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Environmental Assessment Registration for the Lafarge Hardscratch Quarry Extension Project

Lafarge Canada Inc.
6509 Airport Road
Mississauga ON L4V 1S7

File: 121510876

October 2013

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1.0 PROPONENT AND PROJECT IDENTIFICATION

1.1 PROPONENT INFORMATION

Name of the Proponent:	Lafarge Canada Inc.
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Registry of Joint Stocks for the proponent company is included in Appendix A.

Company President and/or Environmental Assessment Contact

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Official Title:	Land Director
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Chi McGuckin — Sept. 30, 2013.

Signature of Company — Date
Chris McGuckin, Land Director

Environmental Consultant Contact

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Tel.:	(902) 468-7777
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1.2 PROJECT INFORMATION

Name of the Undertaking:	Lafarge Hardscratch Quarry Extension Project
Location of the Undertaking:	Yarmouth, Yarmouth County, NS

2.0 PROJECT INFORMATION

2.1 DESCRIPTION OF THE UNDERTAKING

Lafarge Canada Inc. (Lafarge; the Proponent) owns and operates the Lafarge Hardscratch Quarry, located in Yarmouth, Yarmouth County, Nova Scotia (Figure 2.1). The quarry property is in the Yarmouth municipal district. It is currently operating under an Industrial Approval (Approval No. 2005-044731) that was obtained from Nova Scotia Environment (NSE), pursuant to Division V of the Activities Designation Regulations. The current Approval is effective from March 29, 2005 until March 29, 2015. A copy of the Approval permit is appended to this report (Appendix A).

Lafarge proposes to extend the approved quarry site to occupy an additional 65 ha of land, in total, to allow for continued aggregate production (blasting, crushing, and stockpiling) and will supply granite, stone and asphalt aggregates to local gravel and concrete markets (the Project). Over the next ten years, the extension will advance in the southwest direction (refer to Figure B1 in Appendix B). The Proponent owns the existing quarry lands and the Project property, which consists of two parcels of land (PIDs 90138991 and 90139023) on which the proposed quarry extension will be situated. The existing quarry has been in operation since 2005, with a total quarrying area to date of approximately 4 ha.

Of the total 65 ha area to be included within the currently proposed quarry extension boundary, only approximately 42 ha will support quarrying activities. The remaining approximately 23 ha (*i.e.*, the eastern third of the extension area) will be set aside as a wetland avoidance area (*i.e.*, Wetland Buffer Zone) in which no quarrying or development will occur, thereby avoiding potential Project interactions with 73% of the wetland habitat present within the Project property as well as a watercourse that is hydrologically connected to fish-bearing waters.

As a result of field and desktop studies undertaken in support of this environmental registration document, the extension area has been located, in part, to reduce potential adverse environmental effects including effects on local residents. The anticipated average production rate will vary from approximately 100,000 tonnes to approximately 200,000 tonnes per year; with the possibility of a higher production rate for limited periods of time should a significant contract be awarded. Weather permitting; the current and anticipated operating schedule is 10-12 hrs/day, five to six days/week, 48 weeks/year or more, depending on the demand for aggregates. Based on current estimates, there are approximately 8-10 million tonnes of rock reserves within the proposed extension area. Depending on market demand, the proposed quarry operations will take place over an extended period of time until the material is exhausted. It is anticipated that the site could sustain aggregate production for more than 50 years.

2.2 GEOGRAPHIC LOCATION

The Lafarge Hardscratch Quarry is in the community of Brooklyn, Yarmouth County, Nova Scotia (Figure 2.1). It is located along Hardscratch Road, and is accessed via a private road that branches off from the main public road. The quarry and proposed quarry extension area are situated on lands that are owned by the Proponent. The surrounding lands are mostly undeveloped.

The Project Area is comprised mainly of a mixture of forest, barrens and forested wetland. Forests in the Project Area vary in age from recently harvested stands to mature forest. Mature softwood forest is present mainly in the eastern half of the property (Figure 2.2). Ten wetlands of varying size are present on the property. Four of these wetlands (*i.e.*, WL1, WL2, WL3, and WL4 on Figure 5.1), comprising 73% of the total wetland area within the Project Area, as well as the dominant watercourse (WC-1) on the site, will be protected by a Wetland Buffer Zone occupying a total area of approximately 23 ha in the eastern third of the Project property (see Section 5). Additional potential habitats include those provided by a small anthropogenic pond, one watercourses and two drainage channels, old roads, and disturbed areas which surround and contain the various activities related to present quarry operations.

Based on available mapping and aerial photography, residential development in the immediate vicinity of the existing Lafarge Hardscratch Quarry is relatively low. There are approximately three structures unrelated to the existing quarry within 800 m (Figure 2.1).

The quarry is located on land that is zoned for “Rural Development”.

2.3 PROJECT COMPONENTS

The existing quarry operations consist of a working / laydown area for the portable crushing equipment, screening, various aggregate stockpiles, quarry floor and working face, settling ponds, weight scales, and a private access road off Hardscratch Road. The existing property currently does not have liquid asphalt permanently stored on-site. However, a portable asphalt plant may be brought on-site as needed for the production of asphalt; this may entail temporary on-site storage of liquid asphalt cement and/or any other materials required during the asphalt production process. Currently there is one 1,965 L diesel tank and one 2,000 L waste oil tank permanently stored on-site, as well as two 4,500 L and one 10,000 L diesel fuel tanks with the portable crusher when it is on-site. There is also one 20,000 L and one 1,000 L furnace oil tanks and up to ten 10 lb propane tanks. There is no planned storage of other hazardous materials, although Lafarge may allow subcontractors to store temporary diesel tanks or mobile asphalt plants, portable crushing spreads, drill and blast, large stripping and rehabilitation campaigns, *etc.* These will vary in size and depend on the volume of work that is being done. Lafarge has best practices in place for handling of hazardous materials as well as an established Environmental Emergency Response Plan for the quarry.

All spatial data contains varying levels of inherent inaccuracies. This product was produced for the sole purpose of supporting information specific to a stantec project and should not be used for other purposes.

N

Hardscratch Road

Cloverhill Brook

NB
PEI
Nova Scotia
Atlantic Ocean
Project Location

Project Features
- Existing Quarry/Disturbance Area
- Project Property
- Proposed Quarry Extension (Project Area)
- Existing Quarry Buffer (800m)
- Proposed Quarry Buffer (800 m)

Map Features
- Building/Structure
- Provincial Highway
- Local Road
- Dirt Road
- Cart Track
- Railway
- Railway; Abandoned
- Transmission Line
- Contour (5m)
- Ditch
- Watercourse
- Wetland; NSDNR (2010)
- Property Boundary (2007)

SOURCE:
Base Data: Nova Scotia Geomatics Centre, Nova Scotia Topographic Database (NSTDB) unless otherwise noted.
Wetlands: NSDNR, Wetland Mapping Inventory, 2010

ST NS 121599095-001

0 100 200 400 600 800
Distance in Metres

PREPARED BY: M. Huskins-Shupe
REVIEWED BY: K. Fraser

LAFARGE

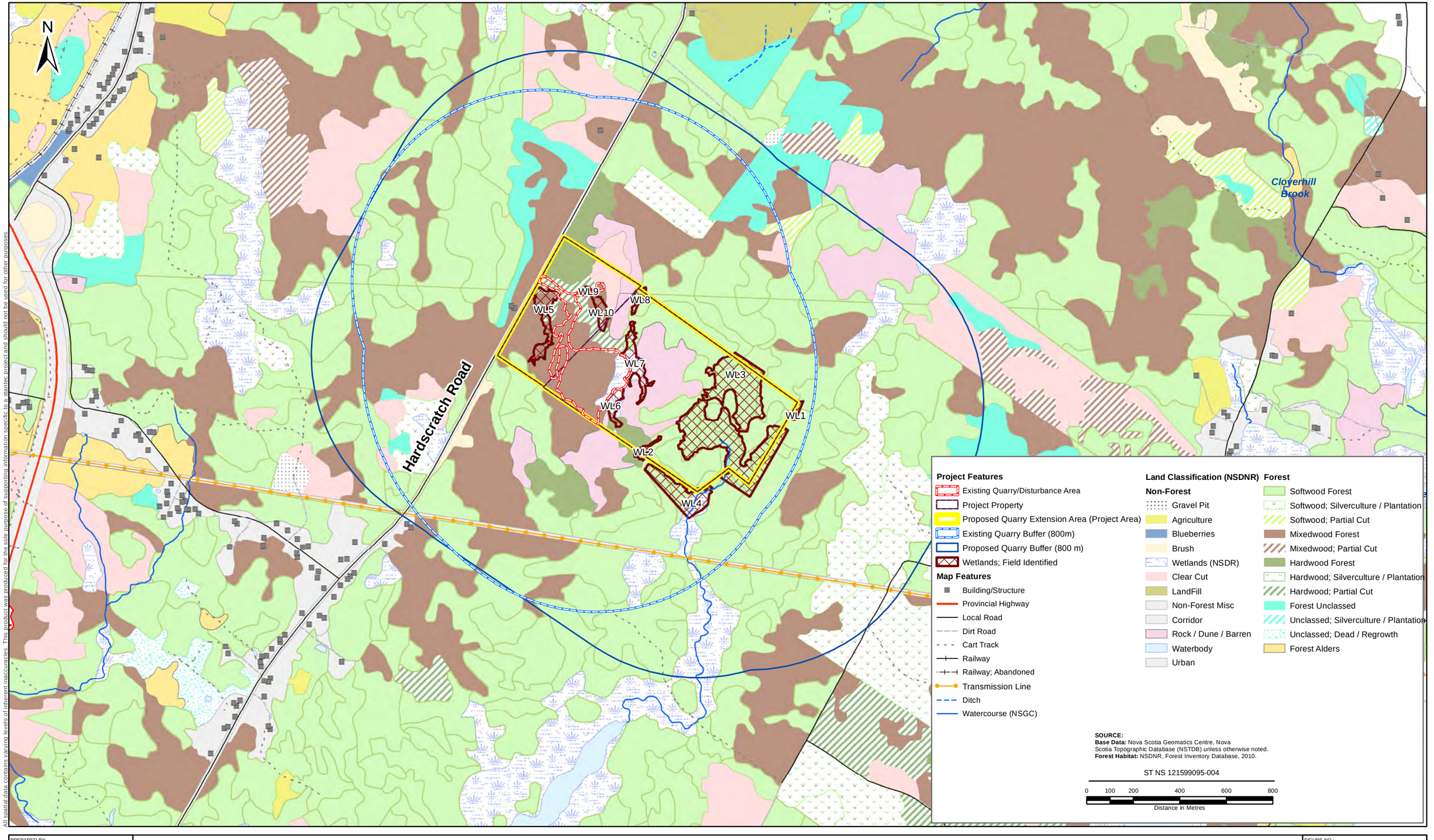
Lafarge Hardscratch Quarry

Project Location

FIGURE NO.: 2.1
DATE: Jul 17, 2013

Stantec

Path: \\CD1213-F02\Profit_Centers\1215\active\121510xxx\121510876_ea_lafarge\geomatics\mapping\mxd\report\ST NS-121510876-001_project_location_201205305.mxd



All spatial data contains varying levels of inherent inaccuracies. This product was produced for the sole purpose of supporting information specific to a Stantec project and should not be used for other purposes.

PREPARED BY: R. Sutcliffe	Lafarge Hardscratch Quarry
REVIEWED BY: K. Fraser	**Land Classification**
LAFARGE	FIGURE NO.: 2.2
	DATE: Jul 17, 2013
	Stantec

Path: \\CD1213-F02\Profit_Centers\1215\active\121510xxx\121510876_ea_lafarge\geomatics\mapping\mxd\report\ST NS-121510876-004_forest habitat_20120305.mxd

Topsoil, grubbing material and overburden that have been stripped prior to drilling and blasting are stored on-site. These materials have been stabilized for subsequent use during site reclamation. The piles have been seeded to reduce potential for erosion and sedimentation. Similar practices will continue throughout the development and operation of the proposed extension area.

The working / laydown area is located on the quarry floor. The rock is processed by portable crushing equipment that is transported to the site as required (*i.e.,* after blasting). Once the quarry is extended, portable crushing equipment is expected to be on-site for 20-24 weeks per year, depending on the amount of work in the local market. Aggregate stockpiles are currently located at various places within the quarry limits.

Quarry drainage and surface runoff collection and controls will be in place for the extended quarry. Surface runoff and quarry drainage will be collected on the quarry floor and ditched or pumped to a settling pond located to the central area of the existing operation. Additional settling pond volume will be developed with the extension in the southern part of the existing quarry, as required, and will direct treated water off-site.

The general direction of quarry advancement will be southeast from the existing quarry face.

2.4 SITE PREPARATION AND CONSTRUCTION

The existing quarry has been in operation since 2005. Access to the existing quarry development is along existing roads. To minimize the potential for erosion and sedimentation, grubbing and removal of overburden has been and will continue to be conducted on an as needed basis, to accommodate drilling and blasting activities. Topsoil, grubbed material and overburden are stockpiled on-site and have been stabilized via seeding for subsequent use during site reclamation. These, or similar stabilization procedures will continue throughout the operations of the proposed extension.

Quarry drainage and surface runoff collects on the quarry floor. Overflow from the quarry floor is currently directed to a settling pond located to the central area of the existing operation. There is little overflow from the settling pond as the majority of the water collected on the quarry floor and in the settling pond infiltrates, evaporates and/or is directed off-site. The results of a water balance calculation conducted as part of a Project-specific Hydrologic Assessment (refer to Appendix C) indicate that, for a total annual precipitation of 1274.1 mm, 44% (559.1 mm) is lost to evapotranspiration, 24% to infiltration and storage (300 mm), and 32% (415 mm) leaves the watershed as surface runoff. Additional surface water management capacity will be created, as needed, as the quarry develops. Details regarding the amount of additional settling pond volume required for proposed quarry operations is presented in Appendix C and will be further refined at the Industrial Approval amendment stage. Excavation will not take place below the groundwater table. Water that has pooled on the quarry floor will be used to provide a water supply for dust suppression during crushing in dry periods, and is also a potential source for washing aggregate.

2.5 OPERATION AND MAINTENANCE

The proposed Project activities will be consistent with the current quarry operations approved by NSE (Approval No. 2005-044731) and will be in accordance with the Pit and Quarry Guidelines (NSE 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.

Aggregate production begins with drilling and blasting. It is anticipated that blasting and crushing of aggregate will occur one to two times per year but could increase to two to four times a year depending on local market activity. This is consistent with current approved operations. A qualified blasting company will conduct this work. The blasting sub-contractor is responsible for blast designs and methods in accordance with the General Blasting Regulations made pursuant to the Nova Scotia *Occupational Health and Safety Act* (1996). Blasting activity will be conducted in accordance with the Pit and Quarry Guidelines. Details of the proposed blasting methods and schedule will be provided to support the application for Industrial Approval. Where appropriate, consideration will be given to recommendations provided in Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (Wright and Hopky 1998).

The blasted rock will be processed by portable crushing equipment that will be on-site. The various aggregate products will be stockpiled in designated areas within the quarry. Piles will be built in layers to minimize segregation and prevent contamination by mixing of different piles. Material is hauled and moved within the quarry with a loader. Other equipment will likely include an excavator. Products will be transported from the quarry via tandem, tandem with pups, and tractor trailer trucks along the existing truck route. The average number of trucks hauling aggregates from the quarry is estimated to be approximately 30 per day, depending on market demand. This is consistent with current truck volume at the existing quarry and could increase, for a short period, if a large aggregate supply contract were awarded. Rock trucks may also be used as necessary to support other Project activities such as production, stripping/rehabilitation campaigns, general earthwork around the property, *etc.*

As the quarry is extended, the Proponent would like to add washing as a component. This would involve washing the quarried material that will be used in concrete. The initial plan is to move the fixed wash plant from Lafarge's Plymouth site to the Hardscratch Quarry.

The anticipated average production rate is approximately 100,000 tonnes per year; with the possibility of a higher production rate for limited periods of time should a significant contract be awarded. Weather permitting, the potential operating schedule may be 10-12 hrs/day, five to six

days/week, 48 weeks/year or more, depending on the demand for aggregates. This proposed schedule is consistent with the current operating schedule.

The existing quarry currently employs one to two employees at the site throughout the year, and an additional four employees during aggregate production. This number can fluctuate depending on the activities taking place on-site. Employment levels are expected to remain the same following site extension. Drilling and blasting activities involve additional resources; these activities are sub-contracted to a professional blasting company. Hauling of materials from the quarry also involves additional labour and equipment requirements. Hauling (or trucking) is typically arranged through the Proponent.

2.6 EFFLUENTS AND EMISSIONS

The implementation and use of environmental devices, techniques and regulations now used in the construction industry will minimize any potential environmental damage to the area. Devices such as diversion ditches, check dams, siltation ponds, straw hay mulch and seeding will be used if necessary to control sedimentation. Best management practices for the control of runoff/overflow and erosion/sedimentation will be implemented so as to prevent runoff and sediments from entering into the Wetland Buffer Zone. All operations will be carried out in a controlled environment to ensure sound, vibration, dust and sediment parameters are met to all provincial and federal guidelines and regulations.

In accordance with best practices and standard NSE requirements, runoff controls will be in place to ensure that effluent generated during operations is managed appropriately. Surface runoff at the quarry collects on the quarry floor. Overflow from the quarry floor drains into a settling pond in the central part of the developed area that is then pumped off-site. Additional pond volume will be installed, as required, in accordance with NSE's Erosion and Sedimentation Control Handbook for Construction Sites (NSE 1988) and the quarry's approval to operate, and in consultation with NSE's engineers/inspectors. Details regarding the amount of additional settling pond volume required for proposed extended quarry operations is discussed in Appendix C and will be further refined at the Industrial Approval amendment stage.

Currently, overland flow drains into settling ponds and ultimately infiltrates, evaporates and/or is trenched off-site. It is expected that the effects on the downstream flows and on water quality associated with the proposed ultimate level of quarry development can be fully mitigated using the placement of free-draining material (*i.e.,* rock/gravel) and properly sized flow retention/siltation treatment areas to meet NSE standards (*i.e.*, final effluent discharge limits prescribed in the Nova Scotia Pit and Quarry Guidelines and current or amended Industrial Approval). Following the use of these mitigative measures, the remaining residual effects on downstream water quality are expected to be minor.

Overflow from the settling ponds, if any, will be monitored and sampled according to the terms and conditions of the existing approval (and future updates) and the Pit and Quarry Guidelines to ensure total suspended solids levels do not exceed the approved final effluent discharge limits as outlined in the facilities Approval permit (Appendix A). In the unlikely event that

overflow associated with a significant rain fall exceeds final effluent discharge limits as determined through monitoring, contingency measures may include pumping of sediment laden water to vegetated areas (away from watercourses) or through filter bags for additional filtration and/or use of additional filtration devices or structures. Pumping locations will be determined during detailed design of the settling pond and presented in the application for Industrial Approval. A Stormwater Management Plan will be submitted as part of the quarry development plan during the Industrial Approval application process.

Dust emissions will be controlled with the application of water, obtained from the water contained in the settling ponds or water that is pooled on the quarry floor. To minimize generation of dust, the working areas and laydown areas will be covered with blasted rock. Stockpiled topsoil and overburden material will be seeded. Dust generated by rock movement along the access road will be minimized by speed control (*i.e.*, maximum of 40 km/hour), proper truck loading, application of dust suppressants, proper construction of on-site roads, and/or other means as required by NSE.

Monitoring of airborne particulate emissions (dust) will be conducted at the request of NSE and in accordance with the Pit and Quarry Guidelines, the Nova Scotia Air Quality Regulations and the facilities Approval permit 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 through proper equipment maintenance and inspection practices to ensure efficient operation. Consideration will be given to methods to reduce truck and equipment idling, as feasible.

As per the Pit and Quarry Guidelines, sound levels from quarry operations will be maintained at a level not to exceed the following sound levels (L_{eq}) at the property boundaries:

- L_{eq} 65dBA 0700-1900 hours (Days);
  60dBA 1900-2300 hours (Evenings); and
  55dBA 2300-0700 hours (Nights).

Sound monitoring will be conducted at the request of NSE.

Light emissions will be generated from road and parking lot lighting, and for the safety of employees. Emissions will be minimized by shielding lights to shine down only where it is needed, without compromising safety.

There is currently one permanent office building located on this site (*i.e.*, the scale house). All solid waste is properly collected, separated into recyclable and non-recyclable materials, and

stored until such time that it can be transported to a provincially approved recycling or waste disposal facility using authorized local services.

Details of any monitoring programs required by NSE (*e.g.,* surface water, noise, dust) will be developed in consultation with NSE and outlined in the Industrial Approval amendment application.

During crushing and screening operations, hazardous materials anticipated on-site will be those associated with the normal operation of construction equipment. These substances include: gasoline, diesel fuel, lubricants and antifreeze liquid. A qualified company will be contracted to conduct regular maintenance of equipment. With the exception of large or complicated repairs, the majority of these equipment maintenance services are currently carried out on-site, with oils and tools stored in sufficient quantities to accommodate these activities. A waste oil tank with a storage capacity of 2,000 L is present on-site.

Used oil and filters are currently removed from the site in accordance with Lafarge's best practice for handling of hazardous material, and this will continue with the proposed extension. All hazardous wastes will be fully contained and temporarily stored in a designated area until they are removed from the site by a licensed contractor and recycled or disposed at an approved facility. Other control measures for hazardous wastes include implementing Lafarge's existing best practices and Environmental Emergency Response Plan to avoid impacts from release of potentially hazardous materials.

Refuelling of equipment will be conducted on-site on a regular basis via the existing diesel fuel tanks which are re-filled by a tanker truck. Refuelling activities will not be conducted within 100 m of any surface water, and equipment operators will remain with the equipment at all times during refuelling in accordance with the Petroleum Management Regulations of the Nova Scotia *Environment Act* and Lafarge best practices for handling of hazardous material.

In the event of a leak or spill during refuelling, maintenance, or general equipment operation, immediate action will be taken to stop and contain the spilled material as per Lafarge's Environmental Emergency Response Plan. All contaminated material will be collected and stored in an appropriate manner so as not to be re-released to the environment until such time as it will be transported to an approved treatment/disposal facility. All spills will be reported to the 24-hour environmental emergencies reporting system (1-800-565-1633) in accordance with the Emergency Spill Regulations.

2.7 DECOMMISSIONING AND RECLAMATION

Lafarge will undertake a progressive rehabilitation program at the quarry site as necessary to offset phased stripping/grubbing activity. The timing and specifics of progressive rehabilitation efforts will depend on production volumes and will therefore vary accordance with the intensity of production-related stripping/grubbing activity. In this phased construction and progressive reclamation process, only the area needed for quarry extension in any one year will be grubbed and all areas affected by quarry activities, including the quarry floor, will be eventually

rehabilitated. The subsoil, topsoil and root mat of this area would be placed in a portion of the pit that is no longer in use. Overburden will be stockpiled for use in future reclamation.

Since this site is under sporadic work schedules, the Proponent will strive to pile all overburden in an area where the gradient and drainage conditions will cause any runoff to collect on the quarry floor and be directed to a settling pond prior to discharge from the site. This will mitigate the potential for off-site siltation effects associated with sediment-laden surface water runoff from overburden. Stockpiles of overburden not necessary for site development may quite possibly be removed for operational purposes.

Seeding stockpiles, as conducted for current operations, will be an acceptable alternative to utilizing root mats in future activities. This approach would provide a source of native plant species well adapted to local soil and climatic conditions and would greatly reduce the need to fertilize the reclaimed pit. If it is necessary to seed reclaimed areas where grubbings have not produced sufficient plant biomass to stabilize soils, wherever practical, native trees should be used for site reclamation. In lieu of native species, seed mixes containing naturalized species which are well established in Nova Scotia and which are free of invasive species and are not aggressive weeds in the plant communities which are present in the area may be used for reclamation.

As distinct areas within the quarry become inactive, the earthen areas will be graded to a stable slope (max 2:1) or rock slopes (max 1:1), where required, or leveled to allow future commercial, industrial, recreational, or residential land use. These inactive areas will be covered with overburden and seeded in the absence of laying a root mat. Generally the rehabilitation will also consist of, but not be limited to: grading and contouring of all slopes and exposed rock faces in consideration of rock falls, slope stability, and safety; spreading existing stockpiled topsoil; and seeding in the absence of laying a root mat.

As for the areas that have been stripped clean of all overburden and have been worked to the appropriate elevation (*i.e.*, quarry floor), they will form part of the staging area for the stockpiles of newly exposed and blasted rock. Once the operations reach a stage where the storage area can be reduced, these areas will be rehabilitated as per the above requirements.

A reclamation plan will be developed for the extended site and submitted to NSE as part of the quarry development plan, to be included in the Industrial Approval amendment application. The reclamation plan will include information on such things as the proposed final topography, maximum slopes, revegetation plans and an outline of the plan for progressive reclamation at the site.

3.0 SCOPE

3.1 SCOPE OF THE UNDERTAKING

Section 2.0 describes the scope of the undertaking (*i.e.,* the proposed Project) that is the subject of the environmental assessment including spatial assessment boundaries (*e.g.,* Project footprints and zones of influence) and temporal assessment boundaries (*e.g.,* Project time frames).

3.2 PURPOSE AND NEED FOR THE UNDERTAKING

The purpose for the Project is to allow Lafarge to extend the existing quarry footprint and continue operations at their quarry in Yarmouth. The quarry is currently operating under an Industrial Approval (No.2005-044731), issued by NSE and effective until March 2015. A copy of the NSE Approval permit is included in Appendix A.

The aggregates produced at the quarry are an important requirement in construction projects in the region and are of an appropriate quality for highway construction and maintenance projects. The Proponent anticipates the source material in the proposed extension area to be of similar quality to the material currently extracted at the existing quarry.

The quarry under consideration as well as other quarries in Nova Scotia are an important component of the natural resource sector of the economy and provide essential raw materials to the province's construction industry. The quarry also provides direct and indirect employment for its workers and suppliers, as well as for the transportation and construction industries.

3.3 PROJECT ALTERNATIVES

Other methods for carrying out the undertaking may include different methods of extraction of the resource and alternative facility locations. The current method of aggregate extraction at the Lafarge Hardscratch Quarry is drilling and blasting. Alternative methods for extraction of the rock (*i.e.,* mechanical means) are not practical or feasible in this instance due to the nature and characteristics of the rock (*e.g.,* hard and dense). Therefore, there are no feasible alternatives to drilling and blasting as a means of extracting this material.

An alternative facility location is also not a feasible alternative. The extension is occurring in an area that has been previously disturbed and is already exposed to mining/quarrying activities. Extension of the quarry will not require immediate construction of any new facilities (*i.e.,* roads or buildings), as the existing facilities are at present sufficient for the current and extended operations. Additional flow retention structures will be installed/constructed, if required, as the quarry develops to accommodate the additional surface runoff and quarry drainage. Relocation of the quarry to another location may likely require development of a new site, construction of new facilities, and would potentially have greater impact on the surrounding biophysical and socio-economic environment.

The Proponent proposes to extend the approved quarry site to occupy approximately 65 ha of land, in total, to allow for continued aggregate production (blasting, crushing, and stockpiling) and will supply granite to local gravel and concrete markets as well as asphalt aggregates. Over the next ten years, the extension will advance in the southeast direction (refer to Figure B1 in Appendix B). The eastern third of the Project Area (*i.e.*, approximately 23 ha of the 65 ha quarry extension area) will be set aside as a Wetland Buffer Zone that will protect approximately 73% of the total wetland area within the Project Area, as well as a watercourse that is hydrologically connected to fish-bearing waters, from future quarrying or development.

3.4 SCOPE OF THE ENVIRONMENTAL ASSESSMENT

The proposed Project must be registered for environmental assessment under the Environmental Assessment Regulations of the Nova Scotia *Environment Act* as a Class I Undertaking. This report fulfils the primary requirements for project registration under this legislation.

Other relevant provincial regulations and guidelines include the General Blasting Regulations made pursuant to the Nova Scotia *Occupational Health and Safety Act* (1996) and the Nova Scotia Pit and Quarry Guidelines (NSEL 1999). Relevant federal legislation and policies include the *Fisheries Act*, the *Species at Risk Act*, and the *Migratory Birds Convention Act*.

The scope of the environmental assessment in relation to the proposed Project has been determined by the Proponent and their consultant and is based upon the proposed Project elements and activities, the professional judgment and expert knowledge of the study team, consultations with 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 (NSEL 2008) was also used to determine/focus the scope of the assessment. The Proponent and their consultant met with NSE on March 19, 2012 to discuss the location of proposed extension, and elements and activities associated with the proposed Project, in an effort to further focus the scope of the assessment. Landowners adjacent to the quarry were also contacted (see Section 4.0) for the purpose of issues identification.

This environmental assessment evaluates the potential environmental effects of the proposed Project elements and activities, for all Project phases, with regard to each Valued Environmental Component (VEC). By assessing potential impacts on VECs within the study boundaries, a meaningful evaluation of project effects on relevant environmental aspects is achieved. The following VECs were identified based on government guidance, consultation, and professional judgment of the study team:

- Surface Water Resources;
- Rare and sensitive flora;
- Wetlands;
- Wildlife;

- Groundwater;
- Archaeological and heritage resources;
- Air quality; and
- Socio-economic environment.

A draft EA Registration document was submitted for review to provincial and federal regulators in March 2013. Government comments on the draft were received by the Proponent in March and April of 2013. All comments were reviewed and updates were made to the EA Registration where appropriate. Government comments and Proponent responses can be found in the disposition table in Appendix I.

4.0 PUBLIC INVOLVEMENT

4.1 METHODS OF INVOLVEMENT

In early March 2012, Project Information Bulletins (Appendix D) were distributed to landowners within approximately 2.0 km of the quarry. The purpose of the bulletin was to advise local residents close to the existing quarry and proposed Project site (*i.e.,* those who are potentially most affected) and provide them with opportunity to comment on the proposed undertaking.

Information letters were also sent to the Confederacy of Mainland Mi'kmaq (CMM), the Native Council of Nova Scotia (NCNS), the Kwilmu'kw Maw-klusuaqn Negotiation Office (Mi'kmaq Rights Initiative; KMKNO), the Union of Nova Scotia Indians (UNSI), and the Chief and Council of the Acadia First Nation to encourage the submission of comments, concerns, and questions regarding the Project (Appendix D).

4.2 STAKEHOLDER COMMENTS AND STEPS TAKEN TO ADDRESS ISSUES

To date, no comments have been received from the public as a result of the Project Information Bulletin. Similarly, no comments have been received in response to the information letters that were sent to the CMM, NCNS, KMKNO, UNSI, and Acadia First Nation. The Proponent will follow up with additional communication and engagement around any expressed issues of concern (if applicable).

The EA Registration document will be subject to a public review process as required under provincial legislation. The document will be posted on the NSE website with paper copies at several locations including near the Project Area. Publication dates and Registration document locations will be advertised in one Province-wide newspaper and one local newspaper. Public comments will be solicited by NSE as part of this process.

5.0 VALUED ENVIRONMENTAL COMPONENTS AND EFFECTS MANAGEMENT

5.1 ASSESSMENT METHODS

Field studies were conducted by Stantec o investigate and establish the existing conditions and to determine appropriate mitigation, if necessary, to manage environmental effects from the proposed extension Project. These consisted of the following surveys:

- Wildlife (breeding bird, mammal, and herpetile), vegetation, and wetland field surveys were undertaken by two qualified terrestrial ecologists on August 30-31, 2011;
- Aquatic field survey was undertaken by two qualified aquatic ecologists on September 16, 2011;
- Follow-up wildlife (breeding bird, mammal, and herpetile) and vegetation field surveys were undertaken by a qualified terrestrial ecologist from June18-20, 2013; and
- A qualified archaeologist conducted a desktop assessment of potential archaeological and heritage resources, followed by a pedestrian field survey of the Project Area on July 4, 2013.

Additional information, in support of the field studies and the assessment, was gathered through a review of: air photos; site mapping; and other information sources, such as the Nova Scotia Museum, Statistics Canada, the Nova Scotia Department of Transportation and Infrastructure Renewal, and the Nova Scotia Department of Natural Resources (NSDNR).

Temporal and spatial boundaries encompass those periods and areas within which the VECs 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. Spatial boundaries are generally limited to the immediate Project Area unless otherwise noted.

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 VEC. 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 has been used as indicators of significance.

5.2 SURFACE WATER RESOURCES

Surface Water Resources was selected as a VEC because of the potential for Project activities to interact with the freshwater environment. Indicators of the VEC include aquatic life, fish habitat and surface water quality, as well as potential water uses for agriculture, recreation, industry or potability. Water quantity is discussed as part of the Groundwater Resources VEC (Section 5.6).

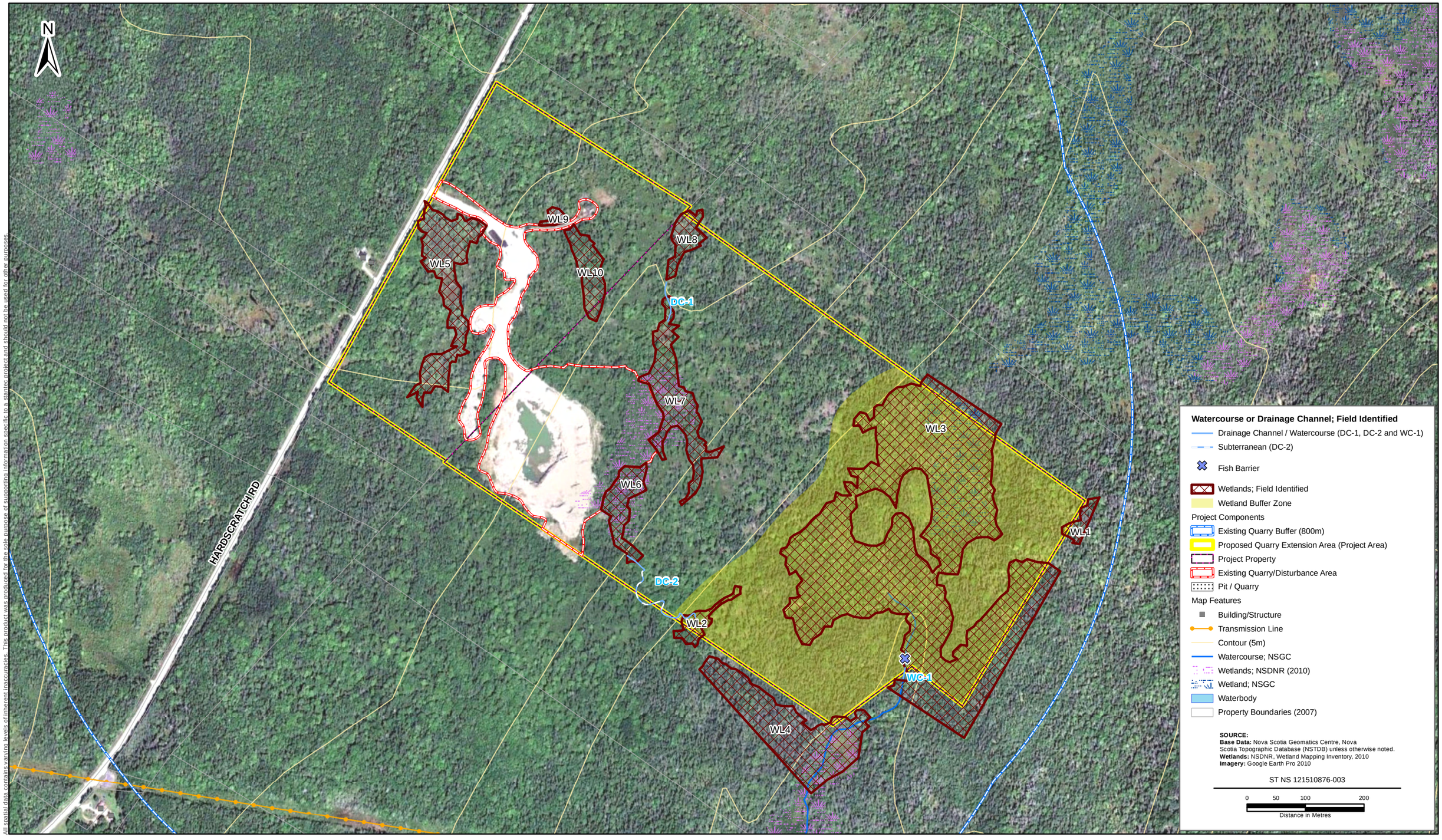
The habitat surveys were conducted using internal Stantec sampling protocol. The internal protocol used was based on multiple existing protocols including the Environment Canada CABIN protocol (Canadian Aquatic Biomonitoring Network; Reynoldson *et al*. 2007), the Ontario Benthos Biomonitoring Network (OBBN) protocols (Jones *et al.* 2005), and the modified New Brunswick Department of Natural Resources (NBDNR) and Fisheries and Oceans Stream Assessment Protocol (Hooper *et al*. 1995). The stream assessment included the identification of physical units (*i.e.*, run, riffle, or pool), designation of substrate type, and description of the riparian zone. The presence or absence of macrophytes, algae, over-head cover, and woody debris was recorded. The depth and width of the stream were also taken and the presence of existing anthropogenic impacts was noted.

Watercourse descriptions are provided below for the assessed stream. This information details the watercourse survey results and characterizes the watercourse. Key water quality results are outlined for the watercourse. The intent of the water quality discussion is to compare the results with applicable guidelines from the Canadian Council of Ministers of the Environment (CCME). Specifically, results are compared with the CCME guidelines for the protection of freshwater aquatic life (CCME-FAL) to determine the capacity for the watercourse to support aquatic life. The water quality parameters collected *in-situ* using a handheld multimeter (YSI 556) include: dissolved oxygen, pH, conductivity and water temperature.

5.2.1 Description of Existing Conditions

Fieldwork was conducted on September 16, 2011 by two Stantec aquatic scientists. Field-based stream assessments included a fish habitat survey and water quality sampling within the one defined watercourse and two drainage channels inside the Project boundaries. Provincial mapping located one watercourse (WC-1) in the southeastern portion of the proposed quarry expansion area. Field investigations carried out by Stantec wetland specialists confirmed two additional drainage areas on the property with channelized above-ground flow. The location of the watercourse, two drainage channels and any associated wetlands are illustrated in Figure 5.1. The dominant watercourse (WC-1) on the site originates from a large wetland (WL3); this wetland encompasses the majority of the southeastern portion of the Project Area and extends past Project Area boundaries. WC-1 flows south through the middle of WL3 and, after flowing outside the Project Area boundaries, flows into a large wetland complex (Chebogue River Meadows, Figure 5.2) leading into the Chebogue River. Both WC-1 and WL3 will be protected within a 23 ha Wetland Buffer Zone in the eastern portion of the Project Area (refer to Figure 5.1) in which no quarrying or development will occur.

In addition to the watercourse located within the Project Area, two drainage channels were observed. Both drainage channels were less than 200 m in length and provide a surface water connection between wetlands. The gradient of drainage channel DC-1 runs from north to south and connects wetlands WL8 to WL7, and the gradient of drainage channel DC-2 runs from west to east and connects WL6 to WL2. At the time of the surveys there was no apparent above-ground channelized connection between wetlands WL7 and WL6.



PREPARED BY: R Sutcliffe

REVIEWED BY: K. Fraser

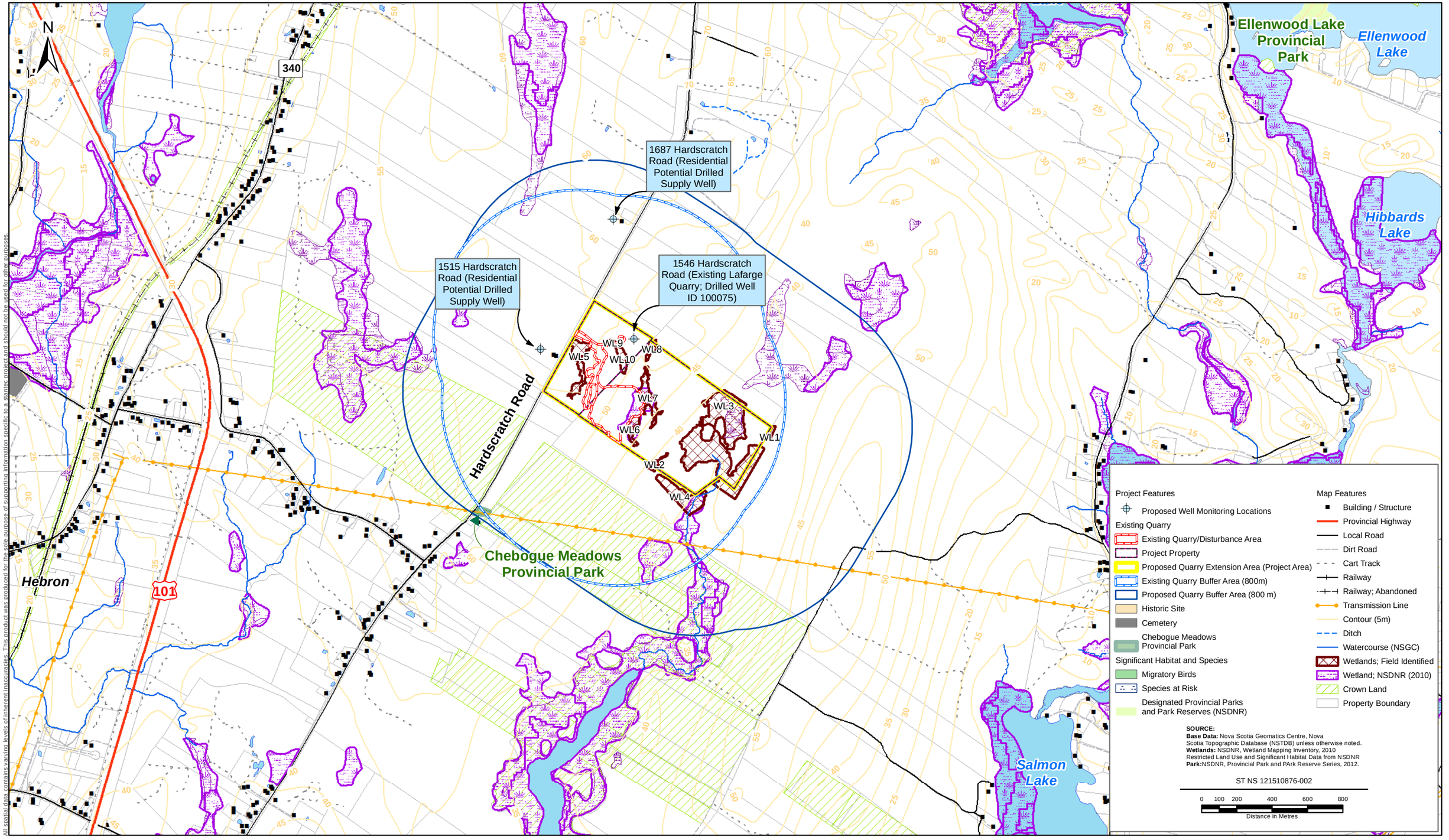
LAFARGE HARDSCRATCH QUARRY

Wetlands and Watercourses / Drainage Areas

FIGURE NO.: 5.1

DATE: Jul 17, 2013

Path: \\CD1213-F02\Profit_Centers\1215\active\121510xxx\121510876_ea_lafarge\geomatics\mapping\mxd\report\ST NS-121510876-003_wetlandsandwatercourses_20120305.mxd



All spatial data contains varying levels of inherent inaccuracies. This product was produced for the sole purpose of supporting information specific to a Stantec project and should not be used for other purposes.

PREPARED BY: R. Sutcliffe	Lafarge Hardscratch Quarry	FIGURE NO.: 5.2
REVIEWED BY: K. Fraser	**Environmental Features and Sensitive Areas**	DATE: Sep 05, 2013
LAFARGE		Stantec

Path: \\Cd1213-f02\workgroup\1215\active\121510xxx\121510876_ea_lafarge\geomatics\mapping\mxd\report\ST NS-121510876-002_envfeatures_20120305.mxd

Drainage channels DC-1 and DC-2 were visually assessed by the Stantec aquatic team in September 2011 and it was determined that they would not be deemed watercourses under the *Environment Act* and would therefore be exempt from Watercourse Alteration permitting requirements under the Activities Designation Regulations. Based on the proximity of the drainage channels to moderately sized wetlands and the influence the drainage channels have on wetland hydrology, it was important to locate the drainage channels for inclusion in the discussion of wetlands (Section 5.5).

Watercourse Descriptions

Watercourse WC-1 is upstream of the Chebogue River Meadows (refer to Figure 5.2) and also forms part of the headwaters of the fish-bearing Chebogue River. This watercourse (WC-1) will be protected within the 23 ha Wetland Buffer Zone proposed for the eastern portion of the Project Area and shown on Figure 5.1. The assessment of the portion of WC-1 located within the Project Area confirmed that the watercourse can be characterized as a deep, darkly tea-stained meandering stream draining from the center of a large wetland (WL3) (see photographs in Appendix E). Within the Project Area, the stream flows along the western edge of WL3 to the Project Area boundary. Once outside the boundary, the stream meanders through a stand of deciduous forest before entering a large wetland complex (Chebogue River Meadows). The substrate within the Project Area is dominated by fines and the flow pattern at the time of the assessment was that of a slow-moving run. Aquatic Macrophytes (aquatic grasses) were abundant in the watercourse with filamentous algae observed attached to the blades of grass. The riparian vegetation is comprised almost entirely of terrestrial grasses within the Project Area. Additional physical habitat features are summarized for watercourse WC-1 in Table 5.1. These measurements were collected at a single point in time and as such will experience natural variation seasonally.

Table 5.1 Summary of Stream Assessments at Lafarge Quarry

Date & Time	**16-Sept-11**
Site Coordinates	256018m E, 4864536m N
Site Description	WC-1: Headwaters of Chebogue River
Site Measurements and Characteristics	
Precipitation Previous 24 hours	None
Wetted Width average (m)	0.3
Bankfull Width average (m)	1.0
Depth (min. - max. range) (cm)	5-10
Woody Debris	Present
Macrophytes	Abundant
Algae	Present
Canopy Cover (%)	40
Riparian Vegetation (Dominant)	Wetland to Mainly Deciduous Forest
Water Quality	
DO (mg/L)	5.34

Table 5.1 Summary of Stream Assessments at Lafarge Quarry

DO(%)	63.4
Water Temperature (˚C)	17.7
pH	4.4

The *in situ* water quality results measured at the time of the survey for WC-1 (Table 5.1) indicate that the water quality was below the Canadian Council for the Minsters of the Environment Guidelines for the protection of Freshwater Aquatic Life (CCME-FAL) for pH and dissolved oxygen. The CCME-FAL include four values for dissolved oxygen, these values are based two factors fish habitat preference and fish life stage, habitat preference is divided into warm or cold water ecosystems. Generally, species who inhabit warm water ecosystems are more adapted to low dissolved oxygen concentrations. The life stage factor is divided into early life stages (eggs to juvenilles) and other life stages (adults) with eggs requiring the highest dissolved oxygen concentrations. The dissolved oxygen content of WC-1 was measured to be 5.34 mg/L, this concentration falls below the guideline value (5.50 mg/L) for warm water adult biota, the least sensitive group. Dissolved oxygen concentrations of this level could cause physiological and behavioral effects in cold water species, while this may not result in direct mortalities in adults, survival of juvenile cold water fish may be reduced.

As is often observed in various areas in Nova Scotia, the pH level measured was acidic (4.4). The pH measured was below the CCME guidelines of 6.5-9.0 but is within the lower range known to support aquatic life in Nova Scotia. Low pH or acidic waters are common in various areas of the province. Acidification can be caused by a variety of combinations of anthropogenic and natural soil composition conditions such as high sulfur content, which, once becoming oxidized leaches into the ground and surface water, lowering pH (Goodwin 2004). The shallow soil depth in southwestern Nova Scotia contributes little to the buffering of acidic runoff (Clair 2011). In addition to soils decomposing organic material, such as found in wetlands, can also create acidic conditions in slow moving aquatic environments (Clair 2011).

None of the watercourses identified on the Project property are known to support drinking water supplies or other protected surface waters. The groundwater section (*i.e.,* Section 5.6) of this document addresses the presence of water supply wells within 800 m of the quarry extension boundaries. All of the water supply wells identified within the 800 m assessment zone were associated with private residences. There are no known Protected Water Areas (PWA) in the vicinity of the Project Property. Therefore, no impact to surface waters with reservoir, private supply, or protected area uses is anticipated to result from the proposed Project Activities.

Fish Survey Results

Based on the results of the habitat assessment and water quality measurements, watercourse WC-1 was not electrofished during the survey. The abundance of vegetation within the stream would have likely reduced or completely eliminated electrofishing catches. In addition, an assessment of connectivity indicated that a barrier to fish passage was located just upstream from the Project Area boundary. A subterranean section of the stream, approximately 1.5 m in

length, would limit fish passage upstream and into the Project Area. Based on the assessment, potential fish habitat in the Project Area is a section approximately 10 m in length located within southernmost portion of watercourse WC-1.

While the sole watercourse (WC-1) in the Project Area is not expected to bear fish, the water contained in the watercourse has direct connection downstream to Chebogue River. As such, appropriate mitigation must be undertaken to prevent downstream effects on fish and fish habitat to meet DFO standards.

The two drainage channels observed (DC-1 and DC-2) were not connected to fish-bearing waters and, at the time of the assessment, one of the channels was completely dry with the other composed of pockets of rainwater (based on water quality collected). Therefore, the drainage channels do not constitute fish habitat based on their ephemeral nature and lack of connectivity to fish-bearing waters.

Summary

During the September 2011 habitat assessments, one watercourse and two drainage channels were confirmed in the Project Area. The watercourse exhibited tea-stained, slow moving water and low quality habitat capable of supporting aquatic life at the time of the survey. This watercourse and associated habitat will be protected within a 23 ha Wetland Buffer Zone in which no quarrying or development will occur. A barrier to fish passage was located in the downstream area of the watercourse, just inside the Project Area. As such, fish are not anticipated to inhabit the upper reaches of the watercourse. The watercourse has a direct connection downstream to Chebogue River which is fish-bearing. Therefore, the potential for downstream effects within Chebogue River must be mitigated through compliance with NSE final effluent discharge limits. The two drainage channels observed do not constitute watercourses as per the Activities Designation Regulations and therefore do not require Watercourse Alteration Permits.

5.2.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

Fisheries and Oceans Canada (DFO) has developed the Policy for the Management of Fish Habitat (DFO 1986), which applies to all development and industrial projects in or near watercourses that could harmfully alter, disrupt, or destroy fish habitat by chemical, physical, or biological means (*i.e.*, HADD). The guiding principle of this policy is to achieve no net loss of the productive capacity of fish habitats. Potential fish habitat is limited to the approximately 10 m of the watercourse within the Project Area downstream of the barrier to fish passage; upstream of the fish barrier, no fish are expected to inhabit the watercourse. Buffering this portion of stream habitat would avoid the HADD authorization and subsequent compensation requirements. In addition to the buffer zone, appropriate mitigation is required to prevent downstream effects on fish and fish habitat from chemical (hydrocarbon spills, minerals, ions, *etc.*) or physical (sedimentation, temperature, *etc.*) effects on the habitat present within the Project Area and the downstream habitat in Cheboque River.

Clearing, grubbing, and topsoil stripping activities can increase the potential for sediment erosion and deposition of sediment, minerals or ions down gradient, 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. Without the implementation of appropriate mitigation measures, the Project could result in sedimentation effects on fish habitat present down-gradient, outside the proposed Project extension boundaries.

Lafarge has proposed a Wetland Buffer Zone surrounding the large wetland WL3 in the eastern portion of the Project Area (shown in Figure 5.1). The buffer zone will consist of an area where no quarrying or development will occur, and natural vegetation will be maintained within the buffer zone. All portions of wetlands WL1 to WL4 located within the Project Area are entirely encompassed by the proposed buffer zone.

In addition to encompassing wetlands WL1 to WL4, the Wetland Buffer Zone protects the riparian zone within 200 m of the watercourse and likely includes the majority, if not all, of the drainage basin which supports watercourse WC-1. This 200 m buffer zone more than meets the separation distance requirements specified in the Nova Scotia Pit and Quarry Guidelines (NSE 1999), which state that no works associated with an active quarry are to be located within 30 m of the bank of any watercourse without prior government approval. As noted in Section 5.2.1, DC-1 and DC-2 do not constitute watercourses under the *Environment Act*; therefore, the 30 m separation distance requirement under the Pit and Quarry Guidelines is not applicable for these drainage channels. Outside of the Wetland Buffer Zone (*i.e*., in the portion of the Project Area that will be subject to development and operation of the extended quarry), 30 m buffers will be maintained from all wetlands that will not be altered.

Based on the results of the watercourse assessment, the use of a Wetland Buffer Zone, and the mitigation proposed, there is very low potential for quarry activities to interact with fish and fish habitat and significant Project-related effects on fish and fish habitat are not likely to occur.

Should Lafarge ever wish to quarry within the Wetland Buffer Zone in the future, approval to alter a watercourse must be granted under the Nova Scotia Activities Designation Regulations. However, it is currently anticipated that alteration of the watercourse will not be required during the life of the quarry extension.

The use of properly sized flow retention structures is expected to mitigate erosion and sedimentation effects in all identified watercourses during clearing, grubbing, topsoil stripping and culvert installation activities. Additionally, as the quarry site develops, exposed soil and stockpiles capable of producing sediment laden-runoff will be stabilized.

Additional retention capacity will be created as the quarry extends and additional settling pond volume will be installed, as needed. The water quality of the effluent exiting the settling pond will meet parameters as stated in the facility's current Industrial Approval and future amendments.

The use of explosives will follow DFO's Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (Wright and Hopky 1998). A blast management plan will be provided to NSE, if requested.

A phased approach to the extension of the quarry will allow for an adaptive approach to monitoring and management of potential effects to surface water and groundwater resources which in turn may affect fish habitat downstream. As well, the eastern portion of the Project Area will be set aside as a wetland avoidance area (*i.e.*, Wetland Buffer Zone) which will also provide protection for the watercourses on-site and downstream of the site (see Figure 5.1). Linking site extension to environmental effects management performance criteria is an effective mitigation strategy to deal with uncertainties and allow sustainable development.

5.3 RARE AND SENSITIVE FLORA

5.3.1 Description of Existing Conditions

The site was surveyed by Stantec botanists during August 30-31, 2011 and June 18-20, 2013. A vascular plant inventory of the Project Area was compiled during each of these surveys and habitat descriptions were performed.

The Project Area is comprised mainly of a mixture of forest, barrens and forested wetland. Forests in the Project Area vary in age from recently harvested stands to mature forest. Mature softwood forest is present mainly in the eastern half of the property (Figure 2.2). These stands are dominated by a mixture of red spruce (*Picea rubens*), white spruce (*Picea glauca*), balsam fir (*Abies balsamea*), and red maple (*Acer rubrum*). The ground vegetation layer of these stands is characterized by a moss/ liverwort carpet composed largely of red-stemmed moss (*Pleurozium schreberi*), bazzania (*Bazzania* sp.) and broom moss (*Dicranum* sp.). The shrub layer consists mainly of advanced regeneration of red spruce and balsam fir.

Hardwood forest is present at the northwestern corner of the Project Area and along the southern boundary (Figure 2.2). These stands are composed largely of red maple with small amounts of red spruce and white spruce in the overstory. The ground vegetation layer is characterized by a dense sward of hay-scented fern (*Dennstaedtia punctilobula*) along with lesser amounts of sedge (*Carex* sp.) and wild lily-of-the-valley (*Maianthemum canadense*).

Mixedwood forest is found mainly at the western end of the Project Area (Figure 2.2). These stands are characterized by a relatively open tree canopy composed of a mixture of red maple, red spruce, white spruce and American larch (*Larix laricina*). The shrub layer is very dense and composed of a mixture of low and tall shrub species including sheep laurel (*Kalmia angustifolia*), possum-haw viburnum (*Viburnum nudum*), black huckleberry (*Gaylussacia baccata*), late low-bush blueberry (*Vaccinium angustifolium*), and mountain ash (*Sorbus Americana*). Advanced regeneration of red spruce and white spruce are also present in the shrub layer. The ground vegetation layer is composed largely of dwarf dogwood (*Cornus canadensis*), bracken fern (*Pteridium aquilinum*) and cinnamon fern (*Osmunda cinnamomea*).

Barrens habitat is present in the center of the Project Area. This habitat is very similar in species composition to the mixedwood forest vegetation type except that the tree canopy is very open consisting of small patches of spruce and red maple. The dense shrub layer is nearly identical to that found in the mixedwood forest vegetation type.

Forest harvesting has been conducted at various locations in the western half of the Project Area. Most harvested sites are only a few years old and there has been relatively little vegetation recovery. In most instances these stands consist of a patchy shrub cover dominated by sheep laurel, black huckleberry and late lowbush blueberry. Ground vegetation cover consists mainly of bracken fern and dwarf dogwood.

Wetlands are widespread and relatively abundant in the Project Area. All of the wetlands are treed swamps although some wetlands contain inclusions of bogs or tall shrub dominated swamp. Inclusions of graminoid dominated vegetation are present in wetlands where hydrological alteration of the wetland has resulted in the loss or thinning of the overhead tree cover. The eastern third of the Project Area is largely occupied by wetland habitat (Wetlands WL1, WL2, WL3, and WL4 in Figure 5.1) that form the headwaters for the Chebogue River.

Most swamps in the Project Area are mixed treed swamps. These swamps have a moderately dense tree canopy formed predominantly by black spruce (*Picea mariana*), red maple, balsam fir, and American larch. These tree species are also important contributors to a moderately dense shrub layer, along with bristly dewberry (*Rubus hispidus*), sheep-laurel, mountain holly (*Nemopanthus mucronata*), and black holly (*Ilex verticillata*). Herbaceous cover is primarily provided by graminoids and ferns, particularly three-seed sedge (*Carex trisperma*), manna-grass (*Glyceria grandis*) and cinnamon fern (*Osmunda cinnamomea*). Peatmoss (*Sphagnum spp.*) coverage is extensive throughout this habitat.

One deciduous treed swamp is present in the Project Area. This wetland is dominated by an overstory comprised predominantly of red maple, with lesser amounts of American larch, balsam fir and black spruce also present. Shrub coverage is minimal and includes scattered patches of stunted balsam fir and red maple. Herbaceous coverage is primarily comprised of ferns, particularly eastern hay-scented fern (*Dennstaedtia punctilobula*) and cinnamon fern. This habitat-type has a moderately well-developed moss layer comprised of a mixture of peatmoss and hair-cap moss (*Polytrichum* sp.) Graminoids are common in this wetland type including manna grass, sedge (*Carex gynandra*) and soft rush (*Juncus effusus*).

Tall shrub dominated swamp is present along a small portion of the southern boundary of the Project Area. This wetland type is characterized by a moderately dense tall shrub canopy that is composed mainly of speckled alder (*Alnus incana*), mountain holly, western poison ivy (*Toxicodendron rydbergii*), and possum-haw viburnum. The ground vegetation layer consists of a continuous peatmoss carpet that is punctuated by patches of cinnamon fern, three-seed sedge and manna grass.

Graminoid dominated swamp is present in the eastern half of the Project Area in wetlands that have had their hydrology altered by anthropogenic activities. This wetland type typically consists

of small to medium sized inclusions of graminoid dominated vegetation that have developed in areas where the overstory tree cover has been killed or thinned as a result of fluctuating water levels. Dominant species usually include manna grass, soft rush, blue-joint reedgrass (*Calamagrostis canadensis*), and cottongrass bulrush (*Scirpus cyperinus*).

Treed bog was present in the center of the largest wetland in the Project Area (WL 3). This wetland type is characterized by a moderately dense cover of stunted black spruce, American larch and red maple along with a dense cover of shrubs including sheep laurel, black huckleberry and mountain holly. Peatmoss and cinnamon fern are the dominant species of the ground vegetation layer. Other common species of the ground vegetation layer include tawny cotton-grass (*Eriophorum virginicum*), three-leaf Solomon's-plume (*Maianthemum trifolia*), blue-joint reedgrass, and whorled aster (*Aster acuminatus*).

Quarry operations are present in the western third of the Project Area. These disturbed habitats typically have exposed sand – cobble substrate and a vegetative community comprised of weedy plants. Whereas exotic plants comprise much of this vegetation, a high diversity of native species adapted to open, disturbed conditions are also present. Forbs and graminoids such as colonial bentgrass (*Agrostis capillaris*), pearly everlasting (*Anaphalis margaritacea*), black starthistle (*Centaurea nigra*), and poverty oat-grass (*Danthonia spicata*) dominate this habitat-type, but a number of shrubs are also present, including narrow-leaved meadow-sweet (*Spiraea alba*) and northern bush-honeysuckle (*Diervilla lonicera*).

Rare Vascular Plants

A rare plant modeling exercise was performed to determine the likelihood of presence of rare or sensitive plants within the Project Area. As part of the modeling exercise, all records of plant species listed by the NSDNR (2011) to be At Risk, May be at Risk, Sensitive to human activities or natural events, or ranked as S1, S2, or S3 by the AC CDC (2011) within a radius of 100 km from the center of the Project Area were compiled by means of an AC CDC data search. The habitat requirements of those species that had been recorded within 100 km from the center of the proposed development were then compared to the range of environmental conditions within the Project Area to determine if suitable habitat was present for these taxa. Knowledge of the habitats present within the Project Area was determined through an interpretation of aerial photography, topographic, and geological mapping. In instances where appropriate habitat was present for a particular species, that taxon was considered to be potentially present in the Project Area, and the habitat was identified as a target for field surveys. The phenology and ease of identification of each of the species potentially present in the Project Area was also incorporated into the model in order to determine when the rare or sensitive taxa would be best identified.

A total of 140 rare or sensitive vascular plant species have been recorded within 100 km of the center of the Project Area. Based on the results of the habitat model, there is potential for 32 of these species to be found within the Project Area. Two rare non-vascular taxa have been recorded within the 100 km radius around the Project Area, neither of which was considered to

have potential to exist in the Project Area. Table F1 in **Appendix F** lists these species, their preferred habitats and their phenology.

The results of the habitat modeling exercise (as summarized in Table F1 in Appendix F) indicated that all of the habitat types present in the Project Area could potentially harbor rare species. However, because many of the rare or sensitive plants were associated with wetlands and dry sandy disturbed sites, these habitats were considered to be most likely to harbor plants of conservation interest. Therefore, although all habitat types present in the Project Area were surveyed, particular attention was paid to the aforementioned areas.

The vegetation field surveys were conducted on August 30-31, 2011 and June 18-20, 2013 . A list of the 238 vascular plant taxa found on the site during field surveys is provided in Appendix G. Twenty-nine of the 32 vascular plant species highlighted by the model could be readily identified during the late August field survey. Three of the species would not be identifiable in late summer, including northern bog violet (*Viola nephrophylla*), southern twayblade (*Listera australis*) and tubercled orchid (*Plantanthera flava var. flava*) but would be identifiable during the June 2013 site visit.

All vascular plants encountered during the surveys were identified to species (when possible) and their population statuses in Nova Scotia were determined through a review of the species status reports prepared by NSDNR (NSDNR 2011), AC CDC (AC CDC 2011), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (COSEWIC 2011), and Species at Risk in Nova Scotia (NSDNR 2010). No “at risk” species, as identified by COSEWIC or the provincial *Endangered Species Act* were found during the surveys. However, southern twayblade was encountered and is currently designated to May be at Risk by NSDNR. Additionally, three species that are considered Sensitive by NSDNR, and are therefore of conservation concern, were encountered within the Project Area, including woods-rush (*Juncus subcaudatus*), sharp-fruited rush (*Juncus acuminatus*) and yellow ladies’-tresses (*Spiranthes ochroleuca*). All four of these species were identified as target species by the modeling exercise. In addition, two species assigned a ranking of “S3” by the AC CDC indicating that they are uncommon within the province were encountered during the field surveys including Nova Scotia agalinis (*Agalinis neoscotica*) and highbush blueberry (*Vaccinium corymbossum*). Both of these species are listed as Secure in Nova Scotia by NSDNR.

Southern twayblade is a small orchid that is typically associated with the shaded sphagnum moss of bogs or treed swamps (Zinck 1998). This species is only visible above ground for several weeks during early summer (mostly in June) and then it senesces. Southern twayblade is considered to be vulnerable to local changes in hydrology, nutrient status, and land use in other parts of its range (Hoy 2003) and it is expected that this would also be true of Nova Scotian populations. It is currently considered to May be at Risk by NSDNR and is given a ranking of S2 by the AC CDC. However, a recent review of the abundance and distribution of this species within Nova Scotia indicates that it is more common and widespread than previous records indicated, and its AC CDC ranking is likely to be changed to S3 or S3S4 in the near future (Blaney, pers. comm. 2013).

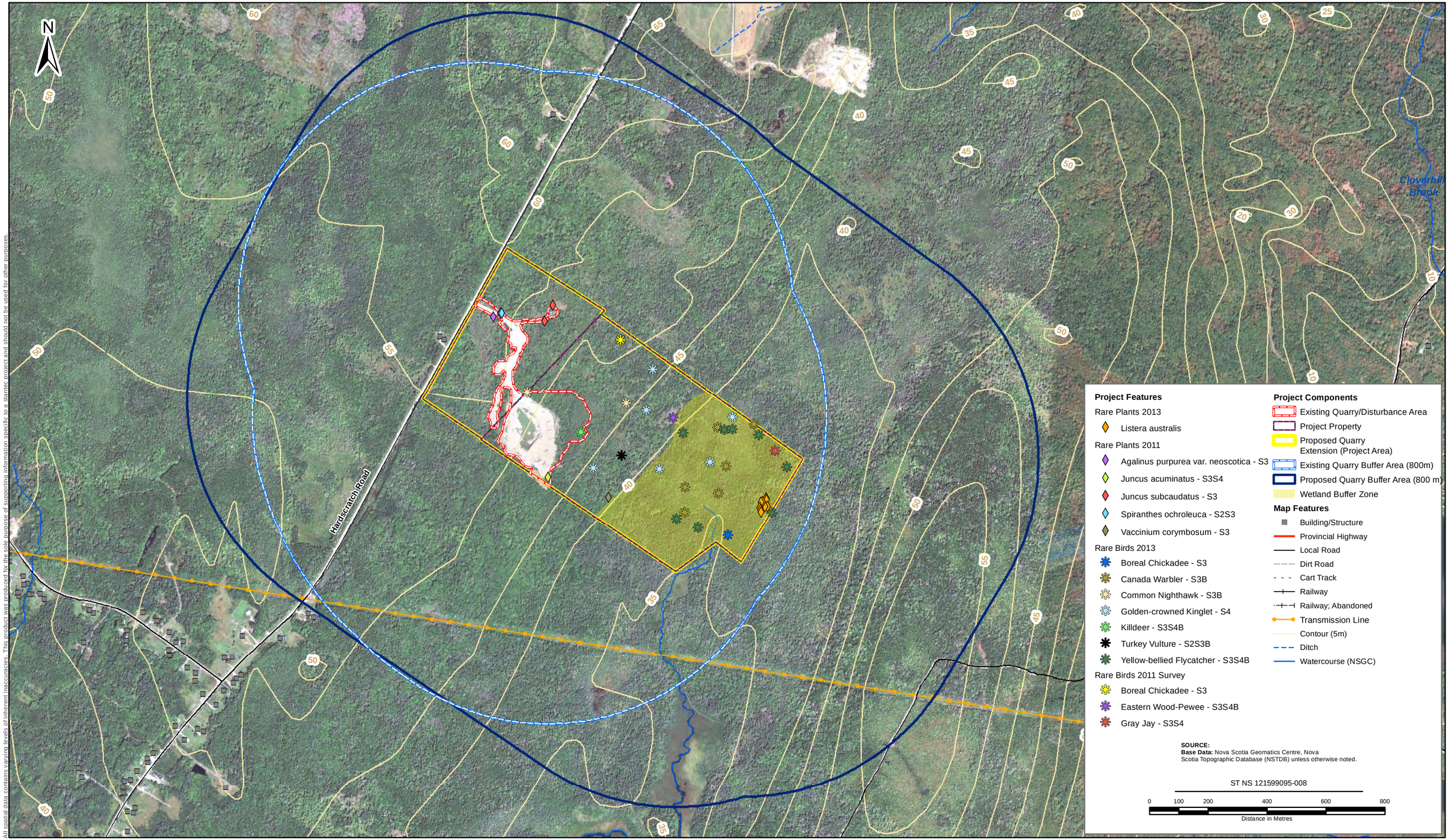
According to 2012 AC CDC records, the nearest population of this species is approximately 42 km away from the center of the Project Area. During the June 2013 vegetation field survey, a population of 14 southern twayblade plants was encountered within a mixed treed swamp (WL3) at the southeastern extent of the Project Area. This population will be protected within the Wetland Buffer Zone.

Yellow nodding ladies'-tresses is considered Sensitive by NSDNR and is assigned a ranking of “S2” by the AC CDC indicating that it is rare throughout its range in the province. Within Nova Scotia, yellow nodding ladies'-tresses are typically associated with the dry sand barrens in southwestern counties but are also found in other habitats such as roadsides and fields, as well as along rivers (Zinck 1998). Within the Project Area, three individuals of this species were observed (Figure 5.3) at the edge of the quarry entrance. According to the AC CDC data search, the closest recorded population of yellow nodding ladies'-tresses is 3 km away from the Project Area and two more have been recorded within 20 km. Two of these occurrences have been associated with anthropogenic habitats, including the sandy edge of a campsite and a gravely roadside edge. Because yellow nodding ladies'-tresses are associated with habitat conditions that are often promoted by quarry activities, the Project is not expected to cause a significant adverse effects to its population. Furthermore, Project activities are expected to have minimal direct interaction with the three individuals of this species observed on-site, given their location at the entrance of the quarry.

Woods-rush is considered sensitive by NSDNR and is assigned a ranking of “S3” by the AC CDC indicating that it is uncommon throughout its range in the province. Woods-rush is typically associated with wet woods and swamps (Zinck 1998) and is part of the coastal plain flora of southwestern Nova Scotia. Woods-rush was encountered at two locations in the Project Area (Figure 5.3). One individual was found along the edge of a ditch pool along an overgrown road near the scale house. At the second location two plants were found at the edge of a disturbed area. Both of these locations were associated with anthropogenic habitats. Continued quarrying activities on the property may result in the production of more sites suitable for this species.

Sharp-fruited rush is listed as Sensitive in Nova Scotia by NSDNR and is listed as “S3S4” by AC CDC indicating that the species is uncommon to fairly common in Nova Scotia. This species is typically found on sandy or muddy flats, on wet clay soils and in sterile meadows and ditches. In the Project Area sharp-fruited rush was found around the margin of a small settling pond at the southeastern end of the existing quarry (Figure 5.3).

Highbush blueberry is considered to be Secure in Nova Scotia by NSDNR and is assigned a rank of “S3” by the AC CDC. Highbush blueberry is associated with a variety of habitats within the southwestern part of Nova Scotia, including bogs, upland barrens, wet pastures, and lakeshores (Zinck 1998). It is also a member of the coastal plain flora. Within the Project Area it was encountered at only one location near the southern property boundary approximately 300 m southeast of the edge of the existing quarry (Figure 5.3).



All spatial data contains varying levels of inherent inaccuracies. This product was produced for the sole purpose of supporting information specific to a Stantec project and should not be used for other purposes.

PREPARED BY: R. Sutcliffe	Lafarge Hardscratch Quarry	FIGURE NO.: 5.3
REVIEWED BY: K. Fraser	**Rare Plants and Rare Birds 2011 - 2013**	DATE: Sep 05, 2013
LAFARGE		Stantec

Path: V:\1215\active\121510xxx\121510876_ea_lafarge\geomatics\mapping\mxd\report\ST NS-121510876-013_rare birds plants2013_20130723.mxd

Nova Scotia agalinis is listed as a Secure species by NSDNR and is listed as “S3” in Nova Scotia by AC CDC. This species is typically associated with damp disturbed areas with exposed mineral soil such as ditches, poorly drained woods roads or gravel pits. In the Project Area several hundred individuals were found at four locations in the ditches alongside the entrance road to the quarry (Figure 5.3).

The Project Area is located near the Tusket River which is the most important area for Atlantic coastal plain flora in Nova Scotia. The Atlantic coastal plain flora includes 90 species that are characteristic of coastal areas farther south. Nova Scotia represents the northern limit of their distributions. Coastal flooding following the retreat of the glaciers has resulted in the loss of the coastal plain habitat that once connected Nova Scotia to the main distribution of Atlantic coastal plain species along the eastern seaboard of the United States. This has resulted in the formation of disjunct populations of Atlantic coastal plain species in Nova Scotia. In Canada, some of these species are found only in Nova Scotia.

Nova Scotia’s Atlantic coastal plain species are often found in shoreline habitats that are infertile and subject to regular disturbance by fluctuating water levels. The rarest Atlantic coastal plain species are typically found in these habitats. The Project Area does not contain the classic shoreline habitat that supports the rarer Atlantic coastal plain species. Nevertheless, it does provide habitat for at least twelve of the Atlantic coastal plain plant species including Nova Scotia agalinis, red chokeberry (*Photina pyrifolia*), twining bartonia (*Bartonia paniculata*), blunt manna-grass (*Glyceria obtusa*), inkberry (*Ilex glabra*), woods-rush , northern bayberry (*Morella pensylvanica*), mild water-pepper (*Polygonum hydropiperoides*), bog fern (*Thelypteris simulata*), poison-ivy (*Toxicodendron radicans*), highbush blueberry, and lance-leaved violet (*Viola lanceolata*). These species were found mainly in ditches, wetlands and barrens habitats. Only two of these species are considered to be species of conservation interest including woods-rush and highbush blueberry. The distribution and population statuses of these species have already been discussed.

5.3.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

The Project has the potential to influence the populations of several of the rare or uncommon plant species as a result of direct habitat loss and indirectly through changes in habitat conditions, such as may be brought about by altered hydrological regimes.

The population of southern twayblade encountered during the field surveys is located within the southeastern extent of the Project Area and will be avoided by quarrying activities (Figure 5.5). Specifically, disturbance to WL3 will be avoided through recognition of a Wetland Buffer Zone.

Yellow nodding ladies'-tresses, woods-rush and sharp-fruited rush, all of which are considered “sensitive” within the province, are associated with anthropogenic habitats that have developed as a result of quarrying activities. As a result, there is unlikely to be a net loss of suitable habitat for these species, and populations could potentially increase over time. Nonetheless, there is potential for existing populations to be adversely affected by activities at the quarry and care

should be taken to minimize the likelihood of disturbing existing populations (*e.g.*, through staking/flagging and avoidance).

Symbolic fencing will be used to mark the locations of the known populations of these species. Nova Scotia agalinis and yellow lady's-tresses were both found in the ditches at the quarry entrance. This area is likely to remain unchanged for long periods of time.

Sharp-fruited rush and woods-rush are associated with wet areas near old roads or settling ponds in areas where quarry expansion could potentially result in the loss of these known populations.

There is less concern for the potential loss of the Nova Scotia agalinis and highbush blueberry populations since both of these species are considered to be secure in Nova Scotia. The Nova Scotia agalinis population is located in an area that is unlikely to be adversely affected by quarrying activities. The one highbush blueberry plant found during the field survey is located in an area that is likely to be subjected to future quarrying operations. This species is relatively widespread in southwestern Nova Scotia and often occurs in high concentrations. The loss of a single highbush blueberry plant at this location will not have any significant effect on the local population. As such, no mitigation is recommended for this species.

The late summer plant survey conducted August 30-31, 2011 was appropriate for identifying the majority of rare or sensitive taxa highlighted during the rare plant modeling exercise. However, because this survey was not suitable for finding three of the plant species identified as potentially present by the model (*i.e.*, northern bog violet, southern twayblade, and tubercled orchid), it was necessary to also undertake an early summer plant survey June18-20, 2013. Southern twayblade is present aboveground only for a period of four weeks in June, and a population of this species was observed within the Wetland Buffer Zone during the early summer survey.

Standard mitigative measures to minimize the environmental effects of the Project on plant communities include the use of seed mixtures free of noxious weeds and invasive species during site reclamation. Wherever practical, native plants should be used for site reclamation. In lieu of native species, seed mixes containing naturalized species which are well established in Nova Scotia and which are free of invasive species and are not aggressive weeds in the wetland and forest plant communities present in the area may be used for reclamation.

In summary, assuming recommended mitigative measures, significant Project-related effects on rare and sensitive flora are not likely to occur.

5.4 WILDLIFE

5.4.1 Description of Existing Conditions

Information regarding use of the Project Area by wildlife was derived from several sources including field surveys and review of existing data. Wildlife field surveys were conducted along

with plant surveys during August 30-31, 2011 and during June18-20, 2013. During these surveys, information was collected regarding the presence of birds, mammals and herpetiles (amphibians and reptiles).

A rare wildlife modeling exercise was performed to determine the likelihood of presence of rare or sensitive wildlife species within the Project Area. As part of the modeling exercise, all records of wildlife species listed by the NSDNR (2011) to be At Risk, May be at Risk, Sensitive to human activities or natural events, or ranked as S1, S2, or S3 by the AC CDC (2011) within a radius of 100 km from the center of the Project Area were compiled by means of an AC CDC data search. The habitat requirements of those species that had been recorded within 100 km from the center of the proposed development were then compared to the range of environmental conditions within the Project Area to determine if suitable habitat was present for these taxa. Knowledge of the habitats present within the Project Area was determined through an interpretation of aerial photography, topographic, and geological mapping. In instances where appropriate habitat was present for a particular species, that taxon was considered to be potentially present in the Project Area, and the habitat was identified as a target for field surveys. The phenology and ease of identification of each of the species potentially present in the Project Area was also incorporated into the model in order to determine when the rare or sensitive taxa would be best identified.

Additional references, such as the Atlas of Breeding Birds of the Maritime Provinces (Erskine 1992, MBBA 2009, Nature Serve 2012), Amphibians and Reptiles of Nova Scotia (Gilhen 1984), and the Nova Scotia Significant Habitat Mapping Database (NSDNR 2007a) were also consulted to provide records of wildlife in the vicinity of the Project Area and to help direct field surveys.

The Project Area has moderate wildlife habitat diversity. Due to recent tree harvesting activities, approximately half of the Project Area is currently at an early stage of successional development. Immature forest habitat is largely restricted to the western end of the Project Area. The eastern end of the Project Area supports the greatest amount of mature forest, all of which is coniferous forest. Patches of mature deciduous forest are found near the center of the south property line and at the northwestern corner of the Project Area. Mature mixedwood forest occurs in small patches near the southwestern corner of the Project Area. The Project Area supports ten swamps, mainly mixedwood treed swamps. Surface water within the wetlands is generally restricted to small pools and channels. Additional habitats found within the Project Area include those provided by a small anthropogenic pond, watercourses, and the anthropogenically disturbed areas associated with present quarry operations.

Birds

Field Survey Data

A breeding bird survey of the Project Area was performed in August 2011. During this time, 15 point counts were performed throughout the Project Area between the hours of 06:30 and 10:00 a.m. Additional observations were made during travels between point count locations and

throughout the day as botanical surveys were being performed. Furthermore, an evening site visit was made to the property between the hours of 21:00 and 22:00 for the purpose of obtaining information on the use of the area by crepuscular or nocturnal species and bird observations were made in August 2011 while performing a botanical survey of the Project Area. During the 2013 breeding bird survey, information on the breeding status of birds was obtained following criteria used by the Atlas of Breeding Birds of the Maritime Provinces (Erskine 1992). “Possible” breeders are generally those birds that have been observed or heard singing in suitable nesting habitat. “Probable” breeders include those that exhibited any of the following: courtship behavior between a male and female; visiting a probable nest site; displaying agitated behavior; and/or male and female observed together in suitable nesting habitat. “Confirmed” breeders are those birds that exhibited any of the following: nest building or adults carrying nesting materials; distraction display or injury feigning; recently fledged young; occupied nest located; and/or adult observed carrying food or fecal sac for young. The population status of all bird species encountered during the site visits were assessed using information from COSEWIC (2011), Species at Risk in Nova Scotia (NSDNR 2007c), the General Status of Wildlife in Nova Scotia (NSDNR 2010), and the AC CDC database (AC CDC 2011).

Thirty-six species were identified during the June 2013 breeding bird survey (Table 1, Appendix H). During this time, five species were identified as “probable” breeders, including Boreal Chickadee, White-throated Sparrow, Black-capped Chickadee, Palm Warbler, and Yellow-rumped Warbler. Another 29 species were identified as “possible” breeders: American Robin, American Crow, Blue Jay, Cedar Waxwing, Hairy Woodpecker, Killdeer, Ruffed Grouse, Alder Flycatcher, American Goldfinch American Robin, Black-and-White Warbler, Black-throated Green Warbler, Blue-headed Vireo, Brown Creeper, Canada Warbler, Chestnut-sided Warbler, Common Yellowthroat, Dark-eyed Junco, Golden-crowned Kinglet, Hermit Thrush, Least Flycatcher, Magnolia Warbler, Mourning Dove, Northern Parula, Ovenbird, Pileated woodpecker, Red-eyed Vireo, Swamp Sparrow, and Yellow-bellied Flycatcher. Two additional species, Common Nighthawk and Turkey Vulture, were observed but did not show evidence of breeding within the Project Area itself.

Twenty-five species of birds were identified in the Project Area during the August 2011 field visit (Table 1, Appendix H). Given the timing of the field survey it was not possible to collect good evidence of breeding activity but in consideration of the habitat types present in the Project Area, 22 of the 25 species were considered to potentially nest in the Project Area during the survey. Four of these species were tentatively confirmed as breeding in the Project Area based on the presence of fledged young including Black-capped Chickadee, Magnolia Warbler, Palm Warbler, and Common Yellowthroat. Eighteen species may be considered as possible breeders including Hairy Woodpecker, Pileated Woodpecker, Eastern Wood Pewee, Gray Jay, Blue Jay, Common Raven, Boreal Chickadee, Brown Creeper, Hermit Thrush, American Robin, Cedar waxwing, Black-throated Blue Warbler, Yellow-rumped Warbler, Black-throated Green Warbler, American Redstart, White-throated Sparrow, White-winged Crossbill, and American Goldfinch. Bird species observed during the field survey that are not expected to nest in the Project Area include Great Blue Heron, Osprey and Common Grackle.

Of the bird species detected during the surveys, three are federally or provincially designated Species at Risk, including Canada Warbler, Common Nighthawk, and Eastern Wood Pewee. An additional six species have been ranked as Sensitive by NSDNR and are therefore considered here to be Species of Conservation Concern, including Boreal Chickadee, Golden-crowned Kinglet, Killdeer, Turkey Vulture, Yellow-bellied Flycatcher, and Gray Jay. Potential Project-related effects on these and other bird species are discussed in Section 5.4.2 below.

Canada Warbler

The Canada Warbler can be found in a wide range of forest types, including deciduous, coniferous, and mixedwood forests. It is often associated with moist mixedwood forest and riparian shrub forests on slopes and ravines (COSEWIC 2008). The presence of a well-developed shrub layer also seems to be associated with preferred Canada Warbler habitat and nests are typically constructed on Sphagnum moss hummocks or among the exposed roots of wind thrown trees. In Nova Scotia nesting begins in early June and most young are fledged by mid-July (Erskine 1992).

Canada Warbler is ranked as “Threatened” on Schedule 1 of SARA and has just recently been designated as Endangered under the Nova Scotia *Endangered Species Act*. Significant declines in the population of this species have been continuing for nearly three decades and although the reasons are not well understood, potential factors for the decline of this species include the loss of habitat in the wintering range (i.e., forests of the northern Andes, primarily Colombia) and the conversion of swamp and forests to agricultural and urban lands in the species’ breeding range. Approximately 80% of the entire breeding range for this warbler is located in Canada (COSEWIC 2008), where it can be found breeding in every province and territory except Newfoundland and Labrador and Nunavut.

Canada Warblers were recorded at six locations during the 2013 survey where they were associated with treed swamp habitats within the large wetland (i.e., WL3) at the southeastern end of the Project Area (Figure 5.3). The area in which the Canada Warblers were encountered will be protected within a 23 ha Wetland Buffer Zone. The majority of wetland area outside of the buffer zone was not observed to have appropriate Canada Warbler habitat and although playbacks were performed in those areas considered to have some potential, no detections were recorded outside of the proposed buffer zone. During the 2011 breeding bird survey this species was both seen and heard singing within potentially appropriate nesting habitat, and it was therefore classified as a “possible” breeder within the Project Area.

Common Nighthawk

The Common Nighthawk is a member of the goatsucker family and is most active at dawn and dusk but also forages during the day and after dark. They are listed as “Threatened” under SARA and COSEWIC, as well as under the Nova Scotia *Endangered Species Act*. Additionally, they have a General Status rank of At Risk within the province (NSDNR 2011) and are ranked “S3B” by the AC CDC (2011), indicating that breeding individuals of this species are uncommon.

Common Nighthawks forage on the wing for high flying insects and nest on the ground in open habitats with little vegetation, such as recent burns and clear-cuts, rocky barrens, rocky

outcrops, grasslands, peat bogs, marshes, dunes, beaches, lake shores and river banks (COSEWIC 2007). BBS data indicate that the Canadian Common Nighthawk population has declined significantly from the early 1980s through to 2000 (BBS 2010). The population has been relatively stable since 2000 at very low levels but the Nova Scotia Common Nighthawk population has generally declined since 1970. Although the exact causes for the decline of this species are not well understood, the decline may be related to the widespread decrease in insect populations upon which this species relies for food (COSEWIC 2007). Other factors that may contribute to the decline of Common Nighthawk populations include loss or modification of breeding habitat such as reforestation of abandoned agricultural land and logged areas, intensive agriculture, forest fire suppression programs and the gradual loss of buildings with gravel covered roofs. Increased predator populations, roadkill and climate change may also be contributing to declines in Common Nighthawk populations.

A Common Nighthawk was heard flying over the Project Area on the evening of the June 19, 2013. This species could potentially nest in the barrens and recent clear-cuts present in the central portion of the Project Area. If quarrying activities do not occur during the nesting season, Common Nighthawks could also potentially establish nests on the floor of the quarry or anywhere where there is little vegetation. Common Nighthawk also has potential to nest in areas of the open / disturbed forests that characterize much of the area surrounding the Project Area. Because this species may be active at relatively far distance from its nesting site (*e.g.*, it often forages at heights of more than 80 m (Brigham 1990; Poulin et al. 1996), and has a home range of over 28 ha in natural areas (Wedgwood 1973)), it was not possible to identify its nesting site during the site visit.

Eastern Wood Pewee

Eastern Wood Pewees are typically associated with deciduous or mixedwood forest although they often nest in ornamental groves, particularly those dominated by elms. They are often associated with forest edges. This species is listed as Vulnerable under the Nova Scotia *Endangered Species Act* and as a species of Special Concern at the federal level (COSEWIC 2012). Furthermore, it is currently provided a rank of Sensitive by NSDNR and AC CDC lists this species as “S3S4B” indicating that it is an uncommon to fairly common breeding bird species in Nova Scotia. BBS data for Canada (CWS 2010) reveals that Eastern Wood Pewee abundance has declined steadily since 1970. The trend for Nova Scotia is different with a rapid decline from 1970 to 1976 followed by slower decline between 1976 and 1989 followed by a period from 1989 until 2009 in which the population was relatively stable. The cause of the decline in Eastern Wood Pewee abundance is poorly understood but is believed to be related to habitat loss.

Eastern Wood Pewee was recorded at one location during the August 2011 survey. The bird was observed in a small clear-cut area in the central portion of the Project Area (Figure 5.3). The interspersion of small harvest plots and remnant mixedwood forest in this area provides potentially suitable breeding habitat for this species and it is therefore possible that one or more pairs of Eastern Wood Pewees could nest in this area. However, this species was not detected during the 2013 breeding survey despite dedicated survey effort for it (i.e., as a follow-up to the

2011 observation), and is therefore not considered to currently utilize the Project Area for breeding purposes.

Gray Jay

Gray Jays are associated with mature coniferous forest habitats. BBS data indicate a gradual decline in the Nova Scotia Gray Jay population since the beginning of the BBS program in 1970. Several factors may be contributing to the decline of Gray Jay populations. Heavy harvesting of mature coniferous forest in Nova Scotia has reduced the amount of available nesting habitat. Climate change may also be affecting Gray Jay populations. Gray Jays are year-round residents of Nova Scotia. In order to survive the winter, Gray Jays cache surplus food items for later consumption. Milder winters result in greater spoilage of these food caches resulting in decreased food availability. NSDNR ranks the Gray Jay as a “Sensitive” species. This species is assessed as uncommon to fairly common (“S3S4”) by AC CDC.

One Gray Jay was observed in the eastern corner of the Project Area during the 2011 field survey (Figure 5.3). This area contains a heavy cover of mature spruce dominated coniferous forest. The eastern third of the Project Area is composed almost entirely of mature coniferous forest that would provide good nesting habitat for this species; this area will be protected within a 23 ha Wetland Buffer Zone.

Boreal Chickadee

Boreal Chickadees are associated mainly with mature coniferous forest habitats. Both mature and immature conifer stands are used; however, older stands typically provide more nesting and winter shelter opportunities in the form of tree cavities as well as better feeding opportunities. BBS data indicates that Boreal Chickadee abundance in Nova Scotia has declined since the late 1960s. Loss of mature coniferous forest habitat as a result of timber harvesting is probably an important factor in the decline of Boreal Chickadee populations in Nova Scotia. NSDNR has ranked this species as a “Sensitive” species. One Boreal Chickadees was observed near the northern boundary of the Project Area during the 2011 field survey and an additional pair was observed in the southern end during 2013 (Figure 5.3), classifying it as a “probable” breeder within the Project Area. The best nesting habitat for this species is present in the eastern third of the Project Area which contains large amounts of contiguous mature coniferous forest that will be protected within a 23 ha Wetland Buffer Zone.

Golden-crowned Kinglet

Golden-crowned Kinglets have been assigned a status of Sensitive by NSDNR and are ranked “S4” by the AC CDC indicating that although they are fairly common throughout their range in the province, they are of long-term concern. BBS data (CWS 2010) indicate that Golden-crowned Kinglet abundance has declined over the past 20 years although abundance is still within ranges present in the 1970s and 1980s. There are concerns that extensive harvesting of softwood forest in recent decades and other factors such as possible reduction in softwood forest cover as a result of climate change could result in substantial long term reductions in the abundance of this species in Nova Scotia.

Golden-crowned Kinglets are typically found in dense coniferous stands of the province where they are year-round residents. Six occurrences of this species were encountered during the 2013 breeding bird survey, all of which were located within the eastern half of the Project Area and associated with coniferous and mixedwood stands (including forested wetlands). This species was typically identified singing within appropriate breeding habitat and was therefore classified as a "possible" breeder within the Project Area.

Killdeer

Killdeers have been assigned a status of Sensitive by NSDNR and a ranking of S3S4B by the AC CDC, indicating that breeding individuals are fairly common within the province. BBS data for Nova Scotia indicate that the Killdeer population has remained relatively stable over the last few decades, although a small overall decline has been observed (CWS 2012).

Killdeers nest on the ground in open disturbed environments such as in open pasture, cultivated fields, or gravel pits. A Killdeer was observed at the edge of the disturbed area of the current quarry operation during the 2013 breeding bird survey and was classified as a possible breeder within the Project Area.

Turkey Vulture

Although historically considered a rare visitor to the regions (Tufts 1986), Turkey Vultures are now known to breed within the southern extent of the province. This species is considered Sensitive by NSDNR and is ranked as S2S3B by the AC CDC, indicating the breeding populations are rare to uncommon. Although observed as a flyover during the 2013 survey, this species did not indicate any evidence of breeding within the immediate vicinity of the Project Area.

Yellow-bellied Flycatcher

Yellow-bellied flycatchers have been assigned a status of Sensitive by NSDNR and a rank of "S3S4" by the AC CDC, indicating that they are uncommon to fairly common throughout their range in the province and are of long-term concern. This species is associated with a variety of habitats, including swamps and damp coniferous woods. Yellow-bellied Flycatcher abundance in Nova Scotia has generally decreased since the mid-1980s.The sensitive ranking assigned to this species by NSDNR is expected to reflect loss of lowland coniferous forest and possible long term loss of coniferous forest habitat as a result of climate change. This species was detected at a number of locations within the southeastern portion of the Project Area where it was associated with wetlands and classified as a "possible" breeder.

Maritime Breeding Bird Survey Data

The Maritimes Breeding Bird Atlas (MBBA) database (MBBA 2012) provides information on the distribution and abundance of birds across the Maritime Provinces of Canada. The Project Area is located in the middle of MBBA square number 19GJ36. The MBBA data collected for this square were used to determine which species may be expected in the Project Area and their breeding status. Both data collected during the first atlas (Erskine 1992) and the second atlas

(MBBA 2012) were used. Processed data was derived from the MBBA web site (MBBA 2012) while point count data collected during the MBBA surveys were obtained from Nature Serve. The breeding status of each species was determined from the criteria used in the MBBA (Erskine 1992). “Possible” breeders are generally those birds that have been observed or heard singing in suitable nesting habitat. “Probable” breeders are those birds that have exhibited any of the following: courtship behavior between a male and female; visiting a probable nest site; displaying agitated behavior; and/or male and female observed together in suitable nesting habitat. “Confirmed” breeders are those birds that exhibited any of the following: nest building or adults carrying nesting materials; distraction display or injury feigning; recently fledged young; occupied nest located; and/or adult observed carrying food or fecal sac for young. In addition, the population status of each bird species identified in the MBBA square was assessed using information from the General Status of Wildlife in Nova Scotia (NSDNR 2010), Species at Risk in Nova Scotia (NSDNR 2007c), and the AC CDC database (AC CDC 2011). The status of nationally rare species was obtained from COSEWIC (2011) unless otherwise noted.

A total of 80 bird species have been recorded in the atlas square in which the Project Area is located and suitable habitat is present in the Project Area for 53 of these species (Table 1, Appendix H). Of the bird species recorded by the MBBA for which suitable nesting habitat is present in the Project Area, the breeding status of 12 has been confirmed, 11 identified as probable, and 28 have been classified as possible. An additional two species have been observed within the breeding bird atlas squares which exhibited no indication of breeding.

The most abundant bird species in the atlas square in descending order of abundance include Song Sparrow (10.9%of all birds recorded during point counts), Common Yellowthroat (7.9%), Alder Flycatcher (7.6%), American Robin (7.1%), Yellow Warbler (6.8%), American Crow (6.3%), Black-capped Chickadee (4.4%), American Goldfinch (4.1%), Magnolia Warbler (3.0%), Common Grackle (3.0%), White-throated Sparrow (2.7%), Chestnut-sided Warbler (2.5%), Yellow-rumped Warbler (2.5%), Black-throated Green Warbler (2.5%), and Ovenbird (2.5%). Together, these species accounted for 74% of all of the birds recorded in the MBBA square. All of these species with the possible exception of Common Grackle are likely to be common species in the Project Area.

Eighteen of the bird species recorded from the MBBA square are listed as species of conservation interest in Nova Scotia. These species include Common Loon, Spotted Sandpiper, Common Nighthawk, Black-billed Cuckoo, Eastern Wood Pewee, Eastern Phoebe, Gray Jay, Tree Swallow, Barn Swallow, Boreal Chickadee, Gray Jay, Golden-crowned Kinglet, Ruby-crowned Kinglet, Wood Thrush, Gray Catbird, Northern Mockingbird, Canada Warbler, Northern Cardinal, Rose-breasted Grosbeak, Bobolink, Brown-headed Cowbird, and Pine Siskin. A comparison of the habitat preferences of these species with the habitat types present in the Project Area suggests that suitable nesting habitat is present for only nine of these species including Common Nighthawk, Eastern Wood Pewee, Tree Swallow, Boreal Chickadee, Gray Jay, Golden-crowned Kinglet, Ruby-crowned Kinglet, Canada Warbler, and Pine Siskin. A description of existing conditions for Common Nighthawk, Eastern Wood Pewee, Boreal Chickadee, Golden-crowned Kinglet, Canada Warbler, and Gray Jay is provided above.

Potential Project-related effects on these and other bird species are discussed in Section 5.4.2 below.

Tree Swallow

Tree Swallows were ranked as a "Sensitive" species in Nova Scotia by NSDNR in 2010. Tree Swallows nest in unoccupied woodpecker holes. They feed largely over lakes, rivers and wetlands containing open water. Their nests are often situated near these foraging sites. The Nova Scotia population has been in decline since the early 1990s.

The Project Area provides marginal nesting habitat for Tree Swallows. Tree cavities are available; however, there is no open water habitat on or near the property. The nearest good foraging habitat would be located along stillwaters on the Chebogue River near the southeastern corner of the property.

Ruby-crowned Kinglet

Ruby-crowned Kinglets have also been recently ranked as "Sensitive" by NSDNR and are given a rank of "S4B" by the AC CDC indicating that they are fairly common throughout their range in the province, but are of long-term concern. For reasons unknown, the population of this species has shown a steady decline in Nova Scotia during the last several decades (CWS 2010). The population for Canada as a whole has remained relatively stable.

Ruby-crowned Kinglets are typically associated with mixedwood and coniferous forest cover types. Suitable nesting habitat for this species is present throughout most of the forested portion of the Project Area with the best habitat present in the eastern half.

Pine Siskin

Pine Siskins typically nest in mature conifer stands or in ornamental conifer plantings. BBS data indicate that this species has undergone a gradual decrease in abundance from the late 1980s to the mid-2000s. Since 2005 there has been a more substantial decline. This species has recently been listed by NSDNR as a Sensitive species.

Potential Pine Siskin nesting habitat is present in the eastern half of the Project Area where mature coniferous forest is present.

AC CDC Modelling

A total of 36 bird species of conservation interest have been recorded within 100 km of the center of the Project Area. Based on the results of the habitat model, there is potential for two of these species, Rusty Blackbird and Long-eared Owl, to be found within the Project Area

Rusty Blackbird

Rusty Blackbirds are listed as a Species of Concern under *SARA*. They are also listed as May be at Risk by NSDNR. BBS data indicate that the Canadian Rusty Blackbird population has declined significantly since the early 1970s although the rate of decline has slowed since the late 1980s. The Nova Scotia population follows a similar trend. Several factors are believed to be responsible for the decline of this species in North America. The most important factor is believed to be the loss of forested wetland wintering habitat along the drainage basin of the Mississippi River. Other contributing causes for the decline are the loss of coniferous treed wetland breeding habitat and mortality of Rusty Blackbirds in blackbird control programs in the United States.

Rusty Blackbirds typically nest in wetlands containing a mixture of coniferous forest, open water and areas of shrub or graminoid cover. Rusty Blackbirds typically construct their nests over or near water. Potential Rusty Blackbird nesting habitat is present in WL3 at the eastern end of the Project Area. This wetland contains large areas of coniferous forest cover and some open water habitat is present in this wetland near the southeastern corner of the property.

Long-eared Owl

The Long-eared Owl is listed as May be at Risk by NSDNR (2010) and is considered to be rare (S2) in Nova Scotia by AC CDC. There is no BBS population data available for this species and population trends are poorly understood. Long-eared Owls are typically active only at night and roost and nest in dense conifer stands. Most foraging occurs in open habitat adjacent to the conifer stands. In the Project Area, there is an area in the center of the property where open habitat in the form of small clear-cuts and barrens habitat is found adjacent to dense conifer stands. It is not clear if these areas would provide good Long-eared Owl foraging habitat since the shrub layer in both the barrens and clear-cut habitats is very dense and may not permit effective hunting by Long-eared Owls.

Mammals

Mammal observations were recorded concurrently with the botanical inventory during August of 2011. The field surveys provide a good indication of the presence of large mammal species in the Project Area. Knowledge of the distribution of small mammals in the Project Area is limited by their secretive nature. Fortunately, many small, rare mammals have very specific habitat requirements which can be used to predict areas where they are likely to be found.

The mammals recorded in the Project Area are generally typical of upland habitats. Evidence of the following species was recorded during the field surveys: red squirrel (*Tamiasciurus hudsonicus*), meadow jumping mouse (*Zapus hudsonianus*), snowshoe hare (*Lepus americanus*), white-tailed deer (*Odocoileus virginianus*), northern racoon (Procyon lotor), and black bear (*Ursus americanus*). None of these species are Red or Yellow listed, or considered “at risk” by provincial or federal sources.

A total of six terrestrial mammal species of conservation interest in Nova Scotia have been recorded within 100 km of the Project Area. Of these, three species are considered "endangered" by the province, including the mainland moose (*Alces americanus*), Canada lynx (*Lynx canadensis*), and American marten (*Martes americana*). These species are also Red listed within Nova Scotia and are assigned an AC CDC ranking of "S1" indicating that they are extremely rare throughout their range. The remaining three species are either yellow listed by NSDNR or are listed as status undetermined. The yellow listed species include southern flying squirrel (*Glaucomys volans*) and eastern pipistrelle (*Perimyotis subflavus*). Hoary bat (*Lasiurus cinereus*) is listed as status undetermined. It is unlikely that the Project Area provides important habitat for any of these species. Given the recent discovery of white nose syndrome in Nova Scotia, it is anticipated that the population status of hibernating bats such as the eastern pipistrelle which are susceptible to this disease will be upgraded.

Moose are commonly associated with wilderness boreal and mixedwood habitats. Their preferred food are the twigs, stems and foliage of young deciduous trees and shrubs, as may be found within forest landscapes recently disturbed by fire, wind, disease or timber harvesting activities. In summer, moose prefer habitats interspersed with wetlands that allow access to submergent and emergent aquatic vegetation and refuge from high temperatures and biting insects. Landscapes which support recently disturbed mixed forests for food and adjacent mature conifer cover for escape and shelter are preferred in winter. The Project Area is located approximately 30 km from two core moose distribution areas, the Tobeatic and the Pubnico (Parker 2003). The closest observation of moose is approximately 23 km away. The Project Area provides marginal moose habitat. Preferred summer feeding and thermal refuge habitats are lacking. Mature coniferous and mixedwood forest is present and it is interspersed with recent clear-cuts; however, preferred forage species are not abundant. No evidence of moose activity was observed during the field surveys. In summary, it is highly unlikely that the Project Area provides habitat for moose.

Within Nova Scotia, Canada lynx live deep in coniferous forests near rocky areas, bogs and swamps. Although the lynx may have historically occupied southern parts of the province, it is now restricted to the Cape Breton Highlands and to areas of higher elevation in central and eastern Cape Breton (Parker 2001). The single AC CDC record of Canada lynx was 66 km from the Project Area and was made in 1978. Due to the absence of this species from southwestern Nova Scotia, it would be unlikely to utilize the Project Area.

American marten prefer habitat containing large contiguous patches of mature softwood or mixedwood forest although mature hardwood forest is used as winter habitat in some portions of their range. In Nova Scotia, two distinct populations have been identified, one in the Cape Breton highlands and one in southwestern Nova Scotia. It is believed that the mainland American marten population is derived from New Brunswick individuals that were released in Kejimkujik National Park, and the current status of this population is considered "data deficient" (Nova Scotia American Marten Recovery Team 2006). The nearest known sighting of this species was made at approximately 22 km from the Project Area. The old growth coniferous

and mixedwood forest habitat preferred by American Marten is not present in the Project Area and it is unlikely that the Project will interact with this species.

Southern flying squirrels are considered sensitive within Nova Scotia and are ranked as “S2S3” by the AC CDC indicating that they are rare to uncommon throughout the province. Within Nova Scotia, they are restricted to southwestern counties where they are typically associated with stands containing large mast bearing red oak that provide suitable foraging and nesting habitat. The closest observation of this species to the Project Area is 72 km away. There is relatively little red oak in the Project Area making it poor southern flying squirrel habitat. Given the distance from the core area of southern flying squirrel distribution in Nova Scotia and the low availability of good habitat within the Project Area, it would not provide important habitat for the this species.

Eastern pipistrelles are considered sensitive within Nova Scotia and are ranked as “S1?” by the AC CDC indicating that they are extremely rare within the province, but that there is some uncertainty regarding their population status. They typically hibernate in cave walls or ceilings where there is minimal airflow. During summer, the sexes live separately; males are often solitary while females form small maternity colonies of 35 individuals or less in buildings, tree cavities, and rock crevices. The eastern pipistrelle forages along forest edges and over ponds and waterways for small insects, such as leafhoppers, ground beetles, flies, small moths, and flying ants. The single AC CDC record of eastern pipistrelle within the Project Area was approximately 80 km from the Project Area. No hibernaculum sites are known in close proximity to the Project Area and the NSDNR Abandoned Mine Openings Database indicates that there are no unfilled abandoned underground mine openings within 8 km (NSDNR 2009). Although the Project Area could provide some minor foraging opportunities for eastern pipistrelles during the summer, it is not likely that the Project will have an important interaction with this species due to its distance from known or potential hibernaculum sites.

Hoary bats are listed as status undetermined in Nova Scotia largely due to the fact that it is very difficult to assess the abundance of this species. Hoary bats occur irregularly in Nova Scotia and it is likely that this species reaches the northeastern limit of its range here. Hoary bats typically roost in either coniferous or deciduous trees usually near the edge of a clearing. They prefer to forage over water bodies and open areas such as meadows. The central portion of the Project Area contains a number of small clear-cuts interspersed with forest that could potentially provide suitable roosting and nursery habitat. The clear-cuts could potentially offer some feeding opportunities although better foraging habitat is probably present to the south of the Project Area along the Chebogue River. Hoary bats are migratory and are present in Nova Scotia only during the summer months. At this time the sexes are segregated. Males tend to wander over the landscape and unlike other bat species females do not form natal colonies or roost together. As such, this species is diffusely spread over the landscape. Females typically carry their offspring with them except for a period of several weeks when they are too large to carry, at which time the young are cached while the female forages. Given the habitat preferences of this species, it is possible that it could occur in the Project Area. However, if it were present it would likely occur in very low numbers and may not be present every year.

A review of the NSDNR significant habitat mapping database (NSDNR 2007b) did not reveal the presence of any rare or sensitive mammal species within the Project Area or critical habitat such as deer wintering areas. In addition, all of the habitats present within the Project Area are commonly encountered throughout the province and are unlikely to provide habitat for rare small mammal species.

Herpetiles

Information regarding amphibians and reptiles within the Project Area was also collected during the field surveys. Field surveys were conducted concurrently with the botanical inventory during August of 2011.

Six herpetile species were encountered during the surveys, including four amphibians and two reptiles. All amphibians were observed within the wetlands of the Project Area and include yellow-spotted salamander (*Ambystoma maculatum*), spring peeper (*Pseudacris crucifer*), green frog (*Rana clamitans*), and wood frog (*Rana sylvatica*). The two reptile species observed included common garter snake (Thamnophis sirtalis) and northern painted turtle (Chysemys picta). The populations of all of the herpetiles observed within the Project Area are considered secure within the province and are ranked as “S5” by the AC CDC indicating that they are common.

A review of the AC CDC data search and *Amphibians and Reptiles of Nova Scotia* (Gilhen 1984) indicate that three rare herpetiles, Blanding's turtle (*Emydoidea blandingii*), wood turtle (*Glyptemys insculpta*), and the Atlantic population of the eastern ribbon snake (*Thamnophis sauritus* pop. 3) have been recorded within a 100 km radius of the Project Area. All of these herpetiles are considered “species at risk” by both COSEWIC and the Province of Nova Scotia.

Blanding’s turtle is listed as endangered under both SARA and the Nova Scotia *Endangered Species Act.* In addition, it is Red-listed by NSDNR and ranked as “S1” by the AC CDC indicating that they are extremely rare within the province. This species is typically found in still-water streams, swamps, marshes and bogs in south central Nova Scotia. Blanding’s turtles prefer water bodies with slow flowing water and muddy bottoms that support dense aquatic vegetation. Between early June and early July female Blanding’s turtles move to gravelly or sandy lake shores to lay their eggs. In the fall, Blanding’s turtles move to aquatic habitats where they hibernate underwater. The nearest known record of Blanding’s turtle is approximately 50 km from the current Project Area. Although the Project Area contains 10 wetlands and several drainage channels, the surface water characteristics of these habitats are not ideal for Blanding’s turtle. Although some summer foraging and hibernation habitat could be provided by the slow-moving portions of the watercourse in WL3 (Figure 5.1), there are no lakes in the Project Area that would provide suitable beach nesting sites. The Project Area is also located outside of the known range of Blanding’s turtle which is restricted to the Mersey and Medway watersheds (The Blanding’s Turtle Recovery Team 2003). As such, it is unlikely that this species would be found within the Project Area.

Wood turtles are considered threatened under SARA, vulnerable under the Nova Scotia *Endangered Species Act*, are ranked as S3 (uncommon) by the AC CDC, and are regarded as sensitive (*i.e.*, Yellow listed) by NSDNR. The nearest known record of wood turtle is approximately 63 km from the Project Area. Wood turtles are typically associated with watercourses and the riparian habitats associated with them. They nest on sandy or gravelly river banks but will also make use of features such as sand pits and road embankments near water courses that provide a sandy or gravelly substrate. Deep pools in larger rivers are often used as hibernaculum sites during the winter. Riparian habitats along watercourses are typically used as feeding sites. Despite the presence watercourses within the Project Area, the presence of wood turtles is considered unlikely. The lack of sandy banks along the watercourses limits nesting opportunities for the wood turtle and the shallow water depths are not suitable for hibernaculum sites. Furthermore, they have not been recorded within the Tusket River Watershed, within which the Project Area is located (MacGregor and Elderkin 2003).

The eastern ribbon snake is listed as a threatened species under SARA and the Nova Scotia *Endangered Species Act*. In addition, it is regarded as sensitive by NSDNR and is assigned a ranking of “S2S3” by the AC CDC indicating that it is rare to uncommon within the province. This species is associated with sluggish streams, marshes, swamps, bogs and lake shores and are typically found within 30 m of open water. They prefer areas that have a heavy cover of aquatic vegetation that provides cover for them and the amphibians and small fish that they feed on. The nearest known record of eastern ribbon snake is approximately 100 km from the Project Area. Marginal northern ribbon snake habitat is present in WL3 at the eastern end of the Project Area. However, the Project Area is located outside of the known range of eastern ribbon snake in Nova Scotia and as such the probability that this species is present is very low (Smith 2002).

5.4.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

A number of activities (*i.e.*, clearing, grubbing, topsoil stripping, blasting, and rock) associated with the Project could interact with wildlife. Potential effects on wildlife include habitat loss, fragmentation and noise and related disturbance due to the presence of humans.

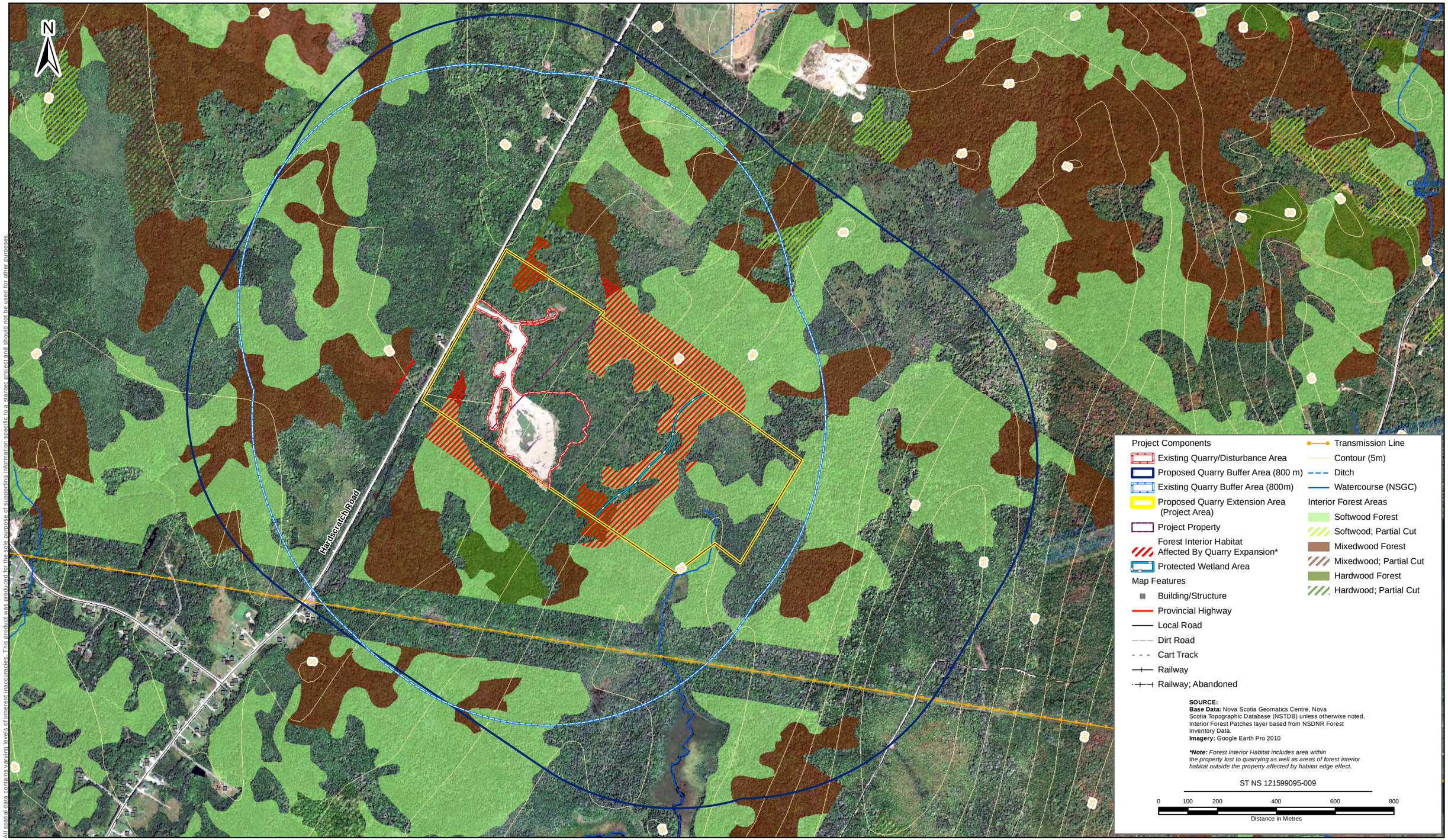
Developments resulting in the removal of wildlife habitat and/or the introduction of noise, visual and olfactory stimuli have the potential to fragment natural habitats. Fragmentation is the partitioning of habitat into discrete units, where some mechanism (*e.g.*, human presence) impedes or prevents the exchange of wildlife between habitat units. Fragmented wildlife populations have a lowered effective population number and are therefore more susceptible to decline or extirpation. Species with limited dispersal capabilities are generally most susceptible to habitat fragmentation. However, habitat fragmentation can also affect highly mobile animals such as birds. During the breeding season some species may be reluctant to cross clearings causing populations to be isolated in resultant habitat fragments. Studies of bird use of forest patches in agricultural areas by the CWS in Quebec found that bird movement between patches decreased with increasing distance between patches (CWS Undated). Physical isolation of a population combined with the deleterious environmental effects of edge may eliminate species in habitat fragments.

The proposed quarry will contribute to local habitat fragmentation while it is operational. There will be little vegetation in the quarry, which will make it difficult for wildlife, particularly small mammals and some insects, to move from one side of the quarry to the other due to lack of cover and increased risk of predation. These effects will be partially mitigated through the phasing of stripping/grubbing activities and the implementation of a progressive rehabilitation process as described in Section 2.7. The protection of approximately 23 ha of undisturbed lands within the Wetland Buffer Zone, including interior forest areas, will also reduce potential habitat fragmentation effects.

Forest interior birds are particularly sensitive to habitat loss since they are affected both by direct habitat loss and through the adverse effects of habitat edge. Forest interior habitat for the purpose of this report is defined as mature forest that is free of edge and is greater than 10 ha in size (D. Busby, pers. comm. 2006). The distribution of mature forest habitat in the forest interior assessment area was determined using NSDNR forest inventory mapping. The area used for the forest interior assessment included an area extending 800 m on either side of the Lafarge property. The amount of forest interior habitat in the forest interior assessment area was determined by establishing 100 m buffers around edge-producing features such as existing highways and streets, electrical transmission lines, heavily disturbed non-forested habitat, borrow pits, quarries, woods roads, recent clear-cuts and large areas of recent wind throw. Areas remaining after buffering these features were classed as forest interior habitat if their tree canopies were greater than 10 m in height and the forest stands were 10 ha or greater in size.

Five patches of forest interior habitat are present in the forest interior assessment area with a total area of 248 ha. The total area of forest interior habitat within the Lafarge property (*i.e.*, Project Area) is 21.5 ha. Forest interior habitat is scattered throughout the forest interior assessment area (Figure 5.4). The proposed quarry expansion impinges upon the largest of the five patches of interior forest. If it is assumed that all of the Project Area north of the 23 ha Wetland Buffer Zone (eastern third of the property) will be quarried, the total amount of forest interior habitat lost as a result of quarry expansion will be 22.5 ha. This is 9.07% of the 248 ha of forest interior habitat present in the forest interior assessment area. The area lost not only includes the forest interior habitat that will be directly lost to Project-related physical disturbance, but also includes intact mature forest that is located outside of the Project Area and in the Wetland Buffer Zone and will be affected by habitat edge effects associated with quarry development (see Figure 5.4). Given the configuration of the property, the final shape of the quarry will be almost square. This shape will help to reduce the loss of forest interior habitat since the amount of edge effect produced is much smaller in a round or square shaped areas than in a linear or irregularly shaped area.

Human presence and noise during quarrying activities may discourage wildlife species from using habitats in close proximity to the quarry while quarrying activities are ongoing. Since the quarry has been operational for seven years (*i.e.*, since 2005), it is unlikely that species particularly sensitive to human activities are currently present in close proximity to the quarry site.



PREPARED BY: R. Sutcliffe	Lafarge Hardscratch Quarry	FIGURE NO.: 5.4
REVIEWED BY: K. Fraser	**Interior Forest Areas**	DATE: Sep 05, 2013
LAFARGE		Stantec

Path: V:\1215\active\121510xxx\121510876_ea_lafarge\geomatics\mapping\mxd\report\ST NS-121510876-009_interior forest_20120305.mxd

Limited direct mortality of some small wildlife, such as rodents, shrews and herpetiles, is likely to occur during certain activities associated with quarry development such as clearing and grubbing. Small animals tend to stay in close proximity to cover when exposed to high noise levels, making them vulnerable to injury and death due to heavy equipment during site clearing and grubbing. Large and medium sized mammals are unlikely to suffer direct mortality from clearing activities as they would flee the area in response to human presence and noise. Such avoidance behaviour by mammals could result in changes in normal movements, migrations and other life history processes. Displaced wildlife species would disperse to adjacent suitable habitat; however, if those habitats are already occupied by that species or a species with a similar niche, the addition of new individuals could result in greater competition for resources and increased levels of mortality as a result of that competition or increased predation. Any avoidance behaviour and associated wildlife displacement effects are expected to be limited and highly localized since the quarry has been operational for many years and species particularly sensitive to human activities would have already left the area.

Some wildlife, such as herpetiles, American black bear, raccoon, striped skunk, and various rodents hibernate or go through prolonged periods of sleep during the winter months. An animal disturbed during periods of extended winter inactivity may die from exposure or subsequent starvation due to expenditure of energy. Therefore, wildlife species in winter sleep are sensitive to disturbance during construction activities.

Adult birds are unlikely to be killed or injured during construction activities as they would flee the area when exposed to human activity in close proximity. Such avoidance behaviour by adult birds could result in changes in normal movements, migrations and other life history processes. The impacts of such avoidance behaviour would be temporary, as birds would likely return to adjacent habitats after construction is complete provided that this habitat is not already fully occupied by that species or a species with a similar niche.

The nesting season is generally the most critical life history stage for birds, since eggs and nestlings cannot move from a source of disturbance. While most bird species construct nests in trees and shrubs, a number of species of birds nest at ground level (*e.g.*, Common Nighthawk, Killdeer), and some species may nest in burrows in stockpiles of soil or the banks of pits (*e.g.*, Bank Swallows). Eggs and nestlings located in areas to be cleared would likely be destroyed. Potential adverse effects due to noise on bird breeding may also result in abandonment of the nest or increased rates of predation and exposure of hatchlings and eggs during temporary abandonment.

Migratory birds are protected under the *Migratory Birds Convention Act* (MBCA). As such, it is illegal to kill migratory bird species not listed as game birds or destroy their eggs or young. Other bird species not protected under the federal Act, such as raptors, are protected under the provincial *Wildlife Act*. In order to avoid contravening these regulations, clearing, grubbing and stripping of areas to be used for the Project will be preferentially conducted outside of the breeding season of most bird species (May 1 to August 31) so that the eggs and flightless young of birds are not inadvertently destroyed. It is anticipated that proper quarry planning will

allow the Proponent to conduct clearing well outside the bird breeding period, which should provide adequate protection for migratory birds. However, in the unlikely case that this is not possible, the Proponent will review the best practical mitigation measures with the Canadian Wildlife Service (CWS). At a minimum, if complete avoidance of these activities during the specified timeframe is not feasible, nest surveys will be undertaken by a qualified biologist and avoidance buffers will be established around active nests.

The field surveys revealed the presence of three Species at Risk, including Canada Warbler, Common Nighthawk, and Eastern Wood Pewee, and six additional Species of Conservation Concern: Boreal Chickadee, Golden-crowned Kinglet, Killdeer, Turkey Vulture, Yellow-bellied Flycatcher, and Gray Jay. Habitat modeling exercises using the MBBA and AC CDC data for the area indicate that there is potential for another Species at Risk, Rusty Blackbird, to inhabit the area as well as four additional Species of Conservation Interest: Long-eared Owl, Tree Swallow, Ruby-crowned Kinglet, and Pine Siskin.

Canada Warbler is considered to be a possible breeder within the Project Area and was found to be restricted to WL3. Although not encountered during field surveys, this same wetland contains potential habitat for Rusty Blackbird. The Proponent has committed to not developing a 23 ha parcel of undisturbed land that comprises the eastern third of the Project Area and contains this wetland (Figure 5.1). As such, the best nesting habitat for these species will be preserved. Preservation of WL3 and surrounding coniferous forest habitat would also benefit a number of the less sensitive bird species of conservation interest that have been recorded in the Project Area or could potentially nest there, including Boreal Chickadee, Gray Jay, Golden-crowned Kinglet, Yellow-bellied Flycatcher, Ruby-crowned Kinglet, and Pine Siskin, all of which nest in mature coniferous forest.

Long-eared Owls require coniferous forest for nesting. The best potential nesting habitat for this species is present in and around WL3 which will be preserved.

Common Nighthawks and Killdeers nest in open essentially unvegetated habitat. As the quarry is developed, the amount of suitable nesting habitat in the Project Area for these species will increase. Therefore, disturbance of active nests has the greatest potential to adversely effect these species should they utilize the Project Area for breeding purposes. Although observations from the 2013 breeding bird survey indicate Killdeer are currently likely to utilize the Project Area for breeding, Common Nighthawk could be using disturbed areas located remote from active portions of the quarry. The current presence of Killdeers within close proximity to the current quarry operations indicate that this species is somewhat tolerant of the range of disturbance activities that are likely to continue at the site.

The field surveys did not reveal the presence of any rare or sensitive mammal or herpetile species within the Project Area. The AC CDC modeling exercise indicated that there was a small possibility that hoary bat may make use of the Project Area. The Project Area is not expected to provide particularly valuable habitat for this species. Clearing of vegetation outside of the breeding season for birds which will be used to minimize potential for contravention of the

Migratory Birds Convention Act will also minimize potential for adverse effects of the Project on hoary bats since this species is not present in the winter.

The habitats present in the Project Area are common throughout the province and are unlikely to provide habitat for rare small mammal species. No critical areas for mammals such as deer wintering areas or critical herpetile habitats are known to exist within the Project Area.

In summary, assuming application of the mitigation measures described above (*e.g.*, protection of a 23 ha Wetland Buffer Zone encompassing WL3 and conducting clearing, grubbing and stripping activities outside of the breeding season for most birds to facilitate compliance with MBCA), significant Project-related effects on wildlife are not likely to occur.

5.5 WETLANDS

5.5.1 Description of Existing Conditions

Ten wetlands are found at least partially within the Project Area (Figure 5.1 and Table 5.2), all of which are swamps as recognized by the Canadian Wetland Classification System (Warner and Rubec 1997). Three of these wetlands (WLs 3, 6 and 7) were partially depicted by the NSDNR Wetland Atlas or NSGC mapping. The remaining wetlands were previously unmapped and were identified and delineated during field surveys conducted August 30-31, 2011. Field surveys determined that the 10 wetlands located at least partially on-site comprise a total of 14.56 ha of wetland habitat within the 65 ha Project Area. Most of the wetlands are less than 2 ha in total size and only three wetlands (WL3, WL5 and WL7) have more than 1 ha located within the Project Area. As shown on Figure 5.1 and in Table 5.2, approximately 73% of the total on-site wetland area (*i.e.*, 10.7 ha), including WL3, will be protected within a 23 ha Wetland Buffer Zone occupying the eastern third of the Project Area. The wetlands to be protected within this zone include the largest and most ecologically important WL3 (refer to Section 5.5.2).

Swamps are mineral wetlands or peatlands with standing water or water flowing slowly through pools or channels. The water table is generally at or near the surface of the swamp. There is internal water movement from the margin of the swamp or from other sources of mineral enriched waters. If peat is present, it consists mainly of well-decomposed wood, underlain at times by sedge peat. The vegetation typically consists of a dense cover of trees or shrubs, herbs and some mosses.

Table 5.2 Wetlands within the Project Area and Information on their Class, Form, Vegetation Type and Size

Wetland #	Class and Form(s)	Vegetation Type(s)	Size of Wetland Areas		
			Within Project Area (ha)	Protected Within Wetland Buffer Zone (ha)	Outside of Project Area (ha)
1	Basin swamp	Mixed treed	0.02	0.02	Unknown*
2	Drainageway swamp	Deciduous treed	0.18	0.18	0.09
3	Drainageway swamp/basin bog	Mixed treed /coniferous treed	10.48	10.48	Unknown*
4	Drainageway swamp	Mixed treed / tall shrub	0.02	0.02	Unknown*
5	Basin swamp	Mixed treed	1.54	0.00	0.00
6	Drainageway swamp	Mixed treed	0.60	0.00	0.00
7	Drainageway swamp	Mixed treed / graminoid	1.32	0.00	0.00
8	Drainageway swamp	Mixed treed / graminoid	0.32	0.00	0.04
9	Basin swamp	Mixed treed / graminoid	0.08	0.00	0.00
10	Basin swamp	Mixed treed	0.55	0.00	0.00
Total Areas			**14.56**	**10.7**	**Unknown**

* The full extent of WLs 1, 3, and 4 outside of the Project Area were not delineated during field surveys.

Wetland Forms and Hydrological Character

The swamps found within the Project Area include basin and drainageway forms (Table 5.3), as identified in the Canadian Wetland Classification System. Basin swamps occur in topographically defined basins where the water is derived locally and by drainage from other parts of the watershed. Drainageway swamps have a sloping surface and are found in confined drainageways or water tracks. Water movement is generally as unilateral sheet flow but intermittent channels are often present. WL3 is a wetland complex comprised of two wetland classes, swamp and bog. Distinguishing individual wetland classes and forms within such complexes is often challenging as a result of their gradation and interspersion. As such, the wetland classes and forms presented in Table 5.3, are meant to help convey the general hydrological and physical character of the wetlands, but are not necessarily identified in the field as discrete units.

Surface water cover within the wetlands was generally low (< 5 %) and confined to small pools (<5 m^2), such as may be found in basins or along drainage channels running through the swamps. Swamps can vary substantially in the degree to which they are exposed to water level fluctuations. Swamps located along the margins of rivers, particularly large rivers may be subject to very large water level fluctuations. The species that live in these swamps must be capable of surviving weeks under water. Other swamps located near the headwater positions of watersheds are characterized by small fluctuations in water level. Water level fluctuations in these swamps can be expected to be greater than encountered in bogs but far less than what is encountered in lotic swamps or marshes. The swamps present in the Project Area are situated in headwater positions and are typically not subject to large water level fluctuations. The vegetation characteristic of these wetlands is tolerant of saturated conditions but is not tolerant of large fluctuations of water levels. As such, these wetlands are sensitive to anthropogenic alterations of wetland hydrology.

Vegetative Character

Vegetation types are derived from those outlined by the Canadian Wetland Classification System and is based on the general physiognomy of the dominant vegetation. Those identified within the Project Area include mixed treed, coniferous treed, deciduous treed, tall shrub, and graminoid vegetation types. Wetland types are identified by combining these with wetland class and form (*e.g.,* mixed treed basin swamp). Many of the wetlands within the Project Area are considered wetland complexes due to having multiple forms and/or vegetation types.

Most swamps in the Project Area are mixed treed swamps. These swamps have a moderately dense tree canopy formed predominantly by black spruce, red maple, balsam fir, and American larch. These tree species are also important contributors to a moderately dense shrub layer, along with bristly dewberry, sheep-laurel, mountain holly, and black holly. Herbaceous cover is primarily provided by graminoids and ferns, particularly three-seed sedge, manna-grass and cinnamon fern. Peatmoss coverage is extensive throughout this habitat.

The one deciduous treed swamp in the Project Area (WL2) is dominated by an overstory comprised predominantly of red maple, with lesser amounts of American larch, balsam fir and black spruce being present. Shrub coverage is minimal and includes scattered patches of stunted balsam fir and red maple. Herbaceous coverage is primarily comprised of ferns, particularly eastern hay-scented fern and cinnamon fern. This habitat-type has a moderately well- developed moss layer comprised of a mixture of peatmoss and hair-cap moss. Graminoids are common in this wetland type including manna grass, sedge (*Carex gynandra*) and soft rush.

Tall shrub dominated swamp is present along a small portion of the southern boundary of the Project Area (WL4). This wetland vegetation type is characterized by a moderately dense tall shrub canopy that is composed mainly of speckled alder, mountain holly, western poison ivy, and possum-haw viburnum. The ground vegetation layer consists of a continuous peatmoss carpet that is punctuated by patches of cinnamon fern, three-seed sedge and manna grass.

Graminoid dominated swamp is present in the western half of the Project Area in wetlands that have had their hydrology altered by anthropogenic activities (WLs 6, 7 and 9). This wetland vegetation type typically consists of small to medium sized inclusions of graminoid dominated vegetation that have developed in areas where the overstory tree cover has been killed or thinned as a result of fluctuating water levels. Dominant species usually include manna grass, soft rush, blue-joint reedgrass, and cottongrass bulrush.

Coniferous treed bog was present in the center of the largest wetland in the Project Area (WL3). This wetland vegetation type is characterized by a moderately dense cover of stunted black spruce, American larch and red maple along with a dense cover of shrubs including sheep laurel, black huckleberry and mountain holly. Peatmoss and cinnamon fern are the dominant species of the ground vegetation layer. Other common species of the ground vegetation layer include tawny cotton-grass, three-leaf Solomon’s-plume, blue-joint reedgrass, and whorled aster.

Two of the five plant species of conservation interest encountered during the field surveys were associated with wetlands. Southern twayblade was observed within the eastern extent of WL3 and will be protected by the Wetland Buffer Zone that is being established in this area. One of two populations of woods-rush was found in a ditch in WL10 which forms the northern boundary of this wetland.

The wetlands support several species with moderate to strong Atlantic coastal plain affinity (*Glyceria obtusa, Ilex glabra, Photina pyrifolia, Toxicodendron radicans, Juncus subcaudatus, and Thelypteris simulata*). These vascular plants are diagnostic indicators of wet Atlantic coastal plain flora. Many species of Atlantic coastal plain flora, particularly the rarer species, are generally associated with open wetland ecosystem types (rather than those with well-established tree canopies) due to being poor competitors with other plants and being somewhat dependent on disturbance processes. As such, the ability of the treed wetlands within the Project Area to provide habitat for the more sensitive elements of the Atlantic coastal plain flora can be expected to be low. Interestingly, the most sensitive Atlantic coastal plain species in a wetland in the Project Area (woods-rush in WL10) was found in a disturbed portion of the wetland.

Human Influences and Socio-Economic Value

Anthropogenic factors have had an important influence on the character of about half of the wetlands in the Project Area. Several wetlands (WLs 5, 6, 7, 9, and 10) have been disturbed in some way by anthropogenic activities. Much of WL5 has been subjected to timber harvesting and the hydrology of this wetland appears to have been altered as a result of road construction. Evidence of hydrological alteration included the presence of more standing water than is normally encountered in treed wetlands and the presence of many dead and dying trees in the tree canopy.

WL6 has been partially infilled as a result of past quarrying operations. A review of the NSDNR Wetland Inventory mapping indicates that WL6 and WL7 were once part of the same wetland. Infilling has resulted in this larger wetland being divided into two. Deposition of mud between the two halves has resulted in alteration of wetland hydrology. The mud deposit has impounded water in what is now WL7 resulting in mortality of some overstory trees and development of graminoid dominated plant communities at various locations under the thinned canopy. The vegetation in WL6 which is downstream of WL7 does not appear to have been noticeably altered. The mud deposits between WL6 and WL7 may reduce the amount of water flowing into WL6 possibly resulting in drier conditions.

It appears that WL9 and WL10 were once one wetland. Construction of a road through the wetland resulted in the physical separation of WL9 from WL10. WL9 which is located upslope of WL10 appears to have had its hydrology altered as a result of the road acting as a dam. The impounding of water in WL9 has resulted in partial mortality of overstory trees and the establishment of graminoid dominated plant communities. On the positive side, the impoundment of water, particularly along the road has created good amphibian breeding

habitat. This has also occurred in WL7. The presence of the road separating WL9 and WL10 has also created habitat for woods-rush.

Apart from providing a source of merchantable wood, most of the swamps have little socio-economic value. No evidence of recreational use within the wetlands was observed within the Project Area during the field surveys. Three wetlands (WL1, WL3 and WL4) appear to be part of a much larger wetland that extends north and south of the Project Area.

Hydrological and Biogeochemical Functions

The swamps are moderately important for providing hydrological and biogeochemical functions. They contribute to surface water flow regulation by slowly releasing their stored water during dry periods, thereby augmenting the flow of watercourses. They may also help to reduce flooding by acting as a reservoir and by slowing surface flow when water levels are high. Some of the swamps may also help improve local water quality. In particular, WL6 and WL7 receive some surface water flow from the margins of the quarry. Sediments or other contaminants carried by the surface waters could be retained within the swamps. Although wetlands are known to be quite efficient at removing sediment and metals from surface water, they are generally poor at retaining hydrocarbons, sodium and chloride ions. The ability of the swamps to provide such functions varies with their size and form. For example, WL3 would be relatively important for providing hydrological and biogeochemical functions as a result of its large size and connectedness to other wetlands, waterbodies, and watercourses via the small streams that drain it. In contrast, many of the smaller basin swamps (WLs 2, 8, and 9) would have much less value for providing these functions.

Habitat Functions

In general, the swamps are moderately important for providing habitat for wildlife. However, their ability to support a diversity of wildlife varies with their size and the availability of appropriate microhabitats, such as those formed by the pooling of surface water. The habitat value of many of the wetlands is somewhat limited by their relatively small sizes (refer to Table 5.2 above) and wooded swamps often provide similar bird and mammal habitat to adjacent upland forested areas. As such, the majority of bird species recorded during the field surveys can be expected to utilize wetland habitats in the Project Area. Although lacking in open wetland environments that could support waterfowl and other waterbirds, the forested wetlands in the Project Area do provide habitat for a number of songbirds that are of conservation interest. In particular, numerous Canada Warblers, a bird that is a federally and provincially designated Species at Risk, were recorded in WL3 along with a number of other Species of Conservation Concern, including Yellow-bellied Flycatcher, Boreal Chickadee, and Golden-crowned Kinglet.

All six of the mammal species recorded in the Project Area can be expected to make use of both the treed swamp and upland habitat. For some species such as black bear, the wetland habitat is of particular importance since it provides early spring food sources such as sedge shoots and thermal cover during hot weather in the summer.

Treed swamps provide good habitat for both amphibian and reptile species; however, this habitat is typically not as productive as marsh or lentic or lotic swamps where there is high interspersion of vegetation and open water. The limited amount of open water habitat in most treed swamps in the Project Area limits the abundance of herpetiles. Highest herpetile productivity in the Project Area was typically associated with disturbed portions of the treed swamps where impoundment increased the availability of pools.

Plant species richness in treed swamps in Nova Scotia is a function of wetland size, structural heterogeneity and fertility. Large fertile wetlands containing a variety of landform features such as pools, seepage areas and a mixture of mineral and peat substrates will typically have the greatest species richness. Wetlands in the Project Area are infertile, mostly small in size and occupy simple basins or drainageways. Consequently, these wetlands are characterized by low species richness. Wetlands in the Project Area provide habitat or potential habitat for several plant species of conservation interest. Woods-rush, a species classed as Sensitive by NSDNR was found in a disturbed portion of WL10.

5.5.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

In Nova Scotia, wetlands are protected under the Nova Scotia Wetland Conservation Policy (NSE 2011) as well as the Activities Designation Regulations made pursuant to the provincial *Environment Act*. Any loss of wetland habitat either through direct infilling or indirectly through alteration of wetland hydrology requires preparation of a wetland evaluation to establish the functional attributes of the wetland. Wetland alteration also requires proponent application and regulatory approval prior to alteration. Approval will be sought progressively as the quarrying area expands, and applications will be submitted at least six months prior to any quarrying activity occurring that may impact wetland habitat. The regional NSE Compliance Environmental Monitoring and Compliance (EMC) office in Yarmouth will be consulted regarding their application timing requirements. If NSE grants approval to infill or alter the hydrology of any wetland in the Project Area, it will be necessary to develop a compensation plan to replace the wetland functions lost as a result of damage to or loss of the wetland.

Due to the nature of quarry activities, complete avoidance of wetlands within the Project Area is not possible. Without mitigation, the Project could potentially result in the complete or partial loss of the 10 wetlands located within the Project extension area over the duration of the Project. However, in consideration of the presence of extensive wetland habitat at the eastern end of the Project Area, the Project footprint has been revised to reduce the loss and degradation of wetlands. Lafarge has committed to preserving approximately one third of the eastern end of the Project Area as a 23 ha Wetland Buffer Zone in which no quarrying or development will occur. This buffer zone will protect approximately 73% of the wetland habitat present within the Project Area; it contains all or part of wetlands WL1 to WL4, as well as watercourse WC-1, and the surrounding terrestrial habitat.

WL3 is the largest and most ecologically important wetland in the Project Area. This wetland, along with WL4 and possibly WL1, is part of a much larger wetland complex that, through a

hydrological connection with WC-1, forms the headwaters of the Chebogue River. WL3 is known to support bird and plant species of conservation interest (*e.g.*, Canada Warbler and southern twayblade). Preservation of this wetland would substantially reduce the potential adverse effects of the Project on wetland habitat and socio-economic functions.

WL10 contains a small population of woods-rush that would be lost if WL10 is subject to quarrying. However, woods-rush is only present in anthropogenic pools in the Project Area. Given that the species is associated with anthropogenic habitats that have developed as a result of quarrying activities, the Project is considered unlikely to result in a net loss of suitable habitat.

Outside of the Wetland Buffer Zone (*i.e.*, in the portion of the Project Area that will be subject to development and operation of the extended quarry), 30 m buffers will be maintained from all wetlands that will not be altered.

The establishment of the aforementioned Wetland Buffer Zone and 30 m buffers , coupled with on-site wetland compensation initiatives (discussed below) will greatly reduce impacts of the Project on wetland functions.

One option for compensation is to enhance, restore, or create wetland habitat on-site. The quarry floor can be used as sites for constructed wetlands. Ideally, rock would be removed to the water table to provide a source of water for the constructed wetlands. On-site compensation should be completed at the same time as wetland alteration, as the substrate of the altered wetland can be collected and used as a substrate and seed bank for the newly created habitat. This will only be feasible if the quarried out areas are not required for stockpiles or other operational components.

Another compensation opportunity could involve creating off-site wetland habitat. In particular, there are large wetlands to the north (Beaverdam Meadows) and south (Chebogue Meadows) of the Project Area that are currently being managed by Ducks Unlimited Canada (DUC). There are likely opportunities to provide support to DUC to further enhance these large wetlands, or increase the functioning of these wetlands. Preservation of wetlands WL1, WL3, and WL4 would help to maintain the ecological integrity of the Chebogue Meadows wetland complex of which these wetlands are a part.

Existing wetlands could also be indirectly influenced by the Project through changes in hydrology, nutrients, or sediment input. However, mitigative measures will be taken during Project activities to maintain existing flows into the wetlands and to prevent inputs of nutrients, or sediments. This will be accomplished through the application of best management practices to maintain hydrology and control erosion and sedimentation, including the use of flow retention structures and energy dissipation measures.

In summary, assuming the application of proposed mitigation measures, including maintaining existing site drainage conditions (except for wetlands to directly affected by Project activities), preservation of wetlands in the eastern third of the Project Area, and providing compensation for

loss of wetland functions, significant Project-related effects on wetland functional attributes are not likely to occur.

5.6 GROUNDWATER RESOURCES

5.6.1 Description of Existing Conditions

Groundwater is an integral component of the hydrologic cycle that originates from the infiltration of precipitation or surface water into the ground. This infiltrating water fills voids between individual grains in unconsolidated materials and fills fractures and other void spaces which have developed in consolidated materials. Within the sub-surface, the upper surface of the saturated zone is called the water table. Where the water table intersects the ground surface, interaction between groundwater and surface water can occur. In general, groundwater flows through soil and bedrock from areas of high elevation (recharge areas) to areas of low elevation (discharge areas) where it discharges from the sub-surface to springs, streams, and lakes. There is a dynamic interaction between groundwater resources and surface water resources in Nova Scotia. Groundwater generally sustains the base flow streams and wetlands during dry periods of the year. More rarely, surface water bodies can contribute to groundwater storage under specific hydrogeological conditions.

An aquifer is a geological formation or group of formations that can store or yield useable volumes of groundwater to wells or springs. The yield of dug or drilled water wells can vary greatly, depending on the hydraulic properties of overburden or bedrock aquifers into which the wells are constructed. Within an aquifer, the natural groundwater quality is directly influenced by the geochemical composition of the sub-surface materials through which the water passes, and the time the water resides within those materials. Groundwater resources are a VEC because they provides potable water supply to approximately half of the population of Nova Scotia, including almost all un-serviced rural residences.

Spatial boundaries for the assessment of groundwater resources are based on a combination of the locations of the known aquifers relative to the Project, aquifer hydraulic properties, expected groundwater flow directions, and the distance between the proposed quarry extension and wells that may be affected by quarry activities. For example, the area of influence or capture area of a typical low yield domestic water well is generally less than about 100 m, and generally in a direction hydraulically up-gradient of the well. A quarry that is excavated below the local water table is analogous to a large well, and groundwater discharging into the quarry would influence water levels by immediately surrounding the excavation to a distance proportional to the size of the quarry.

Project-related contamination (*e.g.,* accidental petroleum hydrocarbon spills from machinery or blasting chemicals) (*i.e.,* fuel oil and nitrate) could theoretically impact the groundwater at the quarry and potentially affect well water quality down gradient of the Project. However, most potential hazards should be contained within the quarry dewatering system and an Environmental Emergency Response Plan is in place in the event of an accident or malfunction.

Vibration damage to a drilled or dug well is generally a function of the distance between the energy source and the receptor well, and the seismic properties of the intervening subsurface materials. With respect to rock type, the risk of water well damage is greater for fractured crystalline bedrock than for overburden wells or soft bedrock (*e.g.,* sandstone or shale) wells. Based on experience, the risk from blasting or major excavation is considered to be greatest within 50 m, moderate from 50 to 200 m, and minimal beyond about 200 m.

Vibration effects caused by blasting are conservatively considered for drilled wells within 800 m of the proposed quarry extension (*i.e.,* the minimum distance from structures allowed for blasting without owner permission specified by the NSE Pit and Quarry Guidelines). Potential effects of accidental spills are considered for all wells located hydraulically down gradient of the proposed quarry extension. The extent of the area potentially affected is dependent on the size and type of release, surface drainage patterns and surficial geology, and can generally extend 200 m in sand and gravel, and typically up to 50 m in less permeable till.

The following discussion of the local groundwater resources and hydrogeology in the vicinity of the Project is based on a desktop study using available mapping and databases, and does not include any water well inspection, groundwater sampling and analysis, or groundwater depth measurements. One well is known to be present on-site within the Project Area (*i.e.*, on the quarry property); however, specific well types and locations have not been confirmed in the field.

Physiography and Drainage

The Project Area is rectangular in shape with its longest dimension (approximately 1,230 m) extending northwest to southeast. The Project Area is approximately 580 m wide (northeast to southwest) at its widest point. Figure 5.1 shows the present and proposed extended quarry outline with the 800 m assessment boundary, along with local topography, watercourses, wetlands and water bodies within in the Project Area.

The topography of the Project Area generally slopes downward towards the southeast, towards a series of wetlands associated with the Chebogue River Meadows. Based on available topographic mapping for the areas, the ground surface elevation in the Project Area ranges from approximately 35 m to 60 m above mean sea level.

The Project Area is located within the Tusket River Watershed, which can be further divided into a number of smaller drainage basins. The Project Area is situated near the headwaters of the Chebogue River drainage basin. Drainage from the Project Area is inferred to be to the southeast, towards a stream and a series of interconnected wetlands identified near, and intersecting, the southeast edge of the site. These water bodies discharge to wetlands associated with Chebogue River Meadows, which in turn drain to Churchills Mill Lake, the Chebogue River and ultimately, Chebogue Harbour.

Surficial Geology

Based on the available surficial geology mapping for the area (Stea *et al.* 1992), surficial soils in the Project Area (refer to Figure 5.5) consists of stony till (ground moraine) derived during the last glaciation, as well as post-glacial organic deposits. Stony till plain or ground moraine deposits can be described as stony, sandy soil derived from local bedrock sources and deposited as material was released from the bottom of melting ice sheets. The variation in thickness of till across the Project Area is unknown; however, based on a water well record for the existing quarry operation located on the northwest side of the Project Area, overburden thickness was reported to be 3 m (refer to NSE 100075, Table 5.3), and mapping for the surrounding area suggests a range in till thickness of 2 to 20 m in the surrounding area. The post-glacial surficial organic deposits, present in the vicinity of the Project Area, were developed over time by the infilling of ponds and watercourses by vegetation. These organic deposits consist of sphagnum moss, peat, gyttja (a fine-grained, nutrient-rich organic mud or peat deposited in lakes and ponds) and clay. The thickness of organic deposits in the Project Area is unknown.

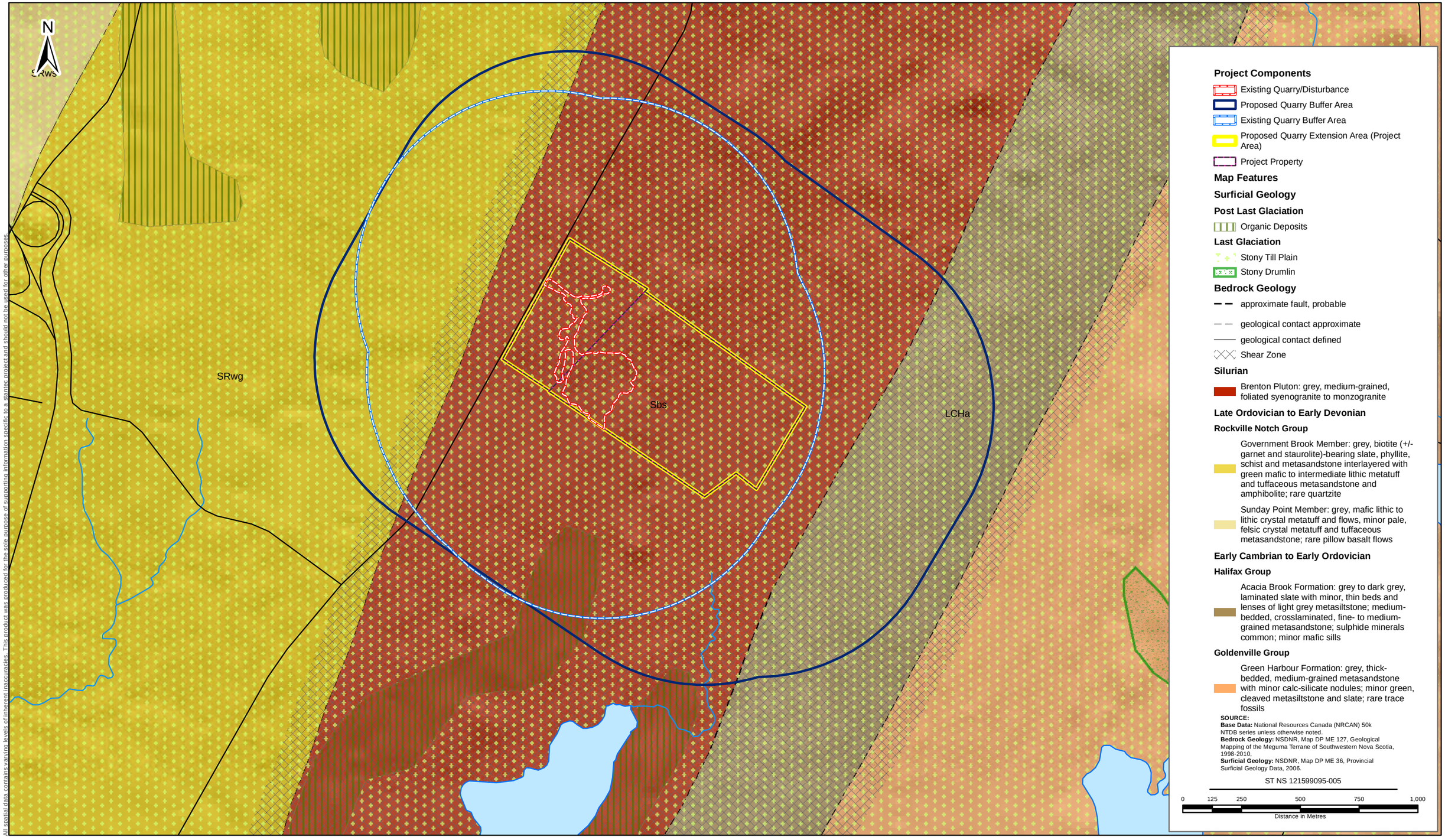
Bedrock Geology

The Project Area is underlain by a Silurian aged plutonic granite unit consisting of grey, medium-grained, foliated syenogranite to monzogranite (NSDNR 2012a; refer to Figure 5.5). Porter (1982) describes the granitic bedrock as granite, granodiorite, quartz and diorite, all displaying variations in texture and composition, but generally grey in colour with biotite and smaller amounts of muscovite.

Directly west of the Project Area is the Rockville Notch Group, which consists of shallow-marine sedimentary rocks (quartzite, metasiltstone, and slate) with hetereogeneously distributed interlayered mafic and felsic volcanic rocks (White *et al*. 2012). The Government Brook Member of this Group is associated with the White Rock Formation (MacDonald 2000), which overlies the Meguma Group and is typified by siltstones, conglomerates, silty shales and dark shales (Porter 1982).

East of the Project Area, older Cambrian-Ordovician aged fractured crystalline rocks are found, including the Acacia Brook Formation of the Halifax Group and the Green Harbour Formation of the Goldenville Group. White *et al.* (2012) describe the Acacia Brook Formation in southwestern Nova Scotia as consisting mainly of grey to dark-grey, laminated slate with minor thin beds, lenses of light-grey metasiltstone, and thicker beds of cross-laminated fine-to-medium-grained metasandstone. The Green Harbour Formation is the most extensive formation in the southeastern part of the Meguma terrane and is dominated by grey, thick-bedded, medium-grained metasandstone, locally interbedded with minor green, cleaved metasiltstone, and rare rusty-weathering black slate (White *et al*. 2012).

Bedrock contacts between the Brenton Pluton and the Government Brook Member and older Acacia Brook formation, respectively, are shown to be located within the 800 m buffer area for the proposed quarry extension.



All spatial data contains varying levels of inherent inaccuracies. This product was produced for the sole purpose of supporting information specific to a Stantec project and should not be used for other purposes.

Project Components

- Existing Quarry/Disturbance
- Proposed Quarry Buffer Area
- Existing Quarry Buffer Area
- Proposed Quarry Extension Area (Project Area)
- Project Property

Map Features

Surficial Geology

Post Last Glaciation

- Organic Deposits

Last Glaciation

- Stony Till Plain
- Stony Drumlin

Bedrock Geology

- approximate fault, probable
- geological contact approximate
- geological contact defined
- Shear Zone

Silurian

- Brenton Pluton: grey, medium-grained, foliated syenogranite to monzogranite

Late Ordovician to Early Devonian

Rockville Notch Group

- Government Brook Member: grey, biotite (+/- garnet and staurolite)-bearing slate, phyllite, schist and metasandstone interlayered with green mafic to intermediate lithic metatuff and tuffaceous metasandstone and amphibolite; rare quartzite
- Sunday Point Member: grey, mafic lithic to lithic crystal metatuff and flows, minor pale, felsic crystal metatuff and tuffaceous metasandstone; rare pillow basalt flows

Early Cambrian to Early Ordovician

Halifax Group

- Acacia Brook Formation: grey to dark grey, laminated slate with minor, thin beds and lenses of light grey metasiltstone; medium-bedded, crosslaminated, fine- to medium-grained metasandstone; sulphide minerals common; minor mafic sills

Goldenville Group

- Green Harbour Formation: grey, thick-bedded, medium-grained metasandstone with minor calc-silicate nodules; minor green, cleaved metasiltstone and slate; rare trace fossils

SOURCE:
Base Data: National Resources Canada (NRCAN) 50k NTDB series unless otherwise noted.
Bedrock Geology: NSDNR, Map DP ME 127, Geological Mapping of the Meguma Terrane of Southwestern Nova Scotia, 1998-2010.
Surficial Geology: NSDNR, Map DP ME 36, Provincial Surficial Geology Data, 2006.

ST NS 121599095-005

0 125 250 500 750 1,000
Distance in Metres

PREPARED BY: R. Sutcliffe	Lafarge Hardscratch Quarry	FIGURE NO.: 5.5
REVIEWED BY: K. Fraser	**Bedrock and Surficial Geology**	DATE: Sep 05, 2013
LAFARGE		Stantec

Path: V:\1215\active\121510xxx\121510876_ea_lafarge\geomatics\mapping\mxd\report\ST NS-121510876-005_bedrockgeology_20120305.mxd

Hydrogeology/Groundwater

Based solely on a review of topography, the inferred direction of shallow groundwater flow in the Project Area is anticipated to be south and/or southeast, towards a series of interconnected wetlands which discharge southward, in turn to Churchills Mill Lake, the Chebogue River, and Chebogue Harbour. Topographic features in the surrounding area suggest the presence of a two local drainage divides: one immediately northwest of the Project Area (coinciding approximately with Hardscratch Road); and, one lying east of the Project Area, between the Project Area and Mood Road.

A review of available mapping information was conducted to determine the probable locations of water wells within 800 m of the Project Area. This review included:

- identification of reported water wells within 2 km of the Project Area using the NSDNR Interactive Groundwater Map in conjunction with the NSE Well Drillers Database for any wells constructed between 1967 and 2010. Information reviewed included location, construction details, yields, *etc.* Where possible, water well records were matched to property ownership information obtained using the Service Nova Scotia (SNS) and Municipal Relations' Property Online database; and,

- identification of developed residential or commercial properties within 2 km of the Project Area using the SNS Property Online database, for which no water well records was recorded in either the NSDNR Interactive Groundwater Map in conjunction with the NSE Well Drillers Database. Figure 2.1 shows the locations of buildings in the vicinity of the Project Area. In rural areas, it can generally be assumed that each residence, agricultural or commercial property has a dug or drilled water supply well.

Water well records were retrieved for a total of eleven domestic supply wells identified within a 2 km radius of the Project Area, primarily along Hardscratch Road and Tinkham Road. One of the eleven wells identified is located at the existing quarry site, within the boundaries of the Project Area. No other wells were identified within 800 m of the Project Area; however, at least two residential properties are located within 800 m (as identified using the SNS Property Online database). Although no water well records were identified using the NSDNR Interactive Groundwater Map and/or the NSE Well Drillers Database, it is likely that these two properties would obtain water from a drilled water supply well. As required in the Pit and Quarry Guidelines (NSE 1999), a pre-blast survey will be undertaken for all structures within 800 m of the point of blast. This survey will be conducted in accordance with NSE's "Procedure for Conducting a Pre-Blast Survey".

Table 5.3, presents a summary of the available well log information for the eleven drilled wells identified within the vicinity of the Project Area using the NSDNR Interactive Groundwater Map and the NSE Well Drillers Database. The approximate locations of the two residences identified within 800 m of the Project Area, for which no water well records were located (1687 and 1515 Hardscratch Road) are shown on Figure 5.2, along with the approximate location of the water

well within the Project Area, on the existing quarry site (NSE 100075 located at 1546 Hardscratch Road).

Table 5.3 Summary of Domestic Water Well Records within 2 km of Project Area

	Well Depth (m)	Casing Length (m)	Estimated Yield (lgpm)	Hydro-stratigraphic Unit	Overburden Thickness (m)	Estimated Distance from Project Area
NSE 000812 – 58 Main Shore Road (drilled January 14, 2000)	38.1	12.2	35.0	Granite	5.5	1.5 km
NSE 051610 – 244 Tinkham Road (drilled June 8, 2005)	38.1	7.9	4.0	Unspecified bedrock	6.7	1.8 km
NSE 060996 – 1293 Hardscratch Road (drilled November 16, 2006)	19.8	6.1	30.0	Slate	1.2	1 km
NSE 060998 – 1932 Hardscratch Road (drilled November 22, 2006)	38.1	6.1	4.3	Granite	3.7	1.7 km
NSE 070374 – 1132 Hardscratch Road (drilled December 18, 2007)	38.1	23.5	5.0	Unspecified bedrock	22.6	1.7 km
NSE 100075 – 1546 Hardscratch Road (drilled April 20, 2010)	44.2	6.1	3.0	Granite	3.0	0 km
NSE 870646 – No civic address listed (drilled July 17, 1987)	38.1	26.5	1.2	Granite	5.5	1.7 km*
NSE 890833 – No civic address listed (drilled June 30, 1989)	19.8	6.1	6.0	Granite	4.6	1.7 km*
NSE 901126 – No civic address listed (drilled September 6, 1990)	35.1	7.9	4.0	Granite	6.1	1.7 km*
NSE 911454 – No civic address listed (drilled June 28, 1991)	13.1	6.1	8.0	Slate	1.2	0.8 km
NSE 921681 – No civic address listed (drilled August 6, 1992)	39.6	12.8	6.0	Quartzite	9.8	1.5 km
Minimum	*13.1*	*6.1*	*1.2*	-	*3.6*	
Maximum	*44.2*	*26.5*	*35.0*	-	*19.8*	
Average	*32.9*	*11.0*	*9.7*	-	*5.6*	

Notes: Information was obtained from the Well Log Database including wells constructed between 1967 and early 2010. lgpm = imperial gallons per minute; m = metres; NSE = Nova Scotia Environment Well Log Reference No.; Estimated distance from Project Area based on well locations provided on the NSDNR Interactive Groundwater Map; * indicates that these three well records are associated with a single location on the NSDNR Interactive Groundwater Map

As noted, there is potential for drilled water supply wells to be located on developed residential properties associated with civic numbers 1687 and 1515 Hardscratch Road. Both of these properties are located within 800 m of the Project Area; however most likely locations for any potential domestic water supply wells at these locations are inferred to be hydraulically up-gradient to cross-gradient of the Project Area. No other wells were identified within 800 m of the Project Area, with the exception of a well located on the existing quarry site (NSE 100075

located at 1546 Hardscratch Road). This well is reportedly 44.2 m deep, having 6.1 m of 158 mm diameter steel casing and an estimated air-lift yield of 3 Igpm. According to the well driller's log, this well has approximately 3.0 m of overburden consisting of clay and boulders (inferred till) and is completed in granite bedrock. In general, for wells completed in this area, the average yields are expected to be low (generally less than 10 Igpm).

A review of the NSE Pumping Test Database for Yarmouth County revealed pumping test information for five wells drilled between 1977 and 1978 completed in the granite aquifer. The average yields for these wells ranged from 5 to 100 Igpm, mean 26 Igpm, with interpreted pumping well transmissivities ranging 1 to 24 cubic m^3/day/metre drawdown, mean 6 m^3/day/m and 20 year safe yields ranging 3.5 to 78 Igpm, mean 21 Igpm.

Water Quality

The water quality potential is determined from known water quality characteristics for each hydrostratigraphic unit, including naturally occurring water quality concerns such as hardness, arsenic, uranium, salinity, iron and manganese.

Porter (1982) completed a regional water resources study in 1979 which included collection and analysis of 24 groundwater samples from wells distributed across southwestern Nova Scotia to gain an understanding of the groundwater quality from the major hydrostratigraphic units. The following characterizes the expected water quality for the granite unit and the Goldenville Formation. Too few samples were collected from the adjacent Halifax and White Rock formations to allow meaningful interpretation (Porter 1982). Considering the Project Area and extension area is underlain by the Middle-Ordovician granite unit, the following provides a summary of the expected groundwater quality for this unit, along with Goldenville Formation.

Wells completed in granite appear to produce calcium and sodium chloride to calcium and sodium bicarbonate type groundwater. Iron concentrations generally range from 0.03 to 3.1 mg/L (mean, 0.62 mg/L), manganese concentrations have been found to range 0.04 to 1.4 mg/L (mean, 0.1 mg/L), hardness concentrations generally range from 3.5 to 330 mg/L (mean, 36 mg/L). Alkalinity concentrations range from 19 to 146 mg/L (mean, 60 mg/L), TDS concentrations range from 60 to 803 mg/L (mean, 147 mg/L) and pH ranges 6.1 to 8.4 (mean, 7.1). Based on general knowledge of the groundwater chemistry for granite units in Nova Scotia, the granite can exceed drinking water quality guidelines for iron, manganese, uranium, arsenic and fluoride, and generally displays a naturally low pH.

Wells completed in the Goldenville Formation can be expected to produce calcium bicarbonate to calcium sulfate type groundwater of generally good chemical quality. Iron concentrations typically range from 0.03 to 1.1 mg/L (mean, 0.34 mg/L) and manganese concentrations typically range from 0.01 to 0.44 mg/L (mean, 0.19 mg/L). Hardness is low to moderate and generally ranges from 35 to 275 mg/L (mean, 84 mg/L). Total dissolved solids (TDS) concentrations typically range from 103 to 491 mg/L (mean, 191 mg/L) and alkalinity concentrations range from 40 to 132 mg/L (mean, 66 mg/L). The pH generally ranges from 5.2

to 8.2 (mean, 7.4). Goldenville bedrock can locally exceed drinking water quality guidelines for arsenic, iron and manganese.

5.6.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

The potential environmental effects on surrounding groundwater resources from a quarry operation include: groundwater table lowering close to the quarry's high wall, depressurization of down-gradient springs, temporary siltation of nearby wells due to intermittent blasting or heavy equipment operation, decrease in well yield due to groundwater level lowering or interception of recharging bedrock fractures, and possible water quality deterioration at down-gradient wells from accidental releases of deleterious substances such as petroleum hydrocarbons or acidic drainage production if a mineralized zone is encountered within the quarry area. Potential impacts to domestic water wells are a function of distance, relative location of a well and the quarry with respect to groundwater flow directions, depth of excavation below the water table, intensity and frequency of blasting, individual well construction methods, and individual depth of well.

Water Quantity Effects

In most hard rock quarry operations, overland flow into the open pit is controlled by perimeter drainage measures. Groundwater inflow from perched sources in overburden and shallow bedrock, and from deeper water-bearing bedrock fractures which may intersect the pit walls, typically form only a small percentage of the total water "make" of the open pit. In low permeability bedrock environments (as is the case for the Project Area), the majority of water discharge from an open pit mine originates from rainfall accumulation within the footprint of the open pit. If the quarry encounters increased groundwater seepage as it is extended, this groundwater will collect with any rainfall accumulation within its lowest point (*e.g.,* a settling pond or sump). Depending on the floor elevation, rainfall amounts, time of year and groundwater conditions, dewatering of the proposed quarry extension may be required.

Based on a review of available well driller's logs and property information in the vicinity of the Project Area, it is expected that residential properties to the west, north and south along Hardscratch Road, to the south and southwest along Tinkham Road, and to the east along Mood Road obtain potable water supplies to meet domestic needs from drilled wells. Although no well driller's logs were retrieved for residences located at 1515 and 1687 Hardscratch Road (the nearest developed residential properties to the Project Area), for the purpose of this groundwater assessment, it has been assumed domestic water wells are located on these properties.

Drilled wells along Hardscratch Road, to the north, south and west of the existing quarry and proposed extension area are inferred to be hydraulically up-gradient to cross-gradient of the Project. Groundwater quantity effects are not anticipated at these locations, with the exception of the wells potentially located at 1515 Hardscratch Road, which is located immediately across Hardscratch Road from the extension area (less than 50 m from the Project boundary), and at 1687 Hardscratch Road, which is located approximately 500 m from the north Project boundary.

The presence and/or absence of a well at both 1687 and 1515 Hardscratch Road will be confirmed by the Proponent during the process of conducting a pre-blast survey of all structures located within 800 m of the Project Area. No well-related complaints have been received with respect to current operations at the existing Hardscratch Quarry.

Groundwater quantity effects are not anticipated at drilled wells outside of the 800 m buffer due to a combination of the distance of these wells from the quarry operations, and the occurrence of inferred hydraulic barriers present to the east and west of the Project Area.

Water Quality Effects

Changes in groundwater quality at wells adjacent to and hydraulically down-gradient of the quarry may theoretically occur as a result of excavations in the recharge area. Potential impacts include: temporary siltation, oil and nitrate from blasting operations, lubricant compounds, and other chemical releases within the quarry area that could migrate outwards through fractured bedrock (if no dewatering is occurring to control local gradients). A further possible long-term impact on well water quality is decreased pH or increased dissolved solids and metals from the attenuation of acidic drainage from exposed sulfide-rich bedrock.

Acid rock drainage is the result of exposure to sulphide rich rocks to oxidizing environments such as rainwater. Earthwork activities around these sulphide rich rocks can increase the rock's exposure and thus the acid generation potential. Not all sulphide-containing rocks end up producing acid drainage. In many cases, rocks contain enough carbonate minerals to buffer the sulphide effect, and in these instances acid rock drainage is not produced. In Nova Scotia, acid rock drainage is most commonly associated with slate from the Halifax Formation of the Meguma Group and coal bearing shales. Bedrock underlying the Project Area consists of Silurian granite. In general, massive granite is not known to be a significant acid drainage risk.

Mitigation of Effects

There are no plans to excavate rock below the water table, which is expected to largely mitigate the potential for groundwater quantity effects.

Based on the separation distance between the quarry and the majority of nearby water wells, the presence of intervening hydraulic barriers (*e.g.,* interconnected wetlands near the south corner of the Project Area, the presence of drainage and/or flow divides to the east and west), the likelihood of a water quality or quantity effects on receptor domestic water supply wells from this quarry operation is considered to be very low, except in the case of the existing on-site quarry well and the nearest potential off-site water wells located at 1687 and 1515 Hardscratch Road. The close proximity of these wells, along with the low anticipated well yields (reported well yield of 3 Igpm for the existing quarry well), it is recommended that the Proponent conduct groundwater sampling and confirm water levels in these three wells, in advance of the extension to establish baseline conditions.

In the event of adverse water level lowering due to quarry operations, mitigation measures would involve deepening of the well or provision of additional in-house storage capacity to provide more well yield and/or peak water storage. Mitigation of short-term turbidity impacts which may be caused by blasting vibration would likely involve temporary provision of bottled water to affected residents, or provision of an in-line dirt filter. In the unlikely event of persisting long-term degraded water quality, or a well yield loss event (*e.g.,* well collapse), the Poponent should replace or repair any water supply well found to be adversely affected by their quarry operation to the satisfaction of the owner.

In summary, assuming the application of proposed mitigation measures, significant Project-related effects on groundwater resources are not likely to occur.

Monitoring

If domestic supply wells are confirmed at 1687 and 1515 Hardscratch Road, groundwater monitoring wells should be installed immediately west and north of the quarry extension (between the quarry area and the domestic wells at these two locations) to establish baseline groundwater quality and water level conditions in advance of the extension. It is also recommended that baseline groundwater sampling and static water level measurements be taken in the existing quarry well at that time. Monitoring of groundwater levels adjacent to the quarry extension should continue as the operation proceeds. All groundwater monitoring wells should be constructed to resemble a typical residential water supply well, and should be incorporated into the existing Lafarge Quarry environmental monitoring system. The wells should be periodically measured for water level, pH and other water quality parameters.

5.7 ARCHAEOLOGICAL AND HERITAGE RESOURCES

5.7.1 Description of the Existing Environment

For the purposes of this assessment, archaeological and heritage resources are defined as physical remains that inform us of the human use of and interaction with the physical environment. These resources may be above or below the surface of the ground and cover the earliest Pre-Contact times to the relatively recent past.

Heritage resources are generally considered to include historic period sites such as cemeteries, heritage buildings and sites, monuments, and areas of significance to First Nations or other groups. Pre-Contact refers to the time before the arrival of non-Aboriginal peoples.

The assessment of heritage resource potential within the proposed extension area incorporated sources that included archaeological site records at the Nova Scotia Museum and archival resources.

Background research was conducted using the records at the Public Archives of Nova Scotia, the Nova Scotia Museum, as well as those available on the Internet.

Background Research

The background research found very little information on the Project Area. The Mi'kmaq were a major presence along the coast and river systems of the Yarmouth area, particularly the Tusket River system. There were no documents found that referred to a Mi'kmaq presence within the Project Area. The first European settlements in the Yarmouth area were the Acadians who arrived after 1685 (Campbell 1876). The Acadians settled around the marshes of the coast and rivers and prospered in several areas such as Chebogue and Chegoggin until the Deportation in 1755 there was no evidence found that suggested the Acadians settled within or near the Project Area, however. The expulsion of the Acadians created a great deal of ungranted land and, in 1761; these were filled by new, English-speaking settlers, the majority of whom were from New England (Campbell 1876). However, no evidence was found of early English settlement within or near the Project Area, and there is no evidence of roads in the general area until well into the nineteenth century. Settlement continued to be centered around the coast or along other waterways, which were the principal means of transportation. The arrival of the Loyalists in 1784 had a profound effect on Nova Scotia and Yarmouth was no exception. The major Loyalist settlement in the province was Shelburne, but this new settlement declined extremely rapidly and many of those who abandoned it made their way to Yarmouth in 1785, many settling in Tusket (Campbell 1876). The Loyalists were also able to prosper on the former Acadian lands and the Town of Yarmouth grew rapidly into the nineteenth century. By 1855 there was a road built that travelled just south of Lake George, approximately 4.5 km north of the Project Area, east to the Kemptville area. The most significant event to occur close to the Project area was the building of the Western Counties Railway, which ran from Yarmouth to Digby, beginning in 1879 (Significant Dates in NS's Railway History 1998). The railway passed just north of the Project Area and there was a station in Ohio, approximately 2.5 km to the north. While the railway would have stimulated settlement in the area at the end of the nineteenth century, no evidence was found for any settlement within the Project Area.

Recorded Archaeological Sites

First Nations

There are no recorded archaeological sites within the Project Area. The closest recorded First Nation's archaeological site is AlDm-08, located on Harris Lake, approximately 4.5 km southeast of the Project Area. The site was from Woodland-period and consisted of artifacts collected by amateurs along the shores of the lake. There are also sites recorded on the Tusket River, in North Chegoggin, and on Butler Lake.

Historic

There are no recorded historic archaeological sites within the Project Area.

Archaeological Potential

First Nations

In general, the potential for an area to contain First Nation's archaeological resources is tied to proximity to water. Lake and river systems not only provided food and water to the Mi'kmaq but were used for traveling between the coast and the interior. As mentioned above, there are no watercourses within the Project Area, and no other resources that would have attracted settlement, so the potential for First Nation's archaeological resources is considered low.

Historic

There was no evidence of historic settlement within the Project Area and the potential for historic archaeological resources is be considered low.

Pedestrian Field Survey

On July 4, 2013, a qualified Stantec archaeologist conducted a pedestrian field survey of the proposed Project Area under Heritage Research Permit A2013NS053. The survey covered the north, west, and central sections of the Project Area, which all surround the existing quarry. The southeast section, which contains the majority of the wetlands as well as the one minor watercourse, will be protected as a Wetland Buffer Zone. This area was examined briefly. A small section of the north corner that abuts Hardscratch Road consists of a hardwood forest. The southwest corner of the survey area is a relatively open mixedwood forest with damp, hummocky terrain and has a gradual slope to the southeast. There are large clear-cut areas in the south central and northeast sections of the survey area. The terrain is relatively high and dry. There are six smaller wetlands (WL5 to WL10) found within the non-buffered portion of the Project Area as well as two small drainage channels (DC-1 and DC-2) (Figure 5.1).

The pedestrian survey began within the Wetland Buffer Zone because it is the area with the highest potential for containing First Nation's archaeological resources due to the presence of the only watercourse on the Project property. It was decided to survey this area, even though it will not be directly impacted by the Project, in order to confirm the overall archaeological potential for the Project Area. The terrain sloped southeast from the central clear-cut area to the buffer zone. The ground became quite rocky and the vegetation changed to young trees and fern groundcover. The area became very wet and difficult to navigate, but it was easy to conclude that the archaeological potential was very low and that the watercourse was not substantial enough to significantly raise the archaeological potential of the area.

Given the lack of a major watercourse, the survey moved up to the northwest with a view at determining if there was any more potential for First Nation's on the relatively high and dry terrain and to determine if there was any historic archaeological potential. The survey of the remainder of the Project Area found no topographic features that would have been exploited by the Mi'kmaq (e.g., high areas overlooking a hunting area). It is possible the Mi'kmaq hunted in the area in the past, but what little material evidence of this that would be left behind (if any) was

not observable on the surface of the ground. The remainder of the survey also failed to find any evidence of historic settlement activity within the Project Area that was not related to the relatively recent clear-cutting activity. There were no roads observed, no changes in vegetation that would have suggested old fields, and no introduced fruit trees that may have hinted at settlement activities. The search for historic archaeological resources concentrated in the area adjacent to Hardscratch Road, which would have been the most likely place for someone to have built a house, but nothing resembling a foundation was observed.

Summary

The background research found no evidence of First Nation's or historic settlement within the Project Area. The purpose of the pedestrian field survey was to locate physical evidence of First Nation's and historic archaeological resources as well as to ground-truth the conclusion that the archaeological potential for the Project Area should be considered low. The field survey found no major watercourses within the Project Area that could have been used by the Mi'kmaq for transportation, fishing, and hunting, which could have been the basis for settlement in the area. It is considerably more likely that the Mi'kmaq chose to concentrate their settlements along the Annis and Tusket River systems where much more abundant food resources were available and there was relatively easy canoe access between the coast to the interior. The survey also failed to find any physical evidence of any First Nation's or historic archaeological resources within the Project Area.

This study concludes that the archaeological potential within the Project Area should be considered as low and that the proposed Project should proceed as planned without the need for further archaeology.

5.7.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

Certain activities associated with the Project (*i.e.,* blasting, road construction), could affect archaeological or heritage sites if they were present within the zone of surficial and subsurface disturbance. These disturbances, if unmitigated, could result in the loss of resources and the potential knowledge to be gained from its interpretation.

The Project Area has low potential for identifiable human use in the pre-Contact and low potential for identifiable human use in the historic periods. It is assumed that no areas beyond the Project Area will be disturbed during the development and operation of the proposed quarry extension. The development and operation of the proposed quarry is unlikely to have adverse environmental effects on unknown heritage resources and it is recommended that no further archaeology is required.

If archaeological or heritage resources are discovered during development and operation of the Project, the find will be immediately reported to the Curator of Archaeology at the Nova Scotia Museum and the Manager Special Places, Heritage Division. If the resources are thought to belong to First Nations, the Chief of the nearest Mi'kmaq band (Acadia First Nation) will also be

contacted. The appropriate authorities will determine further actions to be undertaken which could include avoidance and further assessment.

In summary, it is recommended that no further archaeological work is necessary because of the low potential or archaeological and heritage resources; significant Project-related effects on unknown resources are not likely to occur.

5.8 ATMOSPHERIC ENVIRONMENT

The Atmospheric Environment VEC examines issues related to potential Project effects on air quality and sound quality.

5.8.1 Description of Existing Conditions

Air Quality

The Project Area and Nova Scotia in general, has good air quality due to the combination of maritime climate and relatively small population and industrial bases (NSDOE 1998). Climatic conditions provide good dispersion of air contaminants. The ambient air quality also benefits from the infusion of relatively clean polar and arctic air masses. Occasionally, however, long-range transport of air masses from central Canada or the eastern seaboard may transfer contaminants into the area, causing occasions of poorer air quality.

Ambient air quality is monitored in Nova Scotia with a network of 13 sites, operated by NSE and Environment Canada. Motor vehicles, electrical power generation, pulp and paper processing and oil refining are the major local sources of air pollutants in the province Common air pollutants monitored regularly are SO_2, total particulate matter (TPM), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), particulate matter less than 10 microns in diameter (PM_{10}), carbon monoxide (CO), ground-level ozone (O_3), nitrogen dioxide (NO_2), hydrogen sulphide (H_2S) and total reduced sulphur (TRS). The closest NSE monitoring site to the Project site is located in Yarmouth at the Yarmouth Weather Office. In 2005 and 2006 ozone (O_3) was the only contaminant measured. The annual average for 2005 and 2006 was 27 ppb (Environment Canada 2008).

In June of 2009 the Government of Nova Scotia, in collaboration with Environment Canada and other non-government organizations, introduced a new air quality health tool, the Air Quality Health Index (AQHI), in four communities in Nova Scotia, Halifax, Greenwood, Kentville and Sydney. It is intended that the AQHI will also be available in Port Hawkesbury and Pictou at a later date. The AQHI measures the current levels of outdoor air pollution and related human health risks using a scale of 1 to 10 representing low to very high risk levels. Three air pollutants are measured in order to calculate the AQHI and include ground-level ozone (O_3), particulate matter ($PM_{2.5}$) and nitrogen dioxide (NO_2) (Government of Nova Scotia 2009). The closest community to the Project that has this program implemented is Greenwood and the current air quality levels can be viewed online at Environment Canada.

The quarry is located in a rural setting with little industrial development nearby. It is not anticipated that the common air pollutants are exceeded at the quarry location due to the separation distance from any large urban centre. Limited residential development can be found within 1 km of the site.

Ambient air quality in Nova Scotia is regulated by the provincial government. The federal government has set objectives for air quality, which are taken into account by federal agencies in a project review. These objectives form the basis for the air quality regulations of several provinces, including Nova Scotia. The Nova Scotia regulated limits correspond to the upper limit of the Maximum Acceptable category for air quality, which are set under the Canadian Environmental Protection Act (CEPA). Air quality guidelines of tolerable, acceptable, and desirable are defined under CEPA. The maximum tolerable level denotes a concentration beyond which appropriate action is required to protect the health of the general population. The maximum acceptable level is intended to provide protection against effects on soil, water, vegetation, visibility, and human wellbeing. The maximum desirable level is the long-term goal for air quality. Additional guidelines are under development by the Canadian Council of Ministers of the Environment (CCME), and ultimately this body will develop Canada-Wide Standards that harmonize the regulations in all jurisdictions.

Sound Quality

The sound quality surrounding the Project is of a concern due to the potential for Project related noise emissions to have an effect on sensitive receptors in close proximity to the Project Area. Noise is defined as unwanted sound and is measured as a sound pressure level (SPL) in decibels. To reflect the sensitivity of the human ear across the audio spectrum, SPL readings are sometimes given in what is termed as the “A” weighted scale and denoted as dBA.

Humans are exposed to a broad range of sound pressure levels. A level of 0 dBA is the least perceptible sound by a human. A change in 3 dBA represents a physical doubling of the SPL but is barely perceptible as a change, whereas most people clearly notice a change of 5 dBA and perceive a change of 10 dBA as a doubling of the sound level. Typically, conversation occurs in the range of 50 to 60 dBA. Loud equipment and trucks passing on a busy road are responsible for noise levels above 85 dBA. Very quiet environments, such as a still night, typically fall below 40 dBA.

The sound quality in an area can be degraded by the presence of unwanted sound (*i.e.,* noise). For the most part noise is a nuisance that detracts from the enjoyment of a quiet acoustic environment. In severe cases noise can cause sleep disturbance, anxiety and consequent health effects. It can also disturb wildlife and wildlife habitat.

The existing ambient sound levels in and surrounding the Project Area would be characteristic of the existing quarry activities and natural background sounds (*e.g.,* wind).

5.8.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

Air Quality

Quarrying activities can generate dust (*i.e.,* particulate emissions) which has the potential to be transported off-site. There are a variety of activities that can lead to the generation of particulate matter on the construction site. The primary potential sources of airborne particulates include:

- Exhaust gas emissions due to incomplete combustion from diesel compression engine;
- Road dust;
- Wind erosion on storage piles;
- Removal of overburden;
- Blasting activities;
- Crushing operations;
- Material handling;
- Material transport; and
- Truck loading / truck unloading.

Some of the more pertinent contributor's airborne particulates are discussed in the following:

- Blasting can result in a concentrated plume of particulate matter, but the volume and time duration of such plumes are constrained. Even when blasts result in a visible plume, the contribution to 24-hour averages, as in the Air Quality Regulations, will be negligible. Much of the material in the initial plume is larger than the aerodynamic diameter of particles that can remain suspended in the air, and deposit within a relatively short distance (*e.g.,* 100 m) of the blast site. As shown on Figure 2.1, there are only buildings located within 100 m of the quarry, one of which is a residence;

- Crushing is a mineral extracting operation that involves the generation of particulate emissions. Uncontrolled processing operations like these can produce nuisances and/or exceedances of particulate standards;

- Material handling activities can result in the generation of particulate matter primarily through the vertical drop of material movement. As the fine material passes through the air, the finest material may become windblown and travel downwind;

- Storage piles and exposed areas are often left uncovered due to the need for frequent material transfer, which can lead to considerable dust generation. Dust emissions can take place during several points in the storage cycle, including material loading onto the pile, disturbances by strong wind currents, and removing loads from the pile;

- Particulate emissions can occur whenever vehicles travel over both paved and unpaved surfaces; and

- Although there are also emissions of combustion gases and products of incomplete combustion from the exhaust of the on-site vehicles and equipment, these are considered nominal.

Efforts to minimize the generation of dust at the site include covering work and laydown areas with blasted materials. Fugitive dust emissions will be controlled as necessary with the application of water obtained from the quarry floor with the use of a water truck.

Dust generated by truck movement will be minimized by limiting speed to 40 km/hour on access roads, proper truck loading, application of water for dust suppression, proper construction of on-site roads, and/or other means as required by NSE.

Monitoring of airborne particulate emissions (dust) will be conducted at the request of NSE and in accordance with the Pit and Quarry Guidelines, the Nova Scotia Air Quality Regulations and the facilities Approval permit 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.

Exhausts emissions from equipment and vehicles will be mitigated by ensuring vehicles are maintained in good working order to ensure efficient operation and minimization of emissions. Consideration will be given to methods to reduce idling, as feasible.

Sound Quality

Quarrying activities will produce noise from equipment operation and blasting. Approximately three buildings/structures are located within 800 m of the Project property.

Blasting operations associated with the proposed extension will be conducted in accordance with current operations at the quarry as permitted by NSE (Approval No. 2005-044731), in accordance with the Pit and Quarry Guidelines (NSE 1999),with a frequency similar to past operations at the site and during daytime hours only. Blasting will be conducted in accordance with the General Blasting Regulations made pursuant to the Nova Scotia *Occupational Health and Safety Act* (1996). It is understood that additional blast monitoring activities and/or reporting may be required by NSE.

Efforts to minimize sound emissions related to the operation of equipment include the use of mufflers on all engines and vehicles and adhering to strict maintenance policies. The scheduling of any potential noisy activities as well should be done so during daytime hours.

As per the requirements of the current operating Industrial Approval and standard provincial guidelines, sound levels from the operation in the extension area will be maintained at a level not to exceed by the provincial guidelines as stated in Section 2.6. Sound monitoring will be conducted at the request of NSE. Details of any required monitoring will be included in the Industrial Approval application.

Summary

The air and sound quality impacts related to the quarry extension can be controlled with standard mitigation practices and therefore the Project is not likely to have a significant adverse effect on the Atmospheric Environment. It is noted that there are only three buildings/structures located within 800 m. Dust and noise monitoring will be conducted as required at the request of NSE with additional mitigative measures taken as necessary.

5.9 SOCIO-ECONOMIC ENVIRONMENT

5.9.1 Description of the Existing Environment

Population and Employment

The existing Hardscratch Quarry and the proposed Project Area are located at 1546 Hardscratch Rd., South Ohio, Yarmouth County, Nova Scotia, which is situated in the Municipality of the District of Yarmouth (Figure 2.1). The municipal district has a population of 10,304 (Statistics Canada 2006). The population in this area decreased by 1.5% between 2001 and 2006. The employment rate in the district is 57.3% and the unemployment rate is 10.9% (Statistics Canada 2006). Over half of the experienced labour force consists of sales and service occupations (26%); trades, transport and equipment operators and related occupations (15%); and occupations unique to the primary industry (13%) (Statistics Canada 2006).

The existing quarry provides local employment, with the number of people working on-site varying throughout the year depending on the level and type of activity (*e.g.*, crushing, stripping/rehabilitation campaigns, aggregate production, *etc.*). Drilling and blasting activities require additional resources; these activities are sub-contracted to a professional blasting company. Transporting materials from the quarry also involves additional resources and is typically arranged through the customer. Hauling activity can vary according to market demand, but an average of up to 30 truck-loads of aggregates is transported from the quarry per day. The existing quarry is an important source of local, high quality aggregates for use in local construction projects (*e.g.,* road building and municipal, residential, and commercial developments), as well as asphalt production**.**

Land Use

The quarry and proposed extension area are situated in a rural setting. Only three buildings/structures are located within 800 m of the existing quarry site. These building are also located within 800 m of the proposed Project, and there are no additional structures within 800 m of the extension (Figure 2.1).

Urban/residential areas are the primary current anthropogenic land uses identified within 800 m of the Project site. Other current land uses that occur within approximately 2 km of the Project Area include waste management facilities (*i.e.*, a landfill, compost facility, and metal scrap yard), agricultural areas (see Figures 2.2). As well, Chebogue Meadows Provincial Park is located just

south of the Project Area (Figure 5.2). These land uses are not expected to interfere with, or be subject to inference from, the proposed quarry extension.

Aberdeen Paving Limited owns a quarry (Aberdeen Hardscratch Quarry) that is located approximately 2.5 km north of the Lafarge Hardscratch Quarry. The Aberdeen Hardscratch Quarry received EA Approval in 2010 to expand their quarry operation. Both quarries have been operating in relatively close proximity for years.

The nearest First Nations reserve (Acadia First Nation Yarmouth Reserve) is located approximately 10 km south of the Project site. Archaeological and heritage resources, including First Nations resources are considered in a separate VEC in Section 5.6 of this document.

The Proponent currently owns the Project property, which consists of two parcels of land (PIDs 90138991 and 90139023) on which the proposed quarry extension will be situated. The quarry is located on land that is zoned for “Rural Development”. An area north of the site, likely the Aberdeen Quarry, is zoned “Industrial Development”; therefore, this type of land use has been accommodated by zoning in the surrounding area.

Mining

A review of the NSDNR Abandoned Mine Openings Database indicates that there is a gold mine shaft (Dominique shaft) situated approximately 8.4 km south of the Project Area in Arcadia. It is not part of a mine district and has a low hazard level. There are also six mine shafts located approximately 9.3 km from the boundaries of the Project property, in the Cranberry Head Gold District in Pembroke Cove, the nearest of which is a gold mine shaft (Ryerson Shaft) (NSDNR 2009). These sites are of sufficient distance from the Lafarge Hardscratch Quarry and extension property that they are not anticipated to interact in any way with the Project. In addition, NSDNR has advised (in Comment No. 21 of the disposition table in Appendix I) that an additional abandoned mine shaft may be located on, or in very close proximity to, the Project property, as suggested by Geological Survey of Canada (GSC) Map 1186A and historical aerial photography from 1945. The shaft was sunk by E.S. Matheson & Associates. Mica within pegmatite dykes was the commodity sought (Stantec 2010). The mine shaft is not anticipated to pose a hazard, as GSC Memoir 349 indicates it is partially infilled.

Agriculture

Agricultural areas are located within the general vicinity of the proposed quarry extension; however, no tracts of agricultural land are located within 800 m of the Project site (refer to Figure 2.2). Several mink farms are located in the vicinity of Highway 340, with mink production activity particularly concentrated south of and parallel to Highway 1 from Weymouth to Hebron, near Yarmouth (Clean Annapolis River Project 2008). Quarry blasting can result in adverse effects at mink farms, especially during the whelping season. However, consultation with Nova Scotia Agriculture has confirmed that the Project is not likely to interact with mink production since no mink ranches are located in close proximity to the quarry. The nearest mink farm is situated 2.5 km to the west of the Project Area. Furthermore, there have been no recorded complaints from

mink ranchers regarding current blasting activities at the existing quarry. Therefore, the Project is not located in a region where conflict with current and future agricultural practices is anticipated.

Forestry

Intensive forestry or silviculture operations have been identified in the region within and surrounding the Project Area. Areas of clear-cut and partially depleted forest cover occur within 800 m of the proposed Project.

Transportation

The Project Area is located approximately 3 km south of the intersection of Hardscratch Road and Highway 340 at East Canaan. The existing quarry is currently accessed via a private road that branches off of Hardscratch Road (Figure 2.1). This private road will continue to provide access to and from the extended operation.

Quarried material will continue to be transported from the site to local markets via tandem trucks or tractor trailing trucks. The average number of trucks hauling aggregates from the extended quarry could be up to 30 per day, depending on market demand. This is consistent with current truck volume at the existing quarry**.** Truck traffic could increase, for a short period, if a large aggregate supply contract were awarded.

A transportation assessment was not conducted in support of this environmental registration. Such a study was not deemed necessary given that the roads surrounding the Project property are in good repair and the Project is not anticipated to result in any significant increase in the volume of truck traffic on public roads compared to current levels.

Recreation and Tourism

Recreational fishing and hunting are permitted in the region surrounding the Project Area. The existing quarry and proposed expansion site are located in Recreational Fishing Area 4 (Nova Scotia Fisheries and Aquaculture 2009). The nearest lakes to the Project that are included in the Provincial recreational fish stocking program are Butlers (Chegoggin) Lake (located approximately 3 km northwest of the Project property), Bird Lake (located approximately 11 km northeast of the Project property), and Sloans Lake (12.5 km northeast), and Allens Lake (located approximately 9 km northwest of the Project property). These lakes are stocked with speckled trout (Nova Scotia Fisheries and Aquaculture 2009).

The quarry is situated in Deer Management Zone 101. Antlerless deer hunting is permitted in the region surrounding the Project Area. For the 2012 season, 1,000 antlerless deer hunting stamps are available for Deer Management Zone 101 (NSDNR 2012b). The seasons for hunting deer during 2011 were as follows: the special youth season ran from October 14-22; the general open season ran from October 28 to December 3; and the bowhunting season ran from September 24 to October 27 and December 5 to December 10. All of these deer hunting seasons exclude Sundays (NSDNR 2011).

The Chebogue Meadows Wildlife Interpretive Trail, maintained by NSDNR, is located approximately 300 m south of the Project property boundary. This wildlife interpretive trail has a series of boardwalks and natural paths through forests and meadows. The main loop is 4.5 km with an optional 1 km return loop to one of the lookout posts over a Ducks Unlimited Protected Area (Hiking Nova Scotia, undated). The Project is close to the trail but no interactions are expected based on current activities at the existing quarry, nor should the quarry expansion affect the trail.

Ellenwood Lake Provincial Park is located approximately 4 km from the Project property boundary, which offers an 87 site campground (open from May to September 7), two picnic areas, a boat launch, a supervised beach, and a walking/hiking trail. The Park occupies 114 hectares and includes forested land consisting of maple, birch, hemlock, spruce, fir and pine trees. The rocky lakeshore provides habitat for rare species of coastal plain flora that are not found anywhere in Canada outside of southwestern Nova Scotia, including pink coreopsis, Plymouth gentian, and water pennywort. These species are protected by provincial and federal governments (Nova Scotia Provincial Parks 2011). The Project is of sufficient distance from the Park that no interactions are expected.

Human Health

Human health related aspects and potential effects on environmental health include potential impacts on air quality and noise; these issues are addressed in Section 5.8.

5.9.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

Population and Employment

The quarry produces valuable products that support development and infrastructure, and the growth of the region's economy. Continued direct and indirect employment associated with operation of Lafarge Hardscratch Quarry is beneficial to the regional economy although employment levels at the quarry are not anticipated to change as a result of the Project.

Expansion of Lafarge Hardscratch Quarry to allow for continued operation will result in an overall positive effect on the regional economy. The availability of additional local supply to the market place should encourage a more stable price for aggregate. In markets in close proximity to quarries, the overall price for aggregates will be lower since cost of aggregate largely reflects the distance it has to be hauled. This, in turn, can significantly reduce costs of construction, which should result in financial benefits in the public infrastructure sector affecting highway development, communities, public works agencies, and taxpayers (NSDNR 2006b).

Land Use

Due to the existing industrial activity in the vicinity of the Project Area (*i.e.,* the existing Lafarge Hardscratch Quarry and nearby landfill, as indicated on Figure 2.2), and the distance of the proposed extension area from residences, impacts on existing and future adjacent land uses

are not expected. All activities at the existing quarry and the proposed Project site will be conducted in accordance with the Pit and Quarry Guidelines (NSE 1999), and all setback distances specified in the Guidelines will be maintained.

Quarrying activities will produce noise from equipment operation and blasting. Approximately three buildings/structures are located within 800 m of the Project property. The owners of these buildings must provide consent in order for blasting to take place within 800 m of their property**.** The potential for noise from the quarry site to have a significant effect on residents is minimal.

Blasting operations associated with the proposed extension will be conducted in accordance with current operations at the quarry as permitted by NSE (Approval No. 2005-0447331), in accordance with the Pit and Quarry Guidelines (NSE 1999) and with a frequency similar to past operations at the site. Blasting will be conducted in accordance with the General Blasting Regulations made pursuant to the Nova Scotia *Occupational Health and Safety Act* (1996). It is understood that additional blast monitoring activities and/or reporting may be required by NSE.

As per the requirements of the current operating Industrial Approval and standard provincial guidelines, sound levels from the operation in the extension area will be maintained at a level not to exceed the following sound levels (L_{eq}) from the property boundaries:

- L_{eq} 65dBA 0700-1900 hours (Days);

  60dBA 1900-2300 hours (Evenings); and

  55dBA 2300-0700 hours (Nights).

Sound monitoring will be conducted at the request of NSE. Details of any required monitoring will be included in the Industrial Approval application.

Transportation

The Project is not anticipated to result in a significant increase in truck traffic on public roads above that associated with the existing Lafarge Hardscratch Quarry operation. Future hauling practices will remain consistent with current practices.

Recreation and Tourism

The existing quarry and proposed extension of the operation are not likely to have an impact on hunting and recreational fishing in the general area. The quarry is situated in a hunting management zone, but the Project is not located on Crown land and thus hunters will require permission from Lafarge to pursue their activities in the area.

Human Health

Project activities may result in a slight increase in air emissions; however, these impacts will be temporary and localized and are not expected to result in any significant effects on human health. Human health related issues pertaining to air quality are discussed in more detail in

Section 5.8. The Project will not result in any impacts on the safety of travelers, as it will not entail any significant effects on traffic on public roads. The health and safety of nearby residences is not expected to be affected by the Project.

Summary

In summary, assuming effective application of mitigative measures (*e.g.,* Pit and Quarry Guidelines, dust suppression) significant adverse Project-related effects on the socio-economic environment are not likely to occur. Continued operation of the quarry will result in economic benefits, including ongoing employment and business opportunities.

5.10 OTHER UNDERTAKINGS IN THE AREA

Aberdeen Paving Limited owns a quarry (Aberdeen Hardscratch Quarry) that is located approximately 2.5 km north of the Lafarge Hardscratch Quarry. The Abderdeen Hardscratch Quarry received EA Approval in 2010 to expand their quarry operation. Both quarries have been operating in relatively close proximity for years. The Proponent is not aware of any other active pit or quarry operations licensed to operate within a 10 km radius of the Project. The existing Lafarge Quarry operation is currently functioning without any issues in terms of noise, dust, emissions, traffic, water, *etc.* Since the proposed extension does not include an increase in production, and assuming the effective application of mitigative measures, significant adverse Project-related effects regarding other undertakings in the area are not likely to occur.

6.0 EFFECTS OF THE PROJECT ON THE ENVIRONMENT

Activities associated with the proposed quarry extension Project, and operation of the extended quarry, will be conducted in accordance with terms and conditions of the current Industrial Approval for the existing quarry operation, as well as future amendments to the Approval, and the Pit and Quarry Guidelines (NSE 1999).

Environmental effects of the quarry extension will include the loss of terrestrial habitat within the proposed revised quarry extension area. The results of flora and fauna habitat modeling show that there is potential for habitats in the Project Area to support rare or sensitive species. More detailed assessment and mitigative measures pertaining to rare and sensitive flora and wildlife are provided in Sections 5.3 and 5.4 respectively.

One watercourse, two drainage channels, and ten wetlands have been identified within the extension area. Four of these wetlands (WL1 to WL4) will be protected by a 23 ha Wetland Buffer Zone in the eastern third of the property which will avoid a substantial amount of sensitive habitat, including the most ecologically important wetland (WL3) and the only watercourse (WC-1) (Figure 5.1). The wetlands to be avoided in the buffer zone comprise 10.7 ha, or approximately 73%, of total on-site wetland habitat area. The Proponent is committed to wetland compensation for the loss of any non-avoided wetland habitat as a result of quarrying operations.

The results of the groundwater study (Section 5.6) indicate that, based on the separation distance between the quarry and the nearest water wells and the presence of intervening surface water barriers, the likelihood of a water quality or quantity effect on receptor domestic water supply wells from this quarry operation is considered to be very low**.**

The hydrological assessment conducted in support of this EA (Appendix C) concludes that the total increase in the mean annual runoff for the site resulting from the proposed expansion (full quarry development) is in the order of 145,216 m^3, and that the flow detention structures for the full quarry expansion should be able to accommodate a volume of 20,500 m^3, which corresponds to a 24 hour 1:25 year rainfall event.

The potential for acid drainage production in this area is presently unknown; however, generally massive granite is not known to be a significant acid drainage risk.

Minor, localized impacts on air quality can be expected through the formation of airborne particulate matter. These impacts are readily controlled through standard mitigative measures (*e.g.,* dust suppression) and follow-up monitoring as necessary (see Section 5.7) and are not expected to be perceptible beyond the immediate Project Area.

A Stormwater Management Plan will be submitted as part of the quarry development plan during the Industrial Approval application process.

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.

7.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

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. Precipitation and runoff may cause temporary delays in quarry construction, operation, and rehabilitation activities. Wet weather or snow may also affect hauling of material from the site.

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 very slightly 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 interruption of service 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 (including accommodation for climate change), and considering weather conditions when scheduling activities, including scheduling of activities to accommodate weather interruptions. All Project activities will be taking place out-of-doors and thus weather has been and will be factored into all Project phases and activities. The Proponent proposes that the quarry remain operational 48 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.

8.0 OTHER APPROVALS REQUIRED

As stated in Section 2.0, the Proponent is required to register this Project as a Class I Undertaking pursuant to the Nova Scotia *Environment Act* and Environmental Assessment Regulations. Other relevant provincial regulations include the Activities Designation Regulations, which requires an amendment to the existing Industrial Approval (Approval No. 2005-044731) from NSE for operation of the Project; and the General Blasting Regulations made pursuant to the Nova Scotia *Occupational Health and Safety Act* (1996). Provincial guidelines to be adhered to include the Pit and Quarry Guidelines (NSE 1999).

No requirements under the *Canadian Environmental Assessment Act, 2012* (*CEAA 2012*) are anticipated.

9.0 FUNDING

The proposed extension will be 100 percent privately funded.

10.0 ADDITIONAL INFORMATION

No additional information is provided in support of this document.

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12.0 Appendices

APPENDIX A	Registry of Joint Stocks and Industrial Approval
APPENDIX B	Proposed Quarry Development Plan
APPENDIX C	Lafarge Quarry Extension Hydrology Study
APPENDIX D	Project Information Bulletin and Letters
APPENDIX E	Fish Habitat Survey
APPENDIX F	Rare and Sensitive Plants Identified during Modelling Exercise as being Potentially Present in Project Area
APPENDIX G	Population Status of Vascular Plants Recorded in Project Area Breeding and Population Status of Birds Recorded in the Project Area and the Breeding Bird Atlas Squares