to the black ash are expected.

Common nighthawk, little brown myotis (bat species), northern myotis (bat species), and tri-colored bat were assessed as having a potential to occur within the Project Boundary based on availability of suitable habitat. With implementation of appropriate mitigation measures (e.g. avoidance of Project related preparation/clearing activities during the breeding bird nesting) no adverse impacts to common nighthawk or these three bat species are expected to occur.

Other VCs

Where the Project is an extension of Scotian's 3.99 ha quarry, the production rates, days/hours of operation, traffic, blasting etc., will be consistent with the current operations. With the effective implementation of mitigative measures and best management practices, Project-related effects on air quality, noise, and the socio-economic environment are not anticipated to be significant. The Archaeological Resource Impact Assessment (ARIA) Study Area was determined to be of low archaeological potential for both First Nations and Euro-Canadian resources.

List of Acronyms

AO	Aesthetic Objectives
ARD	Acid Rock Drainage
ARIA	Archaeological Resources Impact Assessment
BCI	Bat Conservation International
BMPP	Best Management Practices Plan
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CCME	Canadian Council of Ministers of the Environment
CDWQ	Guidelines for Canadian Drinking Water Quality
CEAA	Canadian Environmental Assessment Agency
CEQG	Canadian Environmental Quality Guidelines
cm	Centimetre
CO	Carbon Dioxide
dB	Decibels
dBA	A-Weighted Decibels
DFO	Fisheries and Oceans Canada
DI	De-Ionized
DMA	Davis MacIntyre and Associates
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
ESA	Endangered Species Act
FEC	Forest Ecosystem Classification
FWAL	Fresh Water Aquatic Life Guidelines
ha	Hectare
HRM	Halifax Regional Municipality
Hz	Hertz
km	Kilometre
Leq	Sound Levels
LOU	Letter of Understanding
m	Metre
MAC	Maximum Acceptable Concentrations
MARI	Maritime Archaeological Resource Inventory
masl	Metres Above Sea Level
MBBA	Maritime Breeding Bird Atlas
mbgs	Metres Below Ground Surface
MEND	Natural Resources Canada Mine Environment Neutral Drainage Program
mg/l	Milligrams per Litre
ML	Metal Leaching
NO_2	Nitrogen Dioxide

NovaWET	Nova Scotia Wetland Evaluation Technique
NPR	Neutralization Potential and Acid Potential
NS	Nova Scotia
NS DNR	Nova Scotia Department of Natural Resources
NSE	Nova Scotia Environment
NSEL	Nova Scotia Department of Environment and Labour
NSTIR	Nova Scotia Department of Transportation and Infrastructure
O_3	Ozone
OG	Operational Guidelines
PHC	Petroleum Hydrocarbons
PID	Parcel Identification Number
$PM_{2.5}$	Particulate Matter Less Than 2.5 Micrometres
POR	Point of Reception
ppb	Parts per Billion
QA/QC	Quality Assurance / Quality Control
SAR	Species at Risk
SARA	Species at Risk Act
SO_2	Sulphur Dioxide
Sranks	Sub-national Ranks
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UTM	Universal Transverse Mercator
VC	Valued Component
VES	Visual Encounter Surveys
WHC	Water Holding Capacity
$\mu g/m^3$	Micrograms per Cubic Metre
µS/cm	Microsiemens per Centimetre

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 PROPONENT INFORMATION

The proponent for the proposed Goffs Quarry expansion is Scotian Materials Limited, a Nova Scotia registered company. Scotian Materials Limited is currently operating a 3.99 hectare (ha) quarry on this property under an existing Industrial Approval (Approval No. 2016-095664). The expansion of this existing quarry beyond 4 ha in area requires a Provincial Environmental Assessment registration as a Class I Undertaking.

Proponent Contact Information:

Proponent Name:	Scotian Materials Limited
Address:	100 Venture Run, Suite 103 Dartmouth, NS B3B 0H9
Tel.:	(902) 481-9800
Fax:	(902) 481-9530
Website:	www.scotianmaterials.ca
Proponent Contact:	Robert MacPherson, P.Eng.
Title:	President
Tel.:	(902) 830-4075
Email:	robert@scotianmaterials.ca

27 July 2017

Signature Date

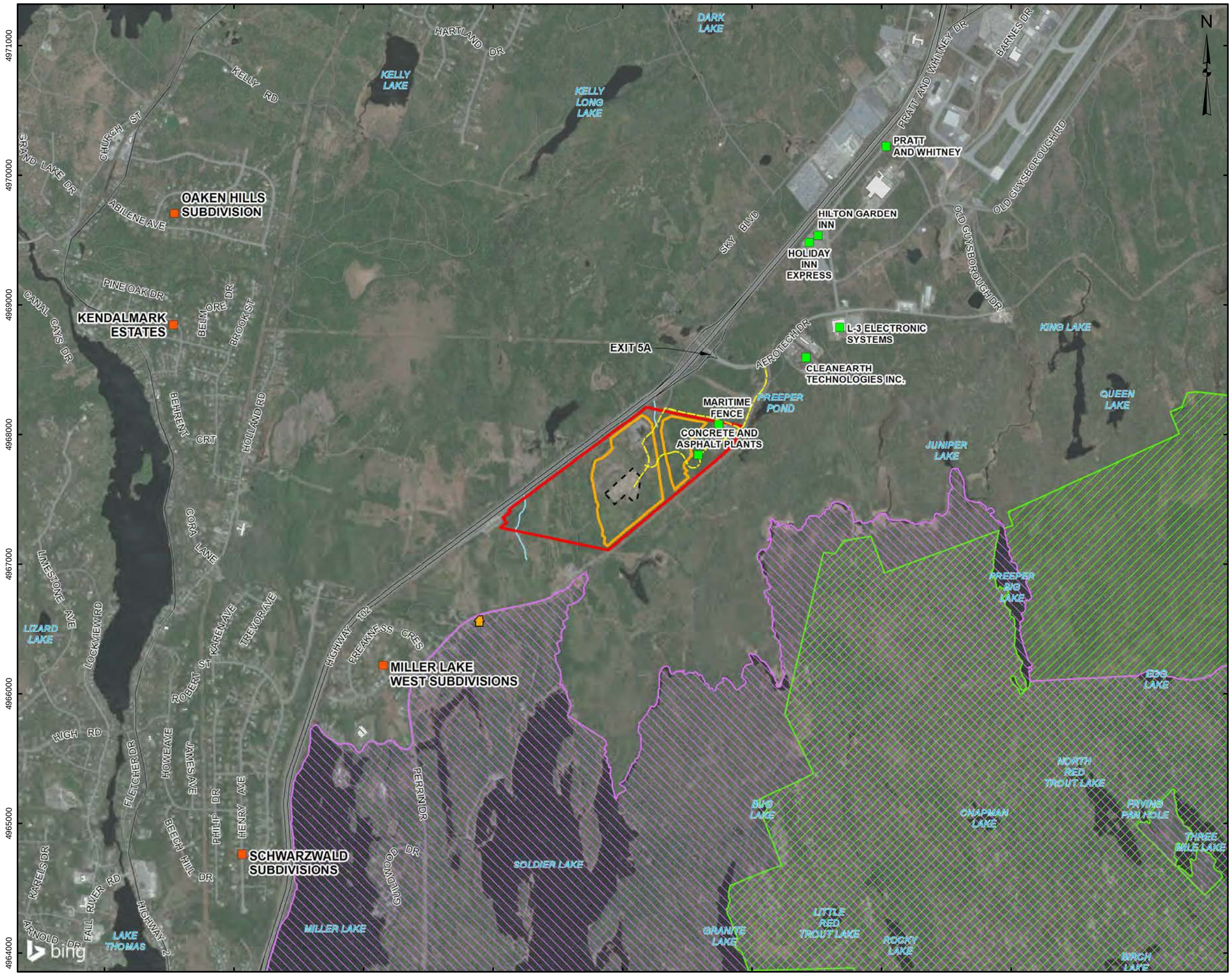
Environmental Assessment Consultant Contact:	Callie Andrews, M.Sc.
Title:	Environmental Assessment Specialist
Company:	Golder Associates Ltd. 102 Brownlow Avenue, Suite 26 Dartmouth, NS, B3B 1W2
Tel.:	(902) 466-1668
Fax:	(902) 466-1669
Email:	Callie_Andrews@golder.com

2.0 THE UNDERTAKING

2.1 Description of the Project

The name of the proposed undertaking is the Goffs Quarry Expansion (the Project). The Project, as proposed by Scotian Materials Limited (Scotian), consists of the extension of an existing 3.99 ha aggregate quarry in Goffs, Nova Scotia (NS). The total area of the proposed Project is 41 ha. The scope of the Project includes the construction, operation, decommissioning and reclamation of the expanded quarry. The Project is located within Halifax Regional Municipality (HRM) and approximately 2.86 kilometres (km) south and west of the Halifax Stanfield International Airport (measured from the northeastern boundary of the Project to closest runway to the southwest) and immediately adjacent to the Aerotech Industrial Park, located northeast of the Project (Figure 1, below).

Scotian currently operates a 3.99 ha quarry (the existing quarry) on the Project property under an existing Industrial Approval (Approval No. 2016-095664), which was issued in June 2017.



LEGEND

- BUSINESS / INDUSTRY STRUCTURE
- NEAREST RESIDENTIAL BUILDING
- RESIDENTIAL AREA / COMMUNITY
- MAJOR ROAD
- LOCAL ROAD
- QUARRY ACCESS/ TRANSPORT
- WAVERLEY GAME SANCTUARY
- WAVERLEY - SALMON RIVER LONG LAKE WILDERNESS AREA
- LESS THAN 4 HECTARE QUARRY
- PROJECT BOUNDARY
- PROPERTY BOUNDARY

REFERENCES

Base Data - CanVec, obtained 2010
Wetlands - obtained from Canvec, 2010, Golder, 2017, and McCallum, 2014.
Watercourse - Golder, 2012
Base Imagery © 2018 Microsoft Corporation © 2018 DigitalGlobe ©CNES (2018)
Distribution Airbus DS
Projection: Transverse Mercator Datum: ATS77 Coordinate System: MTM Zone 5

250 125 0 250 500 750 1,000
SCALE 1:30,000 METERS

PROJECT
SCOTIAN MATERIALS GOFFS QUARRY EARD

TITLE
PROJECT LOCATION

GOLDER

PROJECT No. 1777778			SCALE AS SHOWN	REV. 0.0
DESIGN	CA	2017-05-26	FIGURE 1	
GIS	LMM	2018-07-24		
CHECK	GM	2018-04-26		
REVIEW	PMMC	2018-04-26		

S:\Clients\Scotian_Materials\Goffs_Quarry\99_PROJ\1777778\40_PROD\0005_EA_Main\1777778-0005-HS-0001.mxd

2.2 Anticipated Schedule

The anticipated average production rate is 150,000 to 300,000 tonnes per year; with the possibility of limited periods of increased production, should significant aggregate contracts awarded dictate. The anticipated operating schedule for the development will be five days a week, ten to twelve hours a day and eight to ten months a year, weather permitting. This schedule may be modified in the event a significant aggregate supply contract is awarded. Based on current estimates, there is approximately 14 million tonnes of rock reserves within the proposed footprint. Depending on market demand, operation of the quarry will take place over a period of 25 to 50 years.

The anticipated timeline of Project activities is outlined in Table 1, below.

Table 1: Anticipated Timeline of Project Activities

Task	Anticipated Completion Date
Environmental Assessment (EA) Registration	June 2018
Expected EA Decision	August 2018
Permitting	August to December 2018
Project Activities (including construction and operation)	Beginning 2019, ending between 2044 and 2069
Decommissioning and Reclamation	Between 2044 and 2069

2.3 Location and Adjacent Land Use

The Project is on lands owned by Scotian located in Goffs, Halifax County, NS (PID 00505941) (herein referred to as the Property Boundary or Property). The proposed footprint of the Project within the land parcel was determined based on topography, the depth of overburden and proximity / setback from existing features (e.g., watercourses, natural gas pipeline). The Property Boundary is bounded to the north by lands of the Nova Scotia Department of Natural Resources (NS DNR) (PID 40885279); to the west by Highway 102; to the east by lands owned by Scotian (PIDs 41197401, 41457201, 41356874, and 41356866); and to the south by lands owned by Scotian (PID 41197401) and NS DNR (PID 00527812). The approximate centre of the Project is located at 455465 Easting, 4965835 Northing, UTM Zone 20. The location of the Project is illustrated in Figure 1.

The Property Boundary includes a former rock quarry which was operated periodically over the past few decades to support provincial transportation and infrastructure projects as well as an existing clay pit (Industrial Approval #2014-089057-T01). Scotian has approved permits to operate an asphalt and/or concrete plant within the eastern portion of the Property Boundary (located southeast of Phase 4), on the same property but outside of the proposed quarry expansion boundaries. Other land uses in the vicinity of the Project include a variety of business and industrial operations north and east of the Project in the Aerotech Industrial Park such as Maritime Fence, Clean Earth Technologies Inc., and L3 Electronics Systems as well as the Halifax Stanfield International Airport. Located west of the proposed quarry is the north bound Highway 102 weigh station, operated by the Department of Transportation and Infrastructure Renewal (NSTIR). Further west, across Highway 102, are a number of residential subdivisions in Fall River. Approximately 1.1 km south west of the Project is a residential community known as the Miller Lake West subdivision (Figure 1).

Immediately south of the quarry property is Perrin Drive which runs northeast – southwest. The majority of Perrin Drive between the entrance to the quarry and Miller Lake West is impassable via automobile. The Maritimes and Northeast Pipeline Halifax Lateral runs parallel to Perrin Drive, on the south side. The Waverly Game Sanctuary and the Waverley Salmon River Long Lake Wilderness Area are located approximately 300 m and 1.2 km south and east, respectively from the Project (Figure 1).

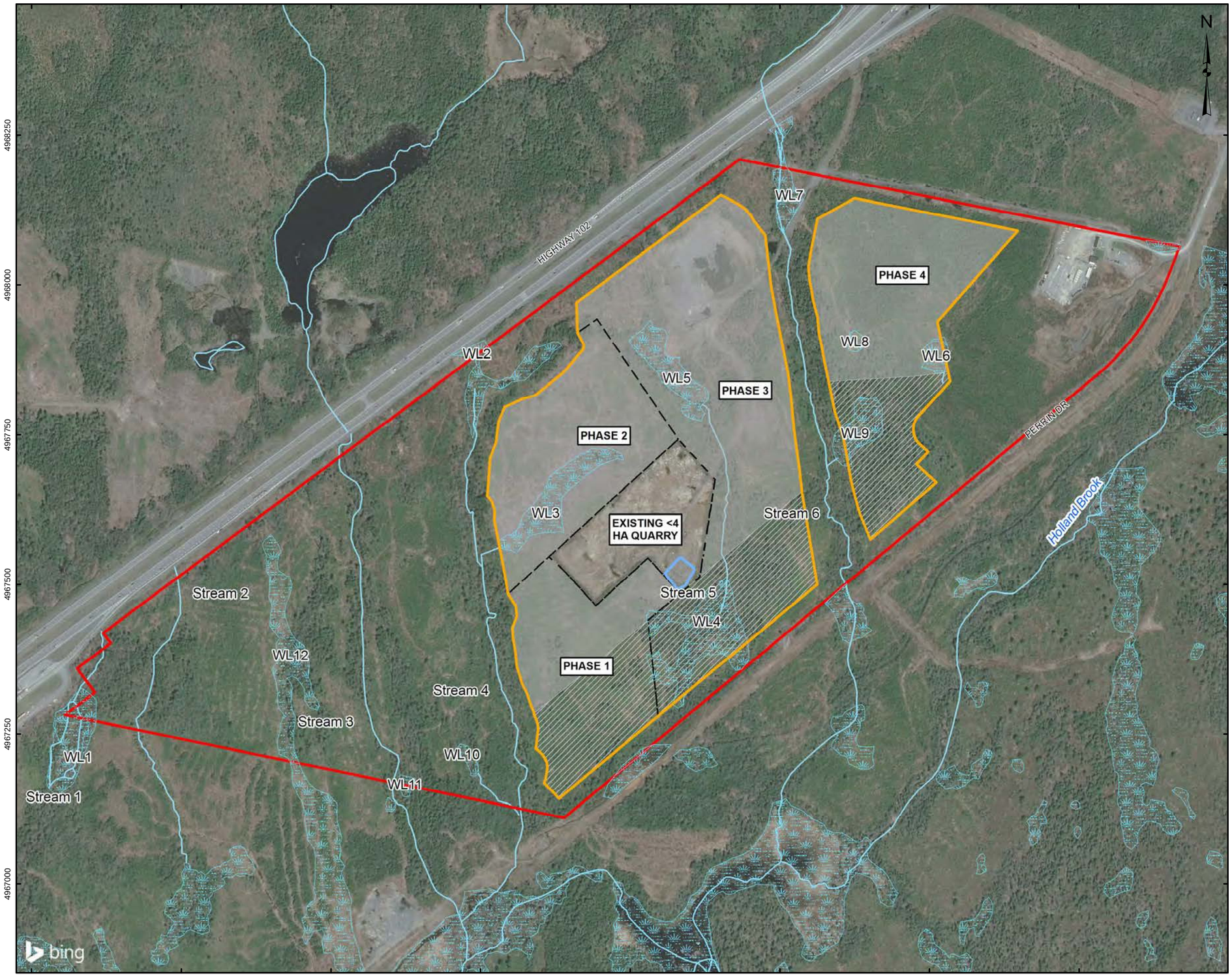
The number of residences within 500 m, 1 km, 1.5 km and 2 km of the undertaking are summarised in Table 2. Based on aerial imagery, the nearest residential structure is approximately 1.1 km southwest of the Project.

Table 2: Number of Residences in Proximity to the Project

Distance from Quarry Boundary	Number of Residences
500 m	0
1 km	0
1.5 km	9
2 km	40

2.4 Physical Components

The proposed quarry operation will be an extension from Scotian's existing 3.99 ha quarry and will consist of the quarry floor and working face, a laydown area for the crushing equipment, overburden and aggregate stockpiles, a wash plant, weigh scales, and a sedimentation pond(s). The quarry will be developed in four phases. The area indicated for each phase includes the quarry footprint, as well as other work areas (i.e., stockpiles, lay down areas, etc.). Upon development, the exact areas of the phases may change based on rock quality and other parameters. The proposed phases are shown on Figure 2 (below).



LEGEND

- WATERCOURSE
- WETLAND
- SEDIMENTATION POND
- PROPOSED EXTRACTION PHASES
- PROPOSED EXTRACTION AREA
- ASSOCIATED DEVELOPMENT AREA
- PROJECT BOUNDARY
- PROPERTY BOUNDARY

REFERENCES

Base Data - CanVec, obtained 2010
Wetlands - obtained from Canvec, 2010, Golder, 2017, and McCallum, 2014.
Watercourse - Golder, 2012
Base Imagery © 2018 Microsoft Corporation © 2018 DigitalGlobe ©CNES (2018) Distribution Airbus DS
Projection: Transverse Mercator Datum: ATS77 Coordinate System: MTM Zone 5

100 50 0 100 200 300 400
SCALE 1:6,500 METERS

PROJECT
SCOTIAN MATERIALS GOFFS QUARRY EARD

TITLE
SITE PLAN

GOLDER

PROJECT No. 1777778			SCALE AS SHOWN	REV. 0.0
DESIGN	CA	2017-05-26	FIGURE 2	
GIS	LMM	2018-07-24		
CHECK	PMMC	2018-02-26		
REVIEW	PMMC	2018-02-26		

S:\Clients\Scotian_Materials\Goffs_Quarry\99_PROJ\1777778\40_PROD\0005_EA_Main\1777778-0005-HS-0002.mxd

In each phase, topsoil, grubbing material and overburden that will be stripped prior to drilling and blasting will be stored on-site for subsequent use during progressive site reclamation. These materials will be stabilized with straw mulch where practical to reduce the potential for erosion and sedimentation.

The crushing equipment to be used at the quarry is portable; however, it may be set up on the quarry floor as a permanent / stationary installation, optimally positioned for long-term use (i.e., the life of the quarry). Aggregate stockpiles will be located as space allows within the quarry footprint.

Crushing equipment, or crushing spread, will consist of a series of crushers, screens, conveyors, hoppers and surge piles designed to breakdown the material efficiently to smaller size fractions. The design of the crushing and screening circuit is a function of the rock type and target product mix required to produce construction grade material for modern practices. Given the variation in types of aggregates to be produced, the configuration of the crushing spread is subject to change.

Surface runoff and quarry drainage will be collected on the quarry floor and will initially drain to the current sedimentation pond, currently in use in the exiting quarry. When required, additional sedimentation ponds will be constructed. Phase 1 and Phase 4 will be designed to provide sufficient area for water management infrastructure to be constructed.

All quarry related truck traffic will access the Project from the north via Aerotech Drive and Highway 102 exit 5A. There will be no through traffic from the Project south to Perrin Drive and vehicles will not travel through the Miller Lake West subdivision.

2.4.1 Preparation and Construction

Preparation and construction will be conducted in the same manner as the existing 3.99 ha quarry and will consist of clearing trees, grubbing (i.e., removal of stumps), stripping of topsoil, and removal of overburden. Stockpiles will be stabilized by the application of straw mulch where practical to minimize erosion and sedimentation for subsequent use during reclamation.

Quarry drainage and surface runoff collection and controls are currently in place for the existing 3.99 ha quarry. Surface runoff and quarry drainage related to Project activities will be collected on the quarry floor and will initially drain to the current sedimentation pond. As indicated in the previous section, when required, additional sedimentations pond will be constructed. The current sedimentation pond will collect all runoff associated with active quarrying limits until the additional pond is constructed. Sedimentation ponds are / will be designed for the water to be held until its Total Suspended Solids (TSS) complies with the NS *Pit and Quarry Guidelines* for effluent discharge (Nova Scotia Environment and Labour [NSEL] 1999). The water will be gravity fed and will flow through a ditch where it will re-enter the natural environment.

2.4.2 Operations and Maintenance

The Project activities will be consistent with industry standard practice and will be in accordance with the NS *Pit and Quarry Guidelines* (NSEL 1999). These guidelines apply to all pit and quarry operations in the province of Nova Scotia and provide: separation distances for operations, including blasting; liquid effluent discharge level limits; suspended particulate matter limits; sound level limits; and requirements for a reclamation plan and security bond.

The Project will be integrated into Scotian's existing 3.99 ha quarry. Aggregate production will begin with drilling and blasting. Drilling and blasting will be conducted by an independent licensed contractor who will be responsible for blast designs and methods in accordance with the General Blasting Regulations pursuant to the Nova Scotia *Occupational Health and Safety Act* (1996). Further, all blasting activity will be conducted in accordance with the NS *Pit and Quarry Guidelines* (NSEL 1999) and blasts will be designed to meet the requirements for air concussion and vibrations as well as minimize the risk associated with flyrock. It is anticipated that blasting could occur four to six times a year however the frequency of blasting may change based on production requirements.

The topography within the proposed quarry area varies from approximately 125 metres above sea level (masl) in the northern section of Phase 4 to approximately 88 masl in the southern end of Phase 1. It is anticipated that Phases 1, 2, and 3 will be extracted to a depth of 88 masl, and that Phase 4 will be extracted to 99 masl.

Blasted rock will be transferred from the working face to the crushing spread. The blasted rock will be loaded into the jaw crusher (primary crusher). From there, the material will be conveyed into another feeder bin and screened. From the screen, material will be conveyed to two separate cone crushers, depending on size. Beyond the primary crushing and screening phase, additional crushing and screening will depend on the size of the aggregate required to supply specifications of the contracts. All crushers will be equipped with dust suppression systems.

The material is re-circulated to the screen and will be crushed again until the required aggregate size is attained at which time the aggregate will be conveyed into various stockpiles. The various aggregate products will be stockpiled within the Project footprint until they are transported to local markets via tandem trucks or tractor trailer trucks.

The proposed quarry will operate five days a week, ten to twelve hours a day and eight to ten months a year, weather permitting. Based on the production rate and proposed operating schedule, the average number of loaded trucks hauling material from the quarry each day is expected to be 75. All quarry related truck traffic will access the Project from the north via Aerotech Drive and Highway 102 exit 5A. There will be no through traffic from quarry related vehicles on Perrin Drive and vehicles will not travel south along Perrin Drive to the Miller Lake West subdivision.

The Project will be an expansion on the 3.99 ha quarry and the existing workforce will be used. The Project is expected to employ at least 10 to 12 direct employees throughout the year, with five to six additional secondary workers being employed by the blasting contractor for at least one week, four times a year. Additional secondary employment through hauling / trucking contractors is estimated to result in the employment of another 20 to 30 workers.

2.4.3 Accidents and Malfunctions

The fueling and vehicle maintenance area associated with the 3.99 ha quarry will be utilized for this Project. Equipment operators will remain with the equipment at all times during refueling in accordance with the Petroleum Management Regulations of the Nova Scotia *Environment Act* (NS 1994-95e).

The following mitigation strategies will be implemented to avoid or minimize potential environmental effects from hazardous materials:

- Repairs and refuelling of equipment will not occur within 30 m of a watercourse or wetland.
- Used oil and filters will be removed from the Project for proper disposal and recycling.

- All refuelling activities will comply with the NS Petroleum Management Regulations (NS Reg. 44/202). Unforeseen events such as leaks, or spills will be responded to immediately and adequate spill response material will be available on-site.
- Spills will be reported to NSE in accordance with the Emergency Spill Regulations (NS Reg. 59/95) (NS 1995-95d).
- Contaminated materials resulting from a spill (i.e. absorbents material, soil) will be stored in an appropriate manner in a designated location until such time as it can be transported off-site for treatment and / or disposal at an approved facility.

2.4.4 Decommissioning and Reclamation

Scotian will undertake a progressive rehabilitation program at the quarry to the extent practical. Reclamation will be done in consideration of the end use of the land. The proposed end use of the land is commercial / industrial, as per a Master Plan prepared by Scotian for their lands in the area.

2.5 Emissions and Discharges

The Project is an extension of Scotian's current operations. The production rates, days/hours of operation, traffic etc., will be consistent with the current operations. The existing controls will be implemented for this Project. The implementation and use of standard environmental controls and compliance with regulations will minimize any potential environmental damage to the area. Environmental controls such as diversion ditches, check dams, settling ponds, straw mulch and hydroseed will be used to control erosion and minimize sedimentation, as required. All operations will be carried out in a responsible manner to ensure regulatory thresholds and guidelines for noise, vibration, dust and sediment are not exceeded.

Water Management

Surface water will be diverted around the Project to minimize the volume of water that may require treatment for suspended sediments. Erosion controls will be in place to ensure that Project runoff generated during operations is managed appropriately. Surface runoff will collect on the quarry floor and drainage ditches, as required, and will be initially conveyed to existing sedimentation pond in the footprint of the existing quarry. Water from the sedimentation ponds will be used for washing aggregates as required. The existing and additional sedimentation ponds will expand as the quarry operation progresses to ensure there is sufficient capacity to treat the anticipated volume of runoff.

Overflow, if any, will be monitored and sampled as per the NS *Pit and Quarry Guidelines* (NSEL 1999) to ensure TSS levels do not exceed effluent discharge limits indicated in the NS *Pit and Quarry Guidelines* (NSEL 1999) prior to discharge into a watercourse or beyond the property boundaries:

- maximum suspended solids concentration in any grab sample - 50 mg/l; and,
- maximum arithmetic monthly average suspended solids concentration – 25 mg/l.

Emissions Control

Dust emissions will be controlled with the application of water, obtained from the water that is pooled on the quarry floor or the sedimentation pond. To minimize the generation of dust, the working areas and laydown areas will be covered with blasted rock. Dust generated by truck movement along the access road will be minimized by

speed control, proper truck loading, application of dust suppressants, proper construction of roads within the Property Boundary, and / or other means as per as per the NS *Pit and Quarry Guidelines* (NSEL 1999).

Monitoring of airborne particulate emissions (dust) will be conducted at the request of Nova Scotia Environment (NSE), in accordance with the NS *Pit and Quarry Guidelines* (NSEL 1999), the Nova Scotia Air Quality Regulations and shall not exceed the following limits at the property boundaries:

- Annual Geometric Mean 70 µg/m^3; and,
- Daily Average (24 hrs) 120 µg/m^3.

Combustion emissions will be generated from the operation of vehicles and equipment during Project activities. Given the scope of the planned operations, these emissions will be minimal, localized and similar in quantities to the operation of a small construction project using one or two pieces of heavy equipment. Emissions will be reduced with proper exhaust systems and through proper equipment maintenance and inspection practices. Consideration will be given to methods to reduce idling, as feasible.

Noise

As per the NS *Pit and Quarry Guidelines* (NSEL 1999), noise levels from quarry operations will be maintained at a level not to exceed the following sound levels (Leq) at the property boundaries:

- 65 A-Weighted Decibels (dBA) 0700-1900 hours (Days);
- 60 dBA 1900-2300 hours (Evenings); and,
- 55 dBA 2300-0700 hours (Nights).

It is anticipated that blasting could occur four to six times a year however the frequency of blasting may change based on production requirements. Factors that influence air concussion and peak ground vibrations include the distance between the blast and the receptor and the explosive weight per delay period during the blast. As per the NS *Pit and Quarry Guidelines* (NSEL 1999), blasting is monitored for both air concussion and ground vibration. Blasting activities may not exceed the following:

- Concussion of 128 dBA within 7 m of the nearest structure located outside of the Property Boundary; and,
- Ground vibration of 0.5 in./sec (12.5 mm/s) peak particle velocity measured at the nearest structure located outside of the Property Boundary.

Waste Management

Where the Project is an extension of Scotian's existing operations, there will be minimal additional solid waste generated as a result of this Project. All solid waste will be properly collected and stored until such time that it can be transported to a provincially approved waste disposal facility.

The only Project related hazardous materials anticipated will be those associated with the normal operation and maintenance of construction equipment. These substances include gasoline, diesel fuel, lubricants and antifreeze liquid. No storage of such materials is anticipated, since all refueling, and maintenance will be carried out on an as needed basis by a mobile fleet in a designated area within the quarry by licenced contractors.

2.6 Purpose and Need for the Undertaking

The purpose for the Project is to allow Scotian to develop and operate an aggregate quarry at their property in Goffs, NS. The property has been historically used for aggregate production since the early 1960's to support highway development and upgrading projects as well as other road and local construction projects.

Construction aggregates are comprised primarily of crushed stone, natural and manufactured sands, and gravel. These resources are a necessity for the development and maintenance of modern infrastructure. For example, aggregate content in concrete is about 80% and about 94% in asphalt. The aggregates that will be produced at the quarry are a critical requirement in many construction projects in the region. Based on historic uses of the aggregate at the adjacent inactive quarry, the rock is of a suitable quality for highway construction and maintenance projects including asphalt production.

This Project as well as other quarries in NS are an important component of the natural resource sector of the economy and provide essential raw materials to the province's construction industry. The Project will also provide direct and indirect employment for its workers and suppliers, as well as for the transportation and construction industries.

2.7 Project Alternatives

Alternatives to an undertaking are defined as functionally different ways of achieving the same end. This may include alternative locations for the development, alternative processing scenarios and transportation routes, alternative means of extraction, and alternatives to the development and operation schedule.

In Nova Scotia, there appears to be no shortage of rock. However, the location of suitable aggregate quality bedrock (or gravel deposits for that matter) is fixed. Access to these quality resources is a critical consideration to quarry developers, and in some instances, to major developers.

Because aggregates are a high bulk and low-cost commodity, the cost of transportation to market / end user can easily exceed the price of the aggregate thereby making the process uneconomical. Locating quarries adjacent to existing transportation infrastructure and within relative close proximity to markets is critical to the success of any pit or quarry operation. Proximity and access to Highway 102 was one of the main reasons for selection of this particular Project. In addition, the close proximity to Scotian's permitted asphalt and concrete plant, ensures a supply of aggregate. Based on the distance from Scotian's Tote Road Quarry located approximately 45 km from the plants, this would result in excessive trucking cost.

The alternative methods for aggregate extraction are highly dependent on the raw material; that is: consolidated or unconsolidated material. Unconsolidated material is most often extracted using common construction equipment such as loaders and excavators. For consolidated material, the rock can be ripped or hammered (i.e., mechanical extraction) or it can be drilled and blasted. Ripping and hammering are only feasible for softer, more friable rock types which are not common aggregate resources. Drilling and blasting are required for hard rock resources. With respect to Project, mechanical extraction methods are not practical or feasible due to the nature and characteristics of the host rock (e.g., hard and dense). Therefore, there are no feasible alternatives to drilling and blasting as a means of extracting this material.

With respect to the processing of the blasted rock, there are no known alternatives to crushing. The configuration of screens and conveyors within the crushing spread can vary depending on the aggregate being produced. Scotian will use crushers, screens, and conveyors to optimize and automate the operation to the extent practical.

Consideration of alternative Project access / transportation routes was given a cursory review. There are only two routes available: to the north of the Project from Aerotech Drive then Highway 102 via Exit 5A, and to the south of the Project down Perrin Drive, through Miller Lake West subdivision and on to Highway 118. There are a number of disadvantages to the latter option such as trucking through a residential area which is avoided whenever possible, and the cost associated with upgrading / reconstruction of approximately 2 km of Perrin Drive that would be required to accommodate truck traffic. As such, Scotian has committed to ensuring all quarry related traffic access the Project from the north.

Options for the precise timing of Project construction will be selected based on when all necessary permits have been acquired and in consideration of the avoidance of sensitive biological features and life cycle periods, to the extent possible.

3.0 REGULATORY FRAMEWORK

The following permits, authorizations, and / or approvals may be required to allow for the construction and operation of the Project:

- *Environmental Assessment* Ministerial Approval pursuant to the Nova Scotia *Environmental Assessment Regulations*, Section 13 (1)(B) (NS 1994-95c);
- An amendment to existing *Industrial Approval* No. 2016-095664 pursuant to the NS *Environment Act and Regulations and Activities Designation Regulations* (NS 1994-95b);
- *Wetland and Watercourse Alterations* pursuant to Nova Scotia *Activities Designation Regulations*, Division I, Section 5A(2) (NS 1994-95b);
- *Water Withdrawal Approval* pursuant to Nova Scotia *Activities Designation Regulations*, Division I, Section 5A(1) (NS 1994-95b); and,
- *Fisheries and Oceans Canada (DFO) Project Authorization* pursuant to Paragraph 35(2)(b) of the *Fisheries Act*, if required (Canada 1985).

Provincial guidelines to be adhered to include the NS *Pit and Quarry Guidelines* (NSEL 1999), the General Blasting Regulations made pursuant to the Nova Scotia *Occupational Health and Safety Act* (1996), and the *Wetland Conservation Policy* (NSE 2011).

There are no known triggers for environmental assessment under the *Canadian Environmental Assessment Act 2012* (CEAA 2012), as the production rates for the quarry do not exceed 3,500,000 tonnes per year.

Other relevant legislation and regulations include:

- *Fisheries Act* (Canada 1985);
- *Species at Risk Act* (SARA) (Canada 2002);
- *Endangered Species Act (*ESA) (NS 1998);
- *Migratory Birds Convention Act* (Canada 1994); and,
- *Aeronautics Act* (Transport Canada 1985);
- *Environment Act* (NS 1994-95a).

4.0 ENVIRONMENTAL ASSESSMENT SCOPE

4.1 Scope of the Undertaking

For the purpose of this preliminary assessment, the scope of the undertaking includes all components and activities associated with the development, operation, and the decommissioning and reclamation of the proposed Goffs Quarry Project. A detailed description of the undertaking is provided in Section 2 and generally includes the following:

Table 3: General Quarry Operation Components and Activities

Components	Activities
Access road	Clearing (tree cutting)
Scale and scale house	Grubbing and stripping
Crusher (primary / jaw and cone crushers)	Drilling
Screens	Blasting
Conveyors	Loading and hauling
Hoppers	Crushing / screening
Wash plant and settling pond	Washing
Stockpiles	Weighing
Transportation	Loading / material handling
Rock face	Reclamation

4.2 Scope of the Environmental Assessment

This Environmental Assessment has been prepared in general compliance with the provincial regulations and the *Guide to Preparing an EA Registration Document for Pit and Quarry Developments in Nova Scotia* (NSE 2009).

The approach and methodology used are based on accepted environmental assessment practice, focusing on environmental and socio-economic issues of greatest concern (e.g., those that are valued by society and / or serve as indicators for environmental change). These components are known as valued components (VCs) and include physical, biological and socio-economic components.

The scope of this EA was determined by the Proponent and their consultant and is based upon the proposed Project components and activities, the professional judgment and expert knowledge of the study team, consultation with adjacent land owners, the public and regulatory authorities on this and similar projects, and the results of field studies conducted in support of this environmental assessment. *The Guide to Preparing an EA Registration Document for Pit and Quarry Developments in Nova Scotia* (NSE 2009) was also used to determine/focus the scope of the assessment.

This EA evaluates the potential environmental effects of the proposed Project components and activities, throughout all Project phases, with regard to each VC. By assessing potential impacts on VCs within the spatial and temporal boundaries of the Project, a meaningful evaluation of project effects on relevant environmental aspects can be achieved. The following VCs were identified based on government guidance, consultation, and professional judgment of the study team:

- groundwater resources;
- surface water resources;
- vegetation;
- wetlands;
- fish and fish habitat;
- species at risk (SAR);
- air quality;
- noise;
- archaeological and heritage resources; and,
- socio-economic environment.

Assessment boundaries provide a meaningful and manageable focus for an EA. Temporal and spatial boundaries encompass those periods and areas within which the VCs are likely to interact with, or be influenced by, the Project. Temporal boundaries are generally limited to the duration of, and for a period of time after, the Project activities, which in this case include the entire lifetime of the quarry including reclamation and decommissioning activities.

Although most quarry activity will occur between April and December, this EA assesses potential effects of the Project throughout the year. Temporal boundaries also address other temporal issues such as seasonal sensitivities (e.g., bird breeding).

The following terms are used to define the spatial boundaries used in this EA:

Property Boundary - the total land area within the property owned by Scotian (PID 00505941) that was the focus of this assessment. The Property Boundary or Property is approximately 100.20 ha.

Project – The total area within the Property Boundary in which aggregate is proposed for extraction, as well as the associated development areas (i.e., for stockpiling). The total area of the Project is 41 ha.

Biophysical Study Area - The Study Area used for assessment of SAR, plant communities, birds, general wildlife, fish and fish habitat, and wetlands. This Study Area corresponds to the area of the predicted groundwater drawdown, which extends a maximum of 431 m from the Project. The Biophysical Study Area is approximately 185 ha.

Archaeological Resource Impact Assessment (ARIA) Study Area – The Study Area used for the assessment of archaeological and heritage resources in the vicinity of the Project.

The following sections are structured as follows:

- Section 5 – Provides an overview of the methodology used to establish baseline conditions and to evaluate the impacts of the Project on the various VCs;
- Section 6 – Establishes the baseline conditions within the Property Boundary;
- Section 7 – Details the impact assessment for each VC and identifies the relevant mitigation measures to be implemented;
- Section 8 – Outlines the monitoring requirements associated with the Project.

In addition, technical support documents for groundwater and surface water are provided in Appendix A and B respectively. All other VCs are detailed in the sections below.

5.0 ENVIRONMENTAL ASSESSMENT METHODOLOGIES

A number of field studies were conducted by Golder Associates Ltd. (Golder) between June 2012 and March 2018 to investigate and establish the existing environmental conditions within and adjacent to the proposed Project area and to identify any specific mitigation that may be required, if necessary, to minimize environmental effects from the proposed Project. Surveys were conducted for groundwater resources, surface water resources, wetlands, flora and fauna species and habitat, fish and fish habitat, noise, and archaeological and heritage resources.

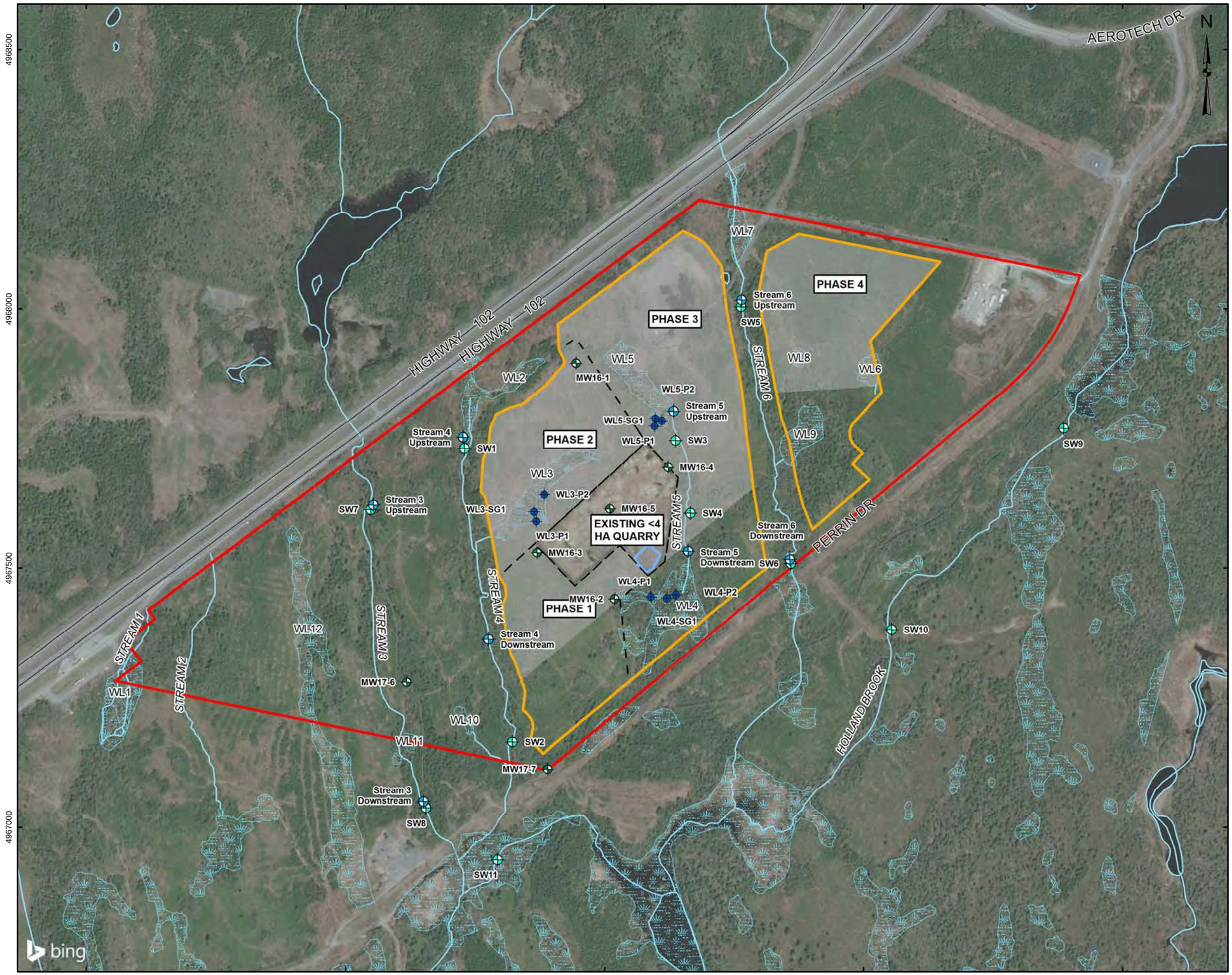
To assess the potential environmental effects of a project and determine the significance of an effect, it is important to consider the magnitude, frequency, duration, geographical extent and reversibility of the potential effect. The study team has considered these elements for each VC. In particular, regulatory standards were used, where appropriate, to determine thresholds of significance for predicted environmental effects after application of mitigation (i.e., residual effects). Where regulatory standards are not available other key factors such as the sustainability of biological populations and rarity of species and critical habitats have been considered as indicators of significance.

5.1 Groundwater Resources

Golder was retained by Scotian to carry out a hydrogeological investigation as a part of this Environmental Assessment. This investigation was completed in order to provide an understanding of the existing groundwater resources in the area of the Project and evaluate the potential impacts of the quarry development on potentially groundwater dependent features located within the predicted groundwater radius of influence. For detailed information, the report titled *Hydrogeological Assessment - Proposed Goffs Quarry* is provided in Appendix A.

Drilling

A total of thirteen (13) Boreholes were drilled at seven locations (Figure 3). These boreholes are instrumented with wells that provide an understanding of the existing groundwater levels and allow for the monitoring of the groundwater levels as the quarry expands. The locations of these well nests are on Figure 3 and denoted as boreholes BH16-1 to BH16-5, BH17-6 and BH17-7. The locations were sited assess for any potential the changes in the groundwater table as the quarry expands, to allow for comparison of groundwater and surface water interactions between the streams and wetlands and can provide early warning on changes to the groundwater table that may affect off-site private wells. Wells were constructed as follows: a well installed in the near surface, shallow, intermediate, deep and then in deeper rock. The deep rock wells were installed below the proposed quarry floor.



LEGEND

- GROUNDWATER MONITORING WELL NEST
- PIEZOMETER AND STAFF GAUGE LOCATION
- STREAM GAUGES
- SURFACE WATER SAMPLING LOCATION
- MAJOR ROAD
- LOCAL ROAD
- WATERCOURSE
- WETLAND
- SEDIMENTATION POND
- PROPOSED EXTRACTION PHASES
- PROPOSED EXTRACTION AREA
- PROJECT BOUNDARY
- PROPERTY BOUNDARY

REFERENCES

Base Data - CanVec, obtained 2010
Wetlands - obtained from Canvec, 2010, Golder, 2017, and McCallum, 2014.
Watercourse - Golder, 2012
Base Imagery © 2018 Microsoft Corporation © 2018 DigitalGlobe ©CNES (2018) Distribution Airbus DS
Projection: Transverse Mercator Datum: ATS77 Coordinate System: MTM Zone 5

100 50 0 100 200 300 400
SCALE 1:7,500 METERS

PROJECT
SCOTIAN MATERIALS GOFFS QUARRY EARD

TITLE
MONITORING LOCATIONS

GOLDER

PROJECT No. 1777778			SCALE AS SHOWN	REV. 0.0
DESIGN	CA	2018-05-04	FIGURE 3	
GIS	LMM	25/07/2018		
CHECK	CA	25/07/2018		
REVIEW	PMMC	25/07/2018		

S:\Clients\Scotian_Materials\Goffs_Quarry\99_PROJ\1777778\40_PROD\0006_EA_Groundwater\1777778-0006-CH-0018.mxd

Groundwater Levels

Following the well installations, groundwater levels were measured in each of the monitoring wells. The wells were manually monitored weekly from September to November 2017 (inclusive) and monthly between December 2017 and February 2018 (inclusive). The monitoring allowed for seasonal variations in the groundwater table to be evaluated. The ground surface at each well nest and the top of pipe elevations for all monitoring wells installed was surveyed in order to report groundwater elevations.

Hydraulic Conductivity Testing

Single well response tests were conducted within each monitoring well to estimate the bedrock hydraulic conductivity. The monitoring wells were instrumented with data loggers, a physical slug was inserted into the well below the static water level resulting in an instantaneous water level increase (falling head test) and left to recover to approximately 80% of the well's static water level. Once recovered, the slug was then removed causing an instantaneous water level decrease (rising head test) and left to recover to approximately 80% of the well's static water level. A further five single well response tests (one rising head test per monitoring well) were completed. The monitoring wells were instrumented with data loggers, a bailer was used to instantaneously decrease the water level in each well (rising head test) and the water level recovery was recorded. In addition, sieve and hydrometer analysis was conducted on soil samples to estimate the overburden hydraulic conductivity.

Groundwater Quality Sampling

Groundwater quality samples were obtained from each monitoring well and these groundwater quality samples provide a baseline against which potential future changes in water quality related to quarry dewatering activities could be compared.

Prior to the collection of samples, each monitoring well was developed by the removal of 3 to 10 well volumes of water, or by pumping the well dry several times. The groundwater quality samples were submitted under chain of custody to Maxxam Analytics in Bedford, NS or AGAT Laboratories in Dartmouth, NS. All groundwater samples were analysed for total and dissolved metals and inorganics. Samples from the MW16-3, MW16-4, MW17-6 and MW17-7 monitoring well clusters were also analysed for benzene, toluene, ethylbenzene and xylene (BTEX) and petroleum hydrocarbons (PHC).

Groundwater was collected from the 21 on-site monitoring wells that are located at seven locations. The MW16 series wells were sampled on June 2016, September 2017, December 2017 and March 2018 and the MW17 series wells were sampled on July 2017, September 2017, December 2017 and March 2018. The sample results were compared with the Guidelines for Canadian Drinking Water Quality (CDWQ), set by Health Canada (2017) and are provided in Appendix A.

The June 2016, July 2017, and September 2017 groundwater samples were very turbid and all exceeded the turbidity maximum acceptable concentrations (MAC) CDWQ. The CDWQ for turbidity was established for drinking water systems to achieve health-based pathogen removal goals and is not based on toxic effects on organisms. It was postulated that the elevated turbidity was causing the concentrations of total metals to be elevated. Hence, a low flow sampling method was implemented for the December 2017 and March 2018 monitoring events in an effort to reduce the amount of solids in groundwater samples, which resulted in lower turbidity.

Two groundwater sample field duplicates were collected in 2016 and 2018 and one field duplicate was collected in 2017 for quality assurance/quality control (QA/QC) purposes. QA/QC results for the duplicate groundwater samples were within acceptable tolerance limits.

2D Groundwater Modeling

Quarry inflows and zone of influence were calculated using the analytical method described in *Simple analytical equations for estimating ground water inflow to a mine pit* (Marinelli and Niccoli 2000). The details of the groundwater modelling are provided in Section 7.1 and are also provided in Appendix A.

5.2 Surface Water Resources

Golder was retained by Scotian to complete a series of hydrological field and desktop studies as part of this Environmental Assessment. These studies were conducted between June 2012 and February 2018 for the purpose of characterizing existing conditions and potential impacts on four un-named watercourses located on the Property Boundary (Streams 3, 4, 5, and 6), and one downgradient watercourse (Holland Brook), with respect to the following:

- Aquatic environment;
- Stream flows;
- Surface water quality; and,
- Catchment area and water balances.

The following sections provide a summary of the methodology used in the hydrological studies conducted for the Project. For more detailed information refer to the technical memorandum provided in Appendix B.

Stream Flows

Water levels and flows were monitored at 12 locations between February 2017 and February 2018: two locations in Stream 4 (SW1 and SW2), two in Stream 5 (SW3 and SW4), two in Stream 6 (SW5 and SW6), two in Stream 3 (SW7 and SW8), and four in Holland Brook (SW9, SW10, SW11, SW12) (refer to Figure 3).

The types of monitoring carried out at each location consisted of the following:

- Surface water level monitoring: A staff gauge was installed and used for manual surface water level measurements during field visits. The staff gauge was geodetically surveyed in order to establish a water level elevation.
- Continuous water level monitoring: A water level transducer and datalogger (level logger) was installed at each location to measure surface water levels at specified intervals.
- Flow monitoring: Instantaneous flow measurements were recorded during field visits.

Surface Water Quality

Surface water quality samples were obtained using standard sampling protocols from upstream and downstream locations in Streams 3, 4, 5, 6, and Holland Brook (Figure 3). Water quality samples were collected in Streams 3 and 6 in July 2017, in Holland Brook in August 2017, and in Streams 4 and 5 on three events between May 2016 and January 2018. Surface water quality samples were submitted under chain of custody to Maxxam Analytics and to AGAT Laboratories in NS. These samples were analyzed for a general suite of inorganics, total metals, and PHCs. In-situ field measurements for pH, conductivity, temperature and total dissolved solids (TDS) were also taken at each location.

Hydrologic Water Balance

A water balance assessment was carried out to assess the potential hydrological impacts of the proposed expansion with respect to post-development (i.e., full development of the proposed Goffs quarry) runoff and infiltration rates. Streams 4, 5 and 6 were assessed due to post-development changes in the drainage areas contributing to these features. Stream 3 was not assessed from a water balance perspective as the drainage area for this feature will not change due to extraction.

Water Balance Parameters

Drainage Catchments

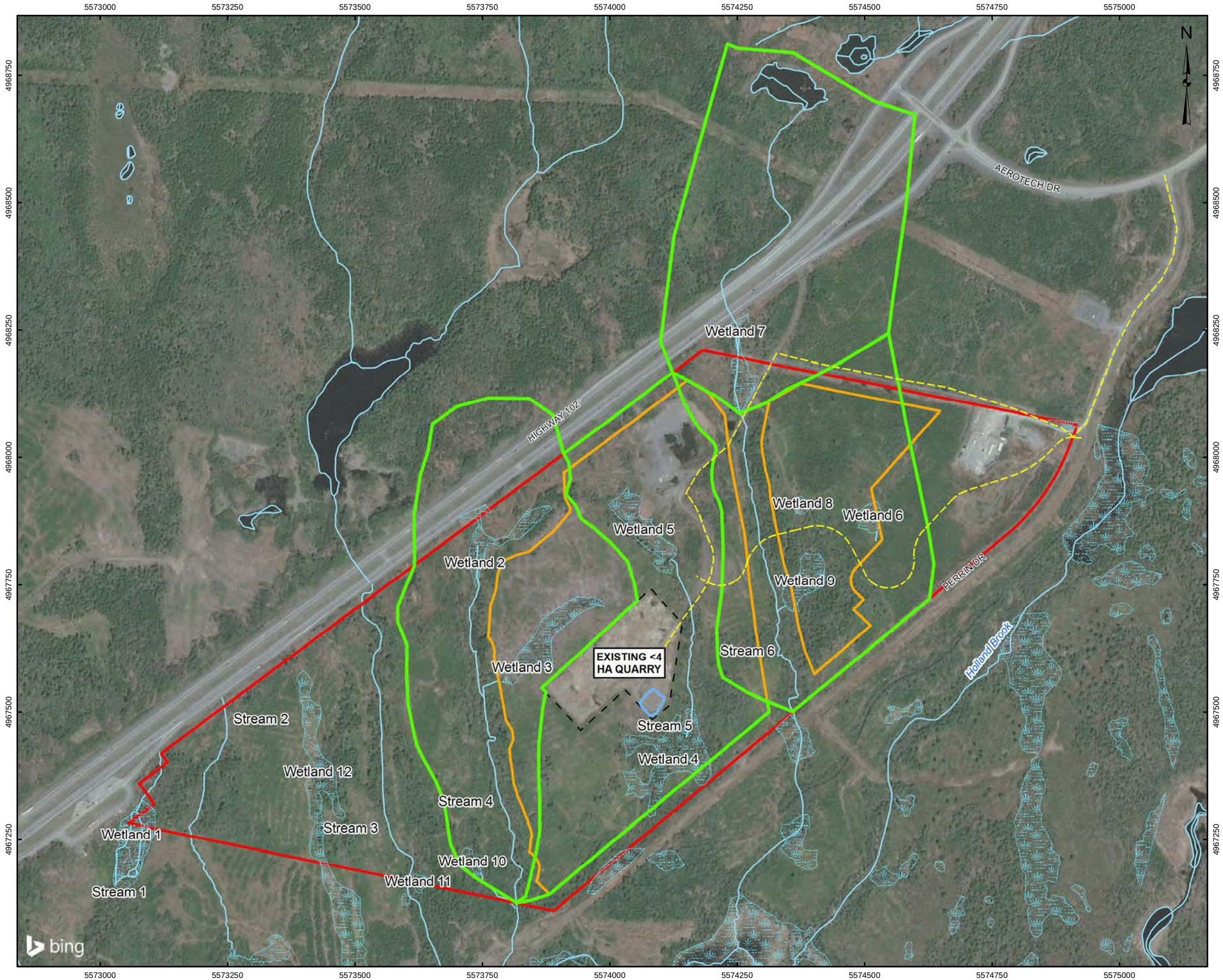
Catchments were delineated to reflect the changes in land use and corresponding water balance characteristics associated with the pre-development and post-development conditions, using available site mapping provided by Scotian.

To evaluate the potential effects of the development of the Goffs Quarry, three streams and one wetland were selected for the assessment (Figure 4 and Figure 5). Catchments are outlined as follows:

- *Stream 4 (pre-development condition):* Approximately 27 ha, represents the drainage area of Stream 4 to the southern property boundary.
- *Stream 5 (pre-development condition):* Approximately 24.1 ha, represents the drainage area of Stream 5 when it joins Stream 4 near the southern property boundary. This catchment includes the existing quarry area.
- *Wetland 7 (unchanged):* Approximately 25.9 ha, represents a local drainage area contributing to Wetland 7.
- *Stream 6 (pre-development condition):* Approximately 49.2 ha, represents the drainage area of Stream 6 to the southern property boundary. This catchment is inclusive of the Wetland 7 catchment area.
- *Stream 4 (post -development condition):* Approximately 54.4 ha, represents the drainage area of Stream 4 to the southern property boundary in post-development condition. This catchment includes the Stream 5 catchment which will be removed during the expansion of the quarry (phases 1 to 3 of the proposed expansion, Figure 5).
- *Stream 6 (post -development condition):* Approximately 44.8 ha, represents the drainage area of Stream 6 to the southern property boundary. This catchment includes Phase 4 of the proposed expansion.

Infiltration and Runoff

Based on the results of subsurface investigation activities within the Property Boundary, the surficial soil type was identified as silty sand. As a result, the soils were modelled as fine sand to fine sandy loam in this assessment. Based on the borehole information collected on-site, the overburden thickness ranges between 5 cm (i.e. bedrock at surface) and 48 cm. Over large areas of the Property the overburden thickness was insufficient to use the recommended water holding capacities. Therefore, the water holding capacities were reduced proportionally based on the average overburden thickness across the Property. Infiltration rates were estimated using the method presented in the Ontario Ministry of the Environment Stormwater Management Planning and Design (SWM) Manual (MOE, 2003).



LEGEND

- QUARRY ACCESS/ TRANSPORT
- WATERCOURSE
- WETLAND
- PRE-DEVELOPMENT CATCHMENT
- SEDIMENTATION POND
- EXISTING <4 HA QUARRY
- PROJECT BOUNDARY
- PROPERTY BOUNDARY

REFERENCES

Base Data - CanVec, obtained 2010
Wetlands - obtained from Canvec, 2010, Golder, 2015, and McCallum, 2014, 2017.
Watercourse - Desisn Point, 2018
Base Imagery © 2018 Microsoft Corporation © 2018 DigitalGlobe ©CNES (2018) Distribution Airbus DS
Projection: Transverse Mercator Datum: ATS77 Coordinate System: MTM Zone 5

100 50 0 100 200 300 400
SCALE 1:7,500 METERS

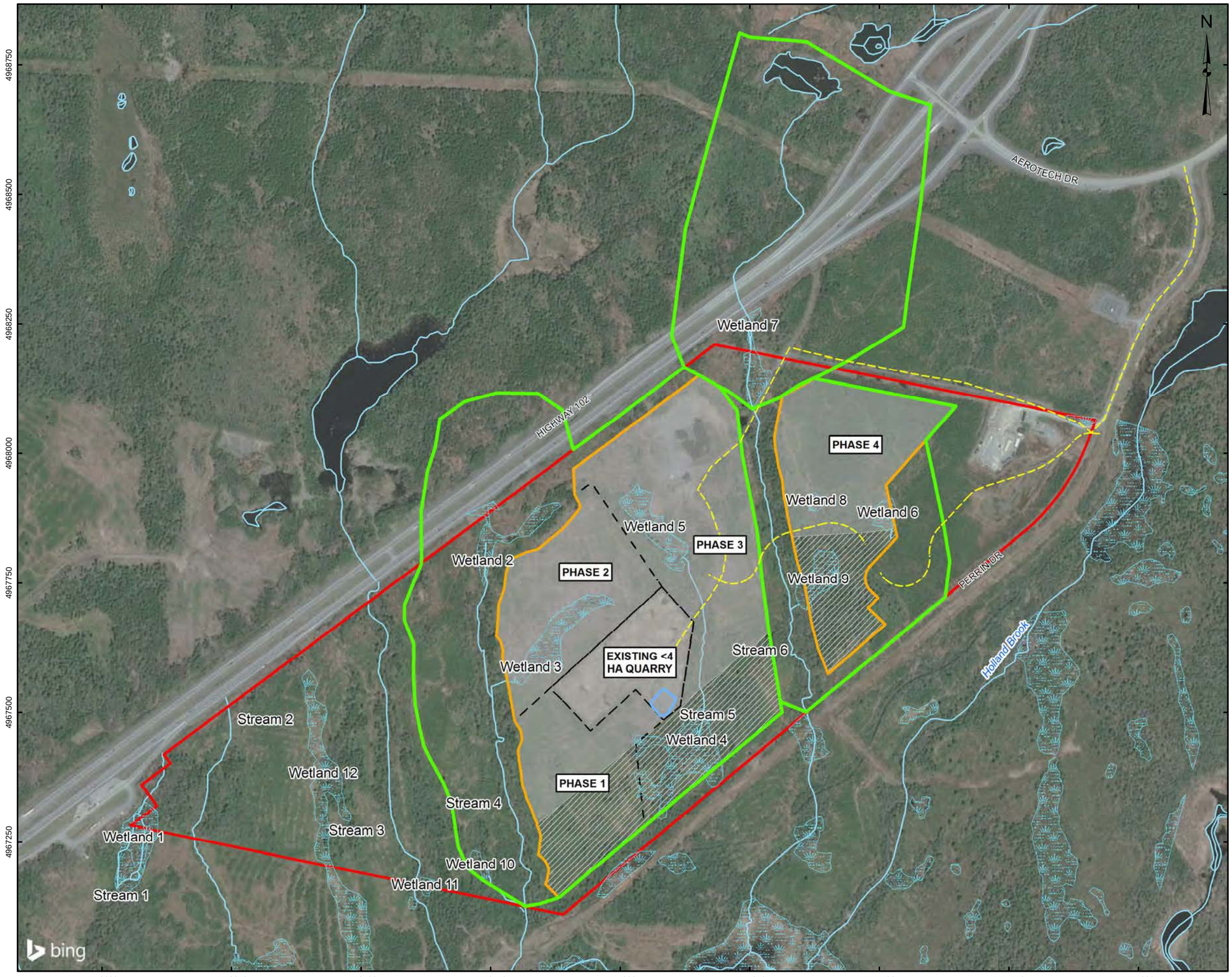
PROJECT
SCOTIAN MATERIALS GOFFS QUARRY EXPANSION EARD

TITLE
PRE-DEVELOPMENT CATCHMENTS

GOLDER

PROJECT No. 1777778			SCALE AS SHOWN	REV. 0.0
DESIGN	CA	2017-05-26	FIGURE 4	
GIS	LMM	26/07/2018		
CHECK	RS	26/07/2018		
REVIEW	CA	26/07/2018		

S:\Clients\Scotian_Materials\Goffs_Quarry\99_PROJ\1777778\40_PROD\0009_EA_Surfacewater\1777778-0009-CS-0002.mxd



LEGEND

- QUARRY ACCESS/ TRANSPORT
- WATERCOURSE
- WETLAND
- POST DEVELOPMENT CATCHMENT
- SEDIMENTATION POND
- PROPOSED EXTRACTION PHASES
- PROPOSED EXTRACTION
- ASSOCIATED DEVELOPMENT
- PROJECT BOUNDARY
- PROPERTY BOUNDARY

REFERENCES

Base Data - CanVec, obtained 2010
Wetlands - obtained from Canvec, 2010, Golder, 2015, and McCallum, 2014, 2017.
Watercourse - Desisn Point, 2018
Base Imagery © 2018 Microsoft Corporation © 2018 DigitalGlobe ©CNES (2018) Distribution Airbus DS
Projection: Transverse Mercator Datum: ATS77 Coordinate System: MTM Zone 5

100 50 0 100 200 300 400
SCALE 1:7,500 METERS

PROJECT
SCOTIAN MATERIALS GOFFS QUARRY
EXPANSION EARD

TITLE
POST DEVELOPMENT CATCHMENTS

GOLDER

PROJECT No. 1777778			SCALE AS SHOWN	REV. 0.0
DESIGN	CA	2017-05-26	FIGURE 5	
GIS	LMM	26/07/2018		
CHECK	RS	26/07/2018		
REVIEW	CA	26/07/2018		

S:\Clients\Scotian_Materials\Goffs_Quarry\99_PROJ\1777778\40_PROD\0009_EA_Surfacewater\1777778-0009-CS-0003.mxd

Net surplus was estimated by multiplying the estimated monthly surplus (mm/month) for the assigned Water Holding Capacity (WHC) by the associated drainage area. Annual evapotranspiration and surplus values were obtained from the meteorological data from the Halifax International Airport Meteorological Station based on the WHC assigned to each land use area. Runoff was calculated as the difference between surplus and infiltration.

5.3 Biophysical Assessment

The investigation of existing conditions within the Biophysical Study Area included a background information search and literature review to gather data about the local area and provide context for the evaluation of the natural features. A number of resources were used to evaluate the existing conditions, including:

- Species at Risk Public Registry (ECCC 2018);
- Categorized List of Species at Risk (NS 2017b);
- Atlantic Canada Conservation Data Center (ACCDC) (ACCDC 2018);
- Bat Conservation International (BCI) range maps (BCI 2018);
- eBird species maps (eBird 2012);
- Maritimes Breeding Bird Atlas (MBBA 2011);
- Provincial Landscape Viewer (NS DNR 2018);
- Nova Scotia Abandoned Mine Openings (AMO) Database (NS 2017a);
- Records of Bats (Chiroptera) at Caves and Mines in Nova Scotia (Moseley 2007);
- Existing Golder and Scotian reports and data; and,
- Available aerial imagery and mapping.

ACCDC tracks species with Sub-national ranks (Sranks) of S1 (Imperiled) to S3 (vulnerable) for NS, as well as SAR. A request for information was submitted to ACCDC for occurrence records within the Study Area, which were used in the background review and SAR screening. The data report prepared by ACCDC is provided in Appendix C. S1 to S3 species that are not listed under the ESA and SARA are still tracked to help identify knowledge gaps and aid conservation. However, these rankings on their own do not represent legal protection under the ESA or the SARA.

To develop an understanding of the drainage patterns, ecological communities and potential natural heritage features that may be affected by the proposed aggregate extraction, available imagery and mapping was used to create base layer mapping for the study area. A geographic query of the Provincial Landscape Viewer (NS DNR 2018) was conducted to identify occurrences of any natural heritage features, including wetlands, sanctuaries and management areas, significant species (including SAR) and other natural heritage features within two km of the Property Boundary.

5.3.1 SAR Screening

SAR considered for this report include those species listed in the ESA and the SARA. An assessment was conducted to determine which SAR had potential habitat within the Property Boundary and in the Study Area. A screening of all SAR which have the potential to be found in the vicinity of the Study Area was conducted first as a desktop exercise using the sources listed in Section 5.3. Species with ranges overlapping the Study Area, or recent occurrence records in the vicinity, were screened by comparing their habitat requirements to habitat conditions in the Study Area.

The potential for the species to occur was determined through a probability of occurrence. A ranking of low indicates no suitable habitat availability for that species within the Property Boundary and/or in the Study Area and no specimens identified. Moderate probability indicates more potential for the species to occur, as suitable habitat appeared to be present within the Property Boundary and/or in the Study Area, but no occurrence of the species has been recorded. Alternatively, a moderate probability could indicate an observation of a species, but there is no suitable habitat within the Property Boundary or in the Study Area. High potential indicates a known species record in the Study Area (including during field surveys or background data review) and good quality habitat is present.

Searches were conducted during field surveys for suitable habitats and signs of all SAR identified through the desktop screening. The screening was refined based on field surveys (i.e., habitat assessment) and/or species-specific surveys. Any habitat identified during ground-truthing or other field surveys with potential to provide suitable conditions for additional SAR not already identified through the desktop screening was also assessed and noted.

5.3.2 Field Surveys

The habitats and communities within the Property Boundary and in the Study Area, where access was possible, were characterized through field surveys. The majority of the field surveys focused within the Property Boundary, although some portions of the Study Area, beyond the Property Boundary, were surveyed. The following sections outline the methods used for each of the field surveys. During all surveys, area searches were conducted and additional incidental wildlife, plant, and habitat observations were recorded. Searches were also conducted to document the presence or absence of suitable habitat, based on habitat preferences, for those species identified in the desktop SAR screening described above. The dates when all surveys were conducted are included in Table 4. Based on the plant communities on the Property, there were no late season blooming plants anticipated that could not be identified in the summer, so a late season botanical inventory was deemed to be unnecessary.

Table 4: Summary of Field Surveys Conducted in the Goffs Study Area in 2012 and 2017

Date	Type of Survey
June 19 to 21, 2012	Plant Community Survey, Wetland Assessment, Botanical Inventory, Breeding Bird Survey, Fish and Fish Habitat Survey, General Wildlife Survey
September 10 & 13, 2012	Wetland Surveys
June 26 to 29, 2017	Plant Community Survey, Wetland Assessment, Botanical Inventory, Breeding Bird Survey, Fish and Fish Habitat Survey, General Wildlife Survey
September 28 to 29, 2017	Wetland Surveys

5.3.3 Plant Community Surveys and Botanical Inventory

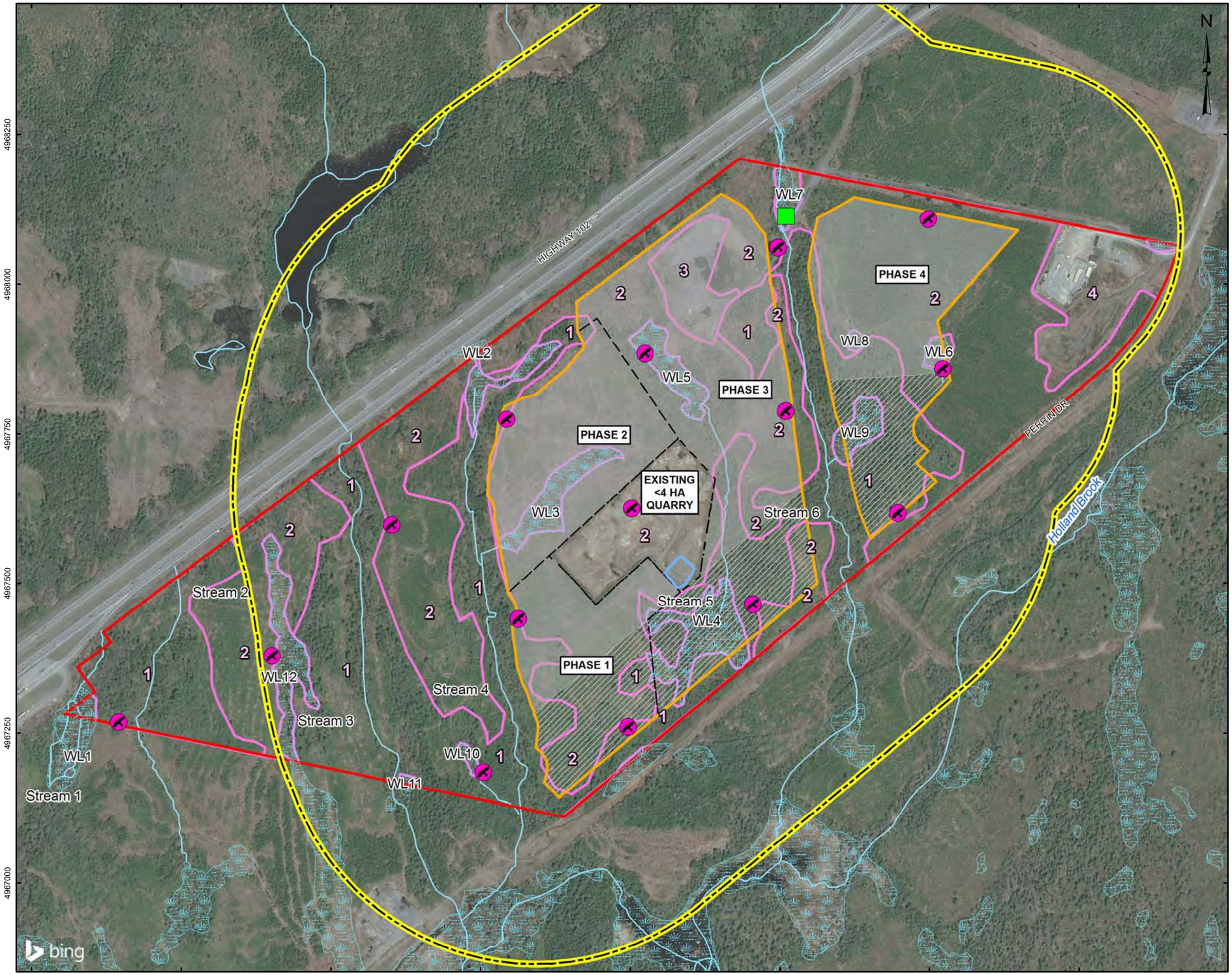
Plant communities within the Property Boundary were first delineated at a desktop level using high resolution aerial imagery, then ground-truthed in the field using the Forest Ecosystem Classification (FEC) system for Nova Scotia (Neily et al. 2010; Keys et al. 2011). The ground-truthing included detailed surveys in each of the plant communities identified at the desktop level (Figure 6). Data on dominant plant species, plant community structure and composition were recorded to better define and refine the plant community polygons.

During the botanical inventories, conducted concurrently with the plant community surveys, vascular plant species and common non-vascular plant species (e.g., mosses) were identified. Representative photographs were also taken in each plant community.

5.3.4 Breeding Bird Survey

Breeding bird point count surveys for songbirds and other diurnal birds were conducted at 15 stations within the Property Boundary (Figure 6 and Figure 7). Surveys followed protocols from the Canadian Breeding Bird Survey (Downes and Collins 2003), and the Maritimes Breeding Bird Atlas (MBBA 2011). Point count stations were established in representative habitats within the Property Boundary and were spaced a minimum of 250 m apart. Surveys were conducted between 30 minutes before sunrise and 10:00 am to encompass the period of maximum bird song.

Each station consisted of a circle with a 100 m radius from the centre point (where the observer stands), and each point count was 10 minutes in duration, and was separated into survey windows of 0-3, 3-5, and 5-10 minutes. All birds seen or heard were noted on pre-printed datasheets and observations were made regarding sex, age and notable behaviour, when possible. Birds heard or seen outside of the 100 m radius were also noted using methods from the MBBA, including estimated distance (where possible).



LEGEND

- BIRD STATIONS
- BLACK ASH
- WATERCOURSE
- WETLAND
- SEDIMENTATION POND
- PROPOSED EXTRACTION PHASES
- PROPOSED EXTRACTION
- ASSOCIATED DEVELOPMENT
- PROJECT BOUNDARY
- PROPERTY BOUNDARY
- FOREST ECOSYSTEM CLASSIFICATION
- STUDY AREA

1. RED SPRUCE – YELLOW BIRCH – EVERGREEN WOOD FERN MIXED FOREST
2. REGENERATING FOREST
3. ABANDONED QUARRY
4. DISTURBED

REFERENCES

Base Data - CanVec, obtained 2010
Wetlands - obtained from Canvec, 2010, Golder, 2017, and McCallum, 2014.
Watercourse - Golder, 2012
Base Imagery © 2018 Microsoft Corporation © 2018 DigitalGlobe ©CNES (2018) Distribution Airbus DS
Projection: Transverse Mercator Datum: ATS77 Coordinate System: MTM Zone 5

100 50 0 100 200 300 400
SCALE 1:6,500 METERS

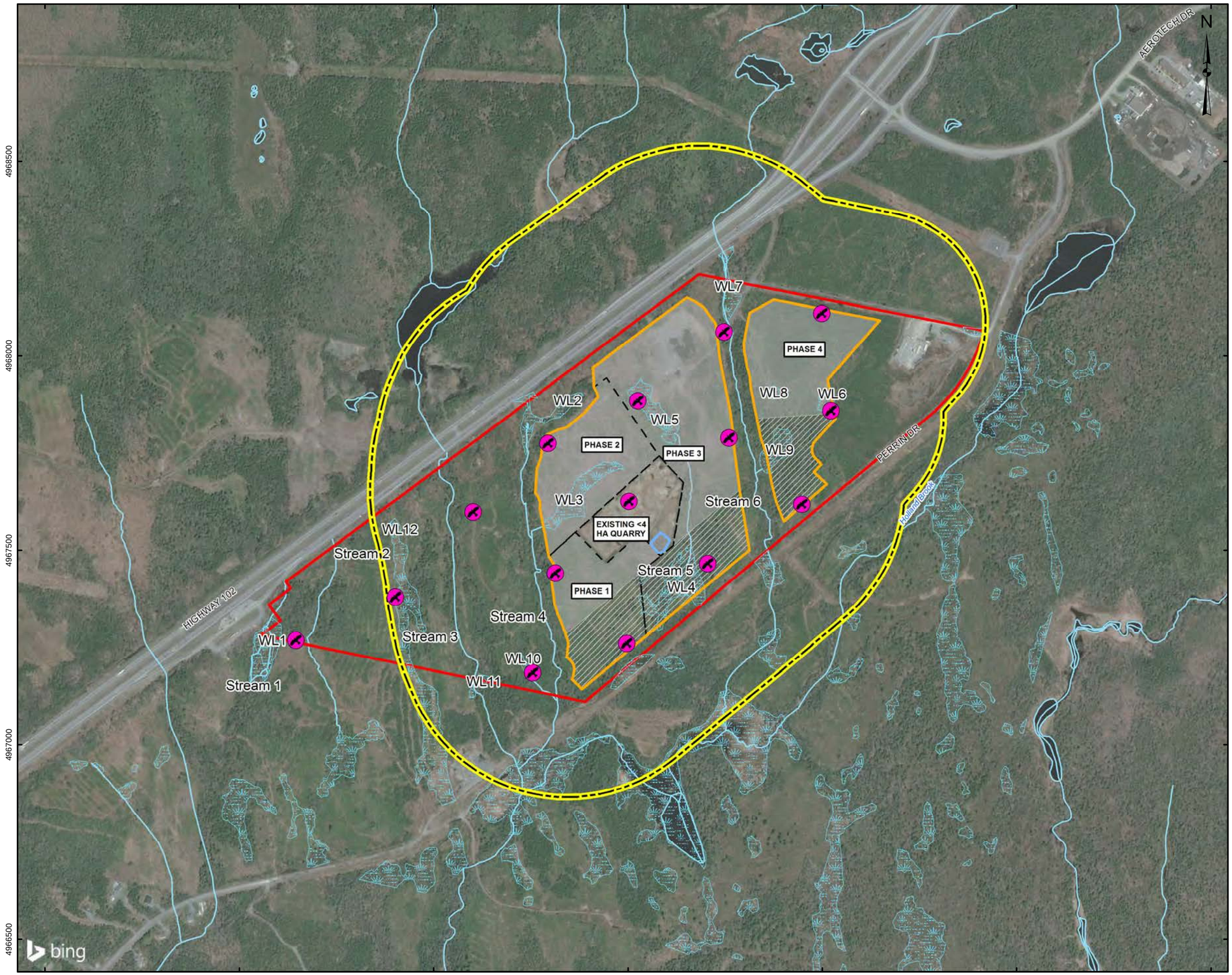
PROJECT
SCOTIAN MATERIALS GOFFS QUARRY EARD

TITLE
NATURAL ENVIRONMENT EXISTING CONDITIONS – SITE

GOLDER

PROJECT No. 1777778			SCALE AS SHOWN	REV. 0.0
DESIGN	CA	2017/05/26	FIGURE 6	
GIS	LMM	25/07/2018		
CHECK	FN	25/07/2018		
REVIEW	PMMC	25/07/2018		

S:\Clients\Scotian_Materials\Goffs_Quarry\99_PROJ\1777778\40_PROD\0010_EA_Natural_Environment\1777778-0010-HS-0001.mxd



LEGEND

- BIRD STATIONS
- WATERCOURSE
- WETLAND
- SEDIMENTATION POND
- PROPOSED EXTRACTION PHASES
- PROPOSED EXTRACTION
- ASSOCIATED DEVELOPMENT
- PROJECT BOUNDARY
- PROPERTY BOUNDARY
- STUDY AREA

REFERENCES

Base Data - CanVec, obtained 2010
Wetlands - obtained from Canvec, 2010, Golder, 2017, and McCallum, 2014.
Watercourse - Golder, 2012
Base Imagery © 2018 Microsoft Corporation © 2018 DigitalGlobe ©CNES (2018) Distribution Airbus DS
Projection: Transverse Mercator Datum: ATS77 Coordinate System: MTM Zone 5

100 50 0 100 200 300 400
SCALE 1:10,000 METERS

PROJECT
SCOTIAN MATERIALS GOFFS QUARRY EARD

TITLE
NATURAL ENVIRONMENT EXISTING CONDITIONS – VICINITY

GOLDER

PROJECT No. 1777778			SCALE AS SHOWN	REV. 0.0
DESIGN	CA	2017/05/26	**FIGURE 7**	
GIS	LMM	25/07/2018		
CHECK	FN	25/07/2018		
REVIEW	PMMC	25/07/2018		

S:\Clients\Scotian_Materials\Goffs_Quarry\99_PROJ\1777778\40_PROD\0010_EA_Natural_Environment\1777778-0010-HS-0002.mxd

5.3.5 General Wildlife Survey

General wildlife surveys, or visual encounter surveys (VES), included track and sign surveys, area searches, and incidental observations, concurrent with other field surveys.

The full range of habitats across the Property, and accessible portions of the Study Area, were searched, with special attention paid to edge habitats and other areas where mammals might be active. Areas of exposed substrate such as sand or mud were located and examined for any visible tracks. Any wildlife (including mammals, butterflies, and dragonflies) seen and identified were recorded. When encountered, tracks and other signs (e.g., tracks, scats, hair, tree scrapes, etc.) were identified to a species, if possible, and recorded. Observations of wildlife species or signs during all field surveys were recorded.

VES for turtles and snakes as well as turtle and snake habitat (with a focus on SAR) were also conducted within the Property Boundary and accessible portions of the Study Area. All suitable habitats for reptiles were searched (e.g., flipping logs and other types of cover objects, observations in piles of rocks) and all reptiles and amphibians observed were identified and recorded.

5.3.6 Fish and Fish Habitat Survey

Surveys to assess fish and fish habitat were completed in six un-named streams as well as in Holland Brook south of the Property Boundary, within the Study Area (Figure 6 and Figure 7). Sampling to determine the presence / absence of fish species was conducted using dip netting, minnow trapping, and beach seining. All captured fish were released alive after identification and enumeration.

Detailed aquatic habitat mapping was also completed for each of the un-named watercourses, along the entire length of the reach within the Property Boundary. Parameters recorded included water depth, morphology, in-stream vegetation and substrates, and riparian conditions. The habitat was hand-drawn on maps, and photos were taken at regular intervals for visual documentation. Water quality measurements (i.e., temperature, conductivity and pH) were taken at a point location along each watercourse, including Holland Brook.

5.3.7 Wetlands

A wetland survey and functional assessment was conducted for the proposed Goffs Quarry within the Property Boundary and surrounding lands from June 27 to 29th and September 28 to 29th, 2017.

The technical approach used for the wetland surveys was based on principles described in the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (US Army Corps of Engineers 2011) using vegetation, soil, and hydrology as wetland indicators. Prior to field surveys, information on the distribution and location of known and prospective wetlands within the Property Boundaries was obtained using data from the Nova Scotia Wetland Inventory Database (NS DNR 2018) and available aerial imagery. The functional assessment was carried out in accordance with the Nova Scotia Wetland Evaluation Technique (NovaWET) method. The assessment will include evaluation of wetland characteristics and specific wetland indicators. Observations related to drainage patterns, wetland classification, SAR (incidental observations) and surrounding land use were noted.

5.4 Archaeological and Heritage Resources

An archaeological resource impact assessment (ARIA) was completed by Davis MacIntyre and Associates Limited (DMA) under Category C Heritage Research Permit A2012NS153 (DMA 2013) within the Property Boundary and adjacent lands. The ARIA consisted of a detailed review of historical maps, manuscripts and published literature as well as the Maritime Archaeological Resource Inventory (MARI) database. A field reconnaissance survey followed the desktop study to further evaluate the potential for archaeological resources.

6.0 EXISTING ENVIRONMENT

6.1 Regional Setting and Context

The Project is located in the Eastern Interior Ecodistrict of the Eastern Ecoregion which is the eastern extension of the Appalachian peneplain which slopes towards the Atlantic Ocean. The ecodistrict is underlain by resistant Meguma Group quartzite and slate. The thickness of the till is quite variable across the ecodistrict, ranging from 1 - 10 m but averaging less than 3 m. The bedrock is highly visible in those areas where the glacial till is very thin, exposing the ridged topography. Where the till is thicker, the ridged topography is masked by the thick softwood forests that occur (Neily et al. 2003). The composition of the forests in this ecodistrict strongly reflects the depth of the soil profile (i.e., hardwoods such as red maple and white birch, with scattered white pine and black spruce on shallow soils and stands of red spruce on deeper soils).

The proposed quarry footprint is situated on the south facing slope of a till ridge which runs northeast-southwest. Elevations across the proposed footprint range from approximately 125 masl in the northern end to approximately 88 masl in the southern end.

The closest waterbodies to the proposed footprint are two tributaries to Holland Brook which flow north to south, following topography: one is approximately 30 m west (Stream 4) and one is in between two phases of the project (Stream 6). Holland Brook is approximately 600 m south and flows northeast to southwest into Soldier Lake. There are numerous bedrock outcrops and small lakes or wetlands filling local depressions which are characteristic of the ecodistrict. The proposed Project footprint and surrounding lands are currently covered by regenerating forests.

6.1.1 Designated Natural Areas

There are no designated natural areas within the Property Boundary or in the Study Area. The closest designated area, a 5,220 ha Game Sanctuary known as the Waverly Game Sanctuary, is located approximately 1 km east of the Property. Approximately 64% of the sanctuary is also considered a Wilderness Area (known as the Waverley-Salmon River Long Lake Wilderness Area) which is protected under the Wilderness Areas Protection Act. Potential impacts to the sanctuary and wilderness area are managed by NS DNR through restriction of activities within the sanctuary/wilderness area boundaries (e.g. hunting, resource development, agriculture) (G. Delano, pers. comm. 2018).

The proposed quarry is not within the boundaries of either the sanctuary or wilderness area, however NS DNR will be engaged through the NSE EA review process. Furthermore, correspondence with DNR on the existing 3.99 ha quarry has indicated that potential impacts related to the current operations on biodiversity values of the sanctuary are expected to be low (G. Delano, pers. comm. 2018).

Designated natural areas are not carried forward into the impact assessment.

6.2 Geological Setting

6.2.1 Regional Geological Setting

Surficial Geology

Surficial geology in the Project area consists of Pleistocene (last glaciation) Till Veneer deposits known as the Beaver River Till and Holocene (postglacial) Lacustrine and Alluvial deposits, according to surficial geology mapping (Utting 2011). The Beaver River Till Veneer deposits are described as a diamicton with a sandy matrix and locally derived clasts. Sediments are deposited by ice and derived from subglacial erosion. The overburden thickness ranges from 0.5 m to 5.0 m in the areas shown as till veneer on Figure 8. The proposed Project footprint also has small areas of lacustrine and alluvial deposits described as gravel, sand, silt, and organic materials deposited from suspension in freshwater lakes, ponds and wetlands or by active streams and rivers (Utting 2011). These deposits coincide with identified wetlands and creeks within, and crossing, the Project footprint. The thickness of these postglacial deposits is estimated to be from 1 m to 10 m.

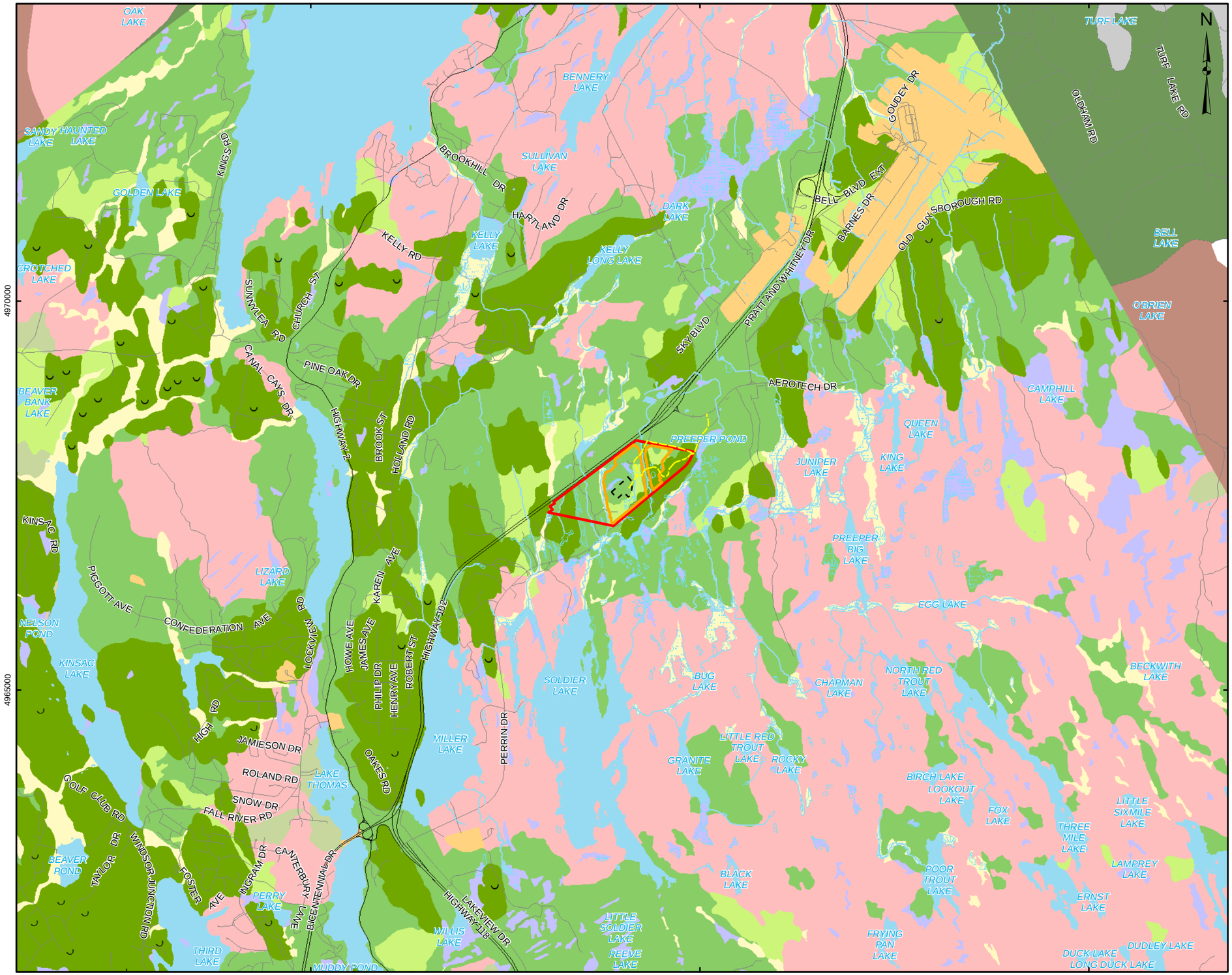
Bedrock Geology

The bedrock geology in the area of the proposed Project footprint (Figure 9) consists of Cambrian to early Ordovician age bedrock of the Goldenville Formation of the Meguma Supergroup which is composed of greenish grey metasandstone and minor interbedded, green, laminated metasiltstone and dark grey-black slate (Home *et al*. 2009). Bedrock exposed in cuts along Highway 102 north of the Project area was mapped as having overturned beds dipping at 85° towards the northwest (Home *et al*. 2009). The strike of the bedrock is parallel to Highway 102 (northeast-southwest). The Goldenville Formation is described as having metasandstone beds ranging in thickness from < 0.5 m to several meters, whereas the metasiltstone beds are typically < 0.5 m thick (White *et al.* 2008). Calcsilicate nodules and large (1-2 cm) pyrite cubes are locally common.

Approximately 0.35 km north of the quarry footprint, the Goldenville Formation has a contact with the Cambrio-Ordovician aged Beaverbank Formation of the Halifax Group of the Meguma Supergroup. The Beaverbank Formation is described as grey metasiltstone, thin metasandstone beds, slate, and locally intervals containing thin (<1-3 cm) coticule layers (Home *et al*. 2009). The area to the south, west and east of the quarry location is Goldenville Formation.

Structural Geology

Based upon a review of the Nova Scotia geological mapping of the area there is one shear fault located 7.8 km to the north-west and one fault located approximately1.8 km to the south-west (Figure 9). There are no faults located within the Property Boundary.



LEGEND

- DRUMLIN
- MAJOR ROAD
- LOCAL ROAD
- QUARRY ACCESS/ TRANSPORT ROUTE
- WATERCOURSE
- WETLAND
- LESS THAN 4 HECTARE QUARRY
- PROJECT BOUNDARY
- PROPERTY BOUNDARY

SURFICIAL GEOLOGY

- ANTHROPOGENIC
- ALLUVIAL
- LACUSTRINE
- HUMMOCKY TILL
- TILL BLANKET
- TILL VENEER
- DRUMLINS
- BEDROCK
- LAKE
- SILTY TILL PLAIN (GROUND MORAINE)
- STONY TILL PLAIN (GROUND MORAINE)
- ORGANIC DEPOSITS

REFERENCES

Base Data - CanVec, obtained 2010
Wetlands - obtained from Canvec, 2010, Golder, 2017, and McCallum, 2014.
Watercourse - Golder, 2012
Surficial Geology - Surficial Geology Mapping Project of the Halifax Metropolitan and Surrounding Areas, Halifax and Hants Counties, Nova Scotia, by D. J. Utting, 2011
Projection: Transverse Mercator Datum: ATS77 Coordinate System: MTM Zone 5

500 250 0 500 1,000 1,500 2,000
SCALE 1:50,000 METERS

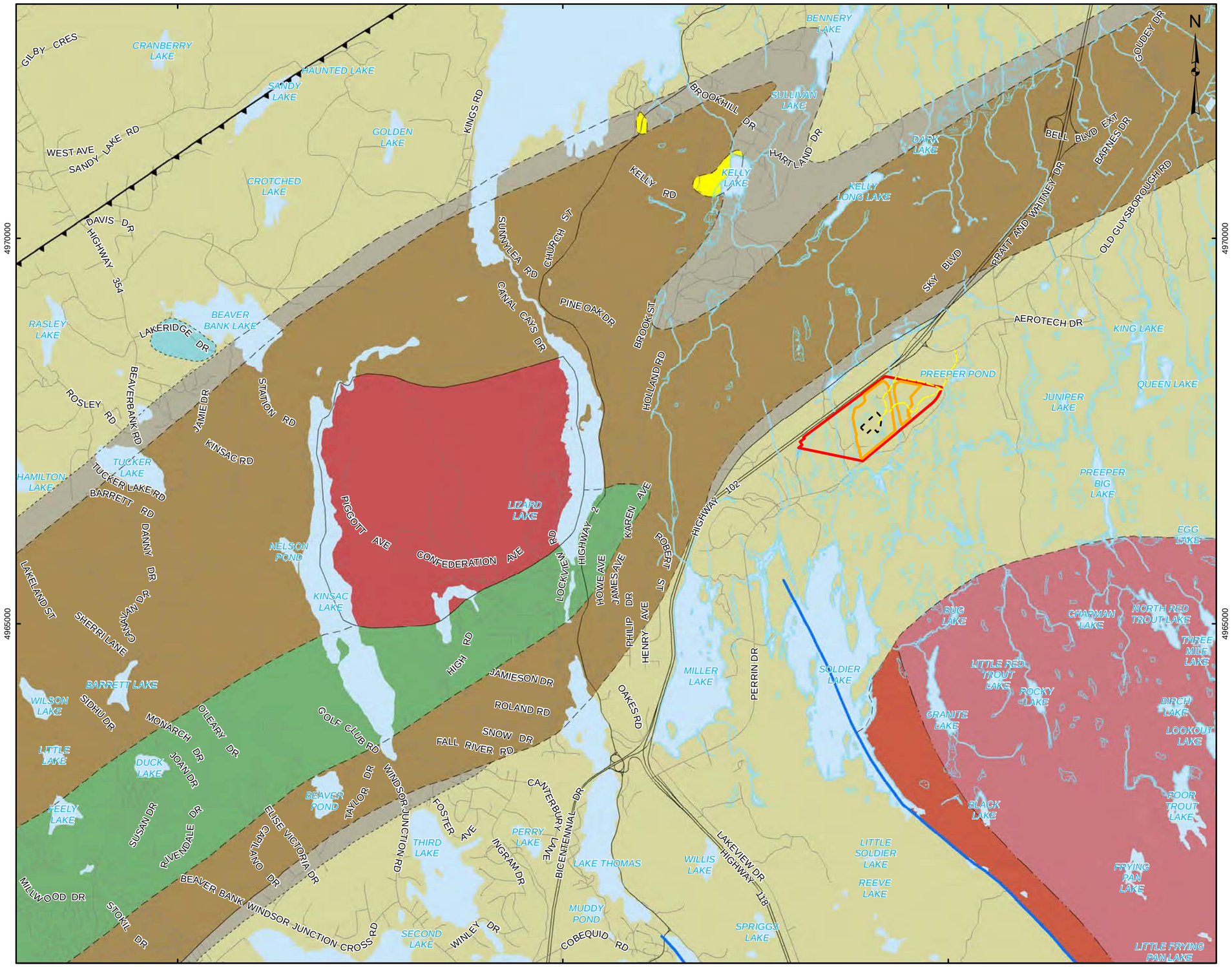
PROJECT
SCOTIAN MATERIALS GOFFS QUARRY EARD

TITLE
SURFICIAL GEOLOGY

GOLDER

PROJECT No. 1777778			SCALE AS SHOWN	REV. 0.0
DESIGN	CA	2018-05-04	FIGURE 8	
GIS	CGE	2018-05-11		
CHECK	CA	2018-05-11		
REVIEW	PMMC	2018-05-11		

S:\Clients\Scotian_Materials\Goffs_Quarry\99_PROJ\1777778\40_PROD\0006_EA_Groundwater\1777778-0006-CH-0002.mxd



LEGEND

- FAULT
- SHEAR FAULT
- GEOLOGICAL CONTACT APPROXIMATE
- GEOLOGICAL CONTACT
- GEOLOGICAL CONTACT GENERAL
- GEOLOGICAL CONTACT GRADATIONAL
- MAJOR ROAD
- LOCAL ROAD
- QUARRY ACCESS/ TRANSPORT
- WATERCOURSE
- WETLAND
- WATERBODY
- LESS THAN 4 HECTARE QUARRY
- PROJECT BOUNDARY
- PROPERTY BOUNDARY

BEDROCK GEOLOGY

- CARROLLS CORNER FORMATION
- COLDSTREAM FORMATION
- LEUCOMONZOGRANITE
- MUSCOVITE-BIOTITE MONZOGRANITE
- KINSAC PLUTON
- GLEN BROOK MEMBER
- CUNARD MEMBER
- BEAVERBANK MEMBER
- GOLDENVILLE FORMATION

REFERENCES

Base Data - CanVec, obtained 2010
Wetlands - obtained from Canvec, 2010, Golder, 2017, and McCallum, 2014.
Watercourse - Golder, 2012
WATER WELLS - DP ME 430, Version 2, 2013, Enhanced Georeferenced Version of the Nova Scotia Department of Environment's Nova Scotia Well Logs Database (2012) compiled by G.W. Kennedy and B. E. Fisher, 2013.
Bedrock Geology - DP ME 147, Version 1, 2009. Digital Geological Data Generated from the Central Meguma Mapping Project, 1995-1999 and 2002-2004, in the Mount Uniacke Area, Halifax and Hants Counties, Nova Scotia, NTS Sheet 11D/13
Projection: Transverse Mercator Datum: ATS77 Coordinate System: MTM Zone 5

500 250 0 500 1,000 1,500 2,000
SCALE 1:50,000 METERS

PROJECT
SCOTIAN MATERIALS GOFFS QUARRY EARD

TITLE
BEDROCK GEOLOGY

GOLDER

PROJECT No. 1777778			SCALE AS SHOWN	REV. 0.0
DESIGN	CA	2018-05-04	FIGURE 9	
GIS	LMM	24/07/2018		
CHECK	CA	24/07/2018		
REVIEW	PMMC	24/07/2018		

S:\Clients\Scotian_Materials\Goffs_Quarry\99_PROJ\1777778\40_PROD\0006_EA_Groundwater\1777778-0006-CH-0016.mxd

6.2.2 Project Geological Setting

Project Geologic Description

From Utting (2011), and as shown in Figure 8, the surficial geology at the Property generally consists of areas of till veneer or till blanket. The till is characterized as diamicton with a sandy matrix and locally derived clasts. The typical thickness of the till veneer is from 0.5 m to 5 m, although localized areas of exposed bedrock and thicker till blanket deposits (> 5 m) are present.

The bedrock geology at the Property consists of the Goldenville Group of the Meguma Supergroup (Horne et al. 2009) as shown on Figure 9. The Goldenville Group is characterized as greenish grey metasandstone and minor interbedded, green, laminated metasiltstone and dark grey-black slate.

Stratigraphy

Based on the field program, the subsurface material encountered generally consists of rootmat and / or topsoil; overlying silt, sand, and gravel till; overlying bedrock. Rootmat and / or topsoil ranged from 5 to 48 cm in thickness followed by till ranging from 5 to 305 cm in thickness.

Bedrock

Bedrock was encountered in all thirteen (13) boreholes. The depth to bedrock from ground surface varies from approximately 1 cm at location MW16-2 to 305 cm at location MW17-6. The bedrock predominately consists of fresh to slightly weathered, dark green-grey, fine to medium grained, greywacke of the Goldenville Formation, interbedded with layers of dark green-grey slate, and dark grey argillite. Based on on-site observations from the drilling program, it was noted that about less than 5% of the rock mass was weathered and more competent rock was encountered anywhere from approximately 3 metres below ground surface (mbgs) to 11 mbgs across the Property.

Acid Rock Drainage and Metal Leaching

Rock samples were collected from the existing quarry in November 2017 to assess the Acid Rock Drainage (ARD) and Metal Leaching (ML) properties of the lithologies that will be encountered during aggregate extraction.

All samples had neutralization potential and acid potential (NP/AP, or NPR) values and CO_3-NPR values greater than 2 and are classified as non-potentially acid generating based on the NPR criteria provided in the Natural Resources Canada Mine Environment Neutral Drainage Program (MEND 2009). All samples contained total sulphur and sulphide sulphur contents less than 0.1 wt % as sulphur. Based on the acid generation potential results, lithologies at the Goffs Quarry are not expected to generate acidic drainage.

The results of the de-ionized (DI) water leach testing indicate that aluminum and arsenic have the potential to become mobilized through weathering and leaching of the pit wall material. However, based on the limited surface area of rock available in the pit walls that will be exposed to meteoric water, mixing of pit wall runoff with non-contact water, and pre-existing elevated concentrations of these parameters, the potential mass loading of aluminum and arsenic to receiver water bodies is not anticipated to have a negative influence upon effluent discharge quality. A single selenium result is noted to slightly exceed the Canadian Environmental Quality Guidelines (CEQG), while the mean result for selenium is below CEQG. All other parameters did not indicate a concern with respect to metal leaching. The available results do not indicate a potential for mass loading of metals to concentrations greater than baseline conditions.

Based on the findings stated above, acid rock drainage and metal leaching were not carried forward to the impact assessment.

6.3 Groundwater Resources

Refer to the *Hydrogeological Assessment - Proposed Goffs Quarry* report provided in Appendix A for detailed findings including hydrogeological cross sections.

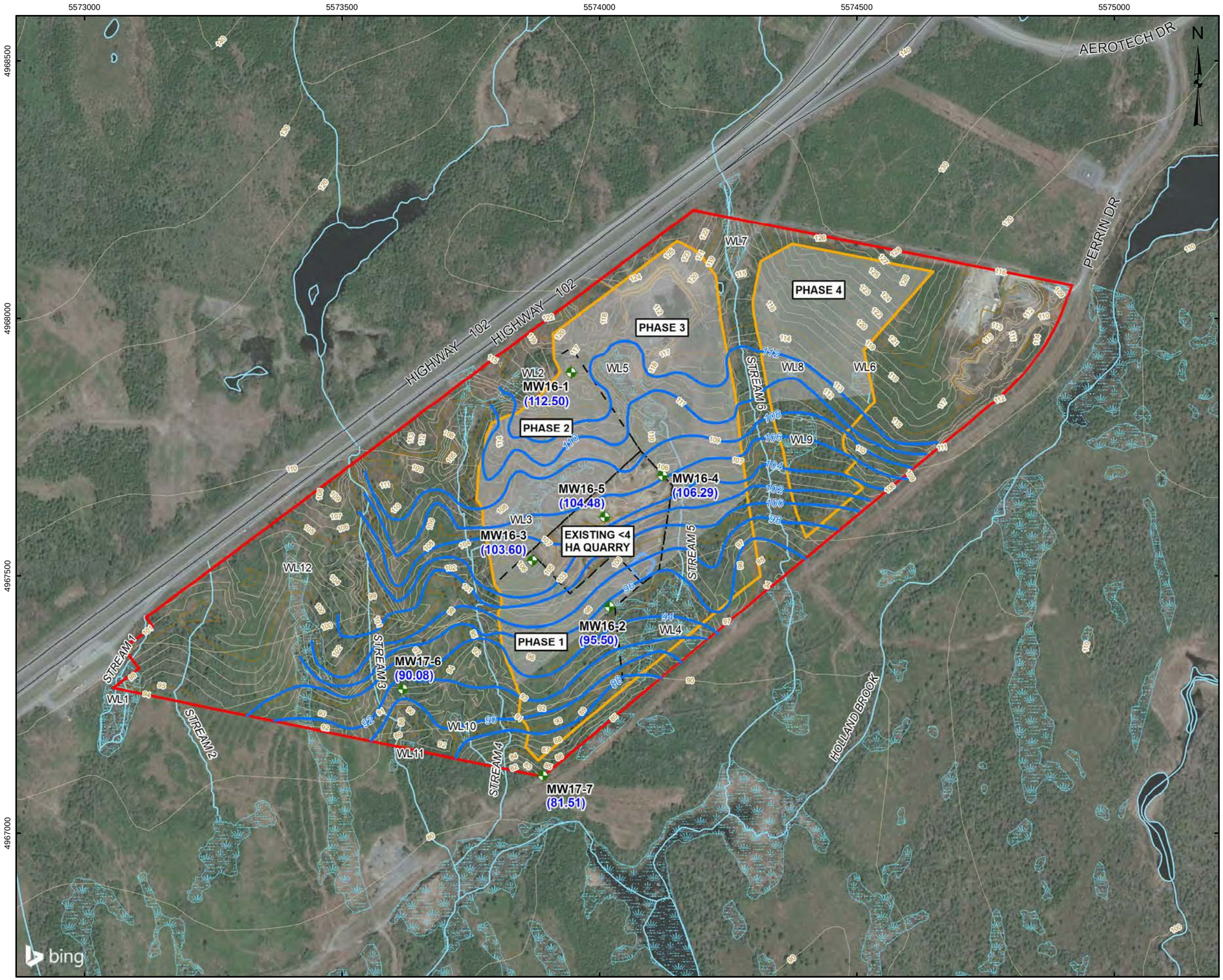
6.3.1 Groundwater Levels

Groundwater levels measured in the monitoring wells generally range from 0.1 to 6.3 mbgs, and 81.51 to 113.57 masl. Groundwater elevations are influenced by local topography, decreasing from north to south across the monitoring well network. The highest groundwater elevations (111.13 to 113.57 masl) were observed at MW16-1, located on the north part of the proposed Project footprint, and the lowest groundwater elevations (81.51 to 83.14 masl) were observed at MW17-7, located at the south edge of the proposed Project footprint.

Downward gradients (indicating downward groundwater flow) were observed at MW16-1, MW16-2, MW16-3, MW16-4 and the upper wells at MW17-6 (MW17-6A-2 and MW17-6B-1). Slight upward gradients were observed between the lower wells at MW17-6 (MW17-6A-1 and MW17-6A-2) and at MW17-7.

Shallow groundwater level contours from September 2017 are shown on Figure 10. Shallow groundwater flow (screened from 114.03 masl to 77.09 masl) is generally found to follow topography, flowing from a high point elevation near BH16-1 in the north-eastern area of the Property to a low point elevation near BH16-2 in the south-western area of the Property.

It should be noted that as a part of the existing operations of the asphalt and concrete plant a water well will be drilled that will allow for confirmation of the water level in the general area of Phase 4.



LEGEND

- GROUNDWATER MONITORING WELL NEST
- 112.50 GROUNDWATER ELEVATION (M), (SEPTEMBER 26, 2017)
- GROUNDWATER ELEVATION CONTOUR (2M)
- MAJOR ROAD
- LOCAL ROAD
- CONTOUR (10 m)
- CONTOUR (MAJOR) 5m
- CONTOUR (MINOR) 2m
- WATERCOURSE
- WETLAND
- SEDIMENTATION POND
- PROPOSED EXTRACTION PHASES
- PROPOSED EXTRACTION AREA
- PROJECT BOUNDARY
- PROPERTY BOUNDARY

REFERENCES

Base Data - CanVec, obtained 2010
Wetlands - obtained from Canvec, 2010, Golder, 2017, and McCallum, 2014.
Watercourse - Golder, 2012
Contours - 15HF0052 AEROTECH SURFACE, 2M, ALLNORTH, JULY 2015
Base Imagery © 2018 Microsoft Corporation © 2018 DigitalGlobe ©CNES (2018) Distribution Airbus DS
Projection: Transverse Mercator Datum: ATS77 Coordinate System: MTM Zone 5

100 50 0 100 200 300 400
SCALE 1:7,500 METERS

PROJECT
SCOTIAN MATERIALS GOFFS QUARRY EARD

TITLE
GROUNDWATER MONITORING WELL LOCATIONS AND SHALLOW GROUNDWATER ELEVATION

GOLDER

PROJECT No. 1777778			SCALE AS SHOWN	REV. 0.0
DESIGN	CA	2018-05-04	FIGURE 10	
GIS	LMM	25/07/2018		
CHECK	CA	25/07/2018		
REVIEW	PMMC	25/07/2018		

S:\Clients\Scotian_Materials\Goffs_Quarry\99_PROJ\1777778\40_PROD\0006_EA_Groundwater\1777778-0006-CH-0005.mxd

6.3.2 Hydraulic Conductivity

The hydraulic conductivity from the single well response tests in the overburden and bedrock wells ranged from $1x10^{-8}$ m/s to $6x10^{-5}$ m/s. The hydraulic conductivity of the overburden, based on grain size analysis, ranged from $4x10^{-7}$ m/s to $1x10^{-4}$ m/s. These hydraulic conductivities are typical of the on-site till overburden that is made up of gravelly, clayey, silt and sand and the slightly weathered bedrock.

6.3.3 Groundwater Quality

Inorganic

Groundwater quality results showed that the turbidity of all samples taken prior to December 2017, using traditional sampling methodology, was elevated above the CDWQ. Results collected in December 2017 and March 2018, using a low-flow sampling methodology, showed reduced turbidity compared to previous results, although were still elevated above the CDWQ. The CDWQ for turbidity was established for drinking water systems to achieve health-based pathogen removal goals and is not based on toxic effects on organisms. The lab-measured pH of samples collected from eight wells (MW16-1C-1, MW16-2B-1, MW16-2B-2, 16-3B-1, MW16-3B-2, MW16-4B-1, MW17-6B-1 and MW17-7A-2 did not meet the CDWQ treatment related operational guideline. Samples from several wells (MW16-1C-1, MW16-1B-1, MW16-1A-2, MW16-1A-1, MW16-2B-1, MW16-2A-2, MW16-3B-2, MW16-3B-1, MW16-3A-1 and MW16-5 did not meet the aesthetic objective for colour.

Metals

Both total and dissolved concentrations of metals were measured in the samples. Some metals did not meet the Aesthetic Objectives (AO) or Operational Guidelines (OG) in 2016 and July 2017 baseline sampling. These metals were: aluminum, manganese, copper and iron. The March 2018 water quality results exceeded for dissolved aluminum, manganese, and iron, which also exceeded historically.

Antimony, arsenic, cadmium, chromium lead and uranium concentrations (dissolved and / or total) were observed in the early sampling results (prior to December 2017). More recent sampling events, using the low-flow sampling methodology, indicated arsenic and or lead in exceedance of the CDWQ. Dissolved arsenic was the only metal parameter sampled in March 2018 that exceeded the CDWQ. Total metals were not sampled in March 2018. As previously discussed, arsenic and other parameters with historical exceedances are believed to be related to the natural chemistry of the soil and rock. A summary of historical exceedances above CDWQ health-related MAC is provided below in Table 5.

Table 5: Summary of Groundwater Quality CDWQ Exceedances

Well ID	Final Well ID	Metals Concentrations Exceeding the MAC			
		June 2016	September 2017	December 2017	March 2018
MW16-1A	MW16-1C-1	Lead (total)	Lead (total)	Lead (total)	None
MW16-1B	MW16-1B-2	Antimony (dissolved and total), Arsenic (dissolved and total), Lead (total)	Arsenic (total), Lead (total)	None	None
MW16-1C	MW16-1B-1	None	Arsenic (total)	None	None
MW16-1D	MW16-1A-2	Lead (total)	None	None	None

Well ID	Final Well ID	Metals Concentrations Exceeding the MAC			
		June 2016	September 2017	December 2017	March 2018
MW16-1E	MW16-1A-1	Arsenic (total), Lead (total)	Arsenic (total), Lead (total)	None	None
MW16-2A	MW16-2B-1	Antimony (total), Arsenic (total), Cadmium (total), Chromium (total), Lead (total), Uranium (total)	Arsenic (total), Cadmium (total), Chromium (total), Lead (total)	Lead (total)	None
MW16-2B	MW16-2A-2	Arsenic (total), Lead (total)	Lead (total)	None	None
MW16-2C	MW16-2A-1	None	None	None	None
MW16-3A	MW16-3B-2	None	Arsenic (total), Lead (total)	None	None
MW16-3B	MW16-3B-1	Arsenic (dissolved and total), Cadmium (total), Lead (total)	Arsenic (total), Cadmium (total), Lead (total)	None	None
MW16-3C	MW16-3A-2	Arsenic (total), Chromium (total), Lead (total), Uranium (total)	None	None	None
MW16-3D	MW16-3A-1	Arsenic (total), Lead (total)	Arsenic (dissolved and total)	Arsenic (dissolved and total)	Arsenic (dissolved)
MW16-4A	MW16-4B-1	Arsenic (total), Lead (total)	Arsenic (total)	None	None
MW16-4B	MW16-4A-2	Arsenic (total), Lead (total)	Arsenic (total), Lead (total)	None	None
MW16-4C	MW16-4A-1	Arsenic (total)	Arsenic (total), Lead (total)	None	None
MW17-6A	MW17-6A-1	Arsenic (total), Chromium (total), Lead (total)	Arsenic (total), Lead (total)	None	None
MW17-6B	MW17-6A-2	Arsenic (total), Chromium (total), Lead (total)	Arsenic (total), Chromium (total), Lead (total)	None	None
MW17-6C	MW17-6B-1	Arsenic (total), Lead (total)	Lead (total)	None	None
MW17-7A	MW17-7A-1	None	None	None	None
MW17-7B	MW17-7A-2	Arsenic (total), Chromium (total), Lead (total)	Arsenic (total), Lead (total)	None	None

BTEX and PHC Results

There were detections of toluene at levels below the CDWQ aesthetic objective at MW17-6A-1, MW17-6A-2, MW17-7A-1 and MW17-7A-2. Detections of C6-C10 (less BTEX) PHCs were reported in samples from MW17-6A-1 and MW17-6A-2 and the concentration of C21-C32 PHC was slightly above the detection limit in the sample from MW16-3A-2. No other hydrocarbons or BTEX parameters were detected. There were no BTEX or PHC concentrations in exceedance of CDWQ.

Summary and Trends

These baseline groundwater quality samples were collected prior to quarrying activities and therefore represent pre-extraction groundwater quality. Should an unexpected change in groundwater quality occur during extraction then these baseline samples can be used for comparison. There were no consistent trends with respect to parameter concentrations with depth. In general, the following parameters appeared to be increasing with depth: arsenic (MW16-4, MW17-6, MW17-7), calcium (MW16-2 and MW16-4); magnesium (MW16-2, MW16-3, MW16-4, MW17-6) and uranium (MW16-2, MW16-4, MW17-6, MW17-7). A decreased concentration with depth was observed for cadmium (MW16-4, MW17-6 and MW17-7) and zinc (MW16-1 and MW17-7). MW16-1 showed no obvious trends in groundwater quality with depth, and MW16-5 is not a multi-level well. In general, samples with higher turbidity levels had a larger number of metals concentrations exceeding the CDWQ guidelines. It should be noted that naturally-occurring water quality problems exist in Nova Scotia which include elevated arsenic, chloride, hardness, iron, manganese, radionuclides, radon, sulphate and uranium. These parameters are related to the natural chemistry of the soil and rock. Increased chloride concentrations can also be attributed to seawater or brackish water and are common in wells located proximal to the ocean (NSE 2014).

6.3.4 Local Groundwater Use

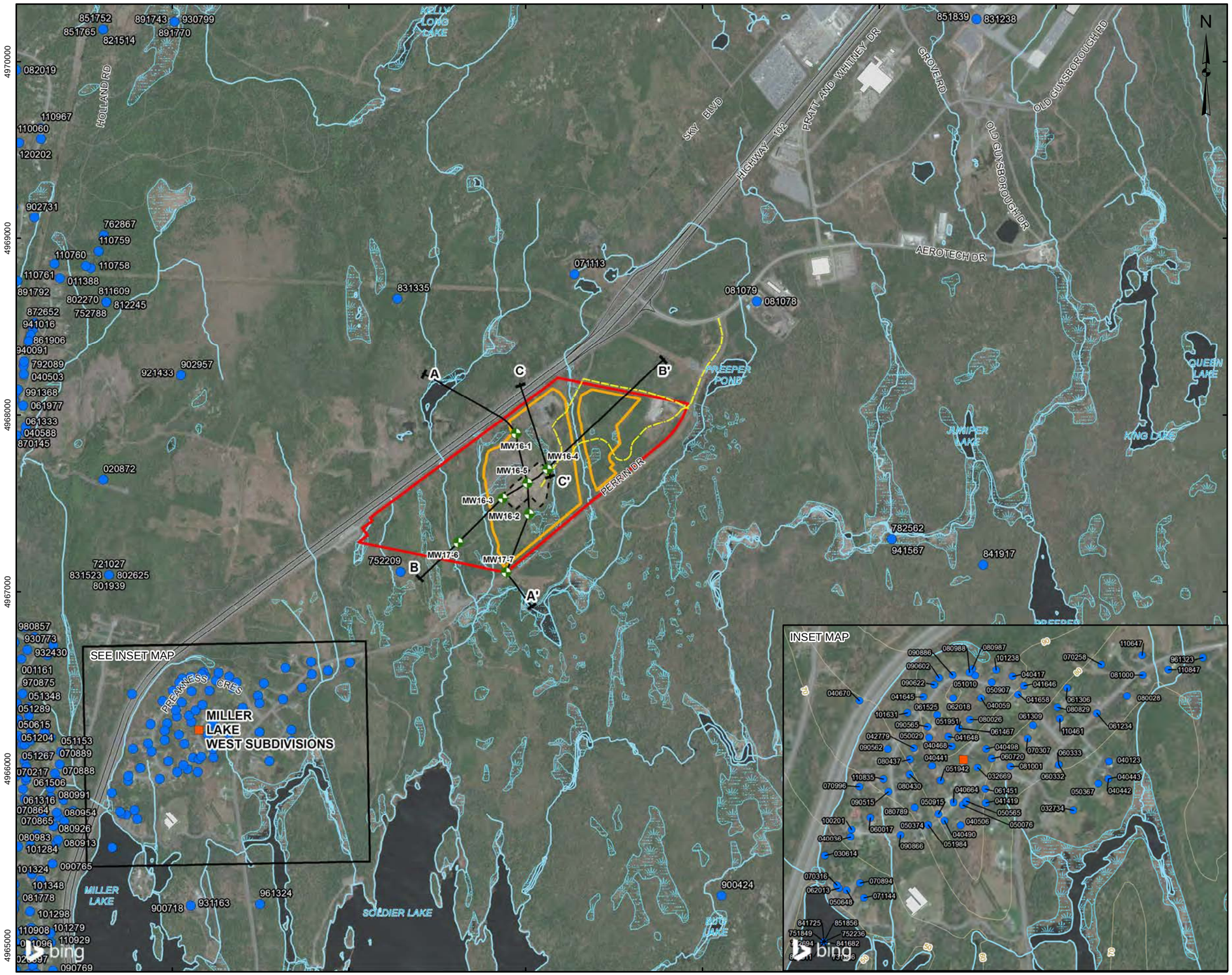
To understand the number and type of groundwater users in the area, the NS Water Well Database was searched for wells located within 2 km of the Project footprint. Most of the wells within the 2 km radius are located in the closest subdivision, Miller Lake West, which is located approximately 1.1 km to the southwest of the Project (as shown in Figure 11). Note that not all wells in the NS Water Well Database are entered with an address and therefore may not include all wells in the area of interest. Data obtained from the NS Well Database is presented in the *Hydrogeological Assessment - Proposed Goffs Quarry* is provided in Appendix A. No wells are located within 0 to 500 m from the radius of the Project. Within the 500 m to 1 km radius of the Project footprint there are 5 wells documented within the NS Water Well database, with 2 listed as domestic well use (752209 and 831335), 2 as industrial use (081078 and 081079) and 1 as a test hole (071113). Based on a review of the database, the following information is available on the domestic wells located within 1 km of the Project:

- Well ID 752209 south-west of the Project is located on lands owned by Scotian. Scotian was unable to confirm the location of the well based on the coordinates provided in the NS Well Database and is not aware of any well located in this area.
- Well ID 831335 north-west of the Project is associated with Lot 20 on Holland Road. The location provided in the database has an accuracy of +/- 1500 m. The coordinates provided in the database indicate that the well is located within an undeveloped parcel of land approximately 2 km from Holland Road and based on a review of aerial photos, there are no residential structures and no road access to this location.

The nearest domestic use wells in the Miller Lake West subdivision are located approximately 1.1 km southwest of the Project.

Based on the database, most domestic water wells are obtaining water from the quartzite, slate or shale bedrock which is presumed to be bedrock of the Goldenville Formation based on the bedrock mapping (Home *et al*. 2009). The Goldenville Formation extends from east of the proposed quarry footprint to the Miller Lake West housing subdivision and beyond.

According to the NS Water Well Database, the depth to bedrock ranges from 0.3 to 30.45 m, with a median depth to bedrock of 7.9 m. The well depths in the area range from 45.68 - 140.07 m with a median depth of 98.96 m. The depth to static water ranges from 0.61 -30.45 m with a median depth of 6.09 m. The well yields range from 0.85 – 136.2 L/min) with a median well yield of 6.81 L/min. Note that the subsurface conditions can change between wells and so the results of the examination of the NS Water Well Database may not be representative of the area around the quarry footprint.



LEGEND

- GROUNDWATER MONITORING WELL NEST
- WATER WELL (DRILLED)
- RESIDENTIAL AREA / COMMUNITY
- CROSS SECTION
- MAJOR ROAD
- LOCAL ROAD
- QUARRY ACCESS/ TRANSPORT
- WATERCOURSE
- WETLAND
- BUILDING FOOTPRINT
- LESS THAN 4 HECTARE QUARRY
- PROJECT BOUNDARY
- PROPERTY BOUNDARY

NOTES

1. Please note that well 752209 could not be located in the field.

REFERENCES

Base Data - CanVec, obtained 2010
Wetlands - obtained from Canvec, 2010, Golder, 2017, and McCallum, 2014.
Watercourse - Golder, 2012
Water Wells - DP ME 430, Version 2, 2013, Enhanced Georeferenced Version of the Nova Scotia Department of Environment's Nova Scotia Well Logs Database (2012) compiled by G.W. Kennedy and B. E. Fisher, 2013.
Base Imagery © 2018 Microsoft Corporation © 2018 DigitalGlobe ©CNES (2018) Distribution Airbus DS
Projection: Transverse Mercator Datum: ATS77 Coordinate System: MTM Zone 5

250 125 0 250 500 750 1,000
SCALE 1:22,000 METERS

PROJECT
SCOTIAN MATERIALS GOFFS QUARRY EARD

TITLE
WATER WELL LOCATION PLAN

GOLDER

PROJECT No. 1777778			SCALE AS SHOWN	REV. 0.0
DESIGN	CA	2018-05-04	FIGURE 11	
GIS	LMM	24/07/2018		
CHECK	CA	24/07/2018		
REVIEW	PMMC	24/07/2018		

S:\Clients\Scotian_Materials\Goffs_Quarry\99_PROJ\1777778\40_PROD\0006_EA_Groundwater\1777778-0006-CH-0011.mxd

6.3.5 Private Well Survey

Scotian conducted a Private Well Survey as a part of Scotian's outreach program to address concerns raised by the public regarding potential impacts of the recently approved Goffs Quarry on the quality and quantity of their well water between August 23rd and September 6th, 2017, Golder conducted private water well surveys in Miller Lake Subdivision, Nova Scotia. There were eight homes invited to participate and five homes agreed to participate. These homes are located at a distance of 1.2 km and greater from the proposed quarry boundaries.

These surveys included the collection of information related to the properties, wells, and sewage systems, the collection of untreated water samples from the wells at the properties, and short-term pumping tests to monitor water levels and well recovery. Results of the surveys were reported to homeowners on October 4, 2017.

The results are confidential and are not provided in this report, but a summary of the findings are as follows:

1) Wells are used for domestic purposes such as drinking, cooking, washing, filling pool, watering lawn and gardening.

2) Well depths range from approximately 97 m to 120 m

3) Static water levels range from approximately 10 mbgs to 20 mbgs

4) Untreated water quality samples were obtained and analysed for general inorganics, metals and petroleum hydrocarbons

5) Majority of the results were consistent with the samples collected from the on-site groundwater monitoring wells. Water quality results were also compared to CDWQ and some samples had exceedances of e-coli, total coliforms, turbidity, aluminium, arsenic, iron, lead and manganese. It is our understanding that some of the wells do have a softeners, filters, reverse osmosis and /or ultraviolet light treatment systems.

6) Resident indicated that the current well usually provides sufficient water for their domestic uses.

6.4 Surface Water Resources

The following sections provide a summary of the findings of the hydrological studies conducted for the Project. For more detailed information refer to the technical memorandum provided in Appendix B.

Stream Flows

The monitored flows in Streams 3, 4, 5, 6 and Holland Brook were within expected seasonal variations with low flows during the summer months and high flows during the spring freshet. The flow measurements obtained during the spring (following the freshet) were similar to the flow measurements taken in the fall for all streams.

Construction activities for the 3.99 ha quarry commenced in September 2017 resulting in four flow monitoring events being conducted as part of the construction phase monitoring. The flows and water levels measured from September to November were similar to the flows and levels measured earlier in the year under baseline conditions. One flow measurement (December 2017) was obtained following the first blast event (November 21, 2017). The December 8, 2017 flow measurements in Stream 5 were taken during a discharge event. It should be noted that monitoring location SW4 (Stream 5 downstream) is located upstream of the overland discharge confluence with Wetland 4. Therefore, monitoring location SW4 represents the flow of Stream 5 upstream of Wetland 4.

During the January 2018 flow monitoring event the streams were frozen and flow measurements could not be obtained in a safe and accurate manner.

The results of this flow monitoring show the streams are responsive to rainfall and snowmelt events, represented by peaks of water level increase. The measured water levels throughout the year followed a typical trend of higher levels in the spring (during the spring freshet) and lower water levels in the summer months. The manual water level readings in the winter were affected by ice conditions.

Surface Water Quality

Surface water quality results were compared to the Canadian Council of Ministers of the Environment (CCME) Fresh Water Aquatic Life Guidelines (FWAL). In addition, if the upstream water quality was above the CCME guidelines, the downstream sample was compared to the upstream sample concentration.

The summary of Stream 3 results are as follows:

- Total aluminum, and total iron concentrations were greater than CCME guidelines at the upstream water quality monitoring station in July 2017. The total iron concentration also exceeded CCME guidelines at the downstream station. All exceeding parameters were greater in the upstream sample compared to the downstream sample.
- There were no exceedances of general chemistry parameters in Stream 3.
- PHCs were not detected in samples taken from Stream 3.
- The July 2017 water quality is representative of baseline conditions.

The summary of Stream 4 results are as follows:

- Dissolved chloride, total aluminum, total cadmium, total copper, total iron, and total lead concentrations were greater than CCME guidelines at the upstream water quality monitoring station in May 2016. The May 2016 water quality is representative of baseline conditions.
- Total aluminum, total copper, total iron, and total lead concentrations were greater than CCME guidelines at the upstream and downstream water quality monitoring station in September 2017. Total cadmium concentrations were greater than the CCME guidelines at the upstream water quality station. Concentrations of total aluminum and total cadmium were greater in the upstream sample compared to the downstream sample. Total copper, total iron, and total lead were greater in the downstream sample than in the corresponding upstream sample. This sampling event was initiated by construction activities at the 3.99 ha quarry. However, Stream 4 does not receive quarry discharge and therefore this sampling round was considered as baseline.
- All parameters during the January 2018 water quality monitoring event, at both upstream and downstream locations, were below the CCME guidelines. Total selenium was greater than CCME guidelines in the downstream duplicate sample in January 2018 at 2 ug/L. However, the Stream 4 downstream sample was less than the detection limit (< 1ug/L) and the CCME guidelines. This sampling event occurred after the blasting activities in November 2017. However, Stream 4 does not receive quarry discharge and therefore this sampling round was considered as baseline monitoring.

- With the exception of dissolved chloride, there were no exceedances of general chemistry parameters (i.e., pH, TDS, TSS, nitrate, and nitrite) in Stream 4.
- PHCs were not detected in samples taken from Stream 4.

The summary of Stream 5 results are as follows:

- Total aluminum, total cadmium, total iron, and total lead concentrations were greater than CCME guidelines at the downstream water quality monitoring station in May 2016. The May 2016 water quality is representative of baseline conditions.
- Total copper was greater than CCME guidelines in September 2017 at the upstream and downstream water quality monitoring stations. This sampling event was initiated by existing quarry activities and is considered part of the monitoring required during the construction phase.
- Total aluminum concentrations were greater than CCME guidelines at the upstream and downstream water quality monitoring stations in January 2018. The total aluminium concentration in the corresponding downstream sample was greater than the upstream sample concentration. Total selenium concentrations at the upstream location were greater than the CCME guidelines in January 2018. However, the total selenium concentrations at the downstream water quality monitoring station were below the detection limit.
  This sampling event occurred after the blasting activities in November 2017 and is considered part of the monitoring required during the construction phase for the 3.99 hectare quarry.
- There were no exceedances of general chemistry parameters (i.e., pH, TDS, TSS, dissolved chloride, nitrate, and nitrite) in Stream 5.
- PHCs were not detected in samples taken from Stream 5.

The summary of Stream 6 results are as follows:

- Total aluminum, total iron, and total lead concentrations were greater than CCME guidelines at the upstream water quality monitoring station in July 2017. The total aluminum concentration also exceeded CCME guidelines at the downstream station. All exceeding parameters were greater in the upstream sample compared to the downstream sample.
- There were no exceedances of general chemistry parameters in Stream 6.
- PHCs were not detected in samples taken from Stream 6.

The summary of Holland Brook results are as follows:

- Total iron and mercury concentrations were greater than CCME guidelines at the upstream water quality monitoring station (SW9) in August 2017. Total iron and mercury concentrations also exceeded CCME guidelines at the downstream station (SW12). All exceeding parameters were greater in the upstream sample compared to the downstream sample.
- PHCs were not detected in samples taken from Holland Brook.

Given the location of the existing quarry activities, the results of the water quality samples obtained from 2016 to 2018 are representative of background conditions.

The September 2017 and January 2018 results for Streams 4 and 5 are considered to be a part of the construction monitoring phase for the 3.99 ha quarry and are consistent with the baseline water quality obtained in May 2016. It should be noted for the January 2018 sampling event, the streams were frozen preventing completion of flow measurements; however, there was sufficient flowing water to collect water quality samples. The water quality parameters that exceeded the CCME guidelines in January 2018 are naturally present at the Property and are consistent with the baseline water quality.

6.5 Watershed Characteristics

The Project is located within the Miller Lake Tertiary Watershed which approximately 4,356 ha in size. The Miller Lake Tertiary Watershed is located in the Shubenacadie/Stewiacke Primary Watershed and secondary Shudenacadie River Watershed. The outlet of the tertiary watershed drains into Lake Thomas. Land use and wetland cover within the Miller Lake watershed is presented in Table 6.

Table 6: Miller Lake Watershed Characteristics

Land Use	Percent Cover (%)
Forested	63.85
Open Natural Land	7.52
Cropland	0.24
Urban/Commercial	6.00
Roads	2.48
Other Developments	1.66
Wetlands	7.87
Open Water	10.38
Wetland Cover and Class	**Percent Cover (%)**
Fen	7.15
Marsh	6.89
Bog or Fen	13.35
Swamp	72.60

The Miller Lake Watershed is dominated by forested areas with approximately 63.85% cover followed by open natural lands and lakes. Wetlands account for 7.87% of the land cover within the watershed and therefore contribute to floodwater detention. Forested wetland cover is underrepresented in the database, as such, wetland cover in NS is typically underestimated (NS 2011). Approximately 6.00% of the watershed is developed for urban use and 2.48% for roads. The dominate wetland types are forested and shrub swamp complexes. Based on urban and road development (5-20%), the watershed is somewhat modified.

6.6 Vegetation

6.6.1 Regional Setting

Forest types within the Eastern Interior Ecodistrict are influenced primarily by the soil depth, with hardwood forests of red maple (*Acer rubrum*) and white birch (*Betula papyrifera*) with scattered white pine (*Pinus strobus*) and black spruce (*Picea mariana*) on shallow soils, and red spruce (*Picea rubens*) forests on the deeper soils. On upper slopes, drumlins and hummocks with deep, well-drained soils, scattered individuals of beech (*Fagus grandifolia*) and hemlock (*Tsuga canadensis*) may occur. In lower areas with poor drainage, black spruce dominants the forest cover (Neily et al. 2003).

6.6.2 Upland Plant Communities

Overall the area within the Property Boundary is a combination of mixed forest, regenerating forest and thicket, disturbed areas, and wetlands. For more information on wetlands, refer to Section 6.7 below. Three upland plant communities were identified within the Property. The following is a description of each of these upland plant communities.

MW1- Red Spruce – Yellow Birch/Evergreen Wood Fern Mixedwood Forest

This semi-mature forest community is found throughout the Property, primarily associated with stream valleys, slopes, and other areas where recent forest harvest practices have not occurred. Tree species composition varies, but overall the canopy and sub-canopy is dominated by varying mixtures of red spruce, yellow birch (*Betula alleghaniensis*), and red maple, with associates such as balsam fir (*Abies balsamea*), white birch, and white ash (*Fraxinus americana*). The understorey ranges from sparse to dense, with a diversity of species such as striped maple (*Acer pennsylvanica*), ferns, Canada mayflower (*Maianthemum canadense*), and starflower (*Trientalis borealis*). Downed woody debris is abundant throughout, and snags are occasional.

Regenerating Forest

This community type is a mixture of seedling, sapling, and immature regenerating forest areas throughout much of the Property. Regenerating forest is the dominant upland habitat type within the Property Boundary. The majority of these areas have undergone clearcutting and other forestry practices in the last five to 15 years. Given the disturbance history, and the seral stage, this community could not be classified using the FEC system. Dominant species vary throughout, but include a mix of trees and shrubs such as balsam fir, red maple, red spruce, white birch, yellow birch, white pine, white ash, striped maple, pin cherry (*Prunus pennsylvanica*), grey birch (*Betula populifolia*) and red raspberry (*Rubus idaeus*). Density ranged from sparse and open to very dense. Along road edges, other disturbed areas, and interspersed within the regenerating stands, patches of meadow and thicket vegetation occur that are too small to map. Downed woody debris, primarily due to forestry operations, were abundant throughout, and snags were rare.

Abandoned Quarry

This is a small, older quarry that appears to have not been operated in recent years. Although it is disturbed with areas of stripped soil, it is slowly becoming naturalized and revegetated. Plant species typical of disturbed sites and meadows are dominant. There is a mix of native species such as Canada goldenrod (*Solidago canadensis*), and alien species such as black knapweed (*Centaurea nigra*).

6.6.3 Botanical Inventory

A list of all plant species identified with the Property Boundary during all surveys is provided in Appendix D. A total of 268 plant taxa were identified during all years of surveys. Of these, 240 (90%) are native and 28 (10%) are alien. Alien species were generally associated with roadsides and other disturbed areas. The majority of the plants identified on the Property are common in the province and are not considered significant or at risk.

6.6.4 Significant and Sensitive Plant Species

Black ash (*Fraxinus nigra*) is designated as threatened under the ESA. A single immature black ash was identified in Wetland 7 during the 2017 surveys (Figure 6). No other plant species designated under the ESA or SARA were identified within the Property Boundary or in the Study Area. Black ash is discussed further in Section 6.10.

Two plant species tracked by ACCDC were identified within the Property Boundary during surveys, including the halberd-leaved tearthumb (*Polygonum arifolium*), ranked as S2 (Imperiled), and the meadow horsetail (*Equisetum pratense*), ranked as S3 (Vulnerable). An individual heart-leaved tearthumb was observed in Wetland 2 during surveys in September 2012, and an individual meadow horsetail was observed in Wetland 3 during surveys in June 2012. However, neither species were observed during the 2017 surveys. The 2017 survey was conducted in the same location as in 2012 to validate the presence/absence of these species. Golder was unable to locate these species and therefore are not carried forward into the impact assessment.

6.7 Wetlands

There are several wetlands throughout the Property (Figure 6). These include swamps and marshes that are either basin or sloped wetlands. The majority of these wetlands are associated with the watercourses, although a few appear to be isolated, or only connected to watercourses during periods of high water. The wetland plant community varies throughout the Property, and includes a variety of species such as red maple, balsam fir, speckled alder (*Alnus incana*), bulrushes (*Scirpus* spp., *Schoenoplectus* spp.), sedges, ferns and forbs.

A functional assessment was completed for all wetlands located within the Property Boundary. NovaWET (2010) evaluates the functions of wetlands as they relate to wetland characteristics, surface and groundwater interactions, shoreline stabilization, plant community, wildlife and fish habitat including SAR. A summary of the wetland characteristics and functions is provided in Table 7. The findings of the functional assessment are presented in Appendix E.

As indicated in Table 7 WL7 provides habitat for a SAR (black ash) as well as fish habitat. These functions are considered critical under the NovaWET evaluation methods.

Table 7: Summary of Wetland Characteristics and Functions

Wetland ID	Size (ha)	Class	Form	Type	Landscape Position	Origin	Water Flow	Water Regime	SAR	Surface Water Detention	Water Quality	Shoreline Stabilization/ Stream Flow	Fish Habitat	Community Use
WL2	0.60	Marsh	Basin	Graminoid	Lotic	Artificial (influenced by Highway 102)	Throughflow	SF/PS	-	XX	XX	XX	-	-
WL3	0.83	Marsh/ Swamp Complex	Basin	Graminoid/ Shrub	Discharge/ Terrene	Natural	Outflow	PS/SS	-	XX	X	-	-	-
WL4	0.69	Swamp	Sloped	Forested	Lotic	Natural	Throughflow	SS	-	XX	X	-	-	-
WL5	0.71	Marsh/ Swamp Complex	Basin	Graminoid/ Shrub	Terrene Pond	Artificial (boundaries defined by quarry berms)	Outflow	PS/TF	-	XX	XX	XX	-	-
WL6	0.21	Swamp	Basin	Shrub	Terrene	Natural	Isolated	SF/SS	-	XX	X	-	-	-
WL7	0.39	Swamp	Basin	Forested	Lotic	Natural	Throughflow	SF/PS	Black Ash (Thr)	XX	XX	X	XX	X
WL8	0.07	Marsh	Flat	Graminoid	Terrene	Natural	Isolated	PS	-	XX	X	-	-	-
WL9	0.53	Swamp	Sloped	Forested	Terrene	Natural	Isolated	PS	-	XX	X	-	-	-
WL10	0.09	Swamp	Sloped	Forested	Terrene	Natural	Isolated	SF/PS	-	XX	X	-	-	-
WL11	0.07	Swamp	Sloped	Forested	Terrene	Natural	Isolated	SF/PS	-	XX	-	-	-	-
WL12	2.95	Swamp	Sloped	Graminoid	Terrene	Natural	Isolated	SF/PS	-	XX	-	-	-	-

PS- permanently saturated SS- seasonally saturated TF- temporarily flooded SF- seasonally flooded

XX – Moderate to High function X – Low Function - -no function or not applicable

Off-site, but within the Study Area, there are additional wetlands. These wetlands appear to be similar in plant community and structure to the wetlands within the Property Boundary. The exception is two larger wetlands associated with Holland Brook south of the Property (Figure 7). Further downstream, Holland Brook flows through a moderately sized riverine marsh community, referred to as the “Horseshoe Wetland”, in the southwest corner of the Study Area. Although the entire wetland was not surveyed in detail, large portions of it appeared to be dominated by emergent marsh vegetation such as bluejoint reed grass (*Calamagrostis canadensis*) and sedges. Shrubs such as willows (*Salix* spp.), occur in patches and along the shoreline throughout. It was noted that there was an obvious channel (Holland Brook) through the middle of this wetland, and flooding occurs throughout. At the southern end of this wetland there is a small lake/pond with open water.

The NS Wetland Policy (2011) defines wetlands of special significance as salt marsh, wetlands within a designated Ramsar site, Provincial Park or protected area. WL7 is a wetland of special significance based on the presence of the black ash (SAR). No other wetlands of special significance were identified within the Property Boundary or within the Study Area.

6.8 Wildlife

A list of all wildlife species identified during all years of surveys is provided in Appendix F. A total of 49 bird, eight herptile, and eleven mammal species were identified within the Property Boundary during field surveys. The majority of species observed are common in the province, as well as common to the habitat types within the Property Boundary, such as black-throated green warbler (*Setophaga virens*), maritime garter snake (*Thamnophis sirtalis*), and red squirrel (*Tamiasciurus hudsonicus*). All of the species observed are native to the province.

According to the Provincial Landscape Viewer (NS DNR 2018), there are no known occurrences of significant species or special wildlife habitats (e.g. deer wintering areas, bat hibernacula, raptor nest sites) in the Study Area.

6.8.1 Significant and Sensitive Species

Eastern wood-pewee (*Contopus virens*) is designated as special concern under both the ESA and the SARA. A single singing male eastern wood-pewee was identified near the northern edge of the Property Boundary, outside of the Project footprint, during the 2012 surveys. This species was searched for and not observed during 2017 surveys therefore it is not carried forward to the impact assessment.

Two bird species tracked by ACCDC were identified within the Property Boundary during surveys: red-breasted nuthatch (*Sitta canadensis*), and ruby-crowned kinglet (*Regulus calendula*). Red-breasted nuthatch was observed during both 2012 and 2017 surveys, while ruby-crowned kinglet was only observed during 2012 surveys. Neither of these species were observed within the proposed Project footprint, therefore they are not carried forward to the impact assessment.

6.9 Fish and Fish Habitat

6.9.1 Fish Habitat

The habitat for each watercourse within the Property Boundary and Study Area is described below, and water quality measurements are provided in Table 8. All of the watercourses within the Property Boundary have a cool to coldwater thermal regime.

Table 8: Water Quality Parameters of Streams within the Property Boundary and Study Area, 2017

Location	Date/Time	Temperature (°C)		pH	Conductivity (µS/cm)
		Air	Water		
Stream 3	June 28/11:15	21	17.1	6.21	59
Stream 4	June 28/10:50	21	13.5	7.42	212
Stream 5	June 28/14:49	22	17.3	7.11	349
Stream 6	June 27/15:33	25	18	7.1	543
Holland Brook	June 28/9:38	20	13.6	7.07	290

µS/cm = micro-Siemens per centimetre

Stream 3

Stream 3 is the largest watercourse on the Property. Stream 3 drains a small lake on the north side of Highway 102 and flows under the highway via a culvert and enters the Property from the northwest (Figure 6). The stream then flows south into a wetland off-site.

The majority of the reach of Stream 3 within the Property Boundary is shallow run and riffle habitat with moderate velocity due to the steep gradient change over the length of the reach. There are also some cascade sections in the mid to lower portion of the reach where the gradient changes more suddenly. Substrates are coarse and consist predominantly of cobble with boulder and/or gravel. There is a short pool section just downstream of the culvert at Highway 102 with a maximum depth of 0.55 m, as well as a shallow pool area with a depth of 0.20 m in the mid-section of the reach created by an ATV trail that crosses the watercourse. There are limited, short lengths of flat in the upper and middle sections of the reach of Stream 3 within the Property Boundary. The average wetted width is 3.5 m and the average wetted depth is 0.15 m. Riparian vegetation is mixed forest with a moderately steep approach slope, and the banks are generally stable. There is abundant woody debris providing instream and overhanging cover, especially in the lower section of the reach. Instream cover is also provided by coarse substrate.

At the time of the surveys, it was noted that there are several potential barriers to fish movement including root wads and woody debris blocking the channel, and potentially impassable sections of cascade under the flow conditions observed at the time of surveys. Because these features are temporary in nature, they are not considered true barriers.

Brook trout and an unidentified cyprinid species were observed in the upper portion of the reach within the Property Boundary. No fish were captured during dip netting. Two minnow traps were set in the south end of the watercourse and two brook trout were captured. It was observed that there is limited quality-spawning substrate for brook trout on the Property and no redds were observed.

Stream 4

Stream 4 originates in Wetland 2 in the north-central portion of the Property and flows south to eventually drain into Stream 3 south of the Property Boundary (Figure 6). The reach of Stream 4 within the Property Boundary consists of headwater-type habitat, and is entirely moderate to low velocity shallow runs for its length on the Property. The stream is shallow and narrow, with wetted width averaging 0.85 m and wetted depth averaging 0.15 mm. The substrate is a mix of sand, silt, gravel, cobble, and boulder, with no one dominant type. One

groundwater seep was observed approximately mid-way on the Property. Riparian vegetation is mixed forest with a moderately steep approach slope and the banks are generally stable. There is abundant woody debris providing instream and overhanging cover.

Within the Property Boundary, the elevation change over the length of the reach of Stream 4 is fairly steep. This causes the channel to flow underground beneath the surficial soil and roots in areas and water to drop steeply over woody debris and coarse substrate, causing potential barriers to fish passage. It was observed that water in the northern portion of the stream flowed underground and there were potential barriers (i.e. root wads and boulders) observed in the southern portion of the stream. There was no standing water observed in Wetland 2 indicating that the wetland likely does not support fish or fish habitat. Overall, the habitat potential for fish in Stream 4 is low..

No fish sampling was attempted in Stream 4 within the Property Boundary, as there were no appropriate areas for minnow traps or seine netting, and no fish were observed to attempt dip netting during the 2012 survey. Juvenile brook trout were observed in Stream 4 within the Property Boundary during 2017 surveys. South of the Property Boundary, within the Study Area, two minnow traps were set just upstream of the confluence with Stream 3. Three fish species were captured in the minnow traps, including white sucker (*Catostomus commersonii*), northern redbelly dace (*Chrosomus eos*), and brook trout. Two seine hauls were also conducted in this reach of Stream 4, but no fish were captured. No brook trout redds, indicating spawning, were observed during the surveys.

Stream 5

Stream 5 is fully contained within the Project footprint and connects Wetlands 4 and 5 in the central portion of the Project (Figure 6). The aquatic habitat in Stream 5 is very similar to that observed in Stream 4 and consists of shallow runs over its length. The stream is shallow and narrow, with depth ranges averaging 0.09 m and wetted width averaging 1.0 m. The substrate is cobble/gravel with sparse boulder throughout. Riparian vegetation is mixed forest, with a gradual approach slope and the banks are generally stable with shallow undercutting in areas. There is abundant woody debris providing instream and overhanging cover for fish refuge.

Several potential barriers to fish migration are present, created by root wads and woody debris piles, as well as the channel flowing underground beneath the surficial soil and roots in some areas. One inflowing tributary that originates as groundwater seepage, was observed approximately mid-way in the stream. There is no direct connection between Stream 5 and any other surface watercourses. However, during high flows, Stream 5/Wetland 4 flows along Perrin Drive and confluences with Stream 4.

Overall the habitat potential for fish in Stream 5 is considered to be low, and no fish were visually observed. No fish sampling was attempted in Stream 5, as there were no appropriate areas for minnow traps or seine netting, and no fish were observed to attempt dip netting.

Stream 6

Stream 6 enters the northeast corner of the Property via a culvert under Highway 102, and flows through Wetland 7 (Figure 6). Stream 6 flows through a defined channel downstream of Wetland 7 adjacent to the Project and flows into Horseshoe Wetland south of the Property Boundary.

The upstream portion of the reach of Stream 6 within the Property Boundary is headwater-type habitat consisting mostly of shallow runs with some limited areas of shallow pools, riffles and flats. Substrate is cobble/boulder with sporadic areas of gravel and silt. The downstream portion of the reach widens slightly and current velocity slows, creating flat habitat with abundant short sections of shallow runs. The substrate in the downstream portion was

noted to be less coarse and more depositional, with silt/gravel dominating with cobble areas. Riparian vegetation is mixed forest, with a gradual approach slope. Banks are generally stable with shallow undercutting in areas. There is abundant woody debris providing instream and overhanging cover for fish refuge.

Several potential barriers to fish movement were noted during the surveys including woody debris piles and cobble/boulder blocking the channel. These potential barriers are likely passable at high flows and because they are temporary in nature, they are not considered true barriers.

Brook trout, including juveniles, were visually observed in Stream 6, and a smolt salmonid was observed in the stream at Wetland 7 during the surveys. Dip netting was conducted, but no fish were captured. The amount of quality-spawning habitat for brook trout was limited within the Property Boundary, and no brook trout redds were observed during the surveys.

Holland Brook

Holland Brook flows southwest from Preeper's Pond south of the Property Boundary, in the Study Area (Figure 6). The upper reach flows through a marshy wetland west of the outlet from Preeper's Pond and continues southwest through the "Horseshoe Wetland" in the southwest corner of the Study Area.

During surveys, it was noted that this watercourse had moderate flow with a mix of riffles, pools and runs. Substrate is cobble/sand/gravel over bedrock, and the banks are generally stable. The stream is shallow, with wetted depth averaging 0.15 m and wetted width averaging 2.0 m, with some occasional deeper pools. Riparian vegetation is mixed forest providing moderate canopy cover and a moderate approach slope. No barriers to fish movement along Holland Brook and in/out of Prepper's Pond were observed.

No fish sampling was conducted in Holland Brook, and no fish were observed during surveys. However, Holland Brook was assessed to have high potential for fish habitat as small-bodied fish were observed in Preeper's Pond. Further, given the observation of brook trout in several of the tributaries of Holland Brook, and the quality of the habitat observed, this watercourse likely is habitat for brook trout, and contains potential suitable habitat for spawning.

6.10 Species at Risk

Five SAR were identified as having a moderate or high potential of occurring within the Property Boundary based on the SAR screening. Only those species identified with a moderate or high potential of occurring are discussed in this report. For a list of all species assessed, and more information on their preferred habitat, refer to Appendix G.

Black Ash

Black ash is designated as threatened under the ESA. A single immature small black ash was identified in Wetland 7 within the Property Boundary and Study Area, but outside of the Project footprint during 2017 surveys (Figure 6). The habitat of black ash (Wetland 7) is protected through the regulations of the ESA. Although there is additional suitable habitat within the Property Boundary, no other individuals were identified during targeted surveys.

Common Nighthawk

Common nighthawk (Chordeiles minor) is designated as threatened under the ESA and the SARA, and was assessed as having a moderate potential to occur within the Property Boundary, including within the Project footprint, based on availability of suitable habitat. Although no individuals were observed within the Property

Boundary, this species is crepuscular and targeted dusk surveys were not conducted. The common nighthawk typically requires large open habitat which includes farmland, open woodlands, clearcuts, burns, rock outcrops, alvars, bogs, fens, prairies, gravel pits (Sandilands, 2007; COWSEIC, 2007). The open and disturbed areas within the Property Boundary are suitable nesting habitat for this species.

Little Brown Myotis, Northern Myotis, Tri-colored Bat

Little brown myotis (Myotis lucifugus), northern myotis (Myotis septentrionalis), and tri-colored bat (Perimyotis subflavus), are designated as endangered under the ESA and the SARA. However, targeted surveys were not conducted. Suitable maternity roosting habitat (i.e., large diameter cavity or snag trees) for these bat species was not observed within the Project footprint. Within the Property Boundary, outside of the Project footprint, some of the forested areas do provide suitable maternity roost habitat, particularly in the southwestern portion of the Property and in the valleylands of Streams 4 and 6. Although no individuals were observed within the Property Boundary, these species are nocturnal and require the use of specialized acoustic equipment to survey for, which was not conducted. Some of the forested areas within the Property Boundary provide suitable maternity roost habitat for these three bat species, particularly in the southwestern portion and in the valley of Stream 4 and Stream 6 (Figure 6). The majority of the trees observed within the Project footprint do not provide suitable roosting habitat for these species. There were no potential hibernacula for any of these bat species noted within the Property Boundary. Based on the desktop assessment, there are no known abandoned mine adits within 2 km of the Property (NS 2017a). In addition, there are no known hibernacula within 2 km of the Property (Moseley 2007).

Lichen

Blue felt lichen (*Degelia plumbea*) and Boreal felt lichen (*Erioderma pedicellatum*) have ranges which overlap the Study Area, but based on the SAR screening, there is low potential for occurrence within the Property Boundary as there is no suitable habitat, and they were not identified during surveys. There is low to moderate potential for these species in the Study Area. Although there are no recent records of these species in the immediately vicinity of the Property Boundary, a search of the Study Area was not completed and there is potential for suitable habitat to be present. Because there is low potential for these species to occur within the Property Boundary, they are not carried forward into the impact assessment. All other SAR with low potential to occur within the Property Boundary or in the Study Area are included in the screening (Appendix G), but not discussed further in this report.

6.11 Atmospheric Environment

6.11.1 Air Quality

Ambient air quality is monitored in Nova Scotia with a network of stations operated by NSE and Environment and Climate Change Canada (ECCC) (i.e., National Air Pollution Surveillance [NAPS] network). The common air quality compounds monitored regularly are respirable particulate (particulate matter less than 2.5 micrometres (µm) in diameter: $PM_{2.5}$), sulphur dioxide (SO_2), carbon monoxide (CO), ground level ozone (O_3), and nitrogen dioxide (NO_2).

The closest air quality monitoring station to the Project is the Lake Major station located north of Cherry Brook Road in Cherry Brook, NS which is operated by NSE. The Lake Major station is located approximately 15 km southeast of the Project, in a rural setting with an active quarry approximately 3.5 km west of the station; therefore, this station is representative of the area surrounding the Project. In 2016, the monitored data at the Lake Major station ranged as follows:

- 0 to 29 µg/m³ for $PM_{2.5}$
- 0 to 11.1 ppb for SO_2
- 0.7 to 53.5 ppb for ground level ozone
- 0 to 21 ppb for NO_2

Carbon monoxide was not measured at the Lake Major station in 2016 however, based on the activities associated with the Project, the primary compound of concern is particulate matter.

Meteorological data from the Halifax International Airport, located approximately 2.86 km northeast of the Project, was used to generate a wind rose for 2016, see Figure 12. The wind rose shows that the predominant wind direction is from the south southwest followed by winds ranging from the west to north northwest.

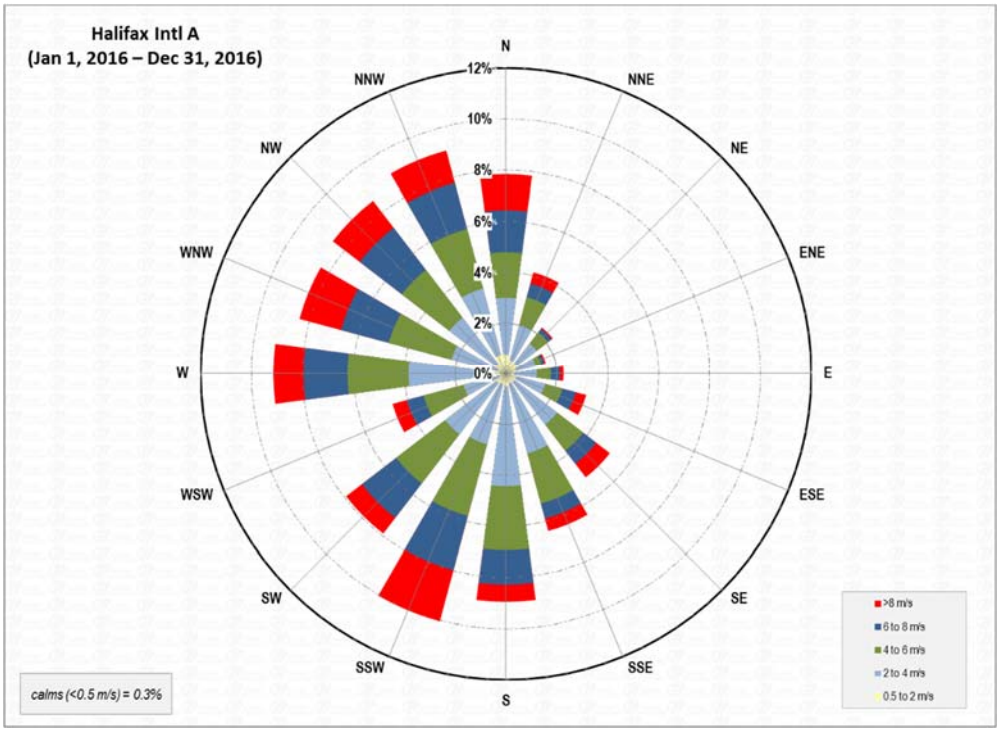


Figure 12: 2016 Wind Rose for the Halifax International Airport

6.11.2 Noise

The noise levels surrounding the proposed Project are of a concern due to the potential for Project related noise emissions to have an effect on sensitive receptors.

Noise is defined as unwanted sound and are measured as pressure variations in the atmosphere. However, due to the extreme range in pressure levels, sound levels are expressed on a logarithmic scale, in units called decibels (dB).

The character of a type of sound (e.g., car, quarry equipment) is determined by its frequency content. The sound data are generally given in terms of octave band frequency distribution. Typically, each octave band is expressed in terms of its centre frequency, namely 31.5, 63, 125, 250, 500, 1000, 2000, 4000 and 8000 Hertz (Hz).

The human ear does not respond to all frequencies in the same way. Human ears are sensitive to sound from 20 to 20,000 Hz but are most sensitive in the frequency range between 500 to 4000 Hz. Above and below this range, the ear is progressively less sensitive to sound. Since sound measuring equipment are more uniformly sensitive, in order to express the measured sound levels in a manner that is more representative of the human hearing response, a weighting is typically applied to each octave band. The most commonly used weighting is called "A-weighting".

Environmental noise levels are usually presented as "A-weighted" decibels (i.e., dBA), which is considered representative of the frequency response of the human ear. There are several sound level descriptors (e.g., Leq, Lmax, Lmin, L10, L90, Lpeak etc.). The Leq or equivalent energy sound level is that constant sound level which has the same energy as a time-varying noise level for a specified duration.

The Leq is commonly used in an environmental (outdoor) context as it takes into account natural variations in sound and the amount of time that the exposure occurs. Table 9 provides some reference noise levels.

Table 9: Noise Reference Levels

Activity Level	dB_A
Loud shout	90
Motorcycle passing 15 m away	85
Car travelling 100 km/hr at 15 m setback	80
Vacuum cleaner at 1 m away	70-75
Moderate rainfall	50-60
Bird singing	50
Quiet living room	40
Whispered speech	35-40
Rural sound level at night	35-40

The NS *Pit and Quarry Guidelines* (NSEL 1999) contain the following noise limits that quarry operators must achieve at the property boundaries containing their facilities. Table 10 summarizes the applicable limits for the various times of day:

Table 10: Noise Guidelines

Time of Day	Property Line Noise Limit (dB_A)
Day (07:00 to 19:00 Hours)	65
Evening (19:00 to 23:00 Hours)	60
Night (23:00 to 07:00 Hours)	55

A baseline noise monitoring program was carried out between August 4th and August 11th, 2012. Table 11 summarizes the locations of 2012 noise monitoring sites.

Table 11: Monitoring Locations

Monitor	Approximate GPS Coordinates	Location	Target representation
LD720#1	Northing:4965001 Easting: 453731	Near Preakness Crescent [1]	Representative of sound levels experienced by points of reception approximately 100 m from Highway 102 (i.e., Homes along Preakness Crescent located in Miller West Subdivision)
LD720#2	Northing:4964940 Easting: 4543133	Near Perrin Drive	Representative of sound levels experienced by points of reception approximately 490 m from Highway 102 (i.e., Homes along Perrin Drive)
LD720#3	Northing:4965902 Easting: 455485	Within the Property Boundary	Representative of sound levels in the general area, in the absence of human activity, specifically during the night-time period. (Approximately 400 m from Highway 102)

Notes:
[1]: While on-site, Golder carried out attended noise measurements within the Preakness Crescent development. In identifying an appropriate location for LD720#1, Golder also carried out noise measurements in the prospective location, and identified a location with sound levels from Highway 102 traffic that was similar to the sound levels measured within the Preakness Crescent development.

The results of the 2012 noise measurement program are summarized in Table 12.

Table 12: Monitored Sound Levels

Period	LD720#1 Sound Levels (dBA)	LD720#2 Sound Levels (dBA)	LD720#3 Sound Levels (dBA)
Day (07:00 to 19:00 Hours)	50	58	46
Evening (19:00 to 23:00 Hours)	48	58	52
Night (23:00 to 07:00 Hours)	49	57	49

At the time of the noise survey it observed that the noise levels in the vicinity of the Project area was dominated by traffic along Highway 102. It is expected that the current noise levels within the Project area continue to be influenced by traffic along Highway 102 at a similar level to those monitored in 2012. In addition, monitoring data obtained during the 2012 program generally shows that the ambient sound levels within the areas of noise monitoring are higher than those typically expected in a rural environment. This is attributed to the proximity to Highway 102 and intermittent airport traffic.

6.12 Socio-Economic Environment

The Project is to be located on undeveloped lands in Goffs, NS (Figure 1). Goffs lies between the larger communities of Fall River, Wellington and Enfield and is located within the HRM.

These communities are generally considered to be suburbs and commuter towns, whose residents live in these areas, but generally work elsewhere (e.g., Dartmouth, Halifax). Typically, such communities have limited commercial or industrial activities beyond small-scale retail or service-based industries focused on serving its residents.

The proposed quarry is situated immediately adjacent to the Aerotech Business Park and approximately 2.86 km southwest of the Halifax Stanfield International Airport. Access to the Project is from the north via Highway 102 Exit 5A to Aerotech Drive then south to an existing private road off of Perrin Drive (Figure 1).

The socio-economic effects of the Project will most likely be concentrated in the area of HRM; however, Project-related effects may also be experienced in areas from which goods and services for the Project are sourced (i.e., Nova Scotia and Canada in general). The following subsections describing the socio-economic environment or setting for the Project are focused on HRM, where Project-related effects are the most likely to occur.

Demography

According to the 2016 Statistics Canada Census profiles, 403,131 individuals were residents of the HRM. The population in HRM has increased by 3.3% between 2011 and 2016, compared to a modest increase of 0.2% for the province as a whole. The median age of HRM residents is 41 years, close to the provincial median of 45.5 years. Figure 13 below illustrates the population of the HRM and of Nova Scotia, for both sexes, per five-year age group (Statistics Canada 2016).

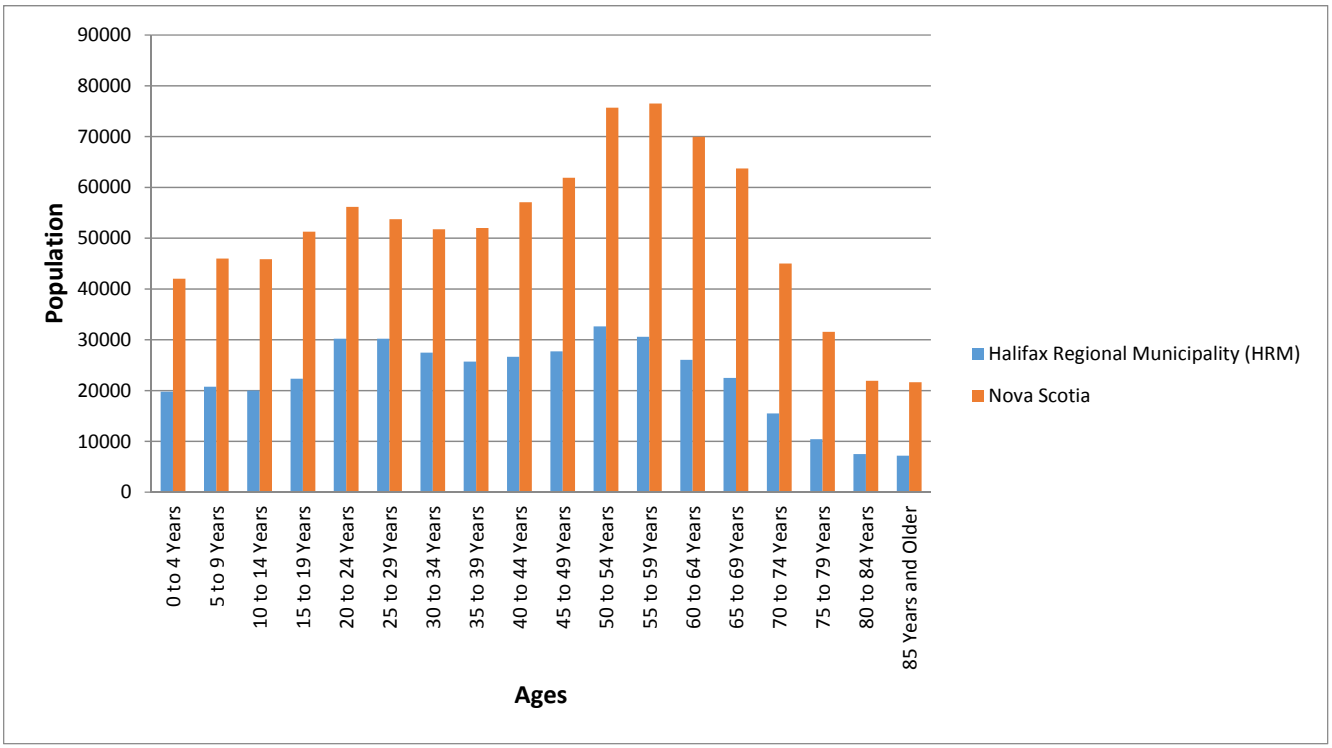


Figure 13: Demographics of HRM and Nova Scotia

Employment and Economy

The most recent national household survey data indicates an employment rate in HRM of 62.1% and an unemployment rate of 7.3%. The employment rate in HRM is slightly higher than for the province as a whole (55.2%), while the unemployment rate is slightly lower than the provincial standard (10.0%) (Statistics Canada 2016).

Over half of the experience labour force within HRM consists of sales and service occupations (24.4%); business, finance and administration occupations (16.3%); and education, law and social, community and government services (13.4%). Natural resources, agriculture and related production occupations, and occupations in manufacturing and utilities employ the fewest individuals (1.2% and 1.7% respectively) (Statistics Canada 2016).

There are several businesses in the Aerotech Business Park as well as Halifax Stanfield International Airport that provide employment (Figure 1). The airport has been in operation since the early 1960s. The business park caters to a number of aviation companies; however, municipal zoning also allows for the operation of other types of businesses and industries. Major tenants of the business park include Pratt & Whitney Canada and Northrup Grumman Canada Corporation (Halifax Stanfield International Airport 2015). Other nearby businesses / industries include two hotels, FedEx, Maritime Fence, Clean Earth Technologies Inc., and L3 Communications.

The existing 3.99 ha quarry employees at least 10 to 12 direct employees throughout the year, with five to six additional secondary workers being employed by the blasting contractor for at least one week, four to six times per year. Additional secondary employment through hauling / trucking contractors is estimated to result in the employment of another 20 to 30 workers. Where the Project is an extension on the existing operations, employment levels are anticipated to remain the same.

Land Use

The proposed Project is located on undeveloped lands owned by Scotian which are bound to the south by DNR lands; to the west by Highway 102; to the east by DNR and private lands; and to the north by private lands. The land parcel within which the Project footprint is located is largely undeveloped with the exception of the existing 3.99 ha quarry, and a former rock quarry which has been operated (by others) periodically over the past few decades to support provincial transportation and infrastructure projects. There is also an existing (permitted) clay pit near the proposed Project which is also owned by Scotian. With the exception of the office trailers and storage yards for the Maritime Fence operation, which is under the same ownership as Scotian, there are no buildings located within 800 m of the proposed Project (Figure 1).

There has been a long history of repeated aggregate extraction at the former quarry located approximately 100 m northeast of the proposed Project:

- in the late 1950s to supply material for airport road infrastructure;
- in the early 1960s, the quarry was used to provide aggregate for roadwork and construction of the bypass at the Fall River Exit of Highway 102;
- in the early 1970s, it was used to supply aggregate for the Highway 102 upgrade (from Fall River to Elmsdale) to its existing twinned format; and,
- in the late 1990s the quarry was used to supply aggregate during construction of the Exit 5A ramps, on the west bound lanes of Highway 102.

Based on recent topographical mapping and aerial imagery, the approximate area of the former quarry workings is 1.43 ha.

A commercial clay pit (owned by Scotian) is also currently located within close proximity to the proposed Project (approximately 110 m east). The primary use of this clay pit has been to provide material for multiple projects at the nearby Halifax Stanfield International Airport, as well as for the supply of material during installation of the Maritimes and Northeast Pipeline natural gas pipeline along Perrin Drive in 2000. The approximate area of the existing pit workings is 1.44 ha.

Other land uses in the vicinity of the Project include:

- Three other former pit / quarry operations located approximately 700 m west and 1.1 km north, across Highway 102, and approximately 2.5 km northeast, towards the airport.
- The Halifax Stanfield International Airport, located approximately 2.86 km northeast.
- A variety of business and industrial operations, north and east in the Aerotech Business Park.
- The north bound Highway 102 weigh station, operated by NSTIR, located approximately one km west.
- The Waverly Game Sanctuary, created in 1926, and the Waverley Salmon River Long Lake Wilderness Area are located approximately 300 m to 1.2 km south and east, respectively.
- The concrete and asphalt plants currently permitted and under construction on Scotian property.

To the west and southwest of the Project, on either side of Highway 102, are a number of residential subdivisions, including Oaken Hills Subdivision and Kendalmark Estates in Wellington, and the Schwarzwald and Miller Lake West Subdivisions in Fall River. The nearest residential community to the Project is the Miller Lake West Subdivision, located approximately 1.1 km to the southwest of the Project.

Other residential communities, such as Wellington and Enfield, are located 3 km west and 10 km north, respectively. The nearest residential structure is approximately 1.1 km southwest of the Project. There are currently approximately 49 residences identified within 2 km of the Project .

Immediately east of the Project is Perrin Drive, which is, for the most part, impassable, and the Maritimes and Northeast Pipeline Halifax Lateral, beyond which lands are undeveloped.

Visual Aesthetics

Due to concerns raised by the public, the potential effects on existing visual aesthetics associated with the proposed Project were considered. The proposed Project footprint is located approximately 55 m southeast from Highway 102. The Property is vegetated and is not visible from the nearby residential communities due to the existing vegetation and topography.

Transportation

The Project is bounded to the west by Highway 102, which is a north-south freeway running between Halifax and Truro and is the busiest highway in Atlantic Canada. The entire highway is a divided four-lane freeway, with the exception of a five-lane section (three lanes northbound) between the Highway 118 interchange at Miller Lake and the Halifax International Airport at Enfield. This three-lane northbound section is not a result of particularly high traffic volumes, but rather it is a relic of the previous configuration of this section of freeway. Previously, the highway from Fall River to Enfield was a three-lane undivided section, including a centre passing lane favouring northbound traffic. When the highway was twinned, the three lanes were left in place for northbound traffic.

Products from the proposed quarry will be transported via tandem and tractor trailer trucks, along an existing access road within the property to Aerotech Drive and ultimately to Highway 102 via Exit 5A. The average number of trucks hauling aggregate from the quarry could be up to 75 per day (assuming an average operational period of five days/week; eight months/year). However, depending on market demand and the truck capacity; the number of trucks could increase for short periods of time if a large aggregate contract were procured.

According to 2013 data obtained from NSTIR, the one-way traffic volume (moving south) on Highway 102, between Exit 5 and Exit 5A (Section 070) was reported to be 24,875 average daily traffic (ADT). Traffic volume for the access ramps to Exit 5A was reported to be 3,157 ADT (NSTIR 2014). 75 trucks represent 2% of total traffic volume on access ramps at Exit 5A.

Recreation and Tourism

In general, recreation and tourism in Nova Scotia is centred on the natural environment and as such is ideal for outdoor activities such as camping, hiking, snowmobiling and boating. There are a number of established outfitters and exploration companies in the province providing opportunities for tourists and locals alike to experience eco-tourism and outdoor adventure. There are a number of departments and associations responsible for recreation and tourism in Nova Scotia, including the provincial Department of Economic and Rural Development and Tourism, Explore Nova Scotia, and Destination Halifax.

The Waverly Game Sanctuary began in 1926 from a request from the Canadian General Council of the Boy Scouts. Some 3000 acres of land were set aside at that time for conservation and preservation of wildlife. The area was eventually enlarged and became designated as a sanctuary under the provincial *Wildlife Act*. The total area is 5228.7 ha; 1056 ha is privately owned land and the remainder is owned by the Province. The sanctuary overlaps with the larger Waverley Salmon River Long Lake Wilderness Area, with 3224.3 ha having both designations. Hunting and trapping are prohibited within the boundaries of the sanctuary (NS DNR 2013).

The Waverley Salmon River Long Lake Wilderness Area, one of 40 wilderness areas protected under the *Wilderness Areas Protection Act* of Nova Scotia. Wilderness Areas protect representative examples of Nova Scotia's natural landscapes, native biological diversity, and outstanding natural features and are used for scientific research, education and a variety of recreation and nature-tourism related activities such as hiking, canoeing, sea-kayaking, sportfishing and hunting (NS DNR 2014b). The Waverley Salmon River Long Lake Wilderness Area is a rugged wilderness of lakes, barren hills, and pockets of old-growth pine and hemlock.
The 8,710 ha area is a recreational treasure in HRM. Granite ridges in the south provide outstanding panoramic views and excellent destination points for rugged wilderness hiking. Abundant connected lakes and rivers provide over 30 km of canoe routes into the remote interior (NS DNR 2014c).

6.13 Archaeological and Heritage Resources

A copy of the ARIA report completed by Davis MacIntyre and Associates is provided in Appendix H.

The property is located within the Nova Scotia Theme Region known as the Halifax Quartzite Barrens (region #413a). The Quartzite Barrens region is interspersed by exposed quartzite bedrock between areas of deeper glacial till where drumlins of reddish Lawrencetown Till are found (DMA 2013).

The land within the ARIA Study Area was purchased from the Barrett Lumber Company in 2011. In the last 15 years, the land was extensively logged, and new growth consists mostly of spruce. Quarrying operations were also carried out in the northeast end of the study area.

According to the MARI database, there are 44 recorded precontact period sites dating from the early to middle Archaic period (i.e., 9,000 to 5,000 years BP) to the Ceramic period (i.e., 2,500 to 500 years BP). These sites are primarily related to land use and occupation along the Shubenacadie waterways. The nearest precontact period find to the Project is located on the west shore of Soldier Lake and consists of a single early to middle Archaic period gouge. Historic documents indicate that the Old Guysborough Road settlement was established in the early 19th century but it does not appear that this area was settled and there is no archaeological evidence to suggest that settlement ever occurred on these lands.

The history of the area of Goffs prior to the 18th century is scarcely documented. This is attributed to the absence of roads until the early 19th century and the inland location and distance from major waterways. The settlement of Goffs was named after Thomas Goff who received a land grant in 1830. The first road into the area (Lookout Road) was built by the British Army between 1810 and 1812 as a transport link between Porters Lake and Musquodoboit. In 1815, this road was connected to Old Post Road in Fall River following trails along Miller Lake. Today the road is known as the Old Guysborough Road. The land within the ARIA Study Area was granted to Elizabeth Ritchie and Richard Chapman in the early 19th century; although it does not appear to have been settled.

The field reconnaissance survey did not uncover any additional precontact period sites or features of an archaeological nature.

7.0 IMPACT ASSESSMENT

Potential environmental effects of the proposed Project components and activities, throughout all Project phases, were evaluated with regard to each VC. By assessing potential impacts on VCs within the spatial and temporal boundaries of the Project, a meaningful evaluation of project effects on relevant environmental aspects can be achieved. The following VCs were identified based on government guidance, consultation, and professional judgment of the study team: groundwater resources; surface water resources; vegetation; wetlands; wildlife; fish and fish habitat; SAR; air quality; noise; the socio-economic environment; and, archaeological and heritage resources.

The following sections outline the methodology and results of the impact assessment of the Project on the VCs.

7.1 Groundwater Resources

Prior to evaluating the impacts of the Project, groundwater modeling was completed to calculate the groundwater radius of influence and to determine the potential receptors that may be affected by a change in groundwater contribution.

Using the *Simple analytical equations for estimating ground water inflow to a mine pit* (Marinelli and Niccoli 2000) a groundwater radius of influence was calculated. A summary of the model inputs and assumptions are outlined below and are provided in Appendix A. In addition to the assumptions inherent in Marinelli and Niccoli, the following site-specific assumptions are utilized in the application of the analytical model:

- Steady-state, long-term average conditions are considered.
- Assumed full extraction of the proposed quarry down to 88 masl (Phases 1, 2 and 3) and to 99 masl (Phase 4) with a total volume of rock to be extracted for Phase 1, 2 and 3 of 4,785,760m3 and Phase 4 and area south of Phase 4 designated as blasting/regrading for closure 1,356,441 m^3.

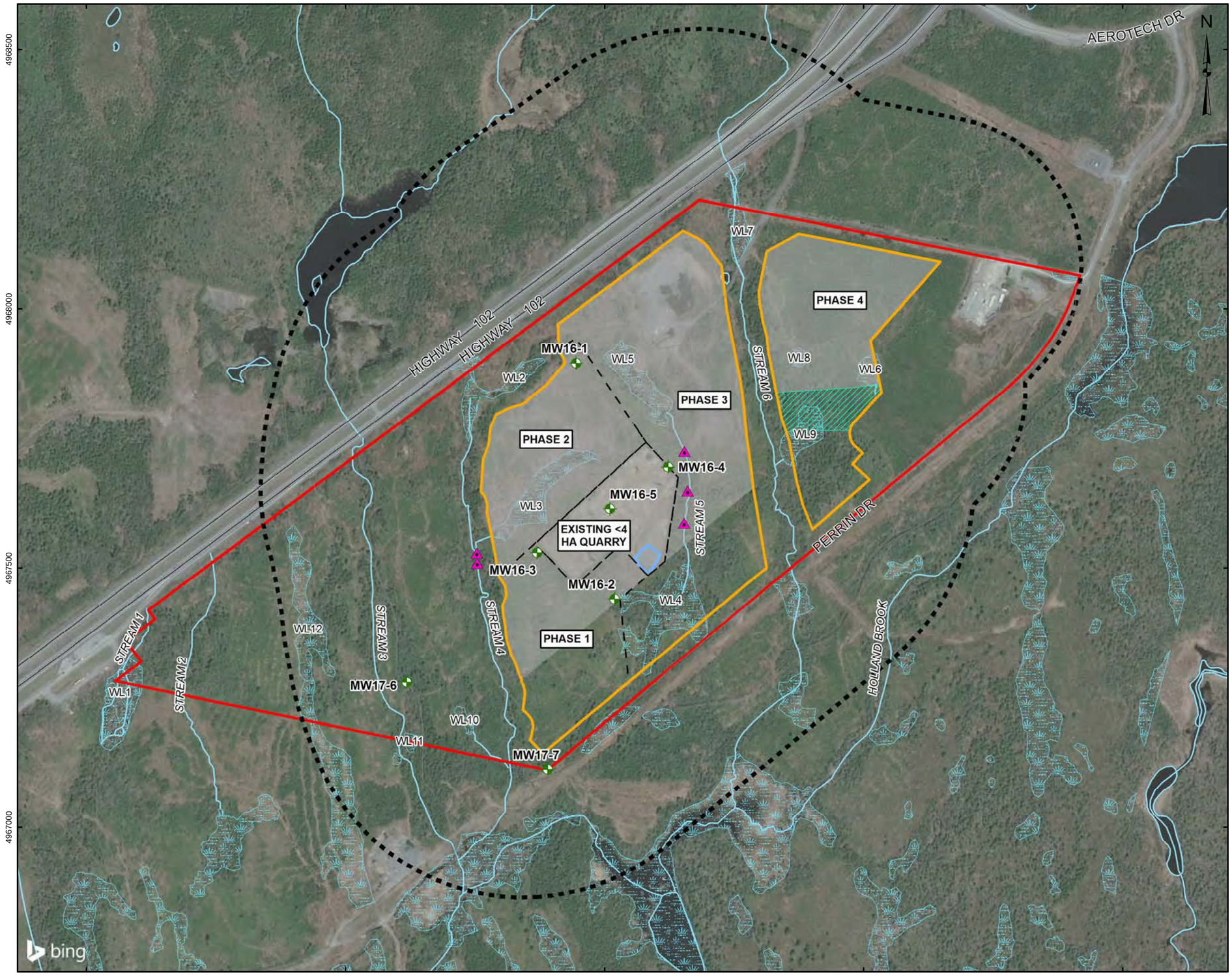
- Water table is assumed to be ground surface and is initially flat;
- Recharge = 200 mm/yr (NS DNR 2010);
- Assume the streams / lakes do not constitute a significant hydrologic boundary within the radius of influence;
- The hydraulic conductivity used was the geomean of the entire dataset is 4 x10 $^{-7}$ m/s. There is some trending towards lessening hydraulic conductivity with the depth however, given the model approach, this has not been taken into account in the model but this would likely mean the radius of influenced calculated may be smaller than predicted. This could be confirmed with groundwater and surface water level monitoring; and
- The hydrogeologic unit under consideration is uniform, homogeneous, and isotropic.

The aforementioned parameters are input into the model spreadsheet and quarry inflows and zone of influence are calculated as follows and are summarised in (Appendix A).

1) Phases 1, 2, 3 and existing <4ha quarry fully extracted to 88 masl has a calculated groundwater seepage estimate of 989 m^3/day.
2) Phase 4 fully extracted to 99 masl has a calculated groundwater seepage estimate of 479 m^3/day
3) Phase 4 and the southerly area designated for blasting/regrading for closure, down to 99 masl has a calculated groundwater seepage estimate of 483 m^3/day

Therefore, the total estimate groundwater seepage for existing <4 ha quarry plus Phase 1, 2, 3, 4 and area south of Phase 4 is 1,472 m^3/day.

The calculated groundwater zone of influence is a circular area with a radius of 431 m for Phase 1, 2 and 3 extraction area and 284 m for Phase 4 and the southerly blasting/regrading area for closure. These groundwater zones of influence are estimated from the approximate centre of the quarry (Figure 14) however for the purposes of assessing potential impacts due to quarry dewatering we have conservatively assumed the potential groundwater radius of influence as being from the edge of the quarry excavation.



LEGEND

- GROUNDWATER MONITORING WELL NEST
- OBSERVED GROUNDWATER SEEPS
- MAJOR ROAD
- LOCAL ROAD
- WATERCOURSE
- WETLAND
- GROUNDWATER RADIUS OF INFLUENCE
- SEDIMENTATION POND
- PROPOSED EXTRACTION PHASES
- PROPOSED EXTRACTION
- BLASTING/REGRADING FOR CLOSURE
- PROJECT BOUNDARY
- PROPERTY BOUNDARY

REFERENCES

Base Data - CanVec, obtained 2010
Wetlands - obtained from Canvec, 2010, Golder, 2017, and McCallum, 2014.
Watercourse - Golder, 2012
Contours - 15HF0052 AEROTECH SURFACE, 2M, ALLNORTH, JULY 2015
Base Imagery © 2018 Microsoft Corporation © 2018 DigitalGlobe ©CNES (2018) Distribution Airbus DS
Projection: Transverse Mercator Datum: ATS77 Coordinate System: MTM Zone 5

100 50 0 100 200 300 400
SCALE 1:7,500 METERS

PROJECT
SCOTIAN MATERIALS GOFFS QUARRY EARD

TITLE
GROUNDWATER RADIUS OF INFLUENCE

GOLDER

PROJECT No. 1777778			SCALE AS SHOWN	REV. 0.0
DESIGN	CA	2018-05-04	FIGURE 14	
GIS	LMM	25/07/2018		
CHECK	CA	25/07/2018		
REVIEW	PMMC	25/07/2018		

S:\Clients\Scotian_Materials\Goffs_Quarry\99_PROJ\1777778\40_PROD\0006_EA_Groundwater\1777778-0006-CH-0006.mxd

Impact Assessment

Within the groundwater radius of influence, the potential groundwater receptors that were identified include private wells and surface water features including streams, wetlands and fish and fish habitat.

This section presents the effects of the change in the groundwater quality and contribution to private wells. The effects of the change in groundwater contribution to surface water resources, wetlands and fish and fish habitat receptors due to quarry dewatering activities are provided in Sections 7.2, 7.4 and 7.6, respectively.

Private Wells

There are no private well users located within the potential radius of influence and it is our current understanding that the location of the nearest well domestic use well is approximately 1.1 m to the south-west of the proposed Project boundary located in the Miller Lake West subdivision. The 2D groundwater model predicts that the groundwater zone of influence is a radius of 431 m for Phase 1, 2 and 3 extraction area and 284 m for Phase 4 and the southerly blasting/regrading area for closure from the proposed quarry boundary (Section 6.2). The model assumes perfect inter-connectivity of the water table and the quarry face. As a result, the model assumes a direct lowering of the water table due to the quarry dewatering. However, the actual groundwater level change due to quarry dewatering will be influenced by the lack of interconnectivity of the fracture bedrock network and the actual radius of groundwater influence is anticipated to be less than predicted. Therefore, impacts related to Project activities on nearby water wells are not anticipated where these wells are located beyond the radius of influence of groundwater level drawdown.

Although no impacts to private well water quality or quantity are anticipated, the results of Private Well Survey outlined in Section 6.3.5, will be used as baseline information against which any potential future well complaints will be compared to determine if changes in well quality and / or quantity are attributed to the Goffs quarry activities. If the changes in the well quality and /or quantity are attributed to quarry water handling practices, then Scotian has committed to replacing the water supply.

Blasting

Use of explosives during Project has the potential to affect groundwater quality. Explosives has the potential to leave nitrogen residual substances (e.g., ammonia nitrate) that can leach into groundwater if combustion is incomplete. Blasting will be designed for the complete combustion of the explosive material to mitigate the impact of blasting on groundwater quality.

7.2 Surface Water Resources

To assess the impacts of the Project on the surface water features, a water balance analysis was completed to evaluate pre-development and post-development conditions. For detailed information on the water balance calculations, refer to Appendix B.

Pre-development describes the condition within the Property Boundary prior to the extraction and development in Phases 1 through 4, and including the extraction of the existing 3.99 ha quarry. Post-development describes the condition within the Property Boundary following the full extraction and development of Phases 1 through 4.

Water balance

The following section present the annual average water balance analysis under the pre-development and post-development conditions. The catchment areas used for the assessment are shown in Figure 4 (pre-development) and Figure 5 (post-development).

Streams 4 and 5

Under pre-development conditions (Figure 4) Stream 5 confluences with Stream 4 upstream of the Property boundary. Therefore, the pre-development assessment for Stream 4 at the Property boundary includes the drainage area of Stream 5.

As shown in Figure 5, the catchment contributing to Stream 4 will be decreased in the post-development condition and Stream 5 will be removed. As a part of the quarry water management system, water from the sedimentation pond, which will include the quarry seepage, will be discharged/returned to Stream 4. Please note that the calculations presented in this section do not include the estimated groundwater seepage component.

In the post-development condition, the total estimated average annual surplus to Stream 4 is 510,030 m^3 and the estimated average annual runoff to Stream 4 is approximately 401,620 m^3. Surplus increased by approximately 11% and runoff increased by approximately 48% compared to pre-development conditions.

Wetland 7

The catchment contributing to Wetland 7 will not be changed by the quarry expansion. Therefore, the water balance results for the post-development condition will be the same as the pre-development condition.

The total estimated average annual surplus to Wetland 7 is 231,590 m^3 and the estimated average annual runoff to Wetland 7 is approximately 120,800 m^3.

Stream 6

The pre-development drainage area is shown on Figure 4.

As shown in Figure 5, the catchment contributing to Stream 6 will be decreased in the post-development condition. As a part of the quarry water management system, water will be discharged/returned to Stream 6 near the southern property boundary.

In the post-development condition, the total estimated average annual surplus to Stream 6 is 408,320 m^3 and the estimated average annual runoff to Stream 6 is approximately 257,330 m^3. Surplus decreased by 7% and runoff increased by 14% compared to pre-development conditions.

Impact Assessment

Based on the findings from the water balance calculations, an assessment was completed to determine the impacts on the surface water features within the groundwater radius of influence. Potential impacts to wetlands and fish and fish habitat are presented in Section 7.4 and 7.6, respectively.

Stream 3 is within the groundwater radius of influence for quarry dewatering, however the drainage area will not change as it will not be extracted as part of the quarry. Since the stream is within the groundwater radius of influence there may be a loss in groundwater baseflow due to the lowering of the water table. However, the runoff within the drainage area (189 ha) and the baseflow from approximately 82% (155 ha) of the drainage area (which is outside of the groundwater radius of influence) will be maintained. Therefore, the potential loss in baseflow is expected to be minimal as only 18% of the drainage area is within the groundwater radius of influence.

Since the Stream 4 catchment is within the groundwater radius of influence for quarry dewatering the majority of the infiltration will flow into the quarry rather than discharging into Stream 4 as baseflow. As a result, it is anticipated that the flows in Stream 4 will decrease in the post-development condition as it is expected that only runoff will contribute to the flow in Stream 4 within the property boundary. In addition, the catchment contributing

to Stream 4 will be decreased by approximately 27% with the quarry expansion thus decreasing the runoff contributing to Stream 4. Through comparison between the surplus (runoff + infiltration (i.e. baseflow)) contributing to Stream 4 under existing conditions and only runoff contributing under post-development conditions, the flow contribution to Stream 4 will decrease on average by approximately 58% (refer to Appendix B Tables D-2 and D-3). However, under average annual conditions the average annual water balance analysis predicts minimal runoff will continue to contribute to Stream 4 during the dry months of the year (i.e. summer) on an average annual basis potentially maintaining a perennial stream. Monitoring in Stream 4 will continue to pro-actively assess if/when potential effects may occur. If, through the monitoring, it is determined that the water levels in Stream 4 become too low to provide the current amount or quality of fish habitat, or if water temperature exceeds levels appropriate for the species in Stream 4, authorizations from NSE and/ or DFO will be obtained and all conditions of any permits will be implemented.

At the southwest property boundary, the runoff contributing to Stream 4 is estimated to increase by approximately 48% compared to pre-development conditions due to the addition of the quarry discharge. However, the estimated increase of flows in Stream 4 at the property boundary are minimal compared to the observed flows in Holland Brook, therefore no measurable impacts to Holland Brook are anticipated. In addition, as stated above, the flows from the quarry will be controlled in sedimentation ponds and slowly released over time decreasing the peak flows from the Property.

In the post-development condition, the flow in Stream 6 within the property boundary will be minimal due to the reduction in catchment area and loss of baseflow. Since the Stream 6 catchment is within the area of influence for the quarry the infiltration component will flow into the quarry rather than discharging into Stream 6 as baseflow. Through comparison between the surplus (runoff + infiltration (i.e. baseflow)) contributing to Stream 6 under existing conditions and only runoff contributing under post-development conditions the flow contribution to Stream 6 will decrease on average by approximately 63% (refer to Appendix B Tables D-5 and D-6) at the southeast Property Boundary. However, under post-development conditions the runoff contributing to Stream 6 from the upstream catchment area may infiltrate through the rock pillar and contribute to the quarry if rock fractures are present. As a result, authorizations from NSE and/ or DFO will be obtained.

Due to the reduction in total catchment area (approximately 30%) as well as the change in land use, the surplus contributing to Stream 6 at the property boundary decreased by 7% compared to pre-development conditions. However, the runoff contributing to Stream 6 at the property boundary increased by 14% compared to pre-development conditions due to the change in land use from forested/shrubs to quarry floor. As a result, it is anticipated that the flows in Stream 6 will increase at the property boundary. However, the estimated increase of flows in Stream 6 at the property boundary are minimal compared to the measured flows in Holland Brook. Therefore, no measurable impacts to the flow in Holland Brook are anticipated due to the change in catchment area or land use. In addition, the flows from the quarry will be controlled in sedimentation ponds and slowly released over time decreasing the peak flows from the Property Boundary.

Since the catchment area contributing to Wetland 7 will remain unchanged in the post-development condition no surface water impacts to Wetland 7 are anticipated. However, the catchment is within the radius of influence therefore the infiltration component within the catchment area may contribute to the quarry as groundwater inflow. Monitoring will occur in Wetland 7 to assess any changes that may result from the quarry expansion.

If left unmanaged, potential effects of the proposed Project could include degradation of water quality from suspended sediment as well as decrease / increase in water quantity in the wetlands and watercourses. Changes in water quality and quantity can affect aquatic species and habitats and interaction with other potential users of surface water resources.

Clearing, grubbing, and topsoil stripping activities can increase the potential for sediment erosion and deposition downgradient, particularly during periods of heavy rainfall or snow melt. These activities will also result in a reduction of evapotranspiration and a corresponding increase in surface runoff, which in turn increases potential for sediment erosion and deposition.

To the extent possible, surface flow will be directed around the Project and / or away from disturbed areas. Quarry drainage, and surface runoff collection and controls, will be in place for the quarry at the commencement of operation. Sedimentation ponds will be designed to hold a sufficient volume of water to allow for settling of suspended sediment. These ponds are expected to mitigate potential erosion and sedimentation effects resulting from clearing, grubbing, and topsoil stripping activities. Additionally, as the quarry develops, exposed soil and stockpiles capable of producing sediment laden-runoff will be stabilized with mulch or hydroseed, as appropriate and practical.

Surface runoff and quarry drainage will be collected on the quarry floor and will initially drain to the current sedimentation pond, currently in use in the 3.99 ha quarry within the Project footprint. When required, additional sedimentation ponds will be constructed. Phase 1 and Phase 4 will be designed to provide sufficient area for water management infrastructure to be constructed.

The current sedimentation pond will collect all runoff associated with active quarrying limits until the additional pond is constructed. Sedimentation ponds are / will be designed for the water to have sufficient settling occur for the TSS concentration to comply with the NS *Pit and Quarry Guidelines* for effluent discharge criteria (NSEL 1999). The water will be discharged by gravity and will flow through a ditch where it will re-enter the natural environment.

As indicated in Section 8.0, a monitoring plan will be put in place to monitor for changes to the adjacent surface water features that may occur as a result of the Project. Based on the mitigation measures that will be established along with the appropriate permits/approvals obtained, Project-related impacts are not anticipated to be significant.

7.3 Vegetation

The proposed extraction will remove areas of MW1 Red Spruce – Yellow Birch Mixed Forest (9.6 ha) and Regenerating Forest (25.8 ha) forest types, which are common in the general vicinity and in the province. A total of 35.4 ha (40%) of upland vegetation within the Property Boundary will be removed. However, these communities appear to be abundant within the region, and the removal is not expected to affect the overall availability or habitat quality available in the region which includes wetland and forested communities. In addition, the Waverley Game Sanctuary and the Waverley Salmon River Long Lake Wilderness Area, approximately 300 m and 1.2 km from the proposed Project footprint, respectively, provide more abundant, higher quality plant communities and habitat than those within the Project Boundary.

7.4 Wetlands

Six wetlands (i.e., Wetlands 3, 4, 5, 6, 8 and 9) are located within the Project footprint and will be directly or indirectly impacted as part of the Project (Figure 7). The wetland type and area of habitat impacted by the Project is presented in Table 13. All wetlands are common in the province and none of the wetlands impacted by the Project are of special significance. WL 5 provides headwater for Stream 5 however, Stream 5 is within the Project footprint and will be removed during the proposed Project development. As indicated in Section 7.6, no fish were observed within Stream 5 and the stream is not considered fish habitat.

Table 13: Wetlands Directly or Indirectly Impacted by the Project

Wetland ID	Type	Total Size (ha)
WL3 and WL5	Marsh/Swamp Complex	1.54
WL8	Marsh	0.07
WL4, WL6 and WL9	Swamp	1.43

In addition, based on the surface water and groundwater assessments (Sections 7.1 and 7.2, respectively), there may be an indirect effect on wetlands to the south of the Project, within the Study Area as there will be a reduction in the amount of groundwater available to these wetlands. An estimated increase in surface water flow from the Property Boundary to the south is expected. However, the estimated increase of flows at the property boundary are minimal compared to the measured flows in Holland Brook. Therefore, no measurable impacts to the surface water flow in Holland Brook are anticipated due to the change in catchment area or land use.

Loss of wetland habitat, either through direct removal/infilling or dewatering or indirectly through alteration of wetland hydrology/hydrogeology, requires a Wetland Alteration Approval (NSE 2011). The wetland alteration application and approval process requires the completion of a functional assessment of the wetland and a wetland habitat compensation plan to replace the wetland functions lost as a result the Project or, in lieu of a compensation plan, a letter of understanding (LOU) between the proponent and a third party wetland restoration professional describing the amount / value of compensation and the commitment to completion of the restoration and ongoing monitoring (NSE 2011). A Wetland Alteration Approval will be obtained for all wetlands expected to be impacted as a result of the Project and all conditions of that permit will be fulfilled, thereby addressing any adverse effects to wetlands.

7.5 Wildlife

Implementation of standard best management practices, such as avoidance of Project related preparation/clearing activities during the breeding bird nesting and bat maternity roost season and managing light pollution (quarry will only operate during daytime hours), will prevent adverse impacts to wildlife within the Property Boundary. Although some wildlife habitat will be lost, nothing within the Property Boundary is unique, and large areas of similar habitat appear to occur in the region. The removal of these areas is not likely to have a negative impact on the overall wildlife habitat available in the region.

7.6 Fish and Fish Habitat

All watercourses in the Study Area likely have a groundwater contribution, at least on a seasonal basis and as a result are considered cool/coldwater habitats. Potential changes to groundwater and surface water as a result of the Project, as well as the potential effects on the watercourses due to those changes are discussed further in the Sections 7.1 and 7.2, respectively.

Stream 3, which provides fish habitat, is outside of the Project boundary. Although the drainage area contributing to Stream 3 will not change, Stream 3 is within the groundwater radius of influence for quarry dewatering. Because of this, there may be a loss in groundwater baseflow due to the lowering of the water table. However, as discussed in the Section 7.2, the potential loss in baseflow is expected to be minimal. Because no measurable decrease in the flows to Stream 3 are expected, it is anticipated that there will be no impact to fish habitat in Stream 3.

Stream 4, which provides fish habitat, is outside of the Project boundary but in the Study Area. However, due to the quarry extraction there will be a 27% reduction in the catchment area for Stream 4 as a result of the proposed Project, which will reduce surface water input into the stream (Section 7.2). Stream 4 is also within the groundwater radius of influence for quarry dewatering with the majority of the infiltration seeping into the quarry rather than discharging into Stream 4 as baseflow. As a result, it is anticipated that the flows in Stream 4 within the property boundary will decrease in the post-development condition. In addition, because Stream 4 is a cool/coldwater thermal regime, the existing water temperature will have to be maintained in order to provide the appropriate quality of habitat to the species known to use this watercourse. Based on the monitoring data collected in Stream 4, the temperature was recorded at a low of 0.6 ^{o}C in January 2018 and from July to October 2017 ranged from 8.9 ^{o}C to 18.5 ^{o}C in the upstream reach on the Property and 8.5 ^{o}C to 19.4 ^{o}C in the downstream reach on the Property. The chronic temperature tolerance for brook trout is approximately 19 ^{o}C and the acute temperature tolerance is approximately 24 ^{o}C. Water temperature should not exceed 19 ^{o}C on a sustained basis in order to mitigate harm to brook trout (Nevada 2017). Changes to the quantity and quality of the water in Stream 4 will be mitigated by on-site water management and monitoring as needed. Monitoring in Stream 4 will continue to proactively assess if/when potential effects may occur. If, through the monitoring, it is determined that the water levels in Stream 4 become too low to provide the current amount or quality of fish habitat, or if water temperature exceeds levels appropriate for the species in Stream 4, authorizations from NSE and/ or DFO will be obtained and all conditions of any permits or approvals will be implemented. With the implementation of these monitoring and mitigation (i.e. authorization) measures, no net loss of fish habitat in Stream 4 is anticipated.

At the southern property boundary, the runoff contributing to Stream 4 is estimated to increase by approximately 48% compared to pre-development conditions due to the addition of the quarry discharge. However, the estimated increase of flows in Stream 4 at the Project boundary are minimal compared to the observed flows in Holland Brook, therefore no measurable impacts to Holland Brook are anticipated. In addition, as stated above, the flows from the quarry will be controlled in sedimentation ponds and slowly released over time decreasing the peak flows from the Property Boundary.

Stream 5 is within the Project footprint and will be removed as a part of the Project operations. Stream 5 was assessed to have low potential to provide fish habitat given the lack of suitable habitat features, as well as barriers to fish migration, and lack of surface connectivity with other streams. Therefore, no impact to fish habitat is expected to occur due to the removal of Stream 5.

Stream 6 provides fish habitat and is within the Project footprint. Based on the groundwater assessment (Section 7.1), the Project is modelled to result in a significant reduction in the amount of groundwater available to Stream 6. In addition, there will be a 30% reduction in the catchment area resulting in loss of surface flow and baseflow to Stream 6 due to the proposed Project (Section 7.2). It is anticipated that due to the changes to the surface and groundwater regimes, through the proposed extraction operations, all fish habitat in Stream 6 will be removed. Appropriate authorizations will be obtained, if deemed necessary though consultation with DFO and/or NSE, including establishing compensation habitat elsewhere if required, and all other conditions of permits will be implemented. As such, it is expected that there will be no net loss of fish habitat, as result of the removal of baseflow to Stream 6.

Holland Brook is located in the Study Area and provides fish habitat, but is outside of the Project footprint, and no direct impacts are expected to occur. Although runoff contributing to Streams 4 and 6 at the southern Property Boundary near the outlet to Holland Brook, it is expected to increase due to addition of the quarry discharge (see Appendix B Tables D-1 to D-6), the estimated increase in flow is minimal compared to observed flows in Holland Brook. In addition, flow from the quarry will be controlled in sedimentation ponds and slowly released over time to decrease peak flows from the Property Boundary (Section 7.2). Thermal impacts to Holland Brook are not anticipated from receiving water from the Project during the proposed extraction operations, however, if through monitoring, it is determined that there will be thermal impacts to Holland Brook, mitigation measures such as canopy cover over the sedimentation ponds will be installed. Based on this assessment, no measurable impacts to Holland Brook are anticipated as a result of the proposed Project and no impacts to fish or fish habitat are expected.

7.7 Species at Risk

Black Ash

The black ash is located within the Property Boundary, but outside of the proposed extraction area and Project footprint. There will be no direct impacts (i.e., removal) to this individual as a result of the proposed extraction. Furthermore, since black ash have a shallow root system (Gucker and Corey, 2005) and where Wetland 7 is primarily surface water fed based on the surface water assessment (Section 7.2) no indirect impacts to the black ash are expected. There are also no changes to the catchment boundary for Wetland 7 expected, and the surrounding wetland habitat will be maintained.

Common Nighthawk

The majority of potential suitable habitat within the Property Boundary is outside of the Project footprint, and will still be available during the operation of the quarry. In addition, the operating quarry may create some nesting habitat for common nighthawk, particularly at the quarry edge where soil is stripped down to bedrock. To avoid direct impacts to any individuals that may be nesting in the Project footprint, vegetation clearing and soil stripping should be conducted outside of the breeding bird nesting period. During operations, on-site staff will report any observations of nesting birds to the Scotian site supervisor and Scotian will implement a no-disturbance setback appropriate for that species until the young have fledged the nest. With implementation of appropriate mitigation measures, and given the large amount of potential suitable habitat available within the Property Boundary and within the region no adverse impacts to common nighthawk are expected to occur.

Little Brown Myotis, Northern Myotis, Tri-colored Bat

These three bat species nor their habitat were confirmed within the Property Boundary or within the Project footprint. Suitable maternity roosting habitat (i.e., large diameter cavity or snag trees) for these bat species was not observed within the Project footprint. Within the Property Boundary, outside of the Project footprint, some of the forested areas do provide suitable maternity roost habitat, particularly in the southwestern portion of the Property Boundary and in the valleylands of Streams 4 and 6. In addition, there are large forested areas in the immediate vicinity of the Property Boundary and within the region. No tree removal is expected to occur outside of the Project footprint. Although there is no quality suitable habitat for these bat species in the Project footprint, tree clearing will not occur during the maternity roosting timing window. With implementation of appropriate mitigation measures, and assuming no tree removal occurs outside of the Project, no impacts to these three bat species or their habitat are expected to occur. The nearest known hibernaculum or abandoned mine adit is approximately 25 km away from the Property, so there will be no adverse effects on hibernating bats as a result of blasting.

7.8 Air Quality

As previously mentioned, the air quality compound of greatest concern from the Project is particulate matter. There are a variety of activities that can lead to the generation of particulate matter at a quarry operation, including:

- road dust;
- removal of overburden;
- blasting activities;
- crushing/screening operations;
- exhaust emissions due to incomplete combustion from diesel compression engine;
- material handling;
- truck loading / truck unloading; and,
- wind erosion on storage piles.

For these types of activities, the quantity of particulate emissions generated decreases as the particle size decreases, meaning the amount of $PM_{2.5}$ generated is less than the amount of PM30. However, the finer particulates (i.e., PM_{10} and $PM_{2.5}$) have the greatest potential to be transported downwind from the source. Generally, particles that are 30 to 100 µm in diameter are likely to settle within approximately 100 m or less from the source. The smaller particles will fallout at a slower rate and may travel further from the emission source allowing more time for them to disperse.

Scotian will follow the following best management practices to manage fugitive dust associated with the Project. The best management practices will include:

- identification and ranking of the main sources of fugitive dust;
- a description of the preventative procedures and reactive control measures in place and / or under development for the Project;

- frequency of inspections as well as any monitoring initiatives to evaluate the effectiveness of the control measures in place;
- a description of non-conformance procedures; and,
- a record of any fugitive dust complaints and how they were addressed.

Project personnel, including any contractors working on the Project, will be trained in the requirements of the best management practices.

The following are some of the mitigation measures that will be implemented to minimize the potential effects on air quality due to the Project:

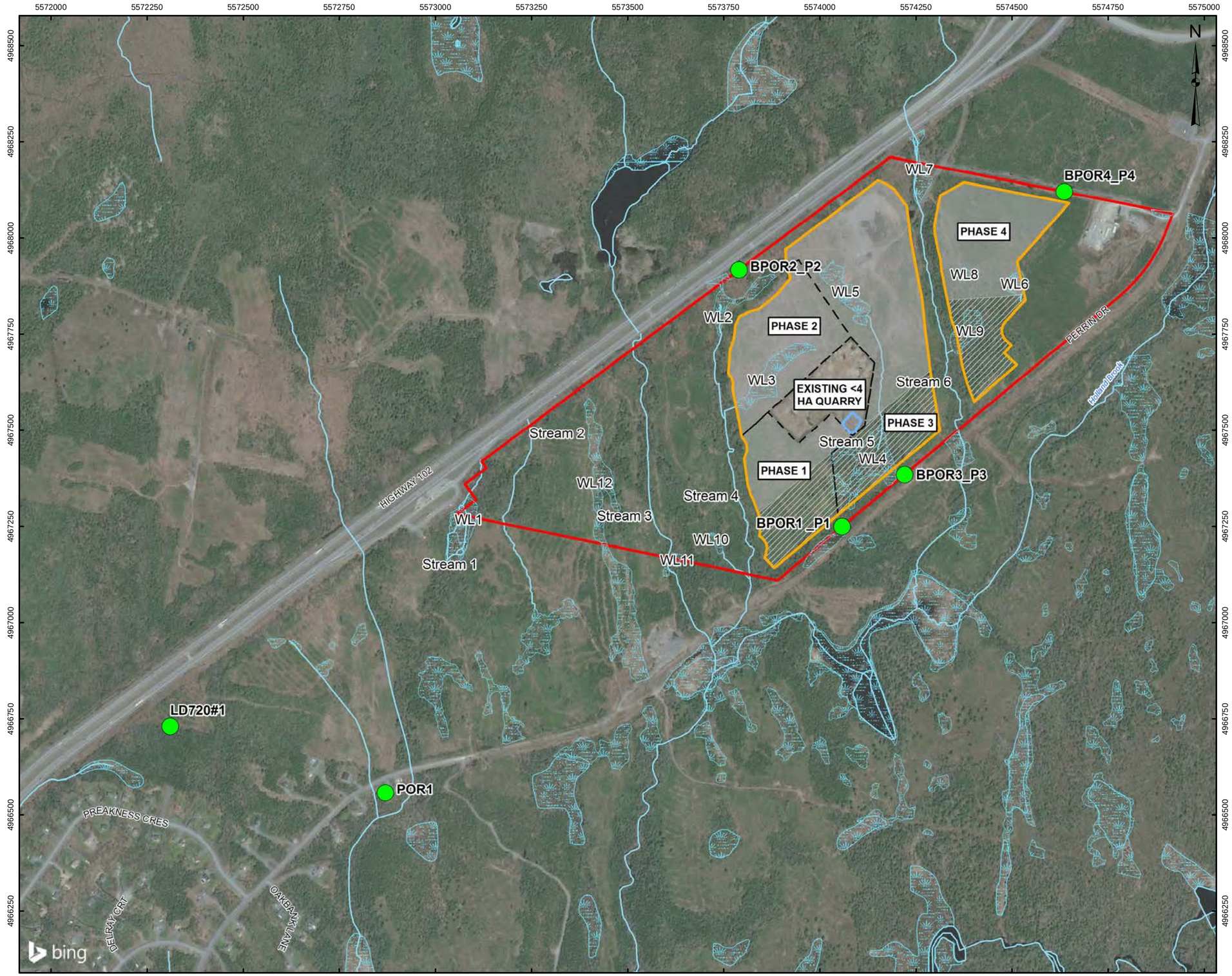
- stabilizing exposed erodible material (e.g., laydown areas and stockpiles);
- enforcing speed limits for on-site vehicles;
- proper truck loading and minimizing freeboard;
- minimizing drop height for material transfer points;
- application of water for dust suppression;
- ensuring vehicles and equipment are maintained as per manufacturer specifications;
- minimize vehicle idling, where possible; and / or,
- any other means as required by NSE.

Given the distance between the source and the nearest receptors (i.e., approximately 1,100 m to the southwest) coupled with the prevailing wind directions (i.e., away from the nearest receptors), levels of particulate matter at the nearest receptors due to the Project should be minor and within the limits established in the IA for a well-maintained quarry operation which is following best management practices.

By implementing best management practices and associated mitigation measures, significant Project-related effects on air quality are not likely to occur.

7.9 Noise

An assessment of the potential noise impacts from the proposed expansion of the quarry operation on off-site Point(s) of Reception (POR(s)) was carried out. The location of POR(s) are shown in Figure 15.



LEGEND

- POINT OF RECEPTION (POR)
- WATERCOURSE
- WETLAND
- SEDIMENTATION POND
- PROPOSED EXTRACTION PHASES
- PROPOSED EXTRACTION AREA
- ASSOCIATED DEVELOPMENT AREA
- PROJECT BOUNDARY
- PROPERTY BOUNDARY

REFERENCES

Base Data - CanVec, obtained 2010
Wetlands - obtained from Canvec, 2010, Golder, 2017, and McCallum, 2014.
Watercourse - Golder, 2012
Base Imagery © 2018 Microsoft Corporation © 2018 DigitalGlobe ©CNES (2018) Distribution Airbus DS
Projection: Transverse Mercator Datum: ATS77 Coordinate System: MTM Zone 5

150 75 0 150 300 450 600
SCALE 1:10,000 METERS

PROJECT
SCOTIAN MATERIALS GOFFS QUARRY EARD

TITLE
PROJECT BOUNDARY AND LOCATION OF POINTS OF RECEPTION (PORS)

GOLDER

PROJECT No. 1777778			SCALE AS SHOWN	REV. 0.0
DESIGN	CA	2018-05-04	FIGURE 15	
GIS	LMM	25/07/2018		
CHECK	GM	25/07/2018		
REVIEW	CA	25/07/2018		

S:\Clients\Scotian_Materials\Goffs_Quarry\99_PROJ\1777778\40_PROD\0011_EA_Noise\1777778-0011-RN-0002.mxd

In completing this assessment, Golder considered the operations of the following equipment:

- power generator;
- primary crusher and associated material hoppers;
- secondary and tertiary crushers;
- wash plant;
- various screens (assumed primary and secondary) and conveyors;
- loaders;
- on-site trucks; and,
- a rock drill.

All relevant sound levels for sources were obtained from Golder's in-house database of similar sources. The predictive analysis was carried out using the commercially available software package CadnaA version 2017 MR1. Geometrical spreading, attenuation from barriers, ground effect and air absorption were included in the analysis as identified in the ISO 9613-1 (1996) standard typically used for the prediction of outdoor sound propagation. It should be noted this standard makes provisions to include a correction to address for downwind or ground-based temperature inversion conditions. Noise predictions have been made assuming a downwind or moderate temperature inversion conditions for all identified PORs.

As described in ISO 9613-2 (1996), ground factor values that represent the ground effect on sound levels range between 0 and 1. Based on the specific Property conditions, the ground factor value used in the modelling of areas associated with the Project was set to 0.2 representing acoustically hard (i.e., reflective) surface. Otherwise, a ground factor value of 1 was used for the remaining areas, this accounts for the surface of the surrounding area which is mainly made up of treed areas between the Project and the identified PORs. Foliage or shielding from woodlots was conservatively not considered. Noise screening from working face with height of 10 m was included in model calculations, however the area surrounding the Project boundary was conservatively modelled as flat terrain.

The computer model developed for the noise assessment considered all four phases planned for the Project. All major stationary noise sources associated with the processing plant were located within the approximate centre of the Project as it is understood that the location of the processing plant will remain permanent through the lifespan of the quarry. Noise sources associated with extraction equipment (i.e., a drill, a loader and haul trucks) were located near the working face aligned with the phase boundary. The most impacted points along the Project boundary were identified for each extraction phase and named as Boundary Point(s) of Reception (BPORs). The Project noise impact was assessed for these representative locations as well as for the two PORs corresponding to the location of closest residential dwelling along Perrin Drive (POR1) and homes along Preakness Crescent (LD720#1).

Assessment Scenarios

Two separated assessment scenarios were considered for in the noise assessment:

- Scenario 1 - normal operations; and,
- Scenario 2 - drilling operations.

The Project is expected to operate up to five days a week, ten to twelve hours a day. Therefore, the noise assessment of both scenarios was conducted considering daytime and evening period only.

Normal Operations

This scenario assumes typical operations of the quarry including material extraction, transfer and processing.

Drilling Operations

Drilling operations will be completed as demanded by production schedule. It is further assumed that drilling can occur concurrently with normal operations. Therefore, this scenario assumes operations of the equipment associated with drilling as well as equipment associated with normal operations. The drill is expected to operate during the daytime and evening time only. The model developed for this scenario assumes the location of the drill to be near the top edge of the working face, thus closest to the Property boundary. Generally, a drill is considered a significant noise source, and when operating near the Property boundary, it will be a major noise contributor.

Assessment Results

The following section presents the results of the noise assessment for the Project.

Scenario 1 – Normal Operations

Table 14 summarizes the results of the noise modelling for the normal operations scenario for the Project.

Table 14: Predicted Noise Levels - Scenario 1 Normal Operations

Point of Reception (POR ID_Phase Number)	Predicted Noise Level (dBA)	
	Daytime	Evening
BPOR1_P1	55	55
BPOR2_P2	51	51
BPOR3_P3	57	57
BPOR4_P4	54	54
POR1[(a)]	36	36
LD720#1[(b)]	33	33

(a) Point of reception associated with residence along Perrin Dr

(b) Point of reception associated with residences along Preakness Crescent

Based on the results presented in Table 14 the noise levels from the operations considered in Scenario 1 will be below noise limits specified in the NS *Pit and Quarry Guidelines* (NSEL 1999) along the Project boundary. In addition, the results indicate that the predicted noise level at a location associated with closest residential POR1 located along Perrin Drive will be approximately 36 dBA, below the monitored baseline noise levels.

Scenario 2 – Drilling

To assess the noise contributions from drilling activities, additional calculations were carried out to evaluate noise levels from Project activities with the drilling activities. Based on the results a minimum drilling setback of 150 m from the Project boundary would be sufficient to demonstrate that the noise levels comply with relevant noise limits. Drilling activities are not likely to occur within a 150 m setback distance from the Project boundary. However, if this was to occur, mitigation would be required to reduce noise level to below NSEL limits along the Project boundary. The mitigation could take the form of an acoustic barrier, or equivalent.

The mitigated results when the drilling activities are occurring at the closest point of the specific extraction phase are presented in Table 15.

Table 15: Predicted Noise Levels - Scenario 2 - Drilling Mitigated

Point of Reception (POR ID Phase Number)	Predicted Noise Level (dBA)	
	Daytime	Evening
BPOR1_P1	60	60
BPOR2_P2	53	53
BPOR3_P3	60	60
BPOR4_P4	60	60
POR1	36[(a)]	36[(a)]
LD720#1	34[(a)]	34[(a)]

[(a)] Based on Phase 1 operations

Based on the results presented in Table 15 the noise levels from the operations considered in Scenario 2 will be below noise limits specified in NSEL along the Project boundary. In addition, the results indicate that the predicted noise level at a location associated with closest residential receptor POR1 located along Perrin Dr will be equal to 36 dBA and noise level predicted for residences along Preakness Crescent will be below 35 dBA, below the monitored baseline noise levels.

By implementing the recommended mitigation measures described in Table 16, when required, significant Project-related noise effects are not likely to occur.

7.10 Socio-Economic Environment

The proposed Project will produce valuable products that will support development and infrastructure within the local and regional area and have an overall positive effect on the regional economy. The availability of locally sourced aggregate to the market place encourages a more stable price for such materials.

The overall price for aggregates are lower where quarries are in close proximity to end use; since cost largely reflects the distance it must be transported. This, in turn, can significantly reduce costs of construction, which, in the case of public infrastructure such as highways, communities, public works agencies, and taxpayers, should result in financial benefits.

Employment levels in the area are not anticipated to result in a significant change as a result of the Project. Project-related employment effects may be minor; however, they will be positive.

In some cases, development of an aggregate extraction Project involves changing the land use of the area, potentially using lands previously used for other resource-based activities (e.g., agriculture, forestry) or recreational activities.

Given the history of aggregate extraction in the area of the Project, the adjacent industrial land uses (e.g., the clay pit, Clean Earth Technologies), and the distance from residences (e.g., further than 800 m), the proposed Project is not considered be incompatible with adjacent and historic uses and light industrial land uses of Aerotech Park. Project activities will be undertaken in accordance with the NS *Pit and Quarry Guidelines* (NSEL 1999), including all maintaining all setback distances.

Noise produced from blasting and equipment operation will not likely result in a significant effect on residences and other land users. Furthermore, blasting will be conducted in accordance with the General Blasting Regulations made pursuant to the Nova Scotia Occupational Health and Safety Act (1996). A blast design plan will be developed for the proposed Project. Pre-blast surveys, blast and / or noise monitoring will be conducted at the request of the relevant regulatory agencies.

The Project is not anticipated to result in any significant increase in the volume of traffic on public roads and highways compared to current levels.

The Project is not located in the immediate vicinity of any major municipal or provincial recreation facilities or commercial recreation areas, such that there will be no significant impact on tourism and recreation in the area. The Project footprint itself is considered to have limited recreational value as the lands are privately owned. The proposed Project footprint is generally 300 m from the Waverley Game Sanctuary and approximately 1.2 km from the Waverley Salmon River Long Lake Wilderness Area. Public access points to these protected areas are not known to occur near the Project or on the adjacent lands. Project activities, including transport of materials, are not expected to interact with the use of these protected areas.

According to the Master Plan developed for the lands owned by Scotian in the vicinity of the Project, the final future land use of the Project footprint will be commercial / industrial (i.e., consistent with current land use along Aerotech Drive). The quarry will be left in a stable condition, suitable for future commercial development.

The Project will result in changes to the visual landscape immediately adjacent to the footprint; however, the Project is not visible from Highway 102 and the Miller Lake West subdivision. Scotian will maintain a treed barrier around the Property Boundary, particularly on the north and west boundaries, bordering Highway 102 and surrounding communities, to ensure the quarry remains shielded from view. All setbacks indicated in the NS *Pit and Quarry Guidelines* (NSEL 1999) will be maintained.

Human health related issues associated with quarry developments pertain to air quality which is discussed in Section 7.8. The Project is not anticipated to result in adverse health impacts to nearby residents.

In summary, assuming effective implementation of mitigative measures, significant adverse Project-related effects on the socio-economic environment areas are not likely to occur.

7.11 Archaeological and Heritage Resources

The potential for a Project footprint to contain First Nations archaeological resources is generally determined by the presence of resources that the Mi'kmaq people depended upon, such as food and water, as well as proximity to watercourses that were large enough to be used as a transportation route or were used to access such a route.

The lands within and adjacent to the proposed Project are rugged and difficult to traverse. Based on the study completed by Davis MacIntyre and Associates, the ARIA Study Area does not appear to contain any resources that may have attracted First Nations peoples to the area. The Shubenacadie waterways, the only substantial waterbodies in the area, are several kilometres west of the proposed Project. First Nations peoples obviously favoured that area for resource exploitation, encampment, and burial; therefore, the ARIA Study Area has been determined to be of low archaeological potential for both First Nations and Euro-Canadian resources.

7.12 Other Undertakings in the Area

Other than the clay pit owned by Scotian approximately 750 m east, there are no active pits or quarries within a 5 km radius of the proposed Project. There are three active quarries within approximately 15 km: Gallant Aggregates approximately 14.5 km northeast, Conrad Bros Quarry approximately 12.5 km south, and Municipal Enterprises Rocky Lake Quarry approximately 11 km southwest.

8.0 MONITORING

In accordance with the *Pit and Quarry Guidelines* and the Industrial Approval for the Project, Scotian will develop any required monitoring program to be approved by NSE prior to the start of Project activities. The program will be designed to monitor for changes to groundwater levels and quality, changes to surface water features such as streams, wetlands and fish and fish habitat. As indicated in Sections 7.8 and 7.9, monitoring of dust and noise will be conducted as per the NS *Pit and Quarry Guidelines* and at the request of NSE.

9.0 EFFECTS OF THE UNDERTAKING ON THE ENVIRONMENT

Detailed descriptions of the potential effects of the Project on groundwater resources, surface water resources, vegetation, wetlands, wildlife, fish and fish habitat, SAR, air quality, noise, the socio-economic environment, and archaeological and heritage resources are provided in Section 7. A summary of the potential interactions between Project activities and operations and the VCs considered is provided in Table 16, below. Potential impacts to VCs as a result of the Project and corresponding mitigation measures are summarized in Table 17.

For the purposes of this report, potential impacts to the VCs considered were defined by the following terms:

Not significant - No permanent or residual impact to the relevant receptor relative to baseline conditions.

Negligible – The potential for a Project/VC interaction however the interaction likely represents a relatively low impact and potential changes to baseline conditions are unlikely.

Significant - Permanent, irreversible, adverse impact to the relevant VC.

Table 16: Potential Interactions between Project Activities and Operations and Valued Components (VCs)

Project Component	Biophysical								Socio-Economic					
	Groundwater Resources	Surface Water Resources	Wetlands	Fish and Fish Habitat	Flora and Fauna	Species at Risk	Air Quality	Noise	Local Economy	Land Use and Value	Transportation	Recreation and Tourism	Archaeology and Heritage	Residential Water Supplies
Construction														
Clearing (Tree Cutting)			X		X	X		X		X			X	
Grubbing and Stripping		X	X	X	X	X	X	X					X	
Operation														
Drilling	X				X	X	X	X				X		X
Blasting	X	X	X	X	X	X	X	X		X		X		X
Loading and Hauling					X		X	X						
Crushing / Screening					X		X	X				X		
Washing		X	X	X	X							X		
Surface Water Management		X	X	X	X							X		X
Transportation of Product					X		X	X	X	X	X	X		
Accidents (Fires and Fuel Spills)	X	X	X	X	X	X	X	X				X		X
Decommissioning and Reclamation	X	X		X	X	X	X	X	X	X		X		

Table 17: Summary of Impacts and Mitigation on Valued Components (VCs)

VC	Description of Effect	Nature of Impact	Significance	Mitigation	Significance After Mitigation
Groundwater Resources	Potential for Acid Rock Drainage and Metal Leaching	Negative	Negligible	Based on acid generation potential results for samples taken from the existing quarry, lithologies at the Property are not expected to generate acidic drainage or metal leachate.	Negligible
	Potential changes to groundwater contributions.	Negative	Not significant	Water well interference related to quarry dewatering is not expected, as the closest water wells are well beyond the estimated radius of groundwater level zone of influence.	Not significant
	Potential changes to groundwater quality related to blasting.	Negative	Negligible	Blasting will be designed for the complete combustion of the explosive material to mitigate the impact of blasting on groundwater quality.	Not significant
Surface Water Resources	Potential changes to surface water flows and quality.	Negative	Significant	To the extent possible, surface flow will be directed around the Project and/or away from disturbed areas. Quarry drainage, and surface runoff collection and controls, will be in place for the quarry at the commencement of operation. Sedimentation ponds will be designed to hold a sufficient volume of water to allow for settling of suspended sediment. These ponds are expected to mitigate potential erosion and sedimentation effects resulting from clearing, grubbing, and topsoil stripping activities. Additionally, as the quarry develops, exposed soil and stockpiles capable of producing sediment laden-runoff will be stabilized with mulch or hydroseed, as appropriate.	Negligible

VC	Description of Effect	Nature of Impact	Significance	Mitigation	Significance After Mitigation
				Vehicle fueling and maintenance will be conducted in clay-lined containment areas enclosed within side curbs and a sloping floor in order to contain any inadvertent spills or leaks.	
Vegetation	Removal of upland vegetation.	Negative	Negligible	The proposed extraction will remove areas of MW1 Red Spruce – Yellow Birch Mixed Forest (9.6 ha) and Regenerating Forest (25.8 ha) forest types, which are common in the general vicinity and in the province. A total of 35.4 ha (40%) of upland vegetation within the Property Boundary will be removed. However, these communities are abundant within the region, and the removal is not expected to affect the overall availability or habitat quality available in the region.	Not significant
Wetlands	Alteration and / or removal of wetlands located within the Project footprint.	Negative	Negligible	Six wetlands (i.e., Wetlands 3, 4, 5, 6, 8 and 9) are located within the Project footprint and will be directly or indirectly impacted as part of the Project. Based on the functional assessments completed for each wetland, no critical functions were identified. No wetlands of special significance will be effected by the Project. A Wetland Alteration Permit will be obtained for all wetlands expected to be impacted as a result of the Project and all conditions of that permit will be fulfilled, thereby addressing any adverse effects to wetlands. As part of this approval process, wetland compensation will be provided for the loss of wetland habits (no net loss).	Negligible

VC	Description of Effect	Nature of Impact	Significance	Mitigation	Significance After Mitigation
Wildlife	Removal of wildlife habitat.	Negative	Significant	Implementation of standard best management practices, such as avoidance of Project related preparation/clearing activities during the breeding bird nesting and bat maternity roost season and managing light pollution, will prevent adverse impacts to wildlife within the Property Boundary. Although some wildlife habitat will be lost, nothing within the Property Boundary is unique, and large areas of similar habitat appear to occur in the region. In addition, the Waverley Game Sanctuary and the Waverley Salmon River Long Lake Wilderness Area, approximately 300 m and 1.2 km from the proposed Project footprint, respectively, provide more abundant, higher quality plant communities and habitat than those within the Project Boundary. The removal of these areas is not likely to have a negative impact on the overall wildlife habitat available in the region.	Negligible
Fish and Fish Habitat	Potential impact to fish and / or fish habitat.	Negative	Significant	Changes to the quantity and quality of the water in Stream 4 will be mitigated by on-site water management infrastructure. Monitoring will be conducted as needed. Monitoring in Stream 4 will continue to pro-actively assess if/when potential effects may occur. If, through the monitoring, it is determined that the water levels in Stream 4 become too low to provide the current amount or quality of fish habitat, or if water temperature exceeds levels appropriate for the species in Stream 4, authorizations from DFO including fish habitat compensation (if required) and/or NSE will be obtained and all conditions of any permits will be implemented (if required). With the implementation of these monitoring and mitigation (i.e. authorization) measures, no net loss of fish habitat in Stream 4 is anticipated.	Negligible

VC	Description of Effect	Nature of Impact	Significance	Mitigation	Significance After Mitigation
				It is anticipated that due to the changes to the surface and groundwater regimes, through the proposed extraction operations, all fish habitat in Stream 6 will be removed. Appropriate authorizations, if deemed necessary though consultation with DFO including fish habitat compensation (if required) and/or NSE will be obtained and all conditions of any permits will be implemented. As such, it is expected that there will be no net loss of fish habitat, as result of the removal of baseflow to Stream 6. Thermal impacts to Holland Brook are not anticipated from receiving water from the Project during the proposed extraction operations, however, if through monitoring, it is determined that there will be thermal impacts to Holland Brook, mitigation measures such as canopy cover over the sedimentation ponds will be installed.	
Species at Risk (SAR)	Potential impact to SAR including black ash, common nighthawk, little brown myotis, northern myotis, and tri-coloured bat.	Negative	Negligible	There will be no direct impacts (i.e., removal) to the black ash as a result of the Project. No indirect impacts to the black ash or its habitat are expected. There are also no changes to the catchment boundary for Wetland 7 expected, and the surrounding wetland habitat will be maintained. To avoid direct impacts to any individuals that may be nesting in the Project footprint, vegetation clearing and soil stripping should be conducted outside of the breeding bird nesting period. During operations, on-site staff will report any observations of nesting birds to the Scotian site supervisor and Scotian will implement a no-disturbance setback appropriate for that species until the young have fledged the nest.	Negligible

VC	Description of Effect	Nature of Impact	Significance	Mitigation	Significance After Mitigation
				Although there is no quality suitable habitat for these bat species in the Project footprint, tree clearing will not occur during the maternity roosting timing window.	
Air Quality	Particulate matter generated by Project activities	Negative	Negligible	The following mitigation measures will be implemented as part of the best management practices to minimize the potential effects on air quality due to the Project: - stabilizing exposed erodible material (e.g., stockpiles); - enforcing speed limits for on-site vehicles; - proper truck loading and minimizing freeboard; - minimizing drop height for material transfer points; - application of water for dust suppression along access road at the quarry; - ensuring vehicles and equipment are maintained as per manufacturer specifications; - minimize vehicle idling, where possible; and/or, - any other means as required by NSE.	Not significant
Noise	Noise generated by Project activities	Negative	Not significant	Noise levels generated by normal operations at the quarry are estimated to be below the limits specified in the NS *Pit and Quarry Guidelines* (NSEL 1999) along the Property boundary. In addition, the results of noise modelling indicate that the predicted noise level at a location associated with closest residential POR1 located along Perrin Drive will be approximately 36 dBA, below the monitored baseline noise levels.	Not significant

VC	Description of Effect	Nature of Impact	Significance	Mitigation	Significance After Mitigation
				Drilling activities are not likely to occur within a 150 m setback distance from the Project boundary. However, if this was to occur, mitigation would likely be required to reduce noise level to below NSEL limits along the Project boundary, based on modelling predicted levels. Noise generated by drilling at the quarry could be mitigated through use of an acoustic barrier, or equivalent.	
Local Economy	Job creation as a result of the Project	Positive	Significant	The proposed Project is expected to employ at least 10 to 12 direct employees throughout the year, with five to six additional secondary workers being employed by the blasting contractor for at least one week, four to six times per year. Additional secondary employment through hauling / trucking contractors is estimated to result in the employment of another 20 to 30 workers.	Significant
Transportation	Increase in truck traffic on Highway 102.	Negative	Negligible	The Project is not anticipated to results in any significant increase in the volume of traffic on public roads and highways compared to current levels.	Negligible
Recreation and Tourism	Potential for Project activities to affect local recreation and tourism.	Negative	Not significant	The Project is not located in the immediate vicinity of any major municipal or provincial recreation facilities or commercial recreation areas, such that there will be no significant impact on tourism and recreation in the area. The Project footprint itself is considered to have limited recreational value as the lands are privately owned.	Not significant

VC	Description of Effect	Nature of Impact	Significance	Mitigation	Significance After Mitigation
				The proposed Project footprint is generally 300 m from the Waverley Game Sanctuary and approximately 1.2 km from the Waverley Salmon River Long Lake Wilderness Area. Public access points to these protected areas are not known to occur near the Project or on the adjacent lands. Project activities, including transport of materials, are not expected to interact with the use of these protected areas.	
Archaeology and Heritage	Potential disturbance of archaeological and / or heritage resources	Negative	Not significant	The ARIA study has determined there to be of low archaeological potential for both First Nations and Euro-Canadian resources.	Not significant

Based on the implementation on the of the mitigation measures identified in Table 17, the Project will not result in significant impacts to the environment, with the exception of positive impacts as described.

10.0 EFFECTS OF THE ENVIRONMENT ON THE UNDERTAKING

The definition of an environmental effect often includes any change to the Project that may be caused by the environment. In the case of a quarry operation, potential effects of the environment on the Project are limited to climate and meteorological conditions, specifically precipitation and the resulting water management and erosion control requirements. Precipitation and runoff may cause temporary delays in quarry construction, operation (including trucking aggregate), and reclamation activities.

On a national basis, Canada shows a warming and cooling pattern with a higher overall warming trend of approximately 1.1 ºC since 1895. The Atlantic Region, however, shows a warming trend from 1895 which peaked in the mid-1950s followed by a cooling trend in the 1990s. The overall warming trend of 0.4 ºC in Atlantic Canada since 1895 is not statistically significant. With respect to precipitation, the Atlantic Region shows an overall increasing trend in precipitation since 1948, with an increasing trend in the number of daily precipitation events above 20 mm and a slight increasing trend in the number of daily snowfall events above 15 cm (Lewis 1997).

There is a number of planning, design, and construction strategies intended to minimize the potential effects of the environment on the Project so that the risk of damage to the Project or operational delays can be reduced to acceptable levels. Mitigation measures include, but are not limited to:

- Designing and installing erosion and sediment control structures to accommodate appropriate levels of precipitation.
- Considering weather conditions when scheduling activities, including scheduling of activities to accommodate weather interruptions.

Weather will be factored into all Project phases and activities. The Proponent proposes that the quarry remain operational approximately 35 weeks per year or more, weather permitting, and will consider severe weather conditions when planning activities. Heavy snowfalls and significant snow accumulation will have an impact on the quarry's ability to remain open.

In summary, climate and meteorological conditions, including climate change, are not anticipated to significantly affect the operation of the quarry over its proposed lifetime

11.0 MI'KMAQ ENGAGEMENT

Scotian prepared an Environmental Assessment Summary which was provided on June 1, 2018 to the following communities and groups via email:

- David Mitchell, Office of Aboriginal Affairs
- Michael Cox, Sipekne'katik First Nation
- Gerald Gloade, Millbrook First Nation
- Twila Gaudet, Kwilmu'kw Maw-klusuaqn Negotiation Office (KMKNO)

This Summary provides a project description of proposed expansion activities at the Goff's quarry, a list of Valued Components considered for the project, a summary of baseline conditions, potential project interactions, and proposed mitigation measures.

Scotian offered to review the findings of the environmental assessment for this project with each community and offered to meet with them or deliver a presentation on the project, should this be of interest to the community members. To date, no requests for a meeting, and no questions specific to the Goff's quarry have been received.

12.0 PUBLIC INVOLVEMENT

The public engagement completed in support of the proposed Project is outlined below. Specific details of the engagement process and materials are provided in Appendix I.

Community engagement for the Goffs Expansion Project was initiated in April 2018. The proposed Project was presented to the Community Liaison Committee on April 24, 2018.

Scotian published a public notice for the proposed Project in the Chronicle Herald paper on May 19, 2018 and on The Laker's website from May 19 to June 5, 2018 during which time members of the public are encouraged to provide comments and / or questions.

Scotian has also created a website to supplement the newspaper distribution of the public notice. The website, scotianmaterials.info/eia, is meant to be the main tool of the consultative process, and contains Project details and an abridged version of the EA. The public will be able to ask questions and submit comments via the website, and any responses will be made available for public viewing. The website will be available for the full duration of the NSE public comment period as well as during the operation period of the Project.

Prior to the Open House, public notices were disturbed via Canada Post to residents in the communities within the Miller Lake West and the Fall River areas. The public notices proved the details of the Open House (date, time, location, etc.) as well as the website details.

An open house was held on June 5, 2018 from 2 – 5 pm and 6 – 9 pm. The open house was structured around information boards and tables, each detailing a different component of the Project, including location, surrounding land use and the following VCs: surface water, groundwater, biophysical, noise and dust. The public was encouraged to ask questions and provide comments to Scotian staff, were stationed at each table. A total of 26 people attended the Open House.

Scotian presented the Project at the annual general meeting/open house for the Shubenacadie Watershed Environmental Protection Society (SWEPS). The SWEPS open house occurred on June 16, 2018 from 10 am - 2 pm at the Gordon Snow Community Centre in Fall River. The format and information presented was the same material from the Scotian open house held on June 5, 2018. The open house was advertised on SWEPS' website (http://www.sweps.org) and on social media. Scotian received two visitors to the open house, neither of which had any comments on the proposed project.

In addition, Scotian has engaged various stakeholders on the proposed Project. Stakeholders include:

- The Halifax International Airport Authority (HIAA);
- Maritimes & Northeast Pipeline;
- East Hants Source Water Protection Advisory Committee
- The Premier's Office and the Minister of Environment; and
- Local Member Legislative Assembly (MLA) and Councillor.

The following table provides an overview of the comments received through this engagement process.

Table 18: Summary of Issues/Concerns Raised During Public Engagement

Issue or Concern	Response/Proposed Resolution
Loss of Wildlife/wildlife habitat	Implementation of standard best management practices, such as avoidance of site preparation/clearing activities during the breeding bird nesting and bat maternity roost season, will prevent adverse impacts to wildlife on the Site. Although some wildlife habitat will be lost, habitat at the Site is not unique, and large areas of similar habitat appear to occur in the region. The removal of these areas is not likely to have a negative impact on the overall wildlife habitat available in the region. See Section 7.5.
Proximately of the proposed Project to the wildlife sanctuaries	The Waverly Game Sanctuary, is located approximately 1 km east of the Site. Approximately 64% of the sanctuary is also considered a Wilderness Area (known as the Waverley-Salmon River Long Lake Wilderness Area) which is protected under the Wilderness Areas Protection Act. Potential impacts to the sanctuary and wilderness area are managed by NS DNR through restriction of activities within the sanctuary/wilderness area boundaries (e.g. hunting, resource development, agriculture) (G. Delano, pers. comm. 2018). Because the proposed quarry is not within the boundaries of either the sanctuary or wilderness area, the Project the potential impacts to the biodiversity values of the sanctuary are expected to be low. See Section 6.1.1.
Loss of wetlands	Loss of wetland habitat, either through direct removal/infilling or dewatering or indirectly through alteration of wetland hydrology/hydrogeology, requires a Wetland Alteration Approval (NSE 2011). The wetland alteration application and approval process requires the completion of a functional assessment of the wetland and a wetland habitat compensation plan to replace the wetland functions lost as a result the Project or, in lieu of a compensation plan, a letter of understanding (LOU) between the proponent and a third party wetland restoration professional describing the amount / value of compensation and the commitment to completion of the restoration and ongoing monitoring (NSE 2011). A Wetland Alteration Approval will be obtained for all wetlands expected to be impacted as a result of the Project and all conditions of that permit will be fulfilled, thereby addressing any adverse effects to wetlands. See Section 7.5.
Acid Rock Drainage	In the Halifax area, acid rock drainage is typically associated with slate which can be found within the Goldenville Formation; however, in the area of the Project, this formation appears to be predominantly quartzite. Should sulphide-bearing slate be encountered in the proposed Project footprint, sampling and analysis for acid-base accounting will be completed to determine the overall acid runoff capacity. Rock from the adjacent quarry has been historically used / suitable for highway construction and asphalt production. Rock samples were collected from the existing quarry in November 2017 to assess the Acid Rock Drainage (ARD) and Metal Leaching (ML) properties of the lithologies that will be encountered during aggregate extraction. Based on the acid generation potential results, lithologies at the Goffs Quarry are not expected to generate acidic drainage. See Section 6.2.2.

Issue or Concern	Response/Proposed Resolution
Employment	The existing 3.99 ha quarry operations employees at least 10 to 12 direct employees throughout the year, with five to six additional secondary workers being employed by the blasting contractor for at least one week, four to six times per year. Additional secondary employment through hauling / trucking contractors is estimated to result in the employment of another 20 to 30 workers. Employment levels in the area are not anticipated to result in a significant change as a result of the Project. Project-related employment effects may be minor; however, they will be positive. See Sections 6.12 and 7.10.
Noise generate by the proposed Project	Noise levels generated by normal operations at the quarry are estimated to be below the limits specified in the NS Pit and Quarry Guidelines (NSEL 1999) along the Property boundary. See Section 7.9.
Potential impacts on groundwater/ Private Wells	No private wells are located within the potential groundwater radius of influence of 431 m (Phase 1, 2 and 3) and 284 m (Phase 4). Therefore, impacts related to Project activities on nearby water wells are not anticipated where these wells are located beyond the radius of influence of groundwater level drawdown. See Section 7.1.
Private Well Complaint Process	Issues should be reported to NSE and/or to Scotian. Scotian's contact details are available at www.scotianmaterials.ca.
Potential impacts on streams/ watershed	On-site water management infrastructure will collect and treat run-off within the limits of the quarry. The existing sedimentation pond is designed to allow for sufficient settling time to remove sediments. Discharge from the sedimentation point will be tested to determine compliance with regulator requirements. A surface monitoring plan will be developed in consultation with NSE and this plan will be implemented prior to initiation of this Project. If it is determined that adjacent streams are impacted by the Project, authorizations from DFO including fish habitat compensation (if required) and/or NSE will be obtained and all conditions of any permits will be implemented (if required). With the implementation of these monitoring and mitigation (i.e. authorization) measures. See Section 7.2 and 7.6.
Vibration as a result of blasting	Blasting will be conducted in accordance the Pit and Quarry Guidelines (NSEL 1999) and the General Blasting Regulations made pursuant to the Nova Scotia Occupational Health and Safety Act (1996). A blast design plan will be developed for the proposed Project. Pre-blast surveys and blast monitoring will be conducted in accordance with the Pit and Quarry Guidelines (NSEL 1999). See Section 2.5.
Proximity to the airport	Scotian will coordinate Project activities with the Halifax International Airport Authority (HIAA) and Navigation Canada as required.
Dust generated by the proposed Project	Scotian has committed to implementing best management practices to manage fugitive dust associated with the Project. Such practices may include measures such as enforcing speed limits for on-site vehicles, proper truck loading and minimizing freeboard application of water for dust suppression and minimize vehicle idling. See Section 7.8.

13.0 FUNDING

The proposed Project will be entirely funded by Scotian Materials Limited.

14.0 ADDITIONAL INFORMATION

Further detail on the hydrogeological and hydrological assessments conducted in support of this Environmental Assessment is provided in Appendices A and B.

15.0 REFERENCES

Atlantic Canada Conservation Data Center (ACCDC). 2018. Species at Risk. Available online at: http://www.accdc.com/

Bat Conservation International (BCI). 2018. Range Maps. Available online at: http://batcon.org/index.php/all-about-bats/species-profiles.html. Accessed January 2018.

Canada, Government of (Canada). 1985. Fisheries Act. R.S.C. 1985, c. F-14.

Canada. 1994. Migratory Birds Convention Act. S.C. 1994, c. 22.

Canada. 2002. Species at Risk Act. S.C. 2002, c. 29.

Canada. 2012. Canada Environmental Assessment Act. S.C. 2012.

Committee on the Status of Endangered Wildlife in Canada (COWSEIC). 2007. COSEWIC Statas Report on the Common Nighthawk (*Chordeiles minor*).

Davis MacIntyre & Associates Limited. 2013. Northern Construction Quarry Archaeological Resource Impact Assessment [Heritage Research Permit A2012NS153].

Delano, G., pers. comm. 2018. Regional Director – Central Region for the Department of Natural Resources. Email to M. Webb, April 11, 2018.

Downes, C.M. and B.T. Collins. 2003. Canadian Breeding Bird Survey, 1967-2000. National Wildlife Research Centre, Canadian Wildlife Service. Ottawa.

eBird. 2012. eBird: An online database of bird distribution and abundance [web application]. eBird, Ithaca, New York. Available online at: http://www.ebird.org. Accessed January 2018.

Environment and Climate Change Canada (ECCC). 2018. Species at Risk Public Registry. Available online at: http://www.registrelep-sararegistry.gc.ca/sar/index/default_e.cfm.

Gucker, Corey L. 2005. Fraxinus nigra. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: https://www.fs.fed.us/database/feis/plants/tree/franig/all.html [2018, May 17].

Halifax Stanfield International Airport. 2015. History of Halifax Stanfield International Airport. December 2015. Available online at: https://halifaxstanfield.ca/wp-content/uploads/2015/12/History-in-English1.pdf.

Health Canada (2017). Guidelines for Canadian Drinking Water Quality – Summary Table. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. February 2017.

Home, R.J., Ryan, R.J., Corey, M.C. and Fox, D.L. 2009: Bedrock geology map of the Waverley area, part of NTS sheet 11D/13 (sheet 1 of 4), Halifax County, Nova Scotia; Nova Scotia Department of Natural Resources, Mineral Resources Branch, Open File Map ME 2009-2, scale 1:25,000.

ISO 1996-2:1987, Acoustics — Description and Measurement of Environmental Noise — Part 2: Acquisition of Data Pertinent to Land Use.

Keys, K., P. Neily, E. Quigley, and B. Stewart. 2011. Forest Ecosystem Classification for Nova Scotia, Part III: Ecosites (2010). Nova Scotia Department of Natural Resources, Renewable Resources Branch.

Lewis, P. J. 1997. Trends. In: Shaw, R.W. (ed.). Climate Variability and Climate Change in Atlantic Canada. Proceedings of a Workshop Halifax, Nova Scotia, 3-6 December 1996. Prepared for Environment Canada. Halifax, NS.

Marinelli, F. and W.L Niccoli, 2000. Simple Analytical Equations for Estimating Ground Water Inflow to a Mine Pit. Ground Water. Vol. 38, No. 2. March – April 2000.

Maritimes Breeding Bird Atlas (MBBA). 2011. Second Atlas of the Breeding Birds of the Maritime Provinces. Available online at: https://www.mba-aom.ca/. Accessed January 2018.

Ministry of the Environment (2003). Stormwater Management, Planning and Design Manual, March 2003.

Moseley, M. 2007. Records of Bats (Chiroptera) at Caves and Mines in Nova Scotia. Nova Scotia Museum. Curatorial Report Number 99.

Natural Resources Canada Mine Environment Neutral Drainage Program (MEND, 2009). Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. MEND Report 1.20.1.

Neily, Peter D., Eugene Quigley, Lawrence Benjamin, Bruce Stewart, Tony Duke. 2003. Ecological Land Classification for Nova Scotia. Volume 1 – Mapping Nova Scotia's Terrestrial Ecosystems. Report DNR 2003 – 2. Prepared for Nova Scotia Department of Natural Resources Renewable Resources Branch. April 2003. 83 pp.

Neily, P., S. Basquil, E. Quigley, B. Stewart and K. Keys. 2011. Forest Ecosystem Classification for Nova Scotia, Part I: Vegetation Types (2010). Nova Scotia Department of Natural Resources, Renewable Resources Branch.

Nevada Division of Environmental Protection. 2017. Brook Trout (Salvelinue fontinalis) Thermal Tolerance Analyses – Juvenile and Adult, Summer. Available online: https://ndep.nv.gov/uploads/water-wqs-docs/BrookTTA.pdf.

Nova Scotia Department of Natural Resources (NS DNR). 2010. Estimation of Regional Groundwater Budgets in Nova Scotia, Open File Illustration MW 2010-2. Available online at: http://novascotia.ca/natr/meb/data/mg/ofi/pdf/ofi_2010-002_dp.pdf

NS DNR. 2013. Waverley Game Sanctuary. Available online at: http://novascotia.ca/natr/wildlife/habitats/sanctuaries/pdfs/waverley.pdf.

NS DNR. 2014a. NS Endangered Species Act: Legally Listed Species. Available online at: http://novascotia.ca/natr/wildlife/biodiversity/species-list.asp.

NS DNR. 2014b. Wilderness Areas. Available online at: http://www.novascotia.ca/nse/protectedareas/wildernessareas.asp.

NS DNR. 2014c. Waverley Salmon River Long Lake Wilderness Area. Available online at: http://www.novascotia.ca/nse/protectedareas/wa_waverly.asp.

NS DNR. 2018. Provincial Landscape Viewer. Available online at: https://novascotia.ca/natr/landscape/. Accessed January 2018.

Nova Scotia Environment (NSE). 2009. Guide to Preparing an EA Registration Document for Pit and Quarry Developments in Nova Scotia. Revised September 2009. Policy and Corporate Services Division Environmental Assessment Branch.

NSE. 2011. Nova Scotia Wetland Conservation Policy. September 2011. 24 pp.

NSE. 2014. Groundwater in Nova Scotia. Available online at: http://www.novascotia.ca/nse/groundwater/groundwaterNS.asp. Updated: March 31, 2014.

Nova Scotia Environment and Labour (NSEL). 1999. Pit and Quarry Guidelines. May 1999.

Nova Scotia, Government of (NS). 1994-95a. Environment Act. 1994-95, c. 1, s.1.

NS. 1994-95b. Activities Designation Regulations made under Section 66 of the Environment Act.

NS. 1994-95c. Environmental Assessment Regulations made under Section 49 of the Environment Act.

NS. 1994-95d. Environmental Emergency Regulations made under Sections 74, 136, and 171 of the Environment Act.

NS. 1994-95e. Petroleum Management Regulations made under Sections 25 and 84 of the Environment Act.

NS. 1998. Endangered Species Act. 1998, c. 11, s.1.

NS. 1996. Occupational Health and Safety Act.

NS. 2011. Nova Scotia Wetland Conservation Policy. Available online: https://novascotia.ca/nse/wetland/docs/Nova.Scotia.Wetland.Conservation.Policy.pdf.

NS. 2017a. Nova Scotia Abandoned Mine Openings (AMO) Database. Available online at: https://novascotia.ca/natr/meb/geoscience-online/about-database-amo.asp. Current to July 10, 2017

NS. 2017b. N.S. Reg. 146/2017 Categorized List of Species at Risk made under Section 12 of the Endangered Species Act. Current to April 12, 2017.

Nova Scotia Transportation and Infrastructure Renewal (NSTIR). 2014. Traffic Volumes Primary Highway System 2004-2013. March 2014. Traffic Services. Available online at: http://novascotia.ca/tran/publications/PRIMARY%20TRAFFIC%20VOLUME%20BOOK%202004-2013.pdf.

Sandilands, A. 2007. Common Nighthawk. pp. 308-309. In Cadman, M.D., D.A. Sutherland, G.G. Beck, D. Lepage, and A.R. Coutourier. Atlas of Breeding Birds of Ontario, 2001-2005. Bird Studies Canada, Environment Canada, Ontario Ministry of Natural Resources, and Ontario Nature. Toronto.

Statistics Canada. 2016. Halifax, Nova Scotia (Code 1209034) and Halifax, Nova Scotia (Code 1209) (table). Census Profile. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Released February 8, 2017. Available online at: http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E.

US Army Corps of Engineers. 2011. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Version 2.0), ed. J.S. Wakeley, R.W. Lichvar, C.V. Noble, and J.F. Berkowitz. ERDC/EL TR-12-1. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Utting, D.J. 2011: Surficial geology map, part of the Waverley Claim Reference Sheet 11D/13A, Halifax County, Nova Scotia; Nova Scotia Department of Natural Resources, Open File Map, ME 2011-006, scale 1:25,000.

White, C.E., Bell, J.A., McLeish, D.F., MacDonald, M.A., Goodwin, T.A. and MacNeil, J.D. 2008: in Mineral Resources Branch, Report of Activities 2007; Nova Scotia Department of Natual Resources, Report ME 2008-1, p. 125-139.

Signature Page

Golder Associates Ltd.

Callie Andrews, M.Sc.
Environmental Assessment Specialist

Phyllis McCrindle, P.Geo. (NS and ON)
Associate, Senior Hydrogeologist

Heather Melcher, M.Sc.
Associate, Senior Ecologist

Natalie Jones
Associate, Senior Air Quality Specialist

Joe Tomaselli
Technical Lead, Senior Noise and Vibration

CA/GM/PMMC/KM/SM/HM/NJ/JT/mvrd
https://golderassociates.sharepoint.com/sites/13545g/shared documents/eard/final eard/180618 revised draft scotian materials goffs quarry eard final.docx