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FINAL REPORT

Environmental Assessment Registration, Elmsdale Quarry Expansion Project

GALLANT AGGREGATES LIMITED

PROJECT NO. 1013296.

Jacques Whitford

An Environment
of Exceptional
Solutions

Registered to
ISO 9001:2000

PROJECT NO. 1013296

REPORT TO

Gallant Aggregates Limited
PO Box 10
Enfield, Nova Scotia
B2T 1C6

FOR

Environmental Assessment Registration
Elmsdale Quarry Expansion Project

June 29, 2007

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EXECUTIVE SUMMARY

Gallant Aggregates Limited proposes to expand the footprint of its existing quarry near the community of Elmsdale, Hants County, Nova Scotia. The quarry property however, is located in Halifax Regional Municipality. The proposal will allow continued aggregate production (blasting, crushing and stockpiling) to supply local construction (*e.g.,* roadbuilding) needs. The existing quarry has been operational for over 20 years and the proposed activities will take place over the next number of years (potentially as many as 50 years) involving a total of approximately 60 ha of land immediately adjacent to the existing quarry.

The quarry opened in 1986 and produces a variety of quartzite aggregate types. The current and anticipated average production rate is approximately 400,000 to 500,000 tonnes per year. The current and anticipated operating schedule is 15 hrs/day, 7 days/week; on a year-round basis, weather permitting.

Proposed Project activities will be consistent with current quarry operations approved by Nova Scotia Environment and Labour and in accordance with the Nova Scotia Pit and Quarry Guidelines (NSEL 1999). Aggregate production will begin with drilling and blasting, which will be conducted by a qualified blasting contractor. Blasting will take place approximately five to six times per year. Portable crushing equipment will be on site to process the blasted material. Various products (*i.e.*, various aggregate sizes) will be stockpiled at the quarry site until they are sold and transported to local markets via tandem trucks or tractor trailer trucks. The primary markets for the products are construction projects such as road building within Hants County, Colchester County and Halifax Regional Municipality.

Gallant Aggregates Limited 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 Industrial Approval from NSEL for the quarry operation, and the General Blasting Regulations made pursuant to the Nova Scotia *Occupational Health and Safety Act* (2003). Provincial guidelines to be adhered to include the Nova Scotia Pit and Quarry Guidelines (NSEL 1999).

This environmental assessment registration evaluates the potential environmental effects of the Project and identifies appropriate mitigation and monitoring to minimize these effects. The document focuses on those aspects of the environment of most concern. Components evaluated include:

- fish and fish habitat;
- rare and sensitive flora;
- wetlands;
- wildlife;
- groundwater resources;
- archaeological and heritage resources;
- air quality; and
- socio-economic environment.

Environmental effects from the quarry expansion will include the loss of habitat within the quarry footprint. 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 or socio-economic effects are likely.

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1.0 PROPONENT AND PROJECT IDENTIFICATION

1.1 Proponent Information

Name of the Proponent: Gallant Aggregates Limited
Postal Address: P.O. Box 10
Enfield, NS
B2T 1C6
Tel.: (902) 883-3020
Fax: (902) 883-8881

Registry of Joint Stocks for the proponent company is included in Appendix A.

Company President and/or Environmental Assessment Contact

Name: Fred Benere
Official Title: President
Address: As above
Tel.: (902) 883-3020
Fax: (902) 883-8881

Environmental Consultant Contact

Name: Angela Swaine
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Tel.: (902) 468-7777
Fax: (902) 468-9009

F. Benere — June 27/07

Signature of President — Date

1.2 Project Information

Name of the Undertaking: Elmsdale Quarry Expansion Project

Location of the Undertaking: Elmsdale, Halifax Regional Municipality, NS

2.0 PROJECT INFORMATION

2.1 Description of the Undertaking

Gallant Aggregates Limited (Gallant Aggregates, the Proponent) owns and operates a quarry, located at 100 Bedrock Lane, near the community of Elmsdale, Hants County, Nova Scotia. The quarry property is actually located in Halifax Regional Municipality (HRM) (Figure 2.1). An Industrial Approval (No. 84-173 Amendment #1) has been recently renewed (2006-050247-R01), pursuant to Division V of the Activities Designation Regulations, and issued by Nova Scotia Environment and Labour (NSEL) on January 30, 2006. This permit allows for construction and operation of a quarry on property parcel number 00524934. A copy of the permit is appended to this report (Appendix A).

Gallant Aggregates proposes to expand the approved quarry site quarry an additional 60 ha to allow for continued aggregate production (blasting, crushing and stockpiling) and intends to supply local construction contracting needs. The Proponent owns the existing quarry lands as well as the adjacent proposed expansion land area, which will effectively allow for the expansion. The existing quarry has been in operation since 1986, with a total disturbed area to date of approximately 12 ha.

As a result of field and desktop studies undertaken in support of this environmental registration report, the expansion area has been carefully considered so as to minimize potential environmental impacts including impacts to wetlands and streams located on the proposed expansion property.

The anticipated average production rate is 400,000 to 500,000 tonnes per year. The current and anticipated operating schedule is 15 hrs/day, 7 days/week; on a year-round basis and weather permitting. Estimated rock reserves in the proposed expansion area is in order of 50 million tonnes. Quarry operations will continue to take place over the next number of years (potentially as many as 50 years) depending upon the demand for aggregate in the area.

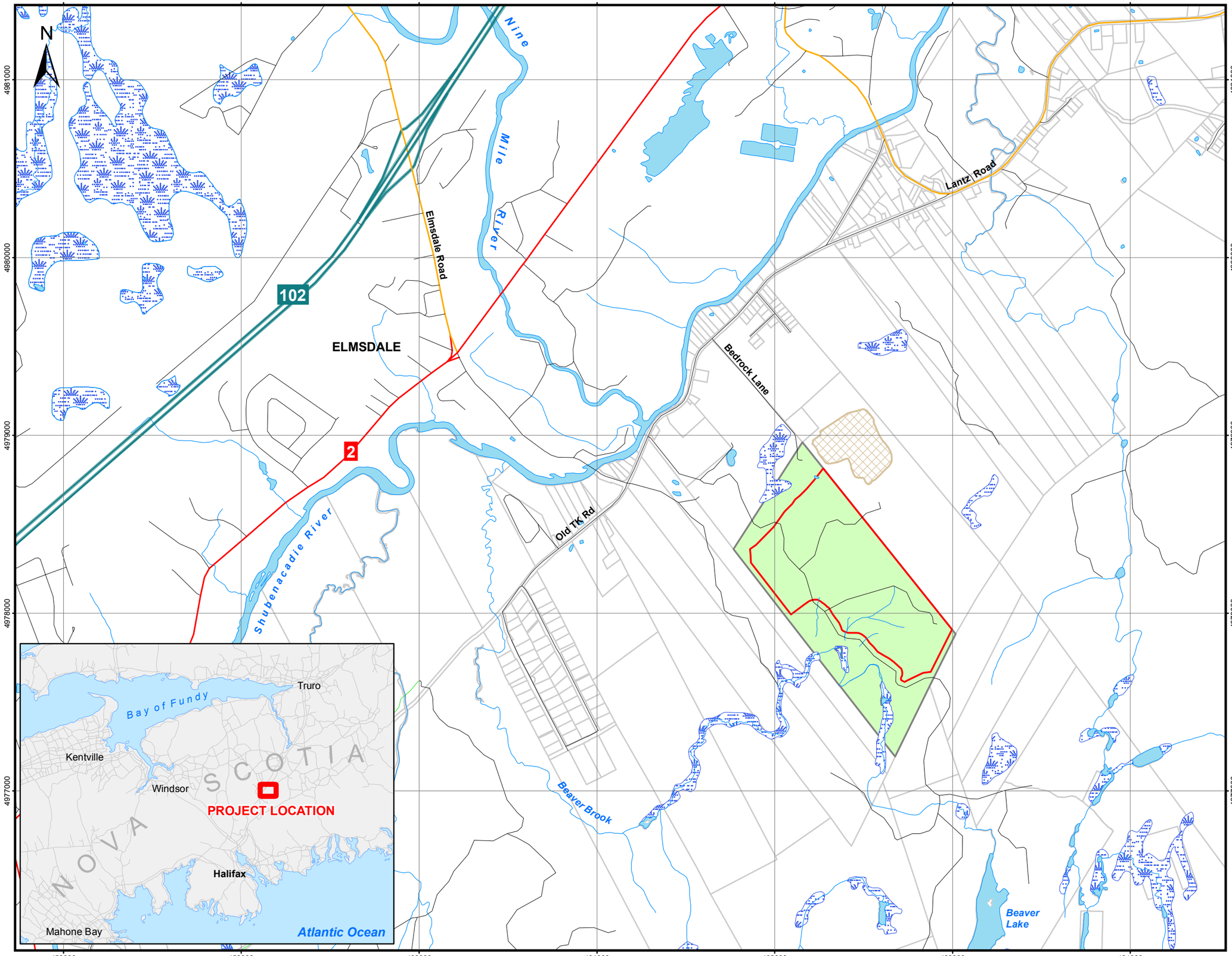
2.2 Geographical Location

The quarry is located at 100 Bedrock Lane, near the community of Elmsdale, Nova Scotia (Figure 2.1). Entrance to the quarry is via a privately owned access road. The quarry and proposed quarry expansion area are situated on lands that are owned by the Proponent that have undergone various stages of clearing over the past 20 to 30 years. The proposed expansion area supports a number of habitat types including mature second growth mixedwood and coniferous forest, immature mixedwood forest, semi-barrens, recent clear cuts, disturbed areas, and wetlands. Generally, the proposed quarry expansion area is surrounded by lands with similar habitat types.

Residential development in the immediate vicinity of the Project is relatively low, with only one structure unrelated to the quarry within 800 m. The working face of the quarry is in fact greater than 800 m from this structure. The Proponent has an existing signed agreement with the owner of this property (Kel-Greg Enterprises Ltd.) and this agreement also applies to the proposed expansion. A subdivision is located, approximately 1.5 km from the eastern boundary of the proposed expansion area (Figure 2.1). The zoning of the land area is Resource.

Gallant Aggregates Ltd.

Figure 2.1
Elmsdale Quarry Site Location



Map Features

- Expressway
- Principal Highway
- Secondary Highway
- Major Road
- Local road
- Trail
- Ferry Route/Ice Road
- Watercourse
- Approximate Existing Quarry Location
- Proposed Expansion Area
- Site Property Boundary
- Waterbody
- NSTDB Wetland

0 250 500 1,000
Meters

Map Parameters
Projection: UTM-NAD83-Z20
Scale 1:20,000
Date: May 1st, 2007
Project No. 1013296

Jacques Whitford

2.3 Physical Components

The existing quarry operations consist of a laydown area for the portable crushing equipment, various aggregate stockpiles, quarry floor and working face, settling pond, scale and scale house, and access road. The expansion property currently has liquid asphalt and fuel oil stored on site. These materials are currently handled in accordance with existing regulations and this will continue following the expansion. No new fuel storage or dangerous goods will be associated with the proposed expansion.

Overburden that has been stripped prior to drilling and blasting are stored on site for subsequent use during site reclamation. The piles have been hydroseeded to reduce potential for erosion and sedimentation. This practice will continue throughout the development and operation of the proposed expansion area.

The laydown area is located on the quarry floor. The crushing equipment is transported to the site as required (*i.e.,* after blasting). Aggregate stockpiles are currently located at various locations within the quarry limits, as space allows. As the quarry expands and additional space on the quarry floor is created, a dedicated stockpile area will be established. Surface runoff and quarry drainage are collected on the quarry floor, which has the capacity to hold a significant quantity of water. Currently, overflow from the quarry floor drains to a settling pond located to the west of the existing operation. Two settling pond areas will be developed with the expansion, one in the north sub-catchment area and one in the south sub-catchment area (as indicated in Appendix B).

The nearest residence is located greater than 800 m from the boundary of the proposed quarry expansion limits. As shown in Figure 2.2, there is one business located within 800 m. This proponent has a signed agreement with the land owner to conduct quarry operations within this 800 m boundary. The general direction of quarry advancement will be southeast from the existing quarry face. The potential for acid drainage production in this area is low.

2.4 Site Preparation and Construction

The existing quarry has been in operation for over 20 years. 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 with hydroseed for subsequent use during site reclamation. These stabilization procedures will continue throughout the operations of the proposed expansion.

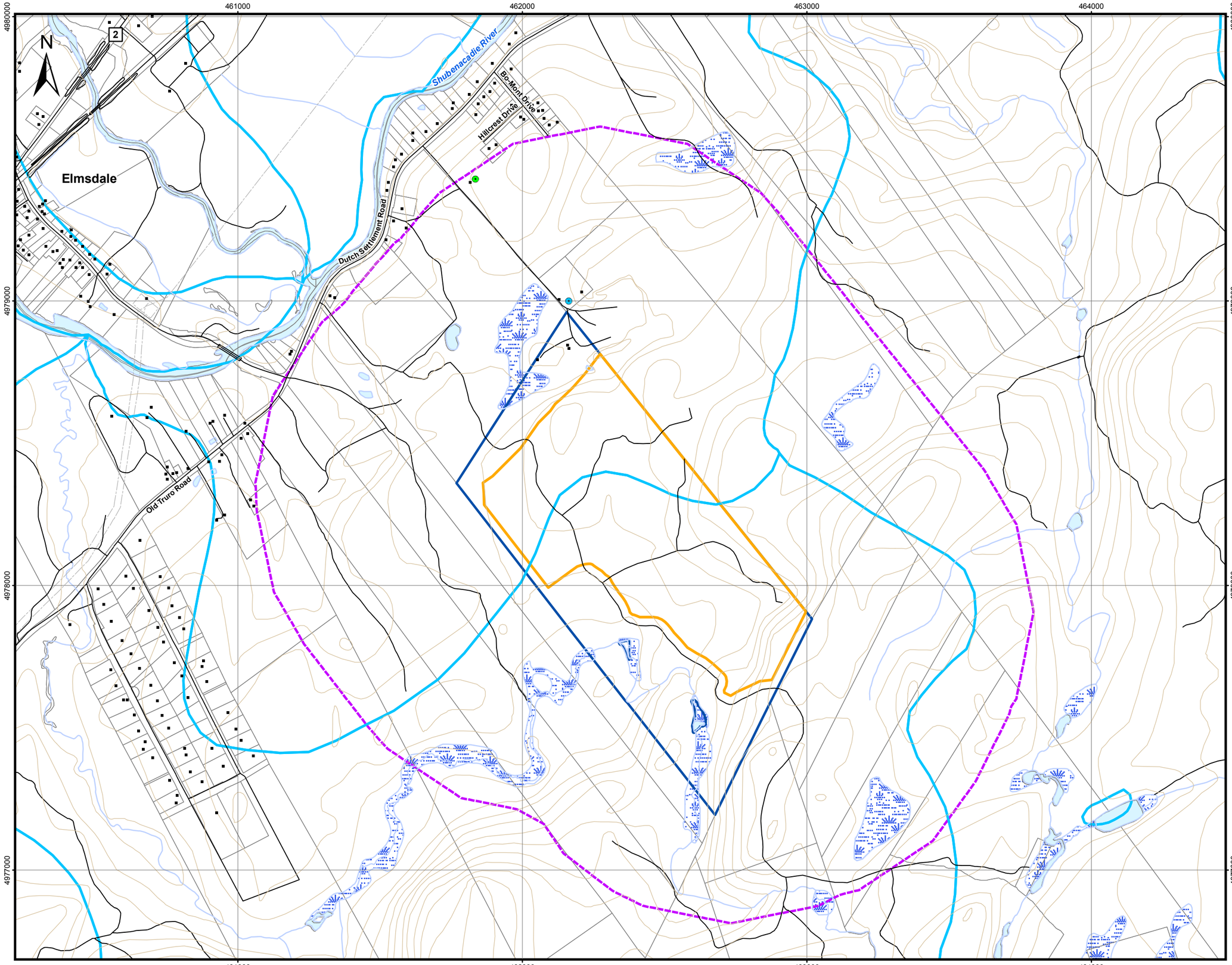
Quarry drainage and surface runoff collects on the quarry floor. Overflow from the quarry floor is currently directed to a settling pond located to the west of the existing developed area. Two additional ponds will be developed as the expansion proceeds. Water from the settling ponds will be used to provide a water supply for dust suppression during crushing during dry periods.

A number of monitoring wells will be installed within the proposed quarry expansion area. Groundwater levels will be monitored regularly to assist with quarry development and water management, to identify effects on groundwater levels and potential effects to other groundwater users (refer to section 5.6) and to identify effects on surface water resourcing, including fish habitat. Details of the groundwater monitoring program will be outlined in the Industrial Approval application.

Elmsdale Quarry Project

Figure 2.2

Buildings and Approximate Water Supply Locations Within 800m of Project



Map Features

Well Type

- Drilled Well
- Dug Well
- Building/Structure
- Contour (5m)
- Road/Trailway/Driveway
- Utility
- Watercourse
- Site Property Boundary
- Property Boundary
- Proposed Expansion Area
- 800m From Proposed Expansion Area
- Waterbody
- Wetland
- Secondary Watershed Divide Of Watershed 1DG as Obtained From Nova Scotia Geomatics Centre, NS Watersheds 1980

0 125 250 500

Meters

Map Parameters
Projection: UTM-NAD83-Z20
Scale 1:12,500
Date: May 1st, 2007
Project No. 1013296

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2.5 Operation and Maintenance

2.5.1 Quarry Operation Activities

The proposed Project activities will be consistent with the current quarry operations approved by NSEL (Renewal 2006-050247-R01) and will be in accordance with the Pit and Quarry Guidelines (NSEL 1999). These guidelines apply to all pit and quarry operations in the province of Nova Scotia and provide: separation distances for operations, including blasting; liquid effluent discharge level limits; suspended particulate matter limits; sound level limits; and requirements for a reclamation plan and security bond.

Aggregate production begins with drilling and blasting. It is anticipated that blasting will occur five or six times a year. 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. A blast design has been prepared and is included in Appendix C. Details of the blast monitoring program will be provided in the Industrial Approval application. 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 and tractor trailer trucks along Route 2. The number of trucks hauling aggregates currently averages approximately 85 per day and is expected to remain unchanged although this may fluctuate periodically due to local market conditions.

The existing quarry currently employs ten people who are directly involved with aggregate production and sales. This number is expected to remain the same following site expansion. 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 customers.

2.6 Effluents and Emissions

In accordance with best practices and standard NSEL 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 to a settling pond constructed in the western corner of the developed area. Additional ponds will be installed, as required, in accordance with NSEL's Erosion and Sedimentation Control Handbook for Construction Sites (NSEL 1988) and the quarry's approval to operate, and in consultation with NSEL's engineers/inspectors.

A hydrological review of the Elmsdale Quarry and the proposed expansion was conducted by a Jacques Whitford Hydrologist (refer to Appendix B). The assessment considered the proposed expansion area. The report states that a reduction in evapotranspiration and a subsequent increase in

the volume of surface runoff (by a factor of approximately 20%) will occur as a result of the quarry development. It was determined that, based on the proposed expansion area, the volume of annual site runoff is estimated to be 607,466 m^3 (assuming the entire proposed expansion is developed and progressive reclamation is not factored in resulting in a very conservative estimate).

Currently, overland flow drains in two directions due to two hydrologic divides. 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. Following the use of these mitigative measures, the remaining residual effects on downstream flows and water quality are expected to be minor.

Overflow, 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. In the unlikely event that overflow 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. 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 pond(s) 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 and covered with hay. Monitoring of airbourne particulate emissions (dust) will be conducted at the request of NSEL and in accordance with the Pit and Quarry Guidelines and the Nova Scotia Air Quality Regulations.

Combustion emissions will be generated from the operation of vehicles and equipment. 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. Consideration will be given to methods to reduce idling, as feasible. Ambient air monitoring will be conducted at the request of NSEL.

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 (Leq) at the property boundaries:

Leq 65dBA 0700-1900 hours (Days)

60dBA 1900-2300 hours (Evenings)

55dBA 2300-0700 hours (Nights)

Sound monitoring will be conducted at the request of NSEL.

Solid waste generated on-site will be minimal (office and domestic refuse). All solid waste will be properly collected and stored until such time that it can be transported to a provincially approved waste disposal facility.

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

2.6.1 Hazardous Materials and Contingency Planning

There is no plan for additional storage of hazardous materials or petroleum products at the quarry site. As noted in Section 2.3, existing storage facilities on the expansion property are operating in compliance with applicable regulations. A qualified company will be contracted to conduct regular maintenance of equipment. Used oil and filters are currently removed from the site and this practice will continue with the proposed expansion.

Refuelling of equipment will be conducted onsite on a regular basis, under contract 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*.

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. 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 of the Nova Scotia *Environment Act*. A Spill Contingency Plan has been developed for the quarry (in support of the existing Industrial Approval) and is on file with NSEL.

2.7 Decommissioning and Reclamation

Gallant Aggregates will undertake a progressive reclamation program at the quarry site. The rehabilitation process at the quarry began during initial site development with the preservation of overburden for future rehabilitation of the quarry. As distinct areas within the quarry become inactive, the area will be graded to a stable slope (3:1), covered with topsoil, and seeded. At the end of the quarry operation (within six months of abandonment), rehabilitation will consist of: grading and contouring of all slopes and exposed rock faces in consideration of rock falls, slope stability, and safety; spreading existing stockpiled topsoil; and hydroseeding. The laydown area within the quarry, which is covered with quarried materials, will be graded, as required, and leveled to allow for future commercial, industrial, recreational, or residential land use. All areas affected by quarry activities including the setting ponds and quarry floor will be rehabilitated. Wetland and fish habitat creation during rehabilitation will be considered as an option for compensation for unavoidable loss of wetland and fish habitat during quarrying. A reclamation plan will be developed for the expanded site and submitted to NSEL as part of the quarry development plan, to be included in the Industrial Approval 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

The proposed Project, as described in Section 2.0, consists of expansion of the existing quarry footprint to allow for continued quarry development and additional stockpiling. The following is a description of the spatial and temporal boundaries of the proposed Project to be considered in the assessment.

The quarry opened in 1986 and produces a variety of quartzite aggregate types. The working face is approximately 20 m (66 ft) in height and does not go below the natural groundwater table (*i.e*., the quarry floor is not under the groundwater table and has not flooded since the quarry opened). The Proponent will continue to excavate from the existing working face.

The facilities and infrastructure associated with the existing quarry include: an access road and gate; various aggregate stockpiles; topsoil and overburden stockpiles; the quarry floor/laydown area (for portable crushing equipment); a scale and scale house; the working face; and a settling pond. Additional facilities and infrastructure associated with the proposed expansion will likely include additional aggregate stockpile areas and additional flow retention structures.

Expansion of the quarry will be initiated following approval from NSEL, as the existing developed area becomes depleted of aggregates. The proposed expansion area will cover a total of approximately 60 ha. Setback distances described in the Pit and Quarry Guidelines will be adhered to. The proponent previously considered a larger area for development; however, in the interest of protecting wetland habitat on the proposed expansion property, the expansion area was revised to exclude the more extensive wetland system.

The proposed operating schedule will be based on 15 hrs/day, 7 days/week, year-round and weather permitting. Blasting of aggregate is expected to occur five or six times a year. The current and anticipated production rate is approximately 400,000 to 500,000 tonnes per year. Transport of aggregates from the quarry is via tandem and tractor trailer trucks to local markets. The average number of trucks leaving the quarry daily is 85 (although this fluctuates depending on market demand) and this number is expected to remain unchanged following the expansion.

Gallant Aggregates will undertake progressive reclamation activities at the quarry. Refer to Section 2.7 for additional information related to decommissioning and abandonment activities

3.2 Purpose and Need for the Undertaking

The purpose for the Project is to allow Gallant Aggregates to expand the existing quarry footprint and continue operations at their quarry in Elmsdale. The quarry is currently operating under an Industrial Approval Renewal (No.2006-050247-R01), issued by NSEL and effective in January of 2006. This permit is for a quarry operation on property parcel 00524934. A copy of the NSEL Approval 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 expansion 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 Elmsdale 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 expansion is occurring in an area that has been previously disturbed and is already exposed to mining/quarrying activities. Expansion 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 expanded operations. Additional flow retention structures will be installed/constructed 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 effect on the surrounding biophysical and socio-economic environment.

The Proponent had originally considered expansion into a larger portion of the property but the proposed expansion was scaled back in consideration of the wetland habitat and streams located at the southeastern end of the property.

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 *Species at Risk Act*, *Migratory Birds Convention Act*, the Federal Policy on Wetland Conservation, A Wildlife Policy for Canada, the Federal Water Policy, the Toxic Substances Management Policy, and the federal strategy for pollution prevention.

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 2002) was also used to determine/focus the scope of the assessment. The Proponent and their consultant met with NSEL on December 1, 2006 to discuss the location of proposed expansion, 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) and Valued Socio-economic Component (VSC). By assessing potential impacts on VECs/VSCs within the study boundaries, a meaningful evaluation of project effects on relevant environmental aspects is achieved. The following VECs/VSSs were identified based on government guidance, consultation and professional judgment of the study team noted above:

- fish and fish habitat;
- rare and sensitive flora;
- wetlands;
- wildlife;
- groundwater;
- archaeological and heritage resources;
- air quality; and
- socio-economic environment.

4.0 PUBLIC INVOLVEMENT

4.1 Methods of Involvement

In January 2007, a Project Information Bulletin (Appendix D) was distributed to landowners within approximately 1.5 km of the quarry. Approximately 180 bulletins were delivered door-to-door. The purpose of the bulletin was to advise local residents and businesses immediately adjacent to the quarry (*i.e.*, those who are potentially most affected) of the proposed expansion and provide them with an opportunity to comment on the proposed undertaking. A letter was posted on January 11, 2007 to the Confederacy of Mainland Mi'kmaq, to encourage the submission of comments, concerns and questions regarding the Project. This consultation effort assists with issues scoping and development of appropriate mitigation for potential adverse effects.

4.2 Stakeholder Comments and Steps Taken to Address Issues

Few comments have been received to date. Table 4.1 summarizes the issues and the Proponent's response/proposed resolution.

TABLE 4.1 Summary of Stakeholder Comments and Concerns

Stakeholder	Issue/Concern	Response/Proposed Resolution
Local Resident	Concerned about the effect the quarry expansion may have on her well. Presently has a well drilled in gypsum and has not been able to use the well as a potable water source since moving in. She was hoping that quarry operations would improve her well water situation.	Proponent indicated the quarry is unrelated to her issue and that no changes to her well water situation can be expected.
Confederacy of Mainland Mi'kmaq	Indicated an Mi'kmaq Knowledge Study should be undertaken.	At this point in time, there is no direction in guidance documents for such a study to be undertaken as part of a provincial environmental registration. The proposed quarry expansion area is entirely on lands privately owned by the proponent. There are no known lands owned or intensively used by First Nations on or in the immediate vicinity of the quarry expansion area. The proponent will undertake any further required studies at the direction of the provincial government.
Local Resident	Concern about size of expansion and associated issues of truck traffic, runoff, noise and dust.	The Proponent presented him with the Pit and Quarry Guidelines and Environmental Registration requirements to demonstrate the regulatory process that must be followed.

5.0 VALUED ENVIRONMENTAL/SOCIO-ECONOMIC COMPONENTS (VEC/VSC) AND EFFECTS MANAGEMENT

5.1 Methodology

Field studies were conducted by Jacques Whitford between June 13 and August 18, 2006, to investigate and establish the existing conditions and to determine appropriate mitigation, if necessary, to minimize environmental effects from the proposed expansion Project. These surveys consisted of: vegetation survey; wetlands survey; breeding bird survey; mammal survey; and herpetile survey. These surveys were undertaken by qualified terrestrial ecologists employed by Jacques Whitford. An assessment of potential archaeological and heritage resources was undertaken by a qualified archaeologist. A reconnaissance survey of road conditions was carried out by a qualified transportation engineer. A water well "windshield" survey was conducted by a Jacques Whitford hydrogeologist on January 15, 2007. 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 Public Works, and the Nova Scotia Department of Natural Resources.

Temporal and spatial boundaries encompass those periods and areas within which the VECs and VSCs are likely to interact with, or be influenced by, the Project. Both the temporal and spatial boundaries for the assessment vary according to the VSC. 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/VSC.

5.2 Fish, Fish Habitat and Surface Water

5.2.1 Description of Existing Conditions

Surface water within 800 m of the site is not used for withdrawal purposes (*e.g.,* water supplies or agricultural/industrial purposes). Streams and brooks on the site are not likely used for recreational boating or swimming, however, they may occasionally be used by nearby residents for recreational angling. The closest public surface water supply is located in the Shubenacadie River, approximately 1.2 km north of the proposed expansion area, as shown on Figure 2.2. A pumping well is located in a pumphouse at the edge of the river and would be recharged from surface water in the Shubenacadie River. This well supplies the subdivision infrastructure, including Bo-Mont Drive and Hillcrest Drive. Since the pumphouse is located upstream from the proposed expansion area and is greater than one kilometer away, the water supply is not considered to be at risk from Project activities.

Fieldwork was conducted on July 14, 2006 by two Jacques Whitford biologists to describe the fish habitat present in four unnamed watercourses within the Project area. The four streams assessed were identified as Streams A – D (Figure 5.1). The assessment of aquatic habitat consisted of identifying

physical units (*i.e.,* riffles, pools, and runs), instream cover, substrate composition, stream depth and width, overhead cover, water colouration, and existing anthropogenic impacts. The presence of fish, aquatic invertebrates, amphibians and wildlife using aquatic habitat and the riparian zone were noted. No electro-fishing was conducted during this survey as DFO regulations prohibit electro-fishing in the waters and tributaries of the Shubenacadie River. Photographs were taken along the streams to document habitat.

Stream A

The wet width near the headwater of Stream A was approximately 0.5 m (Photograph 1, Appendix E). The bottom substrate consisted of fine grained sand as well as deep organic sediments and detritus in quiescent areas. The general appearance of the water colour was a tea-stained light yellow/brown, likely due to the high organic (humic) content.

The stream flowed in a southerly direction from a marshy region near the road. Where the channel was defined, the wet width was roughly 0.5 m and the average depth was 15 cm. The bottom substrate was consistent along the surveyed reach downstream of the road and consisted mainly of fine grained sand, decaying leaves and other detritus and underlying soft organic sediments.

The stream flowed through a dense mature mixed wood area. Overhead canopy cover was typically high, varying between 70-100% (Photograph 2, Appendix E). Mosses and ferns were the dominant plant types in the riparian zone.

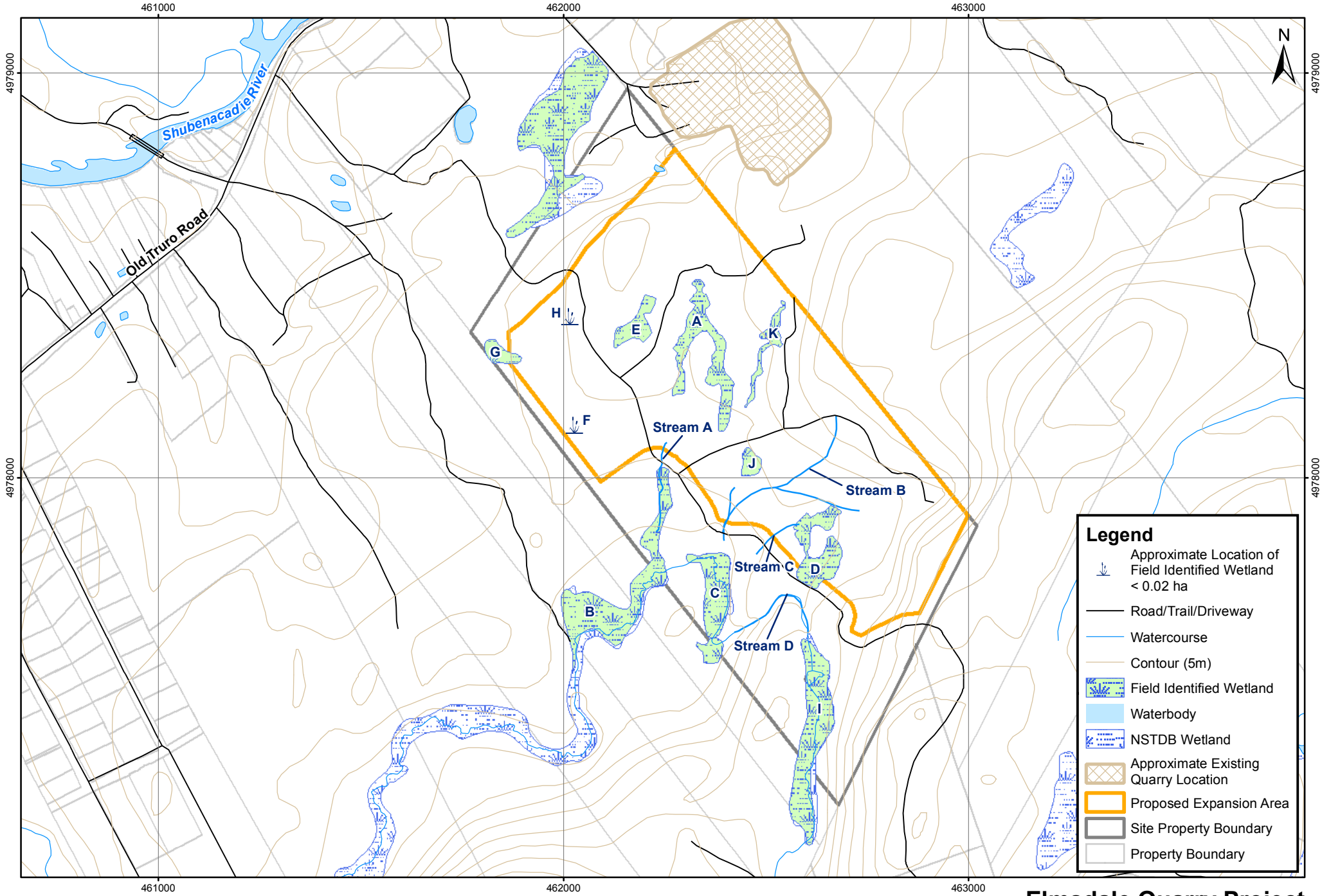
As the stream flowed farther south, it became a series of riffles and pools before gradually becoming braided, poorly defined and draining into Wetland B (Photograph 3, Appendix E).

Stream B

Stream B appeared to be a short ephemeral watercourse and originated approximately 120 m north of the road. Terrestrial vegetation was observed within the stream channel confirming the periodic nature of the water flow. The wet width of the upstream reach was approximately 0.3 m. The bottom substrate consisted of fine grained sand and deep organic sediments and detritus. The general appearance of the water colour was a tea-stained light yellow/brown, likely due to the high organic (humic) content.

This short stream flowed south through mature mixed woods. Dense canopy cover was present and mosses and ferns were the dominant plant types in the riparian zone.

Physical units along the upstream reach of the stream consisted mainly of slow moving flats and runs (Photograph 4, Appendix E). The stream became progressively more defined, flowing over a small cascade before crossing the road (Photograph 5, Appendix E). The stream then flowed over the road into a wide beaver flooded area (Photograph 6, Appendix E). The wet width of the stream was approximately 30 cm along its course and had a mean depth of 20 cm.



Map Parameters
Projection: UTM-NAD83-Z20
Scale 1:12,000
Date: May 1st, 2007
Project No: 1013296
Data Source: NSGC, NSDNR, JW Field Survey

Figure 5.1
Wetlands & Surface Water

0 140 280 560
Meters

Elmsdale Quarry Project

Jacques Whitford

Stream C

Stream C flowed in a south-westerly direction from a mixed wood wetland approximately 100 metres upstream of the road and flowed through mature mixed woods.

Along the surveyed reach, the stream changed from a low flow pool into a series of fast flowing riffles and pools with gravel and cobble for bottom substrate. The mean wet width of the channel was 1.5 m with some braiding of the channel downstream. Instream cover was high and consisted of roots, snags and other coarse woody debris. Dense canopy cover (70-100%) was present along the length of the watercourse. Mosses and ferns were the dominant plant types in the riparian zone (Photograph 7, Appendix E).

Stream D

Stream D was surveyed along a short section below the beaver dam at the outlet of the wetland located at the southern tip of the property boundary (Photographs 8 and 9, Appendix E).

Immediately below the beaver dam the stream profile was steep and consisted of a series of cascades and shoots. The average width of the stream below the beaver dam was 3 m with an approximate depth of 50 cm. The substrate was predominantly boulder and bedrock (Photograph 10, Appendix E).

This stream flows westerly through a series of wetlands and receives flow from at least two tributaries before turning north to join the Shubenacadie River.

Summary

Habitat suitable to support fish was observed in streams A and D, with habitat for resident fish populations observed in streams B and C. No fish were caught for positive identification as DFO regulations prohibit electro-fishing in the waters and tributaries of the Shubenacadie River; however, some small fish (likely sticklebacks) were observed in the lower reaches of Stream A and several brook trout (*Salvenius fontinalis*) were observed in Stream D near the confluence with Stream A earlier in the year during terrestrial surveys. No fish were observed in streams B and C during field surveys.

The Shubenacadie River provides habitat for a variety of anadromous and freshwater fishes, some of which support important commercial and recreational fisheries. The tidal waters of the Shubenacadie River provide access to fresh water for anadromous fish species to spawn, and access to the ocean for their offspring to mature. American eel (*Anguilla rostrata*), gaspereau (Alewife) (*Alosa pseudoharengus*), striped bass (*Morone saxatilis*), Atlantic salmon (*Salmo salar*), brown trout (*Salmo trutta*) (an introduced species) and brook trout all inhabit the Shubenacadie River. Stream D flows for approximately 5 km over gently sloping terrain prior to entering the Shubenacadie River. Due to this connection to the Shubenacadie and its large size, Stream D may provide spawning and nursery areas for Shubenacadie fish populations, particularly brook trout. The Inner Bay of Fundy populations of Atlantic salmon (including the population in the Shubenacadie River) are listed as endangered on Schedule 1 of the federal *Species at Rick Act* (*SARA*). It is unlikely that salmon occur in Steams A and D, given their small size and paucity of suitable spawning habitat (*i.e*., well aerated gravel beds). The population of striped bass in the Shubenacadie River is designated as threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Striped bass spawn in the Stewiacke River at the head of tide and spend the rest of the year in the Shubenacadie and Stewiacke Rivers, the

estuary of the two rivers and Grand Lake. Striped bass do not normally occur in small, shallow streams and thus are unlikely to be found in the streams on the proposed expansion property.

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

The planned area for quarry expansion in the near future (*i.e.,* five years) is not located in close proximity to the streams identified on the property. However, further authorization may be required in the future if quarry expansion is predicted to directly overlap with fish habitat. Fisheries and Oceans Canada (DFO) has developed the *Policy for the Management of Fish Habitat* (1986), which applies to all development and industrial projects, both large and small, in or near watercourses that could alter, disrupt, or destroy fish habitat by chemical, physical, or biological means. The guiding principle of this policy is to achieve no net loss of the productive capacity of fish habitats. The regulatory instrument for approving the habitat loss and ensuring adequate compensation is the harmful alteration, disruption or degradation (HADD) authorization. A key requirement for this authorization would be the development of a suitable fish habitat compensation plan for the loss of fish habitat. This policy may be applied to the Project in the future if the proponent desires to alter or otherwise disturb fish habitat on-site and will require further consultation with DFO representatives. However, in the interim, as specified in Nova Scotia Pit and Quarry Guidelines, no active areas will be located within 30 m of the banks of all streams identified on the property and natural vegetation will be maintained within this buffer. No Project-related vehicles will be driven through streams.

Clearing, grubbing, and topsoil stripping activities can increase the potential for sediment erosion and deposition downgradient, particularly during periods of heavy rainfall or snow melt. These activities will also result in a reduction of evapotranspiration and a corresponding increase in surface runoff, which in turn increases potential for sediment erosion and deposition. Due to their connection to the Shubenacadie River, the concern with this Project is the potential sedimentation effects on fish habitat present in streams A and D.

The placement of free-draining material (*i.e.,* blasted rock) over disturbed areas and the use of properly sized flow retention structures are expected to mitigate erosion and sedimentation effects. As the quarry develops, exposed soil capable of producing sediment laden-runoff will be stabilized with blasted rock and stockpiles of topsoil and overburden will be stabilized with hydroseed. Additional retention capacity on the quarry floor will be created as the quarry develops and additional settling pond(s) will be installed, as needed. A stormwater management plan will be submitted as part of the quarry development plan during the Industrial Approval application process.

As discussed in Appendix B, the Proponent will construct future settling ponds so as to maintain current drainage patterns to sub-watersheds. Surface runoff will be directed to the settling pond(s). Overflow from the final settling ponds will be monitored and sampled in accordance with the terms and conditions of the existing Approval (and future updates) and the Pit and Quarry Guidelines to ensure suspended solids levels do not exceed the approved final effluent discharge limits. Details on proposed discharge locations and outlet structures will be submitted to DFO as part of the quarry development plan during the Industrial Approval application process.

As discussed in Section 5.6.2, a groundwater monitoring program will be designed to ensure that changes in groundwater flow patterns and water quality are detected proactively such that measures can be employed to mitigate potential adverse effects to local groundwater and surface water.

A phased approach to development 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. Linking site expansion to environmental effects management performance criteria is an effective mitigation strategy to deal with uncertainties and ensure sustainable development.

Based on the results of the fish and fish habitat assessment 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. In the unlikely case that at-risk fish species are present in any if the streams, suggested mitigation precludes interaction between quarry expansion and at-risk fish populations. Effects of quarry expansion are not predicted to occur in the Shubenacadie River which is core habitat for at-risk fish species such as Atlantic salmon and striped bass.

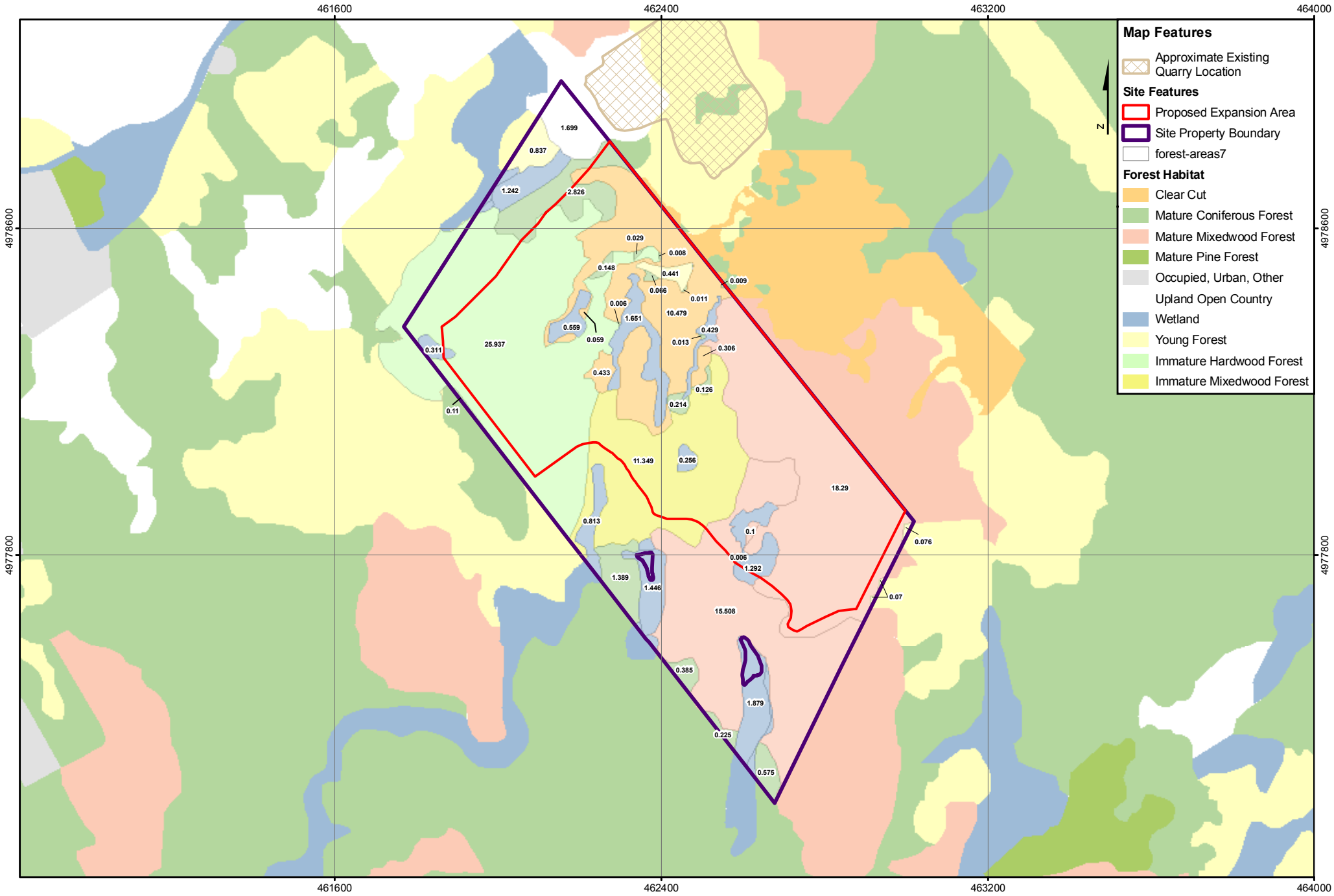
5.3 Rare and Sensitive Flora

5.3.1 Description of Existing Conditions

The site was surveyed by a senior terrestrial ecologist (Mr. Michael Crowell) on June 13, July 4, August 10 and August 18, 2006. Vascular plant inventories of the property were compiled on July 4 and August 10. The botanical survey conducted on August 18 was restricted to one of the wetlands found on the property. The study area consisted of the proposed quarry expansion area. The proposed expansion area supports a number of habitat types including mature second growth mixedwood and coniferous forest, immature mixedwood forest, semi-barrens, recent clear-cuts, disturbed areas and wetlands. Figure 5.2 shows the distribution of these habitats in the study area.

The northern portion of the property adjacent to the existing quarry site has been subject to timber harvesting. Vegetation cover consists mainly of stump sprouts of red maple (*Acer rubrum*) and paper birch (*Betula papyrifera*) as well as surviving understory plants including bracken fern (*Pteridium aquilinum*), sheep-laurel (*Kalmia angustifolia*), late lowbush blueberry (*Vaccinium angustifolium*) and velvetleaf blueberry (*Vaccinium myrtilloides*). The total area of this habitat type present in the study area is 11.3 ha, of which 11.2 ha (99%) will eventually be lost as a result of quarry expansion.

Immature mixedwood forest is found in the central part of the property south of the existing quarry and along the sides of the access road. Approximately 11.3 ha of this habitat is present within the property boundary. It is estimated that 8.1 ha (71%) will be lost as a result of quarry expansion. These young stands are composed mainly of red maple, paper birch, balsam fir (*Abies balsamea*) and red spruce (*Picea rubens*). The understory of these stands typically supports a moderate cover of sheep-laurel, late lowbush blueberry and velvetleaf blueberry. Most of these stands occur on moderately well drained stony soils.



Map Parameters
Projection: UTM-NAD83-Zone20
Scale 1: 12,000
Date: June 01st, 2007
Project No.: 1013296
Habitat: NSDNR, 2006

Figure 5.2
Terrestrial Habitat in the Study Area

0 100 200 400 600 800 Metres

Jacques Whitford

The northeastern end of the property is occupied by immature hardwood. This habitat consists of an open tree canopy composed mainly of red maple and paper birch, with some red spruce, and white pine also present. Development of the tree canopy is limited by the presence of a dense cover of ericaceous shrubs composed mainly of sheep-laurel, blueberries, and black huckleberry (*Gaylussacia baccata*). Possum-haw viburnum (*Viburnum nudum*) is also abundant in these stands. This habitat type is typically found on dry rocky sites where bedrock is close to the surface. Approximately 25.9 ha of this habitat type is present within the property boundary. Approximately 15.7 ha (61%) will be lost as a result of expansion of the quarry.

Mature second growth mixedwood forest is found mainly along the southern end of the proposed quarry expansion area. Most mature mixedwood stands on the property are composed of a mixture of red spruce, balsam fir, paper birch and red maple. In richer areas, the hardwood species are more abundant and yellow birch (*Betula alleghaniensis*) is present. Balsam fir is also more abundant in the richer areas. Approximately 40.0 ha of mature mixedwood forest is found within the property boundary. Approximately 20.9 ha (52%) of this habitat will be lost as a result of quarry expansion.

Mature second growth conifer stands are present in more poorly drained sites such as areas around the margins of wetlands. These stands are dominated by a mixture of black spruce (*Picea mariana*), red spruce, balsam fir, and some red maple. These stands were too small to be mapped.

Twelve wetlands are found on the property, five of which are located within or adjacent to the proposed quarry expansion area. The five wetlands located within the proposed quarry expansion support a variety of wetland plant communities including mixedwood treed stream swamp, mixedwood treed basin swamp, coniferous treed basin swamp, and basin marsh. The total area of wetland habitat present in the Project area is 9.9 ha. Approximately 4.1 ha (41.3%) of this habitat will be directly affected by quarrying activities. Wetlands are further discussed in Section 5.4.

The mixedwood treed stream swamp is characterized by an open tree canopy composed largely of red maple, balsam fir and white ash (*Fraxinus americana*). The mixedwood treed basin swamp is characterized by a relatively open tree canopy that is dominated by a mixture of red maple and black spruce and a moderately dense tall shrub understory composed of speckled alder (*Alnus incana*) and black holly (*Ilex verticillata*).

The deciduous treed basin swamp was found in a recently flooded basin. Prior to flooding this wetland habitat would have been mixedwood treed basin swamp. Black spruce, although tolerant of wet conditions, is intolerant of fluctuations in water level and has been largely eliminated from this wetland habitat.

Coniferous treed basin swamp in the proposed quarry expansion area is characterized a moderately dense tree overstory predominantly composed of black spruce and American larch (*Larix laricina*) and a dense shrub understory composed mainly of rhodora (*Rhododendron canadense*).

The low shrub dominated stream swamp habitat consists of a dense low shrub cover of sweet bay berry (*Myrica gale*), narrow-leaved meadow-sweet (*Spiraea alba*) and leatherleaf (*Chamaedaphne calyculata*) with scattered patches of taller speckled alder.

Basin marsh habitat is restricted to areas of wetland habitat that have been disturbed by forest harvesting activities. This wetland habitat is dominated by herbaceous graminoid species, the most

abundant of which are cottongrass bulrush (*Scirpus cyperinus*), soft rush (*Juncus effusus*), and little prickly sedge (*Carex echinata*). Prior to forest harvesting, this habitat would have been mixedwood treed basin swamp.

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 modelling exercise, all records of vascular plant species listed by the Nova Scotia Department of Natural Resources (NSDNR) as at risk (Red listed) or sensitive to human activities or natural events (Yellow listed) (NSDNR 2005) within a radius of 100 km were compiled by means of an Atlantic Canada Conservation Data Center (ACCDC) data search. The habitat requirements of these species were compared to the habitat descriptions compiled for the Project Area to determine if suitable habitat was present for these species. In instances where appropriate habitat was present for a particular species, that species was considered to be potentially present and the suitable habitat in the Project Area 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 the best times to conduct the field surveys.

A total of 121 Red or Yellow-listed species have been recorded within 100 km of the Project Area. Based on the results of the habitat model, 25 Red or Yellow-listed species could potentially be present in the Project Area. Table 5.1 lists these species and the habitats present in the Project Area where they could potentially be found.

TABLE 5.1 ACCDC Vascular Plants Potentially Found in Project Area

Binomial	Common Name	NSDNR Rank	Preferred Habitat	SARA Rank	ACCDC Rank
Carex castanea	Chestnut-colored Sedge	Red	Swamps and wet meadows, cliff crevices and ledges.	Not listed	S2
Carex tuckermanii	Tuckerman Sedge	Red	Swales	Vulnerable	S1
Goodyera pubescens	Downy Rattlesnake Plantain	Red	Woodlands and thickets. Usually found in dry or moist coniferous or mixed woods, often in a sandy soil.	Not Listed	S1
Hepatica nobilis	Round-lobe Hepatica	Red	Dry, usually mixed deciduous forest.	Not listed	S1
Listera australis	Southern Twayblade	Red	Among the shaded sphagnum moss of bogs or damp woods.	Not listed	S1
Botrychium simplex	Least Grape-fern	Yellow	Usually on lakeshores or the mossy edges of streams or waterfalls although it has been reported in a wide variety of habitats.	Not listed	S2S3
Empetrum eamesii ssp. atropurpureum	Purple Crowberry	Yellow	Exposed sand dunes, infrequently around bogs and occasionally in rocky habitat.	Not listed	S2S3
Viola nephrophylla	Northern Bog Violet	Yellow	Cool mossy bogs, the borders of streams, and damp woods.	Not listed	S2
Viola sagittata	Arrow-leaved Violet	Yellow	Dry sterile woods, clearings and fields.	Not listed	S3S4
Ranunculus flammula var. flammula	Greater Creeping Spearwort	Yellow	Semi-aquatic, in bogs and cold streams.	Not listed	S2

TABLE 5.1 ACCDC Vascular Plants Potentially Found in Project Area

Binomial	Common Name	NSDNR Rank	Preferred Habitat	SARA Rank	ACCDC Rank
Rubus pensylvanicus	Pennsylvania Blackberry	Yellow	Thickets, the edges of woods and clearings.	Not listed	S3?
Rudbeckia laciniata	Cut-leaved Coneflower	Yellow	Swales, the edges of swamps, or in gullies.	Not listed	S2S3
Salix pedicellaris	Bog Willow	Yellow	Acid bogs and sphagnous lakes.	Not listed	S2
Salix sericea	Silky Willow	Yellow	Low thickets and stream banks	Not listed	S2
Polygala sanguinea	Field Milkwort	Yellow	Poor or acidic fields, damp slopes, and open woods or bush.	Not listed	S2S3
Ophioglossum pusillum	Adder's Tongue	Yellow	Sterile meadows, grassy swamps, and damp, sandy, or cobbly beaches of lakes.	Not listed	S2S3
Lindernia dubia	Yellow-Seed False-Pimpernel	Yellow	Wet areas and the muddy edges of streams. Drained millponds and gravel pits.	Not listed	S3S4
Hudsonia ericoides	Golden-Heather	Yellow	Dry rocky and sandy barrens. Recently disturbed areas or on open sandy soils.	Not listed	S2
Gratiola neglecta	Clammy Hedge-hyssop	Yellow	Usually in wet or muddy places.	Not listed	S1
Fraxinus nigra	Black Ash	Yellow	Low ground, damp woods and swamps.	Not listed	S3
Eriophorum gracile	Slender Cotton-Grass	Yellow	Wet peat and inundated shores.	Not listed	S2
Epilobium strictum	Downy Willow-Herb	Yellow	Boggy areas and wet meadows.	Not listed	S3
Epilobium coloratum	Purple-Leaf Willow-Herb	Yellow	Low-lying ground, springy slopes and similar locations.	Not listed	S2?
Cypripedium parviflorum var. pubescens	Large Yellow Lady's-Slipper	Yellow	Rich calcareous woodlands, also in drier sections of seepage fed wetlands or old beaver pond wetlands.	Not listed	S2
Calamagrostis stricta ssp. stricta	Northern Reedgrass	Yellow	Damp woods and shaded cliffs.	Not listed	S1S2
Atlantic Canada Conservation Data Centre Species Rank Definitions					
S1	Extremely rare throughout its range in the province (typically 5 or fewer occurrences or very few remaining individuals). May be especially vulnerable to extirpation.				
S2	Rare throughout its range in the province (6 to 20 occurrences or few remaining individuals). May be vulnerable to extirpation due to rarity or other factors.				
S3	Uncommon throughout its range in the province, or found only in a restricted range, even if abundant at some locations. (21 to 100 occurrences).				
S#S#	Numeric range rank: A range between two consecutive numeric ranks. Denotes uncertainty about the exact rarity of the species (*e.g.*, S1S2)				
S#?	Inexact or uncertain ranking.				
Nova Scotia Department of Natural Resources General Status Ranks					
Red	Known to be or thought to be at risk.				
Yellow	Sensitive to human activities or natural events.				
Source: ACCDC 2006; NSDNR 2006					

The results of the habitat modeling exercise indicate that virtually all habitat types present in the Project area could potentially harbour rare species that have been recorded within a 100 km radius of the Project area. As such, during the field surveys, all habitat types present in the study area were surveyed. The model results suggest that surveys should be conducted in April, June and August to

detect all of the 25 species identified by the model as potentially present during the period when they are in flower. Flowering specimens are often required for vascular plant identification, particularly by inexperienced botanists. The Project area was visited by an experienced botanist on June 13, July 4, August 10 and August 18. One of the 25 species that could potentially be present, silky willow (*Salix sericea*), flowers between late March and early May. It was not possible to conduct a site visit early enough to detect this species in flower. Fortunately, this species is quite distinctive, having narrowly elliptic leaves with dense silvery hairs on the undersides of the leaves. No willows having these characteristics were encountered in the Project area.

The results of the vegetation surveys conducted in the proposed quarry expansion area are presented in Appendix F. A total of 242 vascular plant species were recorded on the property. All species of vascular plant encountered during the surveys were identified and their population statuses in Nova Scotia were determined through a review of the species status reports prepared by NSDNR (NSDNR 2003), ACCDC (ACCDC 2006), and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2006).

Four vascular plant species listed as uncommon by ACCDC were recorded during the field survey including alderleaf buckthorn (*Rhamnus alnifolia*), Bicknell northern crane's-bill (*Geranium bicknellii*), large purple-fringe orchis (*Platanthera grandiflora*), and swamp rose (*Rosa palustris*). All of these species with the exception of alderleaf buckthorn are considered by the Nova Scotia Department of Natural Resources (NSDNR) to have secure populations in Nova Scotia. Alderleaf buckthorn is categorized as a Yellow listed species by NSDNR according to the Nova Scotia General Status of Wild Species database, indicating that the Nova Scotia population is sensitive to human activities and natural events.

Rhamnus alnifolia (Alderleaf Buckthorn) was observed in Wetlands B, D and K. This species was most abundant in the northern half of Wetland B where approximately 80 alderleaf buckthorn shoots were encountered. Twenty-four alderleaf buckthorn shoots were noted in Wetland K and five shoots were noted in Wetland D. This species is generally found in calcareous bogs, swamps, swampy woods and meadows. The literature suggests that it is associated with rich or calcareous sites. The initial air photo interpretation and site visit suggested that wetlands in the study area were unlikely to be nutrient rich or calcareous. As such, alderleaf buckthorn was not identified in the rare plant model as potentially present in the study area. Subsequent vegetation surveys revealed the presence of this species in three of the wetlands. The areas where alderleaf buckthorn was found were typically ground water seepage areas. These areas were typically characterized by the presence of a mixture of plant species characteristic of moderately nutrient rich wetlands. In 2006, the botanist who conducted the vegetation surveys also encountered alderleaf buckthorn in moderately rich upland sites (clear-cuts) in the Stewiacke area and in nutrient poor swamps in New Brunswick suggesting that this species is not restricted to calcareous or nutrient rich wetlands. In 2006, Jacques Whitford biologists found this species in three locations near Alton, Colchester County, suggesting it may not be as restricted as the literature would suggest.

Bicknell northern crane's-bill was found in Wetland A and in several locations in recent clear-cuts situated in the northern part of the study area. The single plant found at Wetland A occurred in a relatively dry area at the edge of the wetland. This species is typically found in recently burned or cleared areas.

Purple-fringe orchis was found in Wetlands B and D. It occurred in moderately rich groundwater seepage areas and at both locations it was associated with alderleaf buckthorn. Swamp rose was also found in moderately rich swamp habitats. It was recorded in Wetlands A, B, D, and K.

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

Expansion of the quarry will result in the loss of all but one of the wetlands within which alderleaf buckthorn, swamp rose and purple-fringe orchis were found. All of the sites where Bicknell northern crane's-bill was found will be lost as a result of quarry expansion. The Nova Scotia populations of swamp rose, Bicknell northern crane's-bill, and purple-fringe orchis are considered to be secure in Nova Scotia and the loss of these species from the proposed quarry expansion area would not significantly adversely affect their populations in the province.

Alderleaf buckthorn is considered to be uncommon by ACCDC but is considered by NSDNR to be sensitive to anthropogenic activities and natural events. The proposed quarry expansion will result in the loss of two of the wetlands in which this species was found. These wetlands (D and K) contain 27% of the total number of alderleaf buckthorn shoots found on the property. The remaining 73% of alderleaf buckthorn shoots were found in Wetland B which will not be physically disturbed as a result of expansion of the quarry. However, as quarrying progresses, Wetland A, an important source of water for Wetland B will be lost resulting in hydrological changes to Wetland B. This could adversely affect the alderleaf buckthorn population in Wetland B. These hydrological effects could be mitigated during the operational phase of the quarry by pumping water from the pit into Wetland B using a settling pond to help regulate water flow. It would probably not be feasible to carry on with this mitigation once the quarry was decommissioned. At this point the only mitigation option (in addition to general wetland habitat compensation) would be to relocate the population. Transplantation is generally not recommended since the habitat requirements for most rare plant species are poorly understood; consequently, the potential for failure is high. In this instance avoidance does not appear to be feasible and moving the alderleaf buckthorn may be the only available form of mitigation.

As part of the wetland compensation program for the Project it is recommended that wetland habitat be created in portions of the quarry that are depleted of quarriable material. Creation of these wetlands would involve salvaging substrate and plant material from the wetlands that would be lost as a result of quarry expansion. As part of the wetland creation program, alderleaf buckthorn could be transferred to these new wetlands or alternatively they could be moved to similar wetlands in the local area. Relocation of the plants will be carried out over a number of years so that transplantation and wetland reconstruction techniques can be improved over time. It will take many years for the quarry expansion to be completed, so the ability to spread the relocation project out over a number of years would be possible. It is recommended that quarrying in the watersheds of Wetlands A and B, D and K be delayed until monitoring studies demonstrate that the populations relocated into constructed wetlands or adjacent natural wetlands have successfully established. The mitigation/salvage and monitoring plans will be developed in consultation with NSEL and NSDNR.

Other mitigation employed in the expansion of the quarry will include the use of progressive reclamation and the use of native plant species wherever possible in the reclamation process. In the progressive reclamation process only the area needed for quarry expansion in any one year would be grubbed. The subsoil, topsoil and root mat of this area would be placed in a portion of the pit that is no longer in

use. Topsoil and root mat would be stockpiled temporarily (no more than one year) until the subsoil was placed. The topsoil would then be placed over the subsoil and dressed with the root mat. The root mat would provide a source of native plant species propagules in the form of buried seeds, roots, shoots and rhizomes as well as soil micro-organisms. 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 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 not aggressive weeds in the barrens, wetland and forest plant communities which are present in the area should be used for reclamation.

In summary, significant Project-related effects on rare or uncommon flora are not likely to occur provided mitigative measures are employed.

5.4 Wetlands

5.4.1 Description of Existing Conditions

Twelve wetlands, either within or directly adjacent to the proposed Elmsdale Quarry Project, were identified through available data and field observations conducted by a senior terrestrial ecologist (Mr. Michael Crowell). The locations of the wetlands are mapped on Figure 5.1. The wetland located to the northwest of the proposed expansion site will be avoided and is not discussed further in this report.

The wetlands that will be potentially affected by the undertaking were evaluated during multiple detailed field surveys conducted in 2006 (see Section 5.3 for specific dates). The wetland surveys collected a variety of information including the type of wetland and a description of its hydrology, a description of the wetland habitat types present in the wetland, inventories of vascular plants, birds, mammals, reptiles and amphibians present in the wetland, any evidence of anthropogenic use of the wetland, and any evidence of damage to the wetland caused by anthropogenic activities. The information collected for each wetland was derived largely from field surveys since there is little existing information for most wetlands in Nova Scotia. The sizes and locations of the wetlands were determined from interpretation of 1:10,000 scale air photography, the NSDNR Wetland Inventory Database and from delineation of the margin of the wetlands on the ground using a Garmin GPS 12 global positioning system.

The wetland type, size, key functions and likelihood of alteration are summarized in Table 5.2.

Generally, the wetlands on site have been heavily impacted due to past disturbance from forestry practices. The Project site is dominated by second and third growth forest, twenty to thirty years in age. The existing wetlands have been impacted by previous harvesting, as evidenced by tree stumps, tractor ruts and slash of varying ages throughout the systems. A large portion of the forested swamp habitat in Wetland A has been harvested by a previous owner; piles of slash remain in the wetland, and the activity of vehicles has created open water channels in the wetland. Approximately two-thirds of Wetland K is similarly impacted.

TABLE 5.2 Wetlands Found Within or Immediately Adjacent the Proposed Quarry Boundaries

Wetland ID	Size	Location/boundaries	Type	Potential for Alteration
A	*1.651 ha*	Northern central area of property, south side of the northern logging road	Complex of undisturbed mixedwood forest basin swamp and basin marsh (formerly mixedwood forest swamp, recently flooded and disturbed by skidders)	Within Quarry Boundaries; direct alteration proposed
B	*2.92 ha*	Western central extent of property and extending beyond the southwestern boundary of the property.	Complex of mixedwood forested stream swamp (old beaver pond) and low shrub dominated stream swamp (beaver flooding)	Indirect alterations as a result of upstream hydrological changes
C	*1.252 ha & 0.28 ha*	Southwestern extent of property	Low shrub dominated stream swamp (beaver flooding)	Indirect alterations as a result of upstream hydrological changes
D	*1.292 ha*	South central, along the logging road that bisects the property NW to SE	Complex of mixedwood forest stream swamp and deciduous forest basin swamp (recently flooded and showing stress)	Within Quarry Boundaries; direct alteration proposed
E	*0.559 ha*	North central; north side of the northern logging road	Coniferous forested basin swamp, partially harvested	Within Quarry Boundaries; direct alteration proposed
F	*<0.02 ha*	Northwestern extent of property	Small anthropogenic swamp	Within Quarry Boundaries; direct alteration proposed
G	*0.32 ha*	Northwestern extent of property	Small anthropogenic swamp	Unlikely to be affected by proposed project
H	*<0.01 ha*	Northwestern extent of property	Small anthropogenic swamp created by road	Within Quarry Boundaries; direct alteration proposed
I	*2.522 ha*	Extreme southern extent of property	Low shrub dominated stream swamp	Unlikely to be affected by proposed project
J	*0.256 ha*	Approximate centre of the property	Possible wetland, not observed in the field	Within Quarry Boundaries; direct alteration proposed
K	*0.429 ha*	Northeastern area of property, south side of the northern logging road	Complex of undisturbed mixedwood forest basin swamp and basin marsh (formerly mixedwood forest swamp, recently flooded and disturbed by skidders)	Within Quarry Boundaries; direct alteration proposed

All species of vascular plant and animal encountered during the surveys were identified and their population statuses in Nova Scotia are determined through a review of the species status reports prepared by NSDNR (NSDNR 2006), ACCDC (ACCDC 2006), and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2006). Three species listed as uncommon (S3) were identified during the detailed field surveys: Bicknell northern crane's-bill (*Geranium bicknellii*), alderleaf buckthorn (*Rhamnus alnifolia*), swamp rose (*Rosa palustris*), and large purple-fringe orchid (*Platanthera grandiflora*) (refer to Section 5.3). With the exception of alderleaf buckthorn, these species are provincially listed as "green" or not believed to be sensitive or at risk.

Alderleaf Buckthorn (*Rhamnus alnifolia*) a provincially designated "Yellow" species (*i.e.,* known to be sensitive to human activities and natural events according to the Nova Scotia General Status of Wild Species database) was identified in Wetlands B, D, and K. Recently, Jacques Whitford biologists have been observing this species in areas throughout central Nova Scotia, suggesting that it may not be as restricted as the literature would suggest.

Wetland J was identified as potential wetland habitat during aerial photograph interpretation; however this wetland was not observed in the field. It will be assumed that there is no wetland in this location. Wetlands F, G, H, and I have very little potential to be affected by the proposed quarry expansion due to their location in the watershed and the commitment to avoid these wetlands in quarrying activities; these wetlands will not be discussed further in this document. The remaining six wetlands (Wetlands A, B, C, D, E, and K) have the potential to be affected by the proposed quarry expansion either directly or indirectly and will be evaluated in this document.

The following is a summary of the dominant vegetation communities observed in the wetlands that may be impacted by the proposed quarry expansion.

Wetland A

Wetland A is a complex of undisturbed mixed wood forest basin swamp and former mixed wood forest basin swamp which now resembles a basin marsh as a result of deforestation and heavy disturbance from skidders.

The undisturbed portion of Wetland A, a small area in its western branch, is characterised by a tree canopy dominated by red maple (*Acer rubrum*) and black spruce (*Picea marina*). Balsam fir (Abies balsamea), grey birch (*Betula populifolia*), and American larch (*Larix laricina*) are also present. The shrub understory of this wetland type is composed primarily of speckled alder (*Alnus incana*). Black spruce, (*Picea marina*), black huckleberry (*Gaylussacia baccata*), black holly (*Illex verticillata*), and balsam fir (*Abies balsamea*) are also present. Ground vegetation is dominated by a discontinuous mat of Sphagnum moss (*Sphagnum spp*.), with sedges (*Carex echinata and Carex gynandra)*, bristly dewberry (*Rubus hispidus)*, American mannagrass (*Glyceria grandis*), cinnamon fern (*Osmunda cinnamomea)*, violets (*Viola* sp.) and open pools.

The disturbed portion of the wetland has no remaining trees. The vegetation is dominated by herbaceous species such as broad-leaf cattail (*Typha latifolia),* sedges (*Carex echinata, Carex lurida, Carex folliculata*), soft rush (*Juncus effusus*), blue-joint reedgrass (*Calamagrostis canadensis*), and tawny cotton-grass (*Eriophorum virginicum*), along with a few shrubs such as red maple (*Acer rubrum*) saplings and speckled alder (*Alnus incana*).

Wetland B

Wetland B is described as a mixed wood forested stream swamp with a portion of low shrub dominated stream swamp.

The northern half of Wetland B follows a small tributary to Beaver Brook. The remainder of Wetland B is situated along the main channel of the Brook.

The treed portion of Wetlands B is dominated by a dense cover of second growth red maple (*Acer rubrum*) and balsam fir (*Abies balsamea*) with white ash (*Fraxinus americana)* interspersed. The understory is a relatively open, with a continuous mat of sphagnum moss (*Sphagnum spp.*), as well as dwarf red raspberry (*Rubus pubescens*) cinnamon fern, sensitive fern (*Onoclea sensibilis*), parasol white-top aster (*Aster umbellatus*), and marsh blue violet (*Viola cucullata*).

The low shrub portion of the swamp, mainly along Beaver Brook, is largely free of trees, and is dominated by sweet bayberry (*Myrica gale),* speckled alder (*Alnus incana*) and large-leaved meadowsweet (*Spiraea latifolia*) with leatherleaf (*Chamaedaphne calyculata*) also present. The understory is dominated by blue joint reed-grass, tussock sedge (*Carex stricta)* and Canada manna-grass (*Glyceria canadensis).*

Wetland D

Wetland D is a complex of mixedwood forest stream swamp and deciduous forest basin swamp (recently flooded and showing stress).

The mixedwood forest stream swamp portion is characterized by a canopy dominated by red maple and balsam fir, with black spruce (*Picea mariana*), white ash, and eastern white pine (*Pinus strobus)* also present. The shrub understory is dominated by speckled alder, along with young or stunted balsam fir and black spruce. Ground vegetation is composed mainly of a mat of Sphagnum moss and cinnamon fern, with royal fern (*Osmunda regalis)*, violet and wild sarsaparilla (*Aralia nudicaulis)* interspersed.

The deciduous forest basin portion of the swamp is composed of a sparse cover of a red maple and balsam fir along with a few black spruce. Shrubs in this portion of the wetland include speckled alder, black holly (*Illex verticillata),* balsam fir saplings, and stunted black spruce (*Picea mariana).* Ground cover is composed of a sphagnum moss mat and cinnamon fern, with marsh fern (*Thelypteris palustris*) and sensitive fern, three-seed sedge (*Carex trisperma*) and blue joint reed-grass also present in notable density.

Wetland E

Wetland E is described as a coniferous forested basin swamp, with an area that has been partially harvested in its northeastern lobe.

The disturbed area is treeless, dominated by a shrub community that consists mainly of rhodora (*Rododendron canadense)* with lesser amounts of black spruce, black huckleberry (*Gaylussacia baccata),* speckled alder, Labrador tea (*Ledum groenlandicum*), balsam willow (*Salix pyrifolia*), black holly, grey birch (*Betula populifolia*) and red maple. The groundcover is primarily three seed sedge and tawny cotton-grass, with sphagnum moss, and bristly dewberry (*Rubus hispidus).*

The undisturbed portion of the wetland is dominated by essentially the same shrub species; however a canopy of trees dominated by black spruce, American larch (*Larix laricina)*, red maple and grey birch is present. Ground cover is dominated by a mat of sphagnum moss*,* three seed sedge and three-leaf Solomon's plume (*Smilacina trifoila*).

Wetland K

Wetland K is described as a mixed wood treed basin swamp with a portion of seepage tract marsh (formerly mixed wood treed swamp).

The western portion of this wetland is largely disturbed by forest harvesting and tractor ruts (~60%). The undisturbed portion in its north eastern lobe is dominated by a canopy of red maple, with white ash, black spruce, and balsam fir. The shrub understory is dominated by speckled alder, and black holly, with saplings of balsam fir and black spruce. The understory is largely dominated by sphagnum moss and cinnamon fern, with sedges (*Carex trisperma* and *Carex echinata*), marsh fern and dwarf red raspberry.

The disturbed portion is characterized by the presence of a few surviving mature quaking aspen (*Populus tremuloides*), as well as young red maple, speckled alder and balsam fir. The understory is largely composed of fowl manna-grass (*Glyceria striata)* and sedges (*Carex echinata, Carex folliculata and Carex crinata*). Canada manna-grass (*Glyceria candensis),* parasol white-top and broad-leaf cattails were also noted.

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

Quarry development could result in the loss of wetlands located within the proposed expansion area (Wetlands A, B, D, E and K). Generally, wetland habitat loss is of particular concern to provincial regulators since wetlands are recognized as productive natural areas that are transitory between terrestrial and aquatic ecosystems. Wetlands often support a large diversity and abundance of organisms and are often threatened by development activities.

Wetlands often coincide with areas suitable for quarrying since bedrock is usually near the surface and the areas are often poorly drained. In areas where the Goldenville formation is near surface, the landscape is typically poorly drained and undulating and highly favorable to the formation of wetlands. Given the extent of wetlands in the study area, total avoidance of wetlands would render most of the property unusable and would therefore not be feasible for this Project. The Proponent had originally planned expansion into a larger portion of the property but scaled back the area of the proposed expansion in consideration of the wetland habitat and streams located at the southwestern end of the property. Proposed methods to minimize disturbance are provided in Table 5.3. Complete wetland functional analysis will be included as part of the Division I Water Approval application.

In consultation with NSEL, Gallant Aggregates will commit to quarry set backs from Wetlands B, C, G, and I.

TABLE 5.3 Methods to Minimize Impact on Wetland Function and Values

Functions and Values	Potential Impact	Potential Mitigative Methods or Design	Residual Effects
Environmental ▪ Head water storage for wetlands lower in local watershed, as well as Beaver Brook ▪ Potentially, groundwater recharge for Beaver Brook Watershed.	The loss of wetlands to moderate the runoff in the upper areas of the watershed may cause "flashy" hydrology in lower portions of the watershed, affecting ecological function of aquatic habitat (*i.e.,* Beaver Brook and Wetlands B & C)	▪ Use of flow retention structures	The hydrological contributions from the Gallant Aggregates property are expected to be minor.
	Loss of wetlands on the property may reduce local groundwater recharge.	Plan progression of the quarry incrementally to minimize the open pit area at any one time. This can be achieved by reinstating exhausted land as new areas are opened up for quarrying.	Minimization of the hard surface area open at any one time will favour water retention and infiltration over runoff and allow continued groundwater recharge, potentially at a reduced quantity.
	Blasting may open or close fractures in bedrock, altering hydrology outside of the direct impact area.	▪ Design blasts to minimize vibration; ▪ Follow regulatory guidelines for blasting.	No significant residual effects
Ecological ▪ Habitat for *Rhamnus alnifolia* (alderleaf buckthorn), a yellow-listed species in the Nova Scotia General Status of Wild Species database.	*Rhamnus alnifolia* plants may occur within the footprint of the proposed quarry expansion, and may be excavated or destroyed during site activities.	▪ Develop a protection plan to prevent or minimize the loss of *Rhamnus alnifolia* plants in consultation with NSEL and NSDNR. ▪ Salvage and transplant to new/existing wetland area if practical	The potential loss of an area of suitable habitat for *Rhamnus alnifolia*
	Blasting may cause temporary (1-2 day) siltation or suspension of materials in nearby wetlands	▪ Design blasts to minimize vibration; ▪ Follow regulatory guidelines for blasting.	Temporary increased turbidity in nearby wetland habitat is not a significant concern. Wetlands quickly remediate water siltation due to stagnant water and high vegetation density.
	▪ Loss of wetland habitat and associated communities.	▪ Wetland compensation plan developed in consultation with NSEL and NSDNR.	No net loss of wetland habitat.

Monitoring will be conducted to confirm the areal extent of wetland loss due to quarry expansions activities, to confirm that efforts to minimize erosion are successful, and to confirm that changes to the hydrology of the wetland have not resulted in degradation of the character of wetlands and watercourses lower in the watershed.

It is proposed that the monitoring plan consist of annual inspection and documentation of

- stream gauging and water level monitoring in Wetlands B and C;
- establishment of a representative reference wetland in an undisturbed area of the watershed (Wetland G and an upper portion of Wetland I may be suitable):
- vascular plant community composition, distribution and richness in reference wetlands and wetlands that may be potentially indirectly impacted; and
- the total ongoing areal extent of wetland loss.

It is anticipated that the quarrying activities will be completed incrementally. When an increment of land to be cleared for upcoming quarrying includes a wetland, all efforts will be made to transplant existing wetland substrate and plant materials to reclaimed lands on site. Material from other wetlands may be selectively harvested for seed banks when lands are being reclaimed at a time when the sites being grubbed for future quarrying do not intersect or encompass a wetland for salvage.

Conceptual Plan

- Identify areas within lands to be reclaimed that may hydrologically support a basin/stream swamp, or can be altered to hydrologically support a basin/stream swamp;
- In advance of the removal of a wetland from areas to be quarried, prepare the site for transplant:
- Monitor water levels, and consider water control structure or berm to achieve objectives;
- Lay initial substrate and compact to appropriate density and place undisturbed vegetation "plugs" on prepared site in an optimal distribution and depth in relation to the water table;
- Distribute appropriate substrate between plugs and consider seeding with an appropriate mix; and
- Cover substrate with straw and temporarily maintain surface moisture artificially if required.

Opportunities

- Transplant wetland plants rather than complete loss of plant life and seed bank;
- Involve research students from local colleges/universities;
- Contribute to the science of progressive wetland restoration in quarry sites while meeting compensation objectives within the same watershed as wetland loss.

Concerns/Issues

- May require detailed design or trials; unknown success rates in Nova Scotia

Detailed plans may be submitted to NSEL with supporting documentation and references of literature to support the theoretical likelihood of success.

A Water Approval application will be submitted to NSEL including a detailed habitat compensation proposal prior to undertaking quarry activities that could alter or destroy any particular wetland. Full wetland evaluations will be completed for the wetlands predicted to be affected by quarry activities. The Proponent is also committed to the development of detailed compensation plans in consultation with NSDNR and NSEL. These plans will address specific mitigation prior to any work being conducted in the wetlands. Further technical information (*i.e.,* translocation of species and likely success rates) will be provided in support of these strategies, to be developed in direct consultation with species of concern experts.

In summary, assuming the application of proposed mitigation measures, including maintaining existing site drainage conditions and the development of an appropriate wetland compensation plan in consultation with NSDNR, significant Project-related effects on wetland functional attributes are not likely to occur.

5.5 Wildlife

5.5.1 Description of Existing Conditions

Information regarding use of the study area by wildlife was derived from several sources including field surveys and reviews of existing data sources. Field surveys were conducted on four occasions (June 13, July 4, August 10 and August 18, 2006) by a senior terrestrial ecologist (Mr. Michael Crowell). During these surveys, information was collected regarding the presence of birds, mammals and herpetiles (amphibians and reptiles). Existing sources of data were also consulted. An ACCDC data search was conducted to determine if any rare or sensitive wildlife species have been recorded in the vicinity of the study area. The ACCDC data were also incorporated into a wildlife model to determine the likelihood of the presence of rare or sensitive wildlife species within the Project area. As part of the modelling exercise, all records of wildlife species listed by the NSDNR as at risk (Red listed) or sensitive to human activities or natural events ("Yellow" listed) (NSDNR 2006) within a radius of 100 km were compiled. The habitat requirements of these species were compared to the habitat descriptions compiled for the Project Area to determine if suitable habitat was present for these species. In instances where appropriate habitat was present for a particular species, that species was considered to be potentially present and the suitable habitat in the Project Area was identified as a target for field surveys.

Reference sources such as the Atlas of Breeding Birds of the Maritime Provinces (Erskine 1992) and Amphibians and Reptiles of Nova Scotia (Gilhen 1984) were also consulted to provide records of wildlife in the vicinity of the study area.

Birds

A breeding bird survey was conducted at the site on June 13, 2006. Additional bird observations were recorded during the vegetation and wetland surveys conducted on July 4, August 10 and August 18, 2006. The surveys were conducted between the hours of 06:00 and 12:00. During the surveys representative habitats on the property were visited by a birder with 20 years experience and all birds heard or observed were recorded. Table G1 of Appendix G lists the number of birds of each species observed in each of the habitats present in the study area. Figure 5.2 presents the distribution of habitats in the study area. Examples of all habitat types present in the study area were surveyed. The breeding status of each species recorded was determined using the methodology employed by the Atlas of Breeding Birds of the Maritimes program (Erskine 1992). Species identified but not exhibiting signs of breeding (such as flyovers) were classified as non-breeders. Species observed or heard singing in suitable nesting habitat were classified as possible breeders. Species exhibiting the following behaviours were classed as probable breeders:

- courtship behaviour between a male and female;
- birds visiting a probable nesting site;
- birds displaying agitated behaviour; and
- male and female observed together in suitable nesting habitat.

Species were confirmed as breeding if any of the following items or activities were observed:

- nest building or adults carrying nesting material;
- distraction display or injury feigning;
- recently fledged young;
- occupied nest located; and
- adult observed carrying food or faecal sac for young.

The population status of each species was determined from existing literature. Lists of provincially rare or sensitive birds were derived from the General Status of Wildlife in Nova Scotia (NSDNR 2006) and Species at Risk in Nova Scotia (NSDNR 2006) while nationally rare species were derived from COSEWIC (2006) and the *Species at Risk Act* (*SARA* 2006).

A list of bird species recorded during the survey is presented in Table G2, Appendix G. A total of 208 birds representing 45 species were recorded during the breeding bird survey. The most abundant species in descending order of abundance were Magnolia Warbler (8.2% of all birds recorded), White-throated Sparrow (7.2%), American Robin (6.2%), Black-and-white Warbler (5.8%), Nashville Warbler (5.8%), Palm Warbler (5.3%), Hermit Thrush (4.8%), and Swamp Sparrow (4.8%). Together these species accounted for 48% of the total number of birds recorded during the survey. Six species were confirmed as breeding on the site, seven were listed as probable breeders, 27 were listed as possible breeders, and no evidence of breeding activities were found for five species.

None of the bird species recorded during the breeding bird surveys is considered to be rare or uncommon in Nova Scotia by the ACCDC (2006) or at risk by NSDNR (2006). Two of the species recorded during the breeding bird surveys are listed by NSDNR as sensitive to human activities or natural events (Yellow listed). These included Common Nighthawk and Canada Warbler. All other species recorded during the breeding bird survey are considered to be secure in Nova Scotia by NSDNR.

Common Nighthawks nest on the ground usually in cut-over and burned forests or on the flat roofs of buildings in urban areas (Erskine 1992). This species has undergone moderate population declines particularly among the urban nesting populations and has been recently added to the list of sensitive (Yellow listed) species in Nova Scotia. One Common Nighthawk was observed flying over the study area on August 10, 2006. Given the timing of the observation, this bird was probably a migrant rather than a local nester.

Canada Warblers are usually found in dense understory vegetation of mature to mid-age mixed forests, and is most closely associated with broad-leafed trees and shrubs, usually with conifers present as well (Erskine 1992). This species has undergone significant population declines although it is still fairly common in Nova Scotia. This species has also been recently added to the list of bird species considered by NSDNR to be sensitive to human activities or natural events. Three Canada Warblers were recorded in the study area, one in mature mixedwood forest at the eastern end of the property and two in mixedwood treed basin swamp habitat (Wetlands B and D).

Partners in Flight (PIF) through the Landbird Conservation Plan (Rosenberg and Hodgman 2000) has identified a number of priority species for the physiographic region in which the study area is found

(Physiographic Area 28: Eastern Spruce-Hardwood Forest). These priority species have been identified as species for which conservation initiatives are recommended. These include both rare and common species. Some of the common species are undergoing population declines and other common species have stable or increasing populations but have a large proportion of their global population located within a particular physiographic region and are therefore vulnerable to large scale land use changes within that physiographic area. Five very high or high priority species were recorded in the study area during the breeding bird survey including Common Nighthawk, Eastern Wood Pewee, Northern Parula, Canada Warbler, and Purple Finch. Information regarding the distribution and abundance of these species in the study area are provided.

Eastern Wood Pewees prefer to nest near gaps and edges in hardwood forest (Erskine 1992). This species has undergone significant declines but is still fairly common in Nova Scotia. One Eastern Wood Pewee was heard singing in an immature hardwood stand in the study area on June 13, 2006 at the western end of the study area.

Northern Parulas nest in mature conifer and mixedwood stands where Usnea lichens are present which they use to construct their nests (Erskine 1992). The Maritime population is currently stable or increasing; however, there is some concern regarding the future availability of mature conifer and mixedwood habitat. One Northern Parula was heard in mature mixedwood forest at the eastern end of the study area.

Purple Finch are known to build their nests in conifers, however they frequent open mixed woodland and well-treed gardens, as well as spruce/fir forests (Erskine 1992). Purple Finches are common in the Maritime Provinces; however, their populations have declined significantly. Two Purple finches were recorded during the field surveys. One was heard singing in mature mixedwood forest near Wetland D. The habitat within which the second bird was heard singing was not recorded.

Additional information regarding use of the area by bird species of concern was derived from a review of the Atlas of Breeding Birds of the Maritime Provinces (Erskine 1992) as well as through an ACCDC data request. A total of 66 bird species have been recorded within the 10 km X 10 km breeding bird atlas square within which the study area is situated. These species along with their breeding status in the square and their provincial population status are listed in Table G3 of Appendix G. Four of these species are considered to be rare, uncommon or sensitive in Nova Scotia by ACCDC, NSDNR or *SARA* including Horned Lark, Boreal Chickadee, Rusty Blackbird, and Red Crossbill. None of these species was encountered in the study area during the field surveys.

Horned Larks are considered to be rare in Nova Scotia by ACCDC; however, NSDNR considers the Nova Scotia population to be secure. Horned Larks nest in open grasslands characterized by low and patchy vegetation. In Nova Scotia, they are known to nest only at airports. Within the breeding bird atlas square that the study area is located in, Horned Larks have been reported from the Halifax International Airport. No suitable nesting habitat is present in the study area.

Boreal Chickadees are considered to be uncommon to fairly common by ACCDC and NSDNR lists the Nova Scotia population as Yellow. Boreal Chickadees nest in coniferous forest, particularly stands dominated by black spruce and balsam fir. No mature coniferous forest was present in the study area. Boreal Chickadees will sometimes nest in mature mixedwood forest; however, none were recorded during the breeding bird survey or any of the other field surveys.

Red Crossbill are considered to have secure populations in Nova Scotia (NSDNR 2006) but are listed as uncommon species by ACCDC. Red Crossbills nest in softwood or mixedwood forests in both dry and wet areas. Nests are typically situated in spruce, fir or hemlock trees. This species typically occurs in low numbers in Nova Scotia during most years but periodically population irruptions occur. Red Crossbills have been confirmed as nesting in the breeding bird atlas square within which the study area is located but were not recorded within the study area. Suitable nesting habitat is present in the study area although the main food trees for this species, eastern white pine (*Pinus strobus*) and eastern hemlock (*Tsuga canadensis*), were not abundant. Given the irruptive nature of Red Crossbill populations along with the fact that Red Crossbills often nest during the winter months it is possible that they nest in the study area but were not detected during the 2006 field surveys.

Rusty Blackbird are listed as uncommon to common (S3S4) by ACCDC and are Yellow listed by NSDNR. Recently, Rusty Blackbirds have been listed as a species of concern by *SARA* (2006). Rusty Blackbirds are typically associated with swamps along sluggish streams or stillwaters. They prefer swamps containing a mixture of tree, tall shrub and low shrub cover. They are most abundant in the interior of the province and are generally found in areas remote from human settlement. Three of the wetlands located in the study area (Wetlands B, C and I) contain stillwaters; however, these wetlands are found in relatively close proximity to human habitation. All of these wetlands were visited during the breeding bird surveys and no Rusty Blackbirds were detected.

The ACCDC habitat model identified one rare or sensitive bird species as being potentially present in the study area. This species was the Long-eared Owl which nests in a variety of forest habitats as well as open habitats. Long-eared Owls do not build their own nest and usually lay their eggs in an abandoned nest or on a witch's broom. Nests are generally found in thick coniferous cover near an opening in the canopy. Most Long-eared Owls leave Nova Scotia during the late fall and return in March. Egg laying begins in April. Suitable nesting and foraging habitat is present in the study area. The mature mixedwood forest located on the eastern part of the study area could provide suitable nesting habitat while the young clear-cuts in the north central part of the property could provide suitable foraging habitat. No Long-eared Owls were encountered during the field visits; however, given the fact that this species is rarely active during the day and nests and roosts in dense conifer cover it could easily be overlooked. This species is best detected in early spring when they are most vocal. It was not possible to conduct a nocturnal owl survey during this optimal time during the field season.

Mammals

Information regarding the presence of rare mammals and sensitive mammal habitat within the study area was derived from field surveys and a review of Nova Scotia significant habitat mapping data base (NSDNR 2006). Field surveys were conducted concurrently with vegetation and breeding bird surveys in June, July and August of 2006. The field surveys provide a good indication of the presence of large mammal species in the study area. Knowledge of the distribution of small mammals in the study 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 study area is characterized by moderate habitat diversity. Approximately 70% of the study area has been harvested within the past 20 to 30 years with approximately 20% of the study area harvested more recently. Remnants of mature mixedwood forest are found in the Project area particularly at the eastern end of the property. Wetland habitat is scattered throughout the study area. Most of the

wetlands are small mixedwood treed swamps. Several larger low shrub dominated stream swamps are present at the eastern end of the property.

The species recorded in the study area are generally typical of woodland and riparian habitats. Evidence of species recorded during the field surveys included Muskrat (*Ondatra zibethicus*), Beaver (*Castor canadensis*), Porcupine (*Erithezon dorsatum*), American Red Squirrel (*Tamiasciurus hudsonicus*), Eastern Chipmunk (*Tamias striatus*), Varying Hare (*Lepus americanus*), Coyote (*Canis latrans*), Red Fox (Vulpes vulpes), American Black Bear (Ursus americanus), Raccoon (*Procyon lotor)* and White-tailed Deer (*Odocoileus virginianus*).

A review of the NSDNR significant habitat mapping database (NSDNR 2006) did not reveal the presence of any rare or sensitive mammal species in the vicinity of the study area or critical habitat such as deer wintering areas. All of the habitats present in the study area are commonly encountered throughout the province and are unlikely to provide habitat for rare small mammal species.

The ACCDC habitat model identified four rare or sensitive mammal species as being potentially present in the study area, including Eastern Pipistrelle, (*Pipistrellus subflavus*), Hoary Bat (*Lasiurus cinereus*), Fisher (*Martes pennanti*), and Moose (*Alces alces*). The Eastern Pipistrelle is a hibernating bat that reaches the northern limit of its range in Nova Scotia. This species typically hibernates in caves or abandoned mines from October to May. During the rest of the year it forages in open forests along the edges of rivers and streams, roosting in caves, rock crevices, attics, and trees. This species is most vulnerable at its hibernation sites where large proportions of the regional population may gather in a single location. No suitable hibernation sites are believed to be present on or immediately adjacent to the property. Eastern Pipistrelles are profound hibernators and are not easily aroused while hibernating unlike Little Brown Bats (*Myotis lucifugus*). As such, Eastern Pipistrelles that might be hibernating in caves or mines near the study area are unlikely to be adversely affected by noise and vibration from blasting. Eastern Pipistrelles could potentially forage in the study area between May and October. The forested habitat bordering Beaver Brook would provide the best foraging habitat. This habitat will not be affected by quarry expansion. It is unlikely that quarry expansion would have a significant adverse effect on Eastern Pipistrelle.

The Hoary Bat is a migratory species which is present in Nova Scotia during the summer and early fall. In General, the Hoary Bat is a solitary tree roosting bat. They are usually observed foraging in open areas in wooded habitat as well as in areas of human habitation where shade trees are present. No Hoary Bats were observed during the field surveys but this is not unexpected given the nocturnal nature of bats and the fact that Hoary Bats can be expected to be widely scattered throughout the landscape. There is a possibility that Hoary Bats could be present in the study area. However, the habitat within the study area is typical of much of Nova Scotia and it is unlikely that the study area provides critical habitat for this species.

Fishers were extirpated from Nova Scotia as a result of over trapping and habitat loss. They have been reintroduced on several occasions and a small population has become established. Fishers are generally associated with mature forest habitat. They prefer to remain in habitat with overhead cover and avoid open areas. They have very large home ranges and usually follow large circular routes during foraging treks, often following river and stream courses. Fishers generally avoid areas of human habitation and early successional forest habitat. Habitat suitable for Fishers is present in the study area including the mature mixedwood forest located on the eastern edge of the study area and the riparian

forest located along Miller Brook. No evidence of Fishers was encountered during the field surveys. Given the large home range of Fishers the amount of spoor left by this species in any particular area would not be substantial and could easily be missed. It is possible although unlikely that the study area is used by Fishers on a regular basis. Most of the study area is early successional habitat and located in close proximity to areas of heavy human activity. Given the large home ranges of Fishers and the small size of the proposed quarry expansion loss of suitable habitat as a result of quarry expansion is unlikely to have a significant adverse effect on Fishers.

The mainland Moose population has recently been listed as Endangered under the Nova Scotia *Endangered Species Act*. The decline of the mainland population is probably attributable to a number of factors including increased exposure to brain worm (*Parastrongylus tenuis*) as a result of high deer populations which spread the parasite, poaching pressure on the reduced population and habitat alteration. The Cape Breton moose population which belongs to a different subspecies is doing well and supports both native harvesting and a limited sport hunt. Moose use a variety of habitats including mature forest, immature forest and wetlands. All of these habitats provide food and the mature forest and wetland habitat also provide thermal refuges during the summer months. Moose are fairly tolerant of human activities but are less tolerant of human activities than White-tailed Deer. Moose are occasionally observed in the general vicinity of the study area. Approximately ten years ago a Jacques Whitford biologist observed a bull Moose in the vicinity of Antrim, approximately 10 km east of the study area. No Moose spoor was found during the field survey. Moose tracks, browse sign and feces are very persistent and noticeable. The fact that no spoor was found during the surveys would suggest that the area is not regularly used by Moose.

Herpetiles

Information regarding amphibians and reptiles and their habitat within the study area was also derived during the field surveys. Field surveys were conducted concurrently with wetland, vegetation and bird surveys conducted between June 13 and August 18, 2006.

Six herpetile species were encountered during the surveys: Green Frog (*Rana clamitans*), Wood Frog (*Rana sylvatica*), Pickerel Frog (*Rana palustris*), Mink Frog (*Rana septentrionalis*), Northern Spring Peeper (*Pseudacris crucifer*) and Maritime Garter Snake (*Thamnophis sirtalis*). None of these species is considered to be uncommon, rare or sensitive in Nova Scotia by ACCDC (2006) or NSDNR (2006).

One rare herpetile species, the Wood Turtle (*Gleptemps* insculpla), was identified by the wildlife model as potentially present in the study area.

Wood turtles have been recorded from the Shubenacadie River and its tributaries (ACCDC 2006). Wood turtles are a species of concern; they are ranked as S3 by ACCDC (2006). Provincially, they are listed as a Yellow species, as well as being listed as vulnerable under the Nova Scotia *Endangered Species Act* (NSDNR 2006). The wood turtle is also listed under the federal *SARA* as a species of special concern.

No wood turtles were encountered during field surveys; however wood turtles are generally widely dispersed, cryptic, and are not easily detected. Wood turtles are almost invariably associated with streams, creeks, and rivers and the associated rich intervale forest, shrub communities, as well as with the meadows and farmland terrestrial habitat associated with these watercourses. Streams with sand and/or gravel bottoms are preferred, but rocky streams are used occasionally. Wood turtles may

wander some distance from watercourses during summer foraging but characteristically remain within linear home ranges. These home ranges are 1 to 6 ha in size and are centred on a suitable river or stream where non-vegetated or sparsely vegetated sandy beaches and banks serve as nesting sites. Natural nesting sites consist of sandy river beaches but may also include select disturbed sites such as railway grades and roadsides. Some turtles may travel considerable distances up small tributaries that lack suitable nesting sites and hibernacula during the summer months that offer good foraging opportunities. These smaller streams may serve as dispersal corridors between populations on different river systems.

The study area does not represent typical habitat for the wood turtles. The portion of Beaver Brook found in and near the study area does not provide good nesting habitat. It is characterized by either rocky banks or low shrub swamp habitat along the shores. The substrate of the brook is either stony or organic fines. Wood Turtles may occasionally follow the brook and use the riparian habitat for foraging. The quarry expansion will not affect this habitat. Wood Turtles will sometimes use sand pits as nesting sites. Wood Turtles nesting in these sites can be accidentally killed by equipment and nests can be destroyed by sand removal or vehicle traffic. The existing quarry in the study area does not provide suitable nesting habitat and is unlikely to be used by nesting Wood Turtles.

Until recently the Four-toed Salamander was listed as Yellow (sensitive to anthropogenic activities and natural events) by NSDNR and rare to uncommon (S2/S3) by ACCDC. It has been relisted as Green (secure). Four-toed salamanders are typically found in bogs and swamps and forest habitat surrounding these wetlands. Local herpetologists generally believe that the Four-toed Salamander is more abundant and widespread than existing records indicate. The lack of records is likely attributable to the cryptic nature of this species. Four-toed Salamanders are rarely found away from cover. During the breeding season females nest in sphagnum moss hummocks; during the rest of the year this species is present under stones, logs and other cover in forest habitats. They emerge from cover only at night to forage.

A recent study of the distribution of the Four-toed Salamander in Nova Scotia supports the contention that this species is not as rare as previously thought and is widely distributed (JWEL 2000). The study found Four-toed Salamanders in more than half of the sites searched and increased the number of recorded nesting sites in Nova Scotia from 20 to 45. Critical habitat requirements for this species are sphagnum moss in which to lay eggs and a semi-permanent or permanent, soft bottomed pond or slow flowing stream adjacent to the sphagnum moss in which the hatched larvae can develop. This species has been found at several sites near the Halifax International Airport. No Four-toed Salamanders were encountered during the field surveys but given the cryptic nature of this species it is possible that it is present in the study area. Suitable breeding habitat was found in Wetlands D and E. Both of these wetlands will be lost as a result of quarry expansion. If Four-toed Salamanders are present in these wetlands, the loss of these populations is not expected to have a significant effect on the population in Nova Scotia or HRM since the species is generally believed to be widely distributed throughout the province.

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

None of the bird species found in the Project area are listed under the Nova Scotia *Endangered Species Act.* Two species considered to be sensitive to anthropogenic activities, Canada Warbler and Common Nighthawk (NSDNR 2007), were recorded during the breeding bird survey. The evidence

suggests that Canada Warblers nest in the study area; however, there was no evidence to indicate that Common Nighthawks nest there. Three Canada Warblers were detected during the breeding bird survey, all in the southern half of the proposed expansion area. One Canada Warbler was recorded just outside of the proposed expansion area. Another was observed in Wetland B and the last bird was recorded in Wetland D. Wetland B and the habitat surrounding it will not be developed. However, Wetland D will be lost to quarry expansion. The Canada Warbler is a forest interior species and as such the creation of nearby edge habitat can also adversely affect populations. Forest interior species are often susceptible to depredation by generalist predators attracted to forest edges or to parasitism by Brown-headed Cowbirds. The adverse effects of edges generally extend up to 100 m into the forest. As such, the ability of intact forest habitat to support Canada Warblers could be degraded up to 100 m beyond the cleared edge of the quarry. Quarry expansion and associated edge effects could adversely affect the habitats in which two of the three Canada Warblers were found. The loss of breeding habitat for two pairs of Canada Warblers will not significantly adversly affect local or regional populations of this species. Nevertheless; this species has recently been listed as sensitive to human activities and mitigative measures should be implemented to minimize the effects of the Project on this species.

It is recommended that quarrying and forest clearing in advance of quarrying in the southern half of the quarry be delayed as long as possible. Progressive reclamation will be employed to help re-establish forest habitat on the site as quickly as possible. Top soil and root mat will be salvaged and placed in abandoned portions of the quarry. Wherever possible, reclaimed areas will be established in a single large patch having a roughly circular or square shape rather than many irregularly shaped patches to minimize the amount of habitat edge. Silvicultural treatments will be applied to help develop stands having a hardwood canopy and a dense conifer understory. This stand configuration is a type that is favoured by Canada Warblers in the Maritime Provinces. It is estimated that it will take approximately 50 years to exhaust the rock in the quarry expansion area. This will not be enough time to re-establish a mature hardwood stand in the abandoned quarry; however, it will be enough time to ensure that a hardwood stand with a conifer understory becomes established.

Expansion of the quarry will result in the loss of habitat for migratory birds. Migratory birds are protected under the *Migratory Birds Convention Act*. It is illegal to kill migratory bird species not listed as game birds (and game birds outside of established hunting seasons) 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*.

To ensure compliance with these regulations, clearing and grubbing of areas to be used as quarry sites will be conducted outside of the breeding season for most bird species (April 1 to August 1) so that the eggs and flightless young of birds are not inadvertently destroyed.

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. The most valuable forest interior habitat consists of mature forest situated at least 100 m away from an edge. The amount of forest interior habitat in the quarry expansion area was determined by establishing 100 m buffers around edge producing features such as the existing quarry, heavily disturbed non-forested habitat, woods roads and recent clear-cuts. Areas remaining after buffering these features were classed as forest interior habitat (all remaining forest habitat regardless of age class) and high quality forest interior habitat (all remaining mature forest habitat). Approximately 3.6 ha of forest interior habitat is present in the quarry expansion area. This represents 6% of the total expansion area. Approximately 7.0 ha of high quality forest interior habitat is present which represents 12% of the quarry expansion area (Figure 5.3). The

relatively low quantity of forest interior habitat present in the quarry expansion area is largely attributable to the presence of recent clear-cuts in the center of the property and an extensive wood road system.

Unfortunately, quarrying activity will result in the loss of this forest interior habitat. It is not possible to remove the rock without disturbing the habitat over it. The proposed quarry expansion site is a reasonably good choice for several reasons. First, the site currently supports relatively little forest interior habitat. In addition, it is located adjacent to the existing quarry site. This will reduce the amount of edge habitat created by quarry expansion. More edge habitat would be created by the development of a second disjunct quarry site.

Mitigation to reduce the effects of loss of forest interior habitat would include:

- Designing the quarry expansion so that it maintains a round or square shape to reduce the amount of edge relative to interior area;
- Clearing only the amount of forest habitat required for any one year's expansion. Cleared areas should not be irregularly shaped to reduce the amount of habitat edge created by forest harvesting.
- Creation of new forest habitat through progressive reclamation of the site as discussed earlier.

Two uncommon or rare bird species Long-eared Owl and Red Crossbill could potentially nest in the study area and could easily have been overlooked during the field surveys. Red Crossbills are considered to be secure in Nova Scotia and are highly irruptive. Development of the study area is unlikely to have a significant adverse effect on provincial or local populations of this species if it does occasionally nest in the study area. Further surveys to determine whether or not this species nests in the study area are not warranted.

Long-eared Owls are relatively rare and if present are expected to use habitat on a continuous basis. Expansion of the quarry could adversely affect Long-eared Owls; however, the severity of this adverse effect would be limited by the fact that only a small portion of the study area (the eastern edge and the southeastern corner of the property) can be considered suitable nesting habitat. The southeastern corner of the property will not be disturbed further reducing potential adverse effects on this species. It is recommended that an owl survey be conducted in April to determine whether or not this species is actually present. If Long-eared Owls are present, appropriate mitigative measures will be developed.

No critical areas for mammals such as deer wintering areas or critical herpetile habitats are known to exist in the study area. The species recorded in the study area are generally typical of woodland habitats. The field survey and a review of existing records (NSDNR 2006) did not reveal the presence of any rare mammal or herpetile species in the vicinity of the study area. The habitats present in the study area are commonly encountered throughout the province and are unlikely to provide habitat for rare small mammal species. The wildlife model identified four rare or sensitive mammal species that could potentially be present in the study area including Eastern Pipistrelle, Hoary Bat, Fisher, and Moose. It is unlikely that the study area provides critical habitat for any of these species.

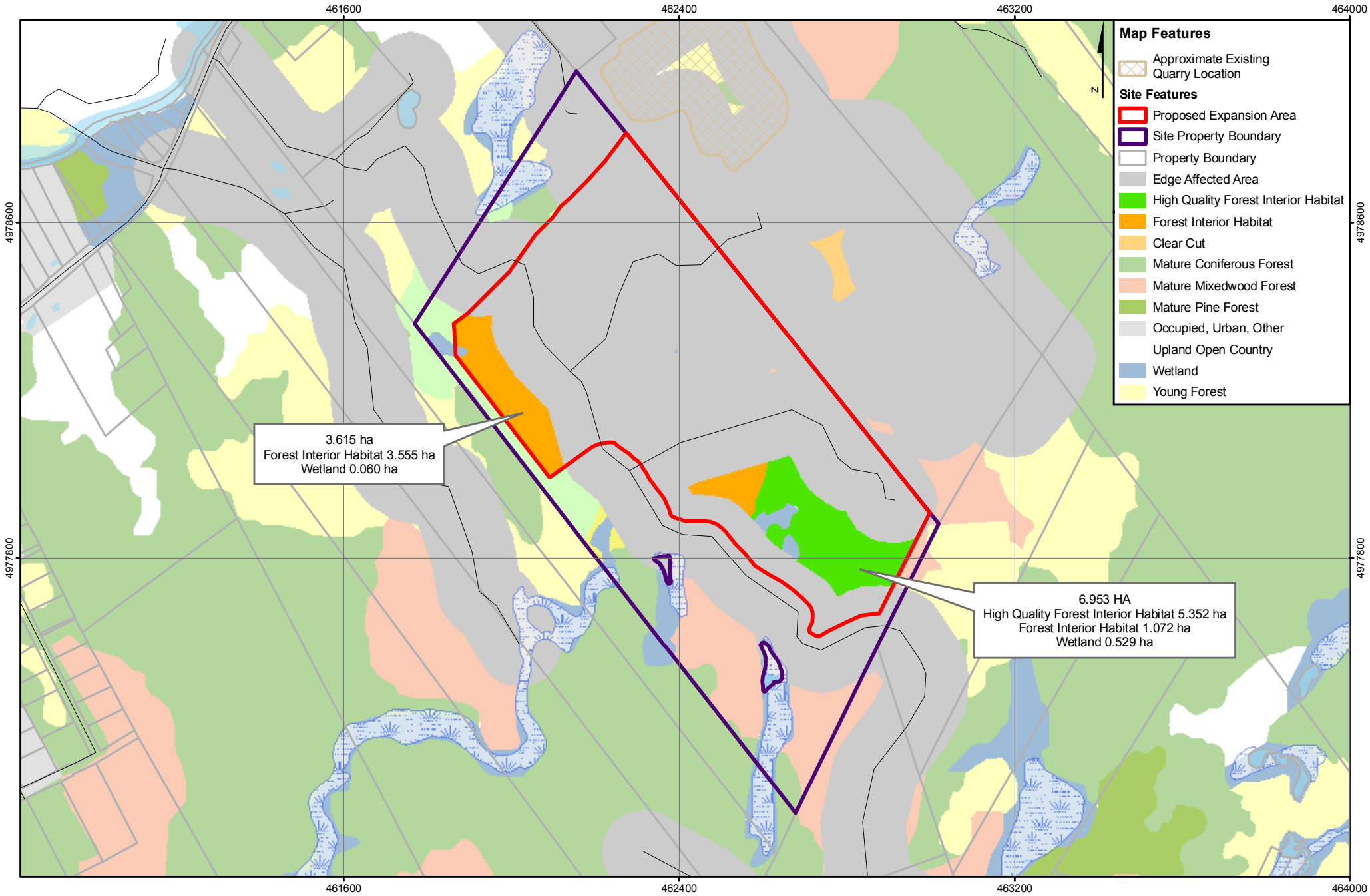


Figure 5.3
Distribution of Forest Interior Habitat in the Quarry Expansion Area

0 100 200 400 600 800 Metres

Map Parameters
Projection: UTM-NAD83-Zone20
Scale 1: 12,000
Date: June 01st, 2007
Project No.: 1013296
Habitat: NSDNR, 2006

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The two bat species could potentially use forest habitat in the study area for roosting and rearing sites for their pups. Felling of trees during the summer months could result in mortality of bat pups. This mortality could be avoided by clearing trees during the winter months (*i.e.*, avoiding the April 1 to August 1 time period), which is recommended as a mitigative measure for migratory birds.

Given the close proximity of the quarry expansion area to the existing quarry and to other industrial and residential areas, it is unlikely that Fishers will make use of the site in spite of the presence of suitable habitat. No mitigative are recommended for this species.

No evidence of Moose activity in the study area was noted during the field surveys suggesting that the area is not frequented by Moose on a regular basis. No mitigation is recommended for this species.

The wildlife model identified two herpetile species, Four-toed Salamander and Wood Turtle that could potentially be present in the study area. Neither species were observed during the field surveys but both are cryptic species that can be overlooked. The study area provides relatively good Four-toed Salamander habitat in two of the wetlands. Local herpetologists believe that Four-toed Salamanders are more widespread and abundant than records would indicate. This has been confirmed by a recent study of the distribution and habitat preferences of this species in Nova Scotia (JWEL 2000). The status of the four-toed salamander has recently been changed from Yellow (sensitive to human activities and natural events) to Green (secure) (NSDNR 2007). The four-toed salamander habitat study also demonstrated that Four-toed Salamanders make use of a variety of anthropogenic habitats such as ditches and wheel ruts. Expansion of the quarry is unlikely to have a significant adverse effect on local Four-toed Salamander populations; nevertheless, the potential habitat loss will be mitigated, at least partially through a wetland compensation program.

The wetland compensation program developed for the Project will incorporate the creation of Four-toed Salamander nesting habitat. This would involve digging small pools to provide suitable rearing habitat for Four-toed Salamander larvae and the positioning of woody detritus or small earthen mounds around the pools to promote the development of the sphagnum moss mounds in which Four-toed Salamander nests can be established. Leaf litter and twigs would be placed in the pools to provide habitat for the invertebrates that would provide food for the larvae and existing ephemeral pools would be netted to provide a source of invertebrates for the new pools. Just prior to the loss of wetlands in the study area containing suitable Four-toed Salamander habitat, these wetlands should be thoroughly searched for Four-toed Salamanders during the nesting season Early May to mid-June. If nests are found they would be relocated to the wetlands that had been modified to provide Four-toed Salamander habitat.

Wood Turtles have been recorded in the Shubenacadie River and its tributaries. Beaver Brook is a tributary of the Shubenacadie River and may be used by Wood Turtles. The portion of Beaver Brook located in and near the study area provides poor Wood Turtle habitat and it is unlikely that it is frequently used by Wood Turtles. This habitat and the adjacent riparian habitat will not be disturbed by quarrying activity and no adverse interactions with Wood Turtles are expected. There are no sand deposits on the property that could attract Wood Turtles away from the Brook and into areas where they could be accidentally killed by quarrying activities or lose reproductive capacity as a result of destruction of nest sites by quarrying activity.

In summary, assuming recommended mitigative measures are applied (*e.g.*, clearing outside bird breeding season, wetland compensation) significant Project-related effects on wildlife are not likely to occur.

5.6 Groundwater Resources

5.6.1 Description of Existing Conditions

Groundwater, an integral component of the hydrologic cycle, originates from percolation of rain, snowmelt, or surface water into the ground. This infiltrating water fills voids between individual grains in unconsolidated materials and fills fractures developed in consolidated materials. The upper surface of the saturated zone is called the groundwater table. The groundwater table intersects the surface at springs, lakes and streams where interaction between the groundwater and the surface water environment can occur. Groundwater flows through soil and bedrock from areas of high elevation (recharge areas) to areas of low elevation (discharge areas) where it exits the sub-surface as 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 of springs, streams and wetlands during dry periods of the year. More rarely, surface water bodies can contribute to groundwater storage under specific hydrogeological conditions.

Groundwater yield of dug or drilled water wells can vary greatly, depending on the hydraulic properties of overburden or bedrock aquifers through which the wells are constructed. An aquifer is a geological formation or group of formations that can store or yield useable volumes of groundwater to wells or springs. Natural groundwater quality is directly influenced by the geochemical composition of the aquifer materials through which it passes, and the time the water resides within that material.

The groundwater resource is a VEC because it provides potable water supply to approximately half of the total population of Nova Scotia, including almost all unserviced rural residences.

Spatial boundaries for the assessment of groundwater resources are based on a combination of aquifer hydraulic properties, expected groundwater flow directions, and the distance between the proposed quarry expansion 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 usually less than about 100 m, and generally in a direction hydraulically up-gradient of the well. A quarry that is excavated below the local groundwater table could be considered to behave like a large well, and groundwater draining into the quarry would influence water levels 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.*, nitrate and fuel oil)) 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.

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 aquifer materials. With respect to rock type, 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.

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

The following discussion of the local groundwater resources and hydrogeology is based on a desktop study and a "windshield" survey, but does not include any water well inspection, groundwater sampling and analysis, or groundwater depth measurements.

The Project area is irregular in shape and is approximately 1400 m long (north-northwest/south-southeast) and 625 m wide (east-northeast/west-southwest) at its longest points. The topography of the Project area is undulating, and with the exception of the northern corner of the area which slopes downward to the north, the site generally slopes downward to the east, south or west depending on the location on the site. Elevations in the Project area range from approximately 34 to 75 m above sea level.

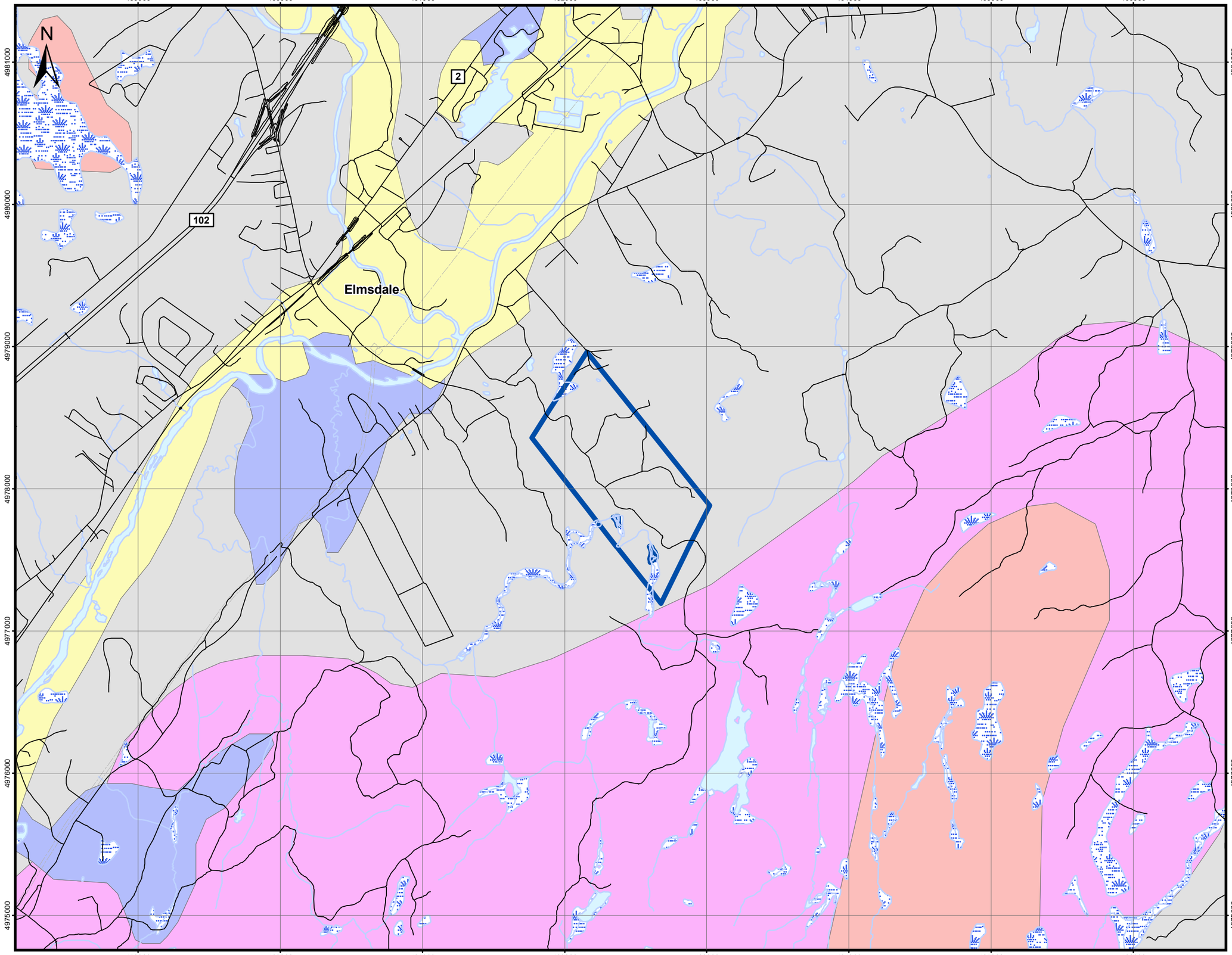
The surficial geology in the Project area (Figure 5.4) consists of silty compact till derived from both local and distal bedrock sources (Stea, Conley, and Brown, 1992). In general, the till contains up to 80% local clasts formed from the local bedrock (Stea and Fowler 1981). Bedrock underlying the site (Figure 5.5) consists of Cambrian Ordovician aged metamorphosed sandstone and slate of the Goldenville Formation of the Meguma Group. Approximately, 160 m northwest of the northern corner of the Project area is the geological contact with the Gays River Formation of the Lower Windsor Group which consists of dolostone and minor limestone. Immediately northwest of the Gays River Formation is the Carrolls Corner Formation also of the Lower Windsor Group. The Carrolls Corner Formation consists of anhydrite, gypsum with minor dolostone and mudstone in thin beds (Giles and Boehner, 1982). Many of the domestic water wells northwest of the Project area are constructed in these sedimentary bedrock units while wells to the west are generally constructed in Goldenville Formation quartzite.

Due to its location, the Project is expected to lie within a groundwater recharge area which is situated on a secondary watershed divide of Nova Scotia Watershed 1DG (Nova Scotia Watershed Series, 1980) as shown on Figure 2.2. Inference of the regional groundwater flow direction has been made based on topography. Because of the location of the ridge (*i.e*., secondary watershed divide) surface water runoff (*i.e*., apparent shallow groundwater flow direction) flows in various directions across the Project site. Eventually, groundwater from both secondary watersheds is expected to discharge into streams and wetlands feeding the Shubenacadie River.

Elmsdale Quarry Project

Figure 5.4

Surficial Geology



Map Features

- Road/Trailway/Driveway
- Utility
- Watercourse
- Site Property Boundary
- Waterbody
- Wetland

Surficial Geology

Pre Last Glaciation

Rock

- Bedrock of Various Types and Ages

Last Glaciation (Wisconsinian)

Glaciolacustrine Deposits

- Sand, Silt, Clay

Ground Morraine and Sreamlined Drift (Silty Till Plain)

- Silty, Compact Till

Post Last Glaciation (Holocene)

Alluvial Deposits

- Gravel, Sand, Mud

Organic Deposits

- Sphagnum moss, Peat, Gyttja, Clay

Note: Surficial Geology mapping obtained from "NSDNR - Mineral Resources Branch Digital Products" - DP ME D92-03, Version 1, 1997. Digital version of Nova Scotia Department of Natural Resources Map ME 1992-3, Surficial Geology Map of the Province of Nova Scotia, 1:500 000, 1992. - http://www.gov.ns.ca/natr/meb/pubs/pubs3.htm

0 250 500 1,000

Meters

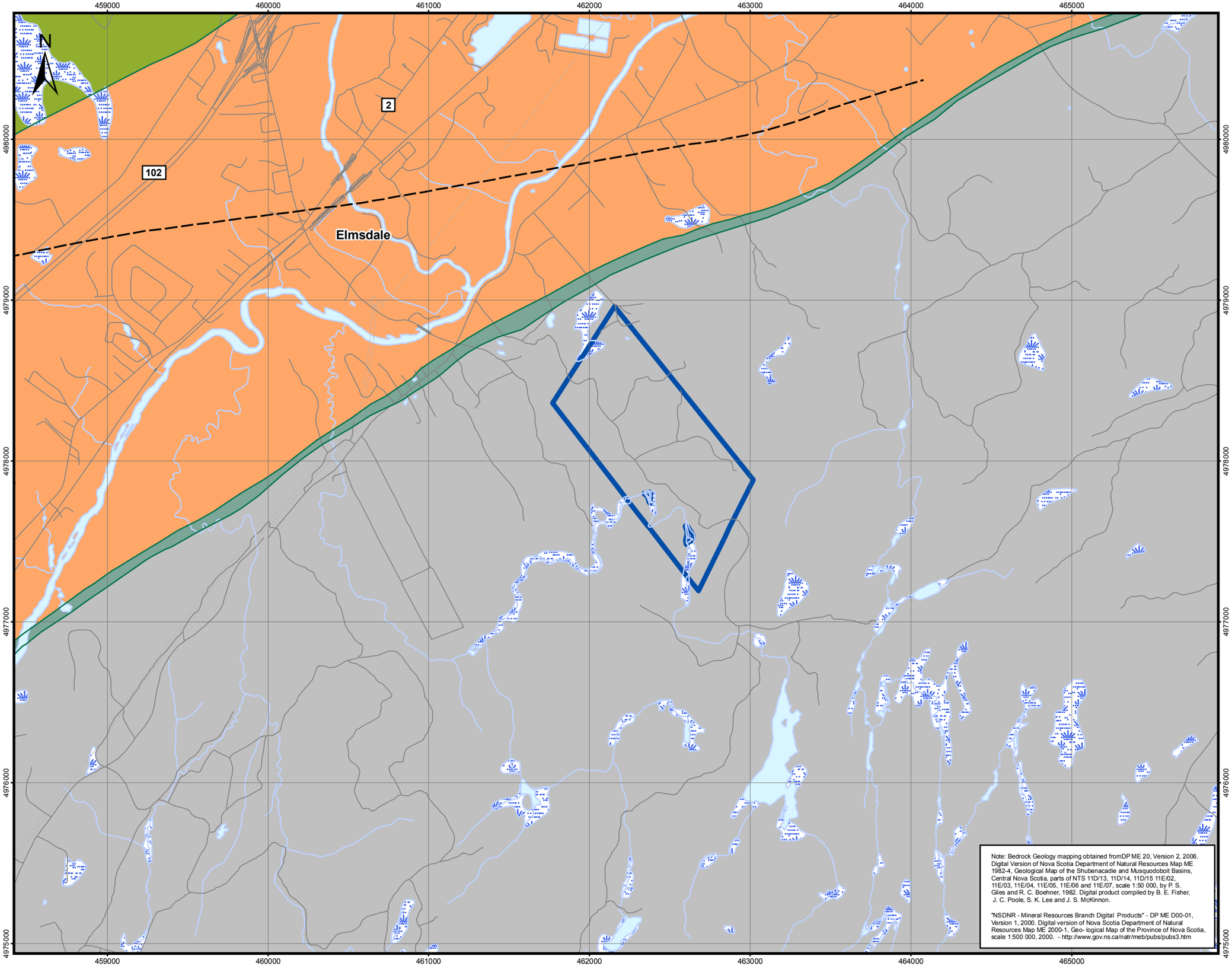
Map Parameters
Projection: UTM-NAD83-Z20
Scale 1:25,000
Date: June 1st, 2007
Project No. 1013269

Jacques Whitford

Elmsdale Quarry Project

Figure 5.5

Bedrock Geology



Map Features

- Road/Trailway/Driveway
- Utility
- Watercourse
- Site Property Boundary
- Waterbody
- Wetland

Bedrock Geology

- approximate fault, probable
- Geological contacts

Mississippian

Middle Windsor Group

MacDonald Road Formation

gypsum,anhydrite and minor halite, with interbeds of grey and maroon siltstone and sheet-like carbonate members

Lower Windsor Group

Carrolls Corner Formation

anhydrite, gypsum, with minor dolostone and mudstone in thin beds

Gays River Formation

dolostone, minor limestone, thinly bedded, argillaceous and bituminous, locally thickly bedded and highly fossiliferous in mound-shaped deposits resting upon pre-Carboniferous rocks

Cambrian-Ordovician

Meguma Group

Goldenville Formation

slate, meta-siltstone, meta-grewacke

0 250 500 1,000

Meters

Note: Bedrock Geology mapping obtained fromDP ME 20, Version 2, 2006. Digital Version of Nova Scotia Department of Natural Resources Map ME 1982-4, Geological Map of the Shubenacadie and Musquodoboit Basins, Central Nova Scotia, parts of NTS 11D/13, 11D/14, 11D/15 11E/02, 11E/03, 11E/04, 11E/05, 11E/06 and 11E/07, scale 1:50 000, by P. S. Giles and R. C. Boehner, 1982. Digital product compiled by B. E. Fisher, J. C. Poole, S. K. Lee and J. S. McKinnon.

"NSDNR - Mineral Resources Branch Digital Products" - DP ME D00-01, Version 1, 2000. Digital version of Nova Scotia Department of Natural Resources Map ME 2000-1, Geo- logical Map of the Province of Nova Scotia, scale 1:500 000, 2000. - http://www.gov.ns.ca/natr/meb/pubs/pubs3.htm

Map Parameters
Projection: UTM-NAD83-Z20
Scale 1:25,000
Date: June 1st, 2007
Project No. 1013269

Jacques Whitford

A windshield water well survey was conducted on January 15, 2007 to determine the locations of water wells located within 800 m of the Project. With the exception of the Proponent owned drilled well located on the current quarry site, no water wells are located within 800 m of the Project area (shown on Figure 2.2). Water supplies for residences farther than 800 m from the Project area located along Old Truro Road, Dutch Settlement Road and side roads located off these arterial roads are derived primarily from privately owned drilled or dug wells, from a community pumping well or pumped directly from the Shubenacadie River.

A review of available NSEL domestic water well records did not provide information on the water well on the Proponent's property. To provide a general description of aquifer properties in the vicinity of the Project a summary of domestic well records for Elmsdale, Nova Scotia is provided in Table 5.4. Although none of these wells are located within 800 m of the Project, the conditions encountered within these wells are indicative of the likely conditions of the soil and bedrock aquifers located on the Project site and within the community of Elmsdale.

TABLE 5.4 Summary of Domestic Water Wells Records in Elmsdale, Nova Scotia

Soil Aquifers	Well Depth (m)	Casing Length (m)	Estimated Yield (igpm)	Water Depth (m)	Overburden Thickness (m)
Minimum	5.3	5.3	4	1.5	N/A
Maximum	6.9	6.4	14	6.1	N/A
Average	6.1	6.0	9.2	2.9	N/A
Median	6.1	6.1	10	2.7	N/A
Number	22	19	18	18	N/A
Goldenville Formation	**Well Depth (m)**	**Casing Length (m)**	**Estimated Yield (igpm)**	**Water Depth (m)**	**Overburden Thickness (m)**
Minimum	15.2	3.0	0.25	0.9	0.3
Maximum	122.6	32.9	55	17.1	20.7
Average	62.1	14.9	5.8	8.4	6.8
Median	59.4	15.2	2.5	7.8	5.6
Number	68	68	69	34	22
Windsor Group	**Well Depth (m)**	**Casing Length (m)**	**Estimated Yield (igpm)**	**Water Depth (m)**	**Overburden Thickness (m)**
Minimum	15.8	11.6	0.2	1.8	29.3
Maximum	109.7	65.2	100	29.0	34.1
Average	52.6	32.1	18.4	16.3	31.7
Median	48.8	30.5	13	20.7	31.7
Number	19	19	18	15	2

Note: Information was obtained from the Well Log Database including wells constructed between 1940 and 2004.

Water Quality

Water quality potential is determined from known water quality characteristics for each unit, including naturally occurring water quality concerns such as hardness and presence of arsenic and iron. Except in minor areas of localized mineralized zones in the Meguma terrain, quartzite bedrock is expected to provide water quality with most paramenters within acceptable drinking water guidelines (Health Canada, 2006). However, arsenic in excess of the 0.025 mg/L health-based guideline can occur in the Goldenville bedrock aquifer, particularly along the crests of anticlines in designated Gold-Bearing areas. Further, elevated iron and manganese in excess of respective aesthetic guidelines of 0.3 mg/L and 0.05 mg/L can occasionally occur within this formation.

Within the Windsor Group bedrock (*i.e.,* Carrolls Corner and Gays River Formations), the most expected concerns are high hardness levels, sulphate, total dissolved solids (TDS) and iron (Chang, 1970). Aesthetic drinking water guidelines for sulphate, TDS and iron are 500 mg/L, 500 mg/L and 0.3 mg/L, respectively. Although there is no guideline for hardness, levels between 80 and 100 mg/L is considered acceptable, levels greater than 200 mg/L are considered to be poor but tolerable, and those in excess of 500 mg/L are considered to be unacceptable (Health Canada, 2006).

In addition to the above naturally-occurring water quality issues, common problems reported by Nova Scotia well owners include: elevated sodium and chloride from road salt; coliform bacteria from surface sources impacting poorly constructed dug and drilled wells; and low pH and/or associate plumbing corrosion in shallow wells constructed in sand aquifers or fractured crystalline bedrock.

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 downgradient 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 in the unlikely event that a mineralized zone is encountered within the quarry area. Potential impacts to domestic water wells are a function of distance, 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, and individual well construction methods.

Water Quantity Effects

If the quarry encounters increased groundwater seepage as it expands, water will collect within its lowest point (*e.g*., a settling pond or sump). Depending on the floor elevation and the resulting amount of groundwater encountered, dewatering of the proposed quarry expansion may be required. There are no plans to mine below the groundwater table.

Water Quality Effects

Changes in water quality may theoretically occur as a result of excavations in the recharge area of the wells. Potential impacts include: temporary siltation from blasting, oil and nitrate from blasting operations, lubricant compounds, and other chemical releases within the quarry area. A possible long term impact of well water quality is decreased pH or increased dissolved solids from attenuation of acidic drainage from exposed sulfide-rich bedrock. The potential for acid drainage production in this area is low. However, although not expected, localized acid generating bedrock is possible within mineralized zones.

Mitigation of Effects

Due to distance, significant impacts on groundwater supplies are not anticipated due to natural attenuation primarily by dilution and dispersion along the groundwater pathways. Short-term turbidity impacts caused by blasting vibration, though highly unlikely given the distance to offsite wells, 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, the proponent will replace or repair any water supply well found to be adversely affected by their quarry operation to the satisfaction of the owner. Acid generating bedrock is not expected, however should a mineralized zone be encountered the rock will be tested for acid generating potential. If determined to be acid generating bedrock, the material will be handled as prescribed in the Nova Scotia Sulfide Bearing Material Regulations. As previously discussed, no residential water wells are located within 800 m of the Project and therefore impacts to offsite wells are not anticipated.

Monitoring

In summary, significant Project-related effects on groundwater resources are not likely to occur. However, it is recommended that groundwater monitor wells be installed in the proposed quarry expansion area so that site specific groundwater data (*i.e.*, depth and general chemistry) can be used as information to assist in quarry development. Details of the monitoring program (*i.e.,* monitoring parameters and frequency) will be developed in consultation with NSEL and outlined in the Industrial Approval application. The groundwater monitoring program will be designed to ensure that changes in groundwater flow patterns and water quality are detected proactively such that measures can be employed to mitigate potential adverse effects to local groundwater and surface water.

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 expansion 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 as well as those available on the Internet. Maps consulted included those by A.F. Church (1871) and Faribault (1903).

There are no recorded pre-Contact archaeological sites within the study area but there are two very close to it, approximately 700 m to the northwest, opposite the confluence of the Shubenacadie and Nine-Mile Rivers. These two sites, BfCu-2 and 3, date between the Maritime Woodland and Late Archaic periods (3500 to 500 years ago) and were reported as long ago as the 1920s. The Nova Scotia Museum has determined that these sites were likely destroyed by cultivation. The proximity of these sites, however, does not raise the archaeological potential of First Nations sites within the study area as the greatest potential is along the banks of the Shubenacadie River.

The 1908 Geological Survey of Canada map shows an “Indian Reserve” approximately 2 km to the west of the study area. This would be the northern edge of the Shubenacadie Grand Lake Band, which was part of the Shubenacadie Band incorporated in 1820 and now part of the Indian Brook First Nation.

Given the location of the study area the potential for it containing pre-Contact archaeological resources should be considered as low. Although there hasn’t been a concentrated professional survey of archaeological sites along the Shubenacadie River, the recorded sites show that settlement was concentrated along its banks and there was little or no reason for the Mi’kmaq to settle inland, unless it was along a tributary such as the Nine Mile River.

There are no recorded historic archaeological sites within or near the study area. There has been mining activity in the general area, predominantly gypsum, clay, and other rock, and the study area is just south of an active mine (*i.e.*, the current quarry). The expansion area is mainly wooded and is intersected with logging roads. There are no obvious buildings, areas of cultivation, or other settlement features evident on the modern aerial photos.

There is very little historical evidence of settlement within or close to the study area. While land grants in the area were awarded in the late eighteenth century, it wasn’t until the building of the Shubenacadie Canal and, later, the railway, that it began to prosper. The 1825 Francis Hall map of the Shubenacadie River shows no settlement features, nor does the map from Haliburton’s 1829 History of Nova Scotia. The A.F. Church map of 1871 shows that this growth was limited to the west bank of the Shubenacadie River; however, it is located where the railway parallels the river. The 1908 GSC map does show some growth on the east bank, most significantly the road that ran more directly to Halifax, presumably the replacement for the old Post Road that ran from Truro to Halifax. Again, however, there are no settlement features shown within the study area.

Based on the background research and informant report the historical archaeological potential for the study area should be considered low. The background research showed that there were few resources that would have attracted Mi’kmaq settlement within the study area and the pre-Contact archaeological potential should be considered as low. The research also showed that the area was subject to moderate settlement and growth from the late eighteenth to the nineteenth centuries but that there was no historic settlement or significant activities within the study area, and the historic archaeological potential should also be considered as low.

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

Certain activities associated with the Project (*i.e.*, grubbing, grading), 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 study area has low potential for identifiable human use in the pre-Contact and historic periods. No archaeological/heritage resources or areas of elevated heritage potential were identified in the study area. It is assumed that no areas beyond study area will be disturbed during the development and operation of the proposed quarry expansion area. As such, development and operation of the proposed quarry are not expected to have any adverse environmental effects on heritage resources.

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 and the Manager Special Places at the Nova Scotia Museum. If the resources are thought to belong to First Nations, the Chief of the nearest Mi'kmaq band will also be contacted. In the case of suspected human remains, the RCMP will be called. The appropriate authorities will determine further actions to be undertaken which could include avoidance and further assessment.

In summary, assuming appropriate measures are undertaken in the event archaeological or heritage resources are discovered, significant Project-related effects on these resources are not likely to occur.

5.8 Air Quality

5.8.1 Description of Existing Conditions

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.

In general, the air quality of Nova Scotia meets the desired ambient air quality criteria (NSDOE 1998). Motor vehicles, electrical power generation, pulp and paper processing and oil refining are the major local sources of air pollutants in the province. Port Hawkesbury is the only area in the province that experiences periodic exceedences in air quality. All other air quality exceedences in the province are caused by ground level ozone, generated outside the region.

Ambient air quality is monitored in Nova Scotia with a network of 28 sites, operated by NSEL, Environment Canada, and Nova Scotia Power Inc. (NSPI). Other industries may also monitor for air quality. Common air pollutants monitored regularly are SO_2, particulate matter (PM), CO, ground level ozone (O_3), NO_2, and H_2S. The closest NSEL monitoring site to Elmsdale Quarry is located in Halifax, Nova Scotia. In addition, since 2002 the province began continuous reporting of an air quality index for the Halifax-Dartmouth region. Since reporting began, air quality has been predominantly in the "Good" category.

The Elmsdale Quarry is located in a rural setting with little industrial development within a distance of 5 km. 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.

The spatial boundary for the assessment of air quality is the approximate zone of influence affected by the quarrying activities. This zone lies within close proximity to the communities of Elmsdale and Lantz, Nova Scotia.

The VEC spatial boundaries were set so that the effects on potential receptors (*e.g.*, residential, institutional development) were considered. The potential effects of routine air emissions from the Project are evaluated to such a distance that the concentration falls to near background level.

Temporal boundaries for the assessment of air quality have been developed in consideration of those time periods during which Project air emissions have the potential to degrade ambient air quality. In general, emissions that could affect air quality will be relatively short-term from such operations as blasting; however, emissions from such sources as vehicles and construction equipment will be fairly regular.

Other temporal considerations for atmospheric emissions include variations in meteorological conditions, which are related to the capacity for contaminant transport. Sensitivity of receptors to certain atmospheric contaminants (*e.g.,* dust) may also vary by season (*i.e.,* more sensitive in warm weather with increased outdoor activities). Winds blow predominantly from the south or southwest in the summer with an average speed of about 10 to 15 km/h. In the winter months the predominant direction is from the west and northwest with an average speed of 22 km/h. Therefore, the community of Elmsdale would be likely be the most probable receptor of air emissions from the project site in the winter and the community of Lantz the most probable receptor in the summer.

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)*. These guidelines may have also been used as a reference by provincial or federal regulators. The air quality guidelines of tolerable, acceptable, and desirable, as defined under *CEPA*, will be used in the evaluation of significance. 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 (CWS) that harmonize the regulations in all jurisdictions.

The contaminants regulated by the Province of Nova Scotia, or which are listed in *CEPA* are discussed below, indicating how the Project may contribute to their release.

Table 5.5 presents the Nova Scotia Air Quality Regulations and *CEPA* Ambient Air Quality Objectives. These standards can be used as comparison to ensure acceptable ambient air quality levels are being met throughout the life of the Project.

TABLE 5.5 Nova Scotia *Air Quality Regulations (Environment Act)* and *Canadian Environmental Protection Act* Ambient Air Quality Objectives

Pollutant and units (alternative units in brackets)	Averaging Time Period	Nova Scotia	Canada			
		Maximum Permissible Ground Level Concentration	Canada Wide Standards (pending)	Ambient Air Quality Objectives		
				Maximum Desirable	Maximum Acceptable	Maximum Tolerable
Nitrogen dioxide µg/m^3 (ppb)	1 hour	400 (213)	-	-	400 (213)	1000 (532)
	24 hour	-	-	-	200 (106)	300 (160)
	Annual	100 (53)	-	60 (32)	100 (53)	-
Sulphur dioxide µg/m^3 (ppb)	1 hour	900 (344)	-	450 (172)	900 (344)	-
	24 hour	300 (115)	-	150 (57)	300 (115)	800 (306)
	Annual	60 (23)	-	30 (11)	60 (23)	-
Total Suspended Particulate Matter (TSP) µg/m^3	24 hour	120	-	-	120	400
	Annual	70	-	60	70	-
PM2.5 µg/m^3	24 hour, 98th percentile averaged over 3 consecutive years	-	30 (by 2010)	-	-	-
PM2.5-10 µg/m^3		-	Under review in 2003	-	-	-
Carbon Monoxide mg/m^3 (ppm)	1 hour	35 (31)	-	15 (13)	35 (31)	-
	8 hour	15 (13)	-	6 (5)	15 (13)	20 (17)
Oxidants – ozone µg/m^3 (ppb)	1	160 (82)	-	100 (51)	160 (82)	300 (153)
	8 hour, based on 4th highest annual value, averaged over 3 consecutive years	-	128 {by 2010} (65)	-	-	-
	24 hour	-	-	30 (15)	50 (25)	-
	Annual	-	-	-	30 (15)	-
Hydrogen sulphide µg/m^3 (ppb)	1 hour	42 (30)	-	-	-	-
	24 hour	8 (6)	-	-	-	-

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

Quarrying activities can generate dust (*i.e.*, particulate emissions) which has the potential to be transported offsite. As per the conditions of the existing Elmsdale Quarry Industrial Approval and the Pit and Quarry Guidelines, particulate emissions will not exceed the following limits at the site property boundaries:

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

There are a variety of activities that can lead to the generation of particulate matter on the construction site. The primary potential sources of TSP include:

- Exhaust gas emissions due to incomplete combustion from diesel compression engine;
- Road dust;
- Wind erosion on storage piles;
- Blasting activities;

- Conveyors;
- Crushing operations;
- Screening operations;
- Material handling;
- Material transport; and
- Truck loading / truck unloading.

Some of the more pertinent contributors are discussed in detail in the following paragraphs.

- 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.
- Both crushing and screening are mineral extracting operations that involve the generation of particulate emissions. Uncontrolled processing operations like these can produce nuisance problems and can have an effect upon attainment of ambient particulate standards.
- Material handling activities can result in the generation of particulate matter. The reason for these emissions is often 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. The potential drift distance of particles caused by wind is determined by the initial injection height of the particle, the terminal settling velocity of the particle, and the degree of atmospheric turbulence.
- Particulate emissions can occur whenever vehicles travel over both paved and unpaved surfaces. Particulate emissions from paved roads are caused by direct emissions from vehicles such as exhaust, brake wear and tire wear emissions and resuspension of loose material on the road surface. Resuspended particulate emissions from paved roads originate from, and result in the depletion of, the loose material present on the surface. Regarding unpaved roads, the force of the wheels on the road surface causes pulverization of surface material. Particles are picked up and dropped from the rolling wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake following the vehicle continues to act on the road surface after the vehicle has passed.
- 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 have been made by covering work and laydown areas with blasted materials, and covering stockpiled topsoil with seed and hay. Fugitive dust emissions will be controlled as necessary with the application of water obtained from the settling pond(s) with the use of a water truck. Monitoring of particulate emissions (dust) will be conducted at the request of NSEL.

Dust generated by truck movement will be minimized by speed control, proper truck loading, application of water for dust suppression, proper construction of on-site roads, and/ or other means as required by NSEL. Details of any required monitoring will be included in the Industrial Approval application.

Exhaust 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.

The air quality impacts of Elmsdale Quarry can be controlled by standard mitigation practices and the Project is not likely to create significant adverse impacts on air quality. Significant impacts on air quality are defined as persistent exceedences of criteria provided in Table 5.5 after application of mitigative measures.

5.9 Socio-economic Environment

5.9.1 Description of the Existing Environment

Population and Employment

The quarry is located in HRM, southeast of Elmsdale. The quarry is located in a rural setting with one commercial structure located within 800 m of the quarry site (with an existing letter of permission authorizing blasting within 800 m of their property). The population in the general area (*i.e.,* HRM) is 359,111 (Statistics Canada 2001). The population in this area increased by 4.7 % from 1996 to 2001. The employment rate in the County is 63.0 % while the unemployment rate is 7.2% (Statistics Canada 2001). Approximately half of the experienced labour force consists of trades, transport and equipment operators and related occupations and sales and service occupations.

The majority of the aggregates from the quarry, to date, have been sold to customers in Hants County, Colchester County and HRM, predominantly for construction projects. The closest town is Elmsdale, located in the East Hants municipal district, where the population is 20,821, which is a 5.3% increase since 1996 (Statistics Canada 2001). The employment rate in the East Hants municipal district is 59.3 % while the unemployment rate is 8.7%. Approximately half of the labour force consists of trades, transport and equipment operators and related occupations and sales and service occupations.

The existing quarry currently employs ten people. Drilling and blasting activities require additional resources; these activities are sub-contracted to a professional blasting company. Hauling of materials from the quarry also involves additional labour resources; hauling (or trucking) is typically arranged through the customers.

Land Use

Mining

A review of NSDNR Abandoned Mine Openings Database indicates that there are 334 Mine Shafts within a 10 km radius of the boundaries of the Project property. These shafts are located in the following three areas:

- 1 Shaft in Goffs (Tungsten);
- 1 Shaft in Keys Brook (Gold); and
- 332 Shafts in Oldham (Gold).

The statuses of these shafts are not known. However, none are in close proximity to the Project property and no interaction is predicted between these mine shafts and the proposed quarry expansion.

Agriculture

The Elmsdale Quarry Expansion Project is not located in a region where conflict with current and future agricultural practices is anticipated.

Forestry

Approximately 70% of the study area has been harvested within the past 20 to 30 years with approximately 20% of the study area harvested more recently. However, intensive forestry or silviculture operations have not been identified in the region within and surrounding the Project area.

Transportation

A transportation assessment and discussion of potential impacts of the quarry operation was conducted by Atlantic Road and Traffic Ltd. in support of the environmental registration. A description of the existing conditions in the area is included in the following paragraphs.

Road Descriptions

The Gallant Aggregates Quarry has been operating on Bedrock Lane, for over 20 years. Bedrock Lane intersects with the east side of Old Trunk Road about one kilometer north of the Elmsdale Road / Old Trunk Road intersection. The existing trucking route from Bedrock Lane to Highway 102 at the EXIT 8 interchange is via Old Trunk Road, Elmsdale Road, and Route 214, a distance of about 3.4 km. The section of Old Trunk Road adjacent to Bedrock Lane is a local road with a rural cross section, including two paved lanes, gravel shoulders, and open ditches. The Bedrock Lane intersection is located on a relatively flat section of roadway and has adequate sight distances for both approaches for the 70 km/h posted speed limit. No stop sign was in place on Bedrock Lane at the Old Trunk Road intersection at the time of the site visit.

Traffic Volumes

While traffic volume data is not available for Old Trunk Road, a site visit indicated that volumes are light to moderate, possibly in the order of 2000 vehicles per day. This suggests a two-way peak hour volume of about 200 vehicles per hour.

Collision Data

The relative 'safety' of an intersection is generally evaluated by review of collision data for reported collisions at or near the intersection being studied. A review of collision data for the road section did not indicate any history of collisions at the Bedrock Lane intersection, however, there was one reported property damage only collision at a driveway near the intersection in 2001. The vehicle identification section of the report was incomplete, however, since there was no mention of a heavy vehicle being involved, it is assumed that the collision did not involve an aggregate transport truck.

Quarry Traffic

The current and projected production rate for the quarry is approximately 400,000 to 500,000 tonnes per year. The current and anticipated operating schedule is 15 hours per day on a year round basis with an average of 85 truck loads shipped each working day. Since the quarry is expected to continue

operating 15 hours per day, hourly truck volumes generated by the quarry will average about six loaded trucks leaving and six empty trucks returning.

Recreation and Tourism

Recreational fishing and hunting are permitted in the region surrounding the Project area. The streams in the Project area may provide some recreational fishing opportunities in the spring, summer and early fall. However, no anglers or discarded fishing gear were encountered during field surveys. Local anglers likely preferentially fish in the nearby Shubenacadie River and its larger tributaries, which provide angling opportunities for a wide variety of species. While moose hunting is not permitted in the region surrounding the Project area, deer hunting is allowed and is a popular activity. The Elmsdale Quarry is situated in Deer Management Zone 5. In 2006, only antlered deer could be taken legally by hunters in this management zone (NSDNR 2006). The general open season during 2006 ran from the last Friday in October to the first Saturday in December. The bowhunting season during 2006 ran from September 30 to October 26 and December 4 to December 9.

There are no designated parks within or surrounding the Project area.

Human Health

Human health related aspects and potential effects on environmental health include potential impacts on air quality (*i.e.*, particulate emissions) and safety of commuters. Air quality is addressed in Section 5.8, and Sections 5.9.1 (collision data) and 5.9.2 will include a discussion of the safety of travelers following completion of the traffic study.

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

Population and Employment

The direct and indirect employment associated with operation of Elmsdale Quarry may be considered a benefit, or positive effect, to the regional economy. In addition, the quarry produces valuable products that support development and infrastructure, and the growth of the region's economy.

Expansion of the Elmsdale Quarry to allow for continued operation will result in an overall positive effect on the regional economy. The availability of additional supply to the market place should encourage a more stable price for aggregate. In some cases (*i.e*., 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, in the case of public infrastructure such as highways, communities, public works agencies, and taxpayers should result in financial benefits (NSDNR 2006).

Another interpretation of Project-related employment effects is that they may be considered neutral. This is because the market that Elmsdale Quarry is supplying is not new, the products are not new, and the demand for aggregate in the local market is currently being met by existing quarries, including the existing Elmsdale Quarry.

Land Use

Due to the existing industrial activity onsite (*i.e.*, quarry) and the distance from residences, impacts on existing and future adjacent land uses are not expected. Quarry activities will be conducted in accordance with the Pit and Quarry Guidelines and all setback distances specified in the Guidelines will be maintained.

Quarrying activities will produce noise from equipment operation and blasting. The proposed expansion area is located greater than 800m from the nearest residence. The existing quarry operation has a signed agreement with the owners of a commercial structure located within 800 m of blasting. The potential for noise from the quarry site to have a significant effect on residents is minimal.

Blasting operations associated with the proposed expansion will be conducted in accordance with current operations at the quarry as permitted by NSEL (Approval No. 2006-050247-R01), in accordance with the Pit and Quarry Guidelines (NSEL 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 NSEL. A blast design has been prepared and is included in Appendix C.

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

Leq 65dBA 0700-1900 hours (Days)

60dBA 1900-2300 hours (Evenings)

55dBA 2300-0700 hours (Nights)

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

Transportation

In general, truck traffic associated with this Project is not anticipated to increase above that of the existing operation.

The transportation impacts of the proposed quarry expansion can be summarized by the following:

- The Bedrock Lane intersection is on a level section of Old Trunk Road with adequate sight distances.
- A STOP sign should be erected on the Bedrock Lane approach to Old Trunk Road.
- The existing black and orange Temporary Truck Entrance signs (WC-54 R and WC-54L, *Manual for Uniform Traffic Control Devices for Canada*, Transportation Association of Canada, 1998) on Old Trunk Road approaches to Bedrock Lane should be replaced by black and yellow Truck Entrance warning signs (WC-8R and WC-8L).
- Daily and peak hourly volumes on Old Trunk Road are estimated to be low to moderate.
- Review of collision data does not indicate any history of collisions at the Bedrock Lane intersection.

In summary, since the quarry has been operating for over 20 years, and since the proposed quarry expansion is not expected to affect existing average daily or hourly aggregate transport truck volumes, noticeable impacts to the level of performance of the road network are not anticipated.

Following the site survey, the Proponent has made steps to erect a stop sign on the Bedford Lane approach to Old Trunk Road and replace the Truck Entrance warning signs.

Recreation and Tourism

The existing quarry and proposed expansion of the operation are not likely to have an impact on hunting and recreational fishing in the general area. An active quarry is already operational on site which likely would deter animals from adjacent habitat. 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 Gallant Aggregates to pursue their activities in the area.

Fishing may also occur in the Project area. However, no impacts are predicted on recreational fishing. Mitigation will be employed to decrease the likelihood of sedimentation (see Section 5.2). Moreover, the Project area appears to be of little importance to local anglers due to the lack of desirable fishing locations.

Human Health

Human health related issues are discussed in Section 5.8 Air Quality and Sections 5.9.1 and 5.9.2 Transportation. The health and safety of nearby residences is not expected to be affected by the Project.

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 employment and ongoing business opportunities.

5.10 Other Undertakings in the Area

5.10.1 Description of the Existing Environment

The Proponent is not aware of any other pit operations licensed to operate within a 10 km radius of the Project.

6.0 EFFECTS OF THE PROJECT ON THE ENVIRONMENT

Activities associated with the proposed quarry expansion and operation will be conducted in accordance with terms and conditions of the existing Industrial Approval for Gallant Aggregates' existing quarry operation, as well as future amendments to the Approval, and the Pit and Quarry Guidelines. Environmental effects of the quarry expansion will include the loss of some habitat within the proposed revised quarry expansion area. The Proponent has redesigned the Project to avoid interactions with some of the watercourses and wetlands identified onsite and is committed to wetland and fish habitat compensation for the loss of habitat as a result of quarrying operations. Field surveys conducted to date indicate that this area does not include unique habitat or rare or sensitive species; therefore, these effects are not anticipated to be significant.

The Proponent has obtained permission from the land owner with a structure within 800 m of quarry activities. An 800m boundary from all other structures will be maintained therefore no further land owner agreements will be required. Although no offsite water wells are located within 800 m of the Project, groundwater data (*i.e,* depth and general chemistry*)* can be used as information to assist in quarry development.

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.

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 or socio-economic effects are likely. Continued operation of the quarry will result in economic benefits, including employment and ongoing business opportunities.

A stormwater management plan will be submitted as part of the quarry development plan during the Industrial Approval application process.

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 are 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, 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 year round, weather depending, and will consider severe winter 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 effect 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 Industrial Approval from NSEL for operation of the Project; the General Blasting Regulations made pursuant to the Nova Scotia *Occupational Health and Safety Act* (1996); and a Division 1 water Approval from NSEL. Provincial guidelines to be adhered to include the *Pit and Quarry Guidelines* (NSDOE 1999). No municipal approvals are required. HADD authorization may be required under the Federal *Fisheries Act* if it is determined that fish habitat will be impacted by the Project.

9.0 FUNDING

The proposed expansion will be 100 percent privately funded.

10.0 ADDITIONAL INFORMATION

No additional information is provided in support of this document.

11.0 REFERENCES

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