SAGEWILL LIMESTONE QUARRY MINING PLAN

French Village, New Brunswick
TE181001

Prepared for:

Sagewill Enterprises Ltd.
French Village, New Brunswick

15-Jun-18

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Prepared for:
Sagewill Enterprises Ltd.
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Prepared by:
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15-Jun-18

Executive Summary

Sagewill Enterprises Ltd. (Sagewill) is planning to develop a limestone quarry in their mineral claim areas located north of the Hammond River at French Village, New Brunswick (NB), hereinafter referred to as "the Project" (Figure 1.1). The product will primarily be high calcium limestone for industrial users and fertilizer, but some may be sold as aggregate. The high quality of the calcium rich limestone and proximity to the Port of Saint John are considered marketing advantages.

Wood Environment & Infrastructure Solutions, a Division of Wood Americas Limited (Wood) was retained by Sagewill to provide environmental and engineering consulting services and to prepare this Mining Plan in support of the registration of the Project under the New Brunswick Environmental Impact Assessment (EIA) and Mine Approval processes.

The initial production volume will be approximately 15,000 tonnes per year (t/y), but may increase to 320,000 t/y, depending on market opportunities. The potential development area is approximately 55 hectares (ha), but the final quarry footprint will be closer to 15 ha. The quarry will be developed in 10 m benches, from south to north, starting at the north limit of the existing quarry (owned by Hammond River Aggregates (HRA). Quarrying will likely be seasonal (typically 8 months), clearing only the areas required for the next season's development. The initial quarry development area will be accessed via the existing HRA quarry road, which connects to Route 860, to the south. If higher production volumes are planned in future, a direct access to Route 1 will be proposed.

A description of the existing environment in the Study Area has been presented based on available information. The potential impacts identified by issue scoping and pathway analysis for the proposed quarry include:

- Dust and Noise;
- Blasting vibration at residences and private wells;
- Site runoff/discharges into local watercourses or ground water;
- Impacts on migratory birds or other wildlife;
- Accidental discovery of heritage and/or archaeological resources;
- Increased truck traffic on local roads; and
- Benefits to local economy (employment/spending) and provincial fees and taxation.

This plan includes measures to mitigate potential environmental concerns and comply with regulatory requirements during construction, operation, and decommissioning. Detailed mitigation and reclamation is addressed in the Environmental Management Plan and Reclamation Plan (under separate cover).

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List of Acronyms

ACCDC	Atlantic Canada Conservation Data Centre
Wood	Wood Environment & Infrastructure Solutions, a Division of Wood Americas Limited
ASNB	Archaeological Services New Brunswick
CAAQs	Canadian Ambient Air Quality Standards
CCME	Canadian Council of Ministers of the Environment
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
EEM	Environmental Effects Monitoring
EIA	Environmental Impact Assessment
GCDWQ	Guidelines for Canadian Drinking Water Quality
AIA	Archaeological Impact Assessment
MBBA	Maritime Breeding Bird Atlas
MBCA	*Migratory Birds Convention Act*
NB	New Brunswick
NBAQOs	New Brunswick Air Quality Objectives
NBDELG	New Brunswick Dept. of Environment and Local Government
NBDERD	New Brunswick Dept. of Energy and Resource Development
NBENV	New Brunswick Dept. of the Environment
NBSRA	*New Brunswick Species at Risk Act*
OWLS	Online Well Log System
PID	Property Identification Number
PM	Particulate Matter
SARA	*Canadian Species at Risk Act*
the Project	Development and Operation of the Sagewill Limestone Quarry
VECs	Valued Environmental Components

List of Units

dB	decibels
dBA	A-weighted decibels
gpm	gallons per minute
ha	hectares
km	kilometres
km^2	square kilometres
Ld	Daytime noise level
Leq	energy equivalent sound level
Ln	Nighttime noise level
m	metres
m^2	square metres
masl	metres above sea level
mbgs	metres below ground surface
mg/L	milligrams per litre
PM_{10}	Particulate Matter less than 10 microns
$PM_{2.5}$	Particulate Matter less than 2.5 microns
ppb	parts per billion
$\mu g/m^3$	microgram per cubic metres

PART 1 - BACKGROUND SURVEY

1.0 Introduction

Sagewill Enterprises Ltd. (Sagewill) (the Proponent) is planning to develop a limestone quarry in their mineral claim areas located north of the Hammond River at French Village, New Brunswick (NB), hereinafter referred to as "the Project" (Figure 1.1). The product will primarily be high calcium limestone for industrial users and fertilizer, but some may be sold as aggregate. The high quality of the calcium rich limestone and proximity to the Port of Saint John are considered marketing advantages.

Wood Environment & Infrastructure Solutions, a Division of Wood Americas Limited (Wood) was retained by Sagewill to prepare this Mining Plan in support of the registration of the Project under the New Brunswick Environmental Impact Assessment (EIA) and Mine Approval processes. As part of this mining lease application, a separate Environmental Management Plan & Reclamation Plan (EMP&RP) has been developed in conjunction with the Mining Plan. The EMP&RP is a living document that will evolve during the mining operation and be reviewed annually and revised appropriately over time (unlike this mining plan). The EMP&RP includes details related to protection of environmental features, emergency response, regulatory compliance, and final abandonment and site reclamation.

1.1 Company Information

Sagewill Enterprises Ltd. is a New Brunswick registered corporation, wholly owned by Ms. Sally Williamson. The Proponent developed the existing quarry (present owner, Hammond River Aggregates (HRA)) in 1998. The mine was operated by the Proponent until 2006, establishing markets along the east coast of the United States (USA), particularly New York. The present owner, HRA, took over operation in 2006, while Sagewill continued to explore claims further north to delineate a source of high calcitic limestone (> 95% calcium carbonate (CaCO3)). Sagewill has identified additional resources in the claim areas, estimated at minimum three (3) million tonnes, and plans to create a new quarry to develop the resource.

1.2 Address and Principal Contacts

The Applicant is the Sagewill Enterprises Ltd. Additional inquiries regarding corporate information may be forwarded to:

Sagewill Enterprises Ltd.
Owner and Primary Contact: Ms. Sally Williamson & Mr. George Williamson
47 East Wind Drive,
P. O. Box 257
Chester, NS B0J 1J0
E-mail: sagewill@shaw.ca
Cell: (250) 300-0718

Path: H:\PROJECTS\TE181001_Sagewill_Enterprises_Limestone_Quarry_French_Village_NB\MXD\06082018_TE181001_SiteLocation_Figure1.mxd User: dale.mccoy Date: 6/8/2018

SOURCE: NTS provided by Government of Canada, Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information.

TITLE: Project Location Sagewill Limestone Quarry French Village New Brunswick	DATE: JANUARY 2018	PROJECT NO.: TE181001	wood.
	DWN BY: RE	DATUM: NAD83 CSRS	
	CHK'D BY: GB	PROJECTION UTM ZONE 20N	
CLIENT: Sagewill Enterprises Ltd.	REV.NO A	SCALE 1:80,000	FIGURE NO.: 1.1

2.0 Site Location

2.1 Geographic Setting

The Project is located on a moderate ridge on the north side of the Hammond River valley, across the river from the residential community of French Village, and approximately 2.5 kilometres west of Quispamsis. The ridge is oriented north-south and is bounded to the east by the TransCanada Highway (Route 1) and to the west by an unnamed tributary of the Hammond River. The site elevation ranges from 95 m at the peak (near the north end of the site) down to 55 m on the western flank (Figure 2.1). The quarry will likely be located along the ridge top with elevations ranging from 70 to 95 m. The gradient along the ridge line is gentle, at 2% and side slopes to the east and west increase up to 15% at the extreme edges of the Site Boundary. The majority of the quarry footprint will likely be less than 5-7% slope. The Hammond River is approximately 350 metres (m) west of the site. The Trans-Canada Highway is approximately 180 m east of the Site Boundary. The small unnamed stream to the west, is approximately 110 m from the Site Boundary.

2.2 Land Use

2.2.1 Mine Site

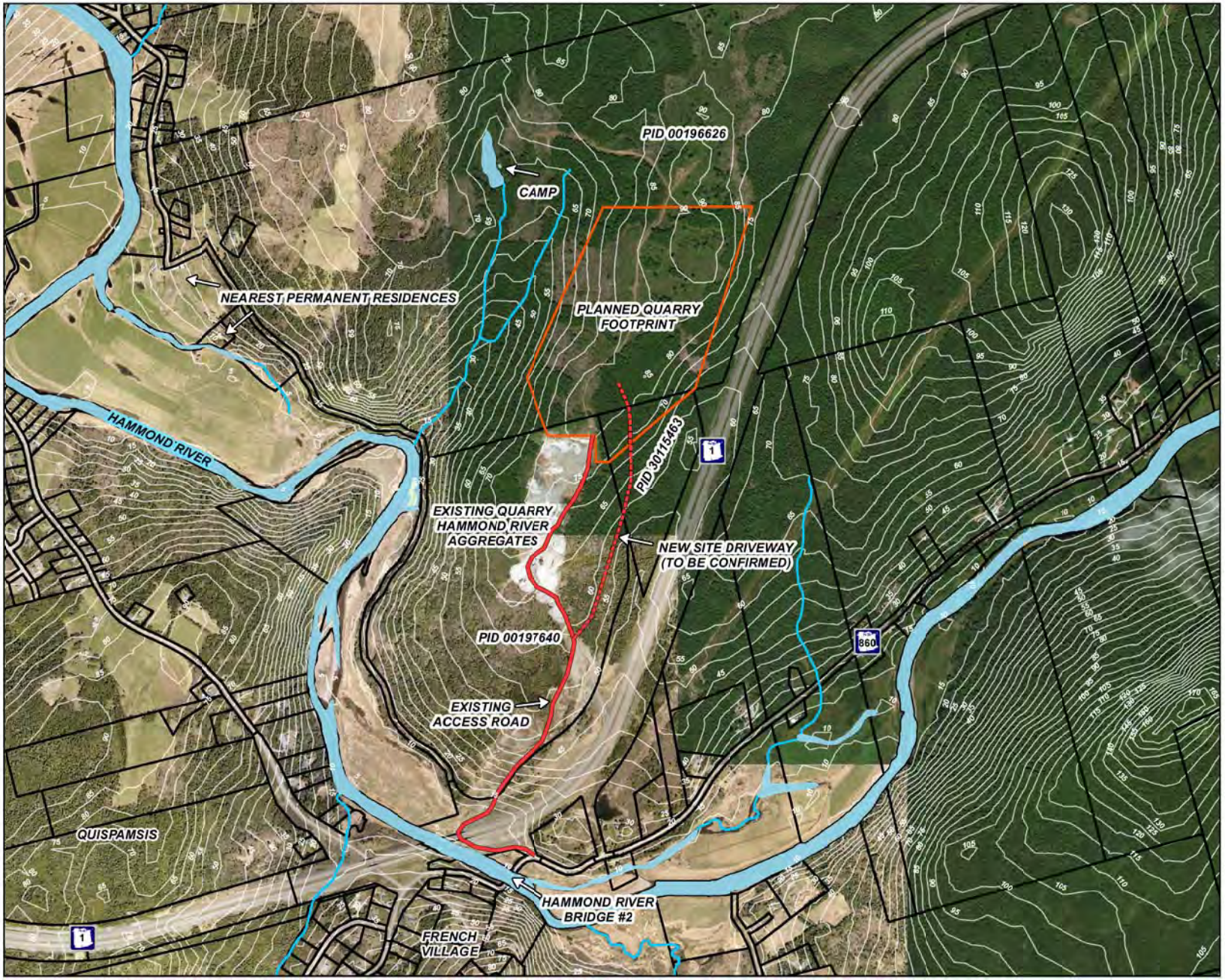
The Project footprint (Figure 2.2) is covered by forest and recent clear-cut, without any previous development. The nearest permanent residences are located over one kilometre (km) to the east and west.

The Project will be located within mineral claim areas held by Sagewill (No's 3367, 8422, and 8573), on private property (PID 00196626) owned by Meadow Brook Farms (Figure 2.2). There is an existing quarry operated by Hammond River Aggregates (HRA) immediately south of the site on private property (PID 0197640) owned by HRA. Sagewill plans to develop the new quarry by extending the north face of HRA's existing quarry.

2.2.2 Adjacent Land Use

To the south, directly adjacent, is an existing limestone quarry operated by Hammond River Aggregates (Figure 2.2). This property is predominately forested, with the existing quarry at the northwest corner, including an unpaved access road that connects to Route 860 to the south, passing under the Route 1 highway bridge at the Hammond River. The properties north and west are mainly undeveloped forest, with a few scattered rural residences and seasonal camps. Land along the Hammond River is used for agricultural purposes. The nearest residence is a camp located approximately 360 m northwest of the Project footprint's perimeter; the closest permanent residence being at a distance of 1 km.

The property to the west is owned by the province, associated with the Route 1 highway right-of-way (Figure 2.1). A portion of this land (PID 30115463) may be included in the quarry footprint and in future may be used for a new unpaved access road (to be confirmed). This property is forested, with no current uses.



Legend

- Site Boundary
- SNB Waterbody
- Kings County PID (Lines)
- Watercourse

0 200 400 800
Meters

CLIENT:

Sagewill Enterprises Ltd.

wood.

PROJECT:

Sagewill Limestone Quarry
French Village New Brunswick

TITLE:

Site Topography and Access

DATUM:	DWN BY:	DATE:
NAD 83 CSRS	RE	January 2018
PROJECTION:	CHK'D BY:	SCALE:
UTM Zone 20 North	GB	1:12,000
PROJECT NO:	REV NO:	FIGURE NO:
TE181001	A	2.1

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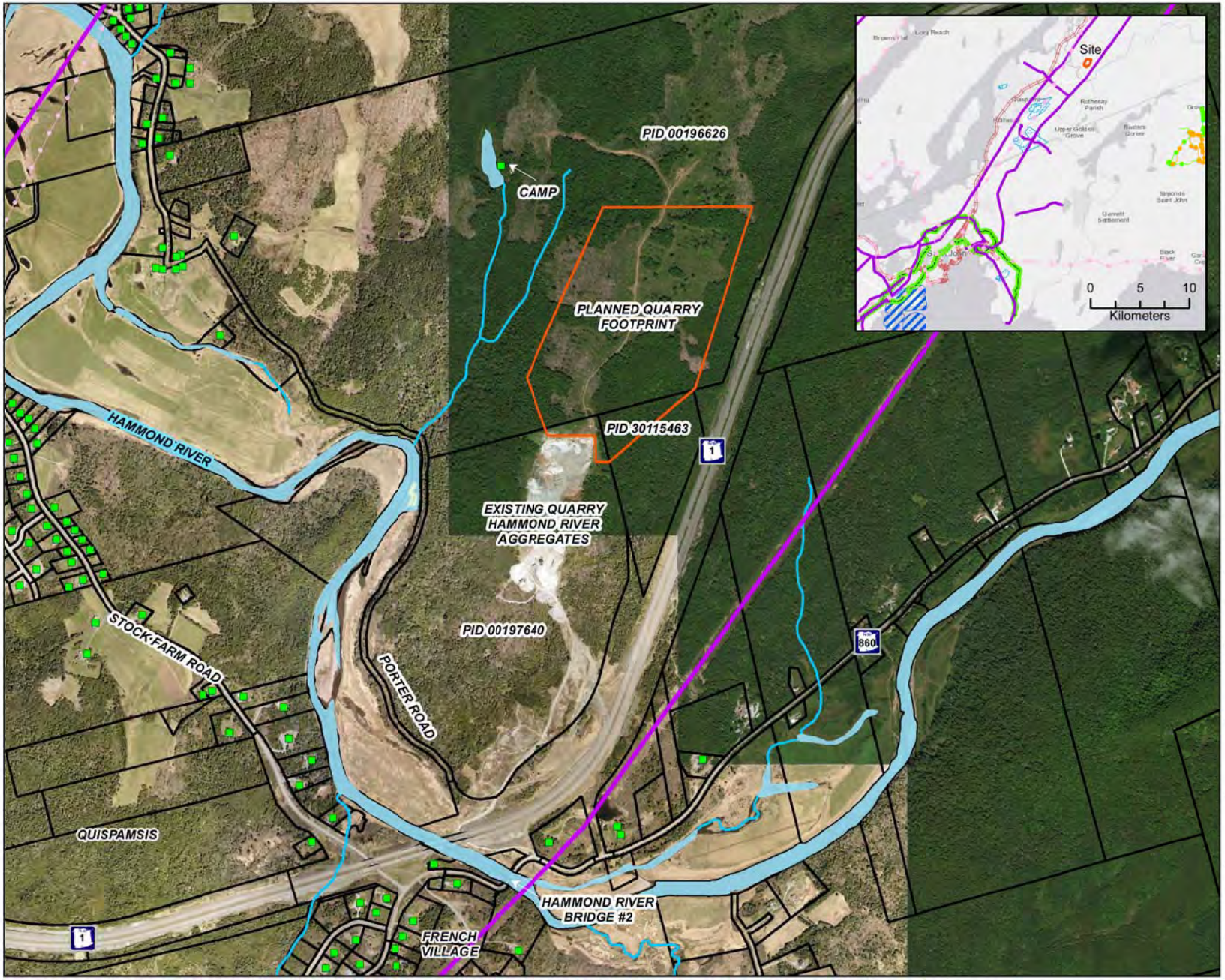

Legend

- Buildings
- Watercourse
- Road
- Site Boundary
- Waterbody
- Kings County PID (Lines)

Inset Legend

- Site Boundary
- Natural Gas Pipeline
- NB Power Transmission Line
- Railroad
- ATV Trails
- Sentier NBTrail
- SnowmobileTrail
- Protected Wellfield
- IBA - Important Bird Area

0 200 400 800
Meters

CLIENT:
Sagewill Enterprises Ltd.

wood.

PROJECT:
Sagewill Limestone Quarry
French Village New Brunswick

TITLE:
Land Use / Ownership

DATUM:	DWN BY:	DATE:
NAD 83 CSRS	RE	6/8/2018
PROJECTION:	CHK'D BY:	SCALE:
UTM Zone 20 North	GB	1:12,000
PROJECT NO:	REV NO:	FIGURE NO:
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2.2.3 Utility Corridors

- **Electricity**

There are no electrical generation facilities in or near the Study Area. There is an NB Power corridor approximately 600 m east of the Site, and 1.5 km to the west on the opposite side of the Hammond River. There is no power service to the Site. The nearest local 3-phase powerline runs along Route 860, to the south.

- **Water / Sewer**

Water and sewer needs for the area are provided by individual septic systems and domestic water wells, further described in Section 5.3.

- **Natural Gas and Oil Pipelines**

The nearest pipelines are located within the City of Saint John, as illustrated in the inset of Figure 2.1. Both are natural gas pipelines owned by Brunswick Pipeline and the Maritimes & Northeast Pipeline (M&NP).

2.3 Access

The Site will be accessed from Route 860, just north of the Hammond River, using the existing Hammond River Aggregates (HRA) quarry access road which traverses beneath the Trans-Canada Highway (Figure 2.1). During initial mine development, Sagewill has obtained agreement with HRA to access the site through the existing quarry; which connects to a logging road that runs north all the way through the middle of the proposed Site Boundary area. The existing quarry has a locked gate, for which Sagewill now has its own padlock. Quarry production truck traffic will be able to access Route 1 by taking Route 860 north or south (within 10-15 km), and can access Route 100 by taking Stock Farm Road to the west.

2.4 Ownership

The Project will be located within mineral claim areas held by Sagewill (No's 3367, 8422, and 8573), on private property (PID 05257416) owned by Meadow Brook Farms (Figure 2.1). There is an existing quarry operated by Hammond River Aggregates (HRA) immediately south of the site on private property (PID 05125627) owned by HRA. Sagewill plans to develop the new quarry by extending the north face of HRA's existing quarry. Contact has been made with HRA and Meadow Brook Farms to discuss the Project impacts and obtain necessary landowner agreement.

Some quarrying activity may occur in the northwest corner of the Crown land property (PID 04289151) to the southeast. This property may also be used in future to locate a new unpaved access road (to be confirmed) to the Sagewill Quarry (Figure 2.1).

3.0 Geology

3.1 Unconsolidated Geology

The site is covered by a moderately well drained non-compact till. The overburden depth is generally shallow (2-3 m) with frequent bedrock outcrops. The soil is a coarse-grained silty loam.

3.2 Bedrock

The bedrock, mapped in Figure 3.1, is described as marble limestone of the Ashburn Formation. However, there is a complex boundary with the Duck Lake Gabbro which extends into the site.

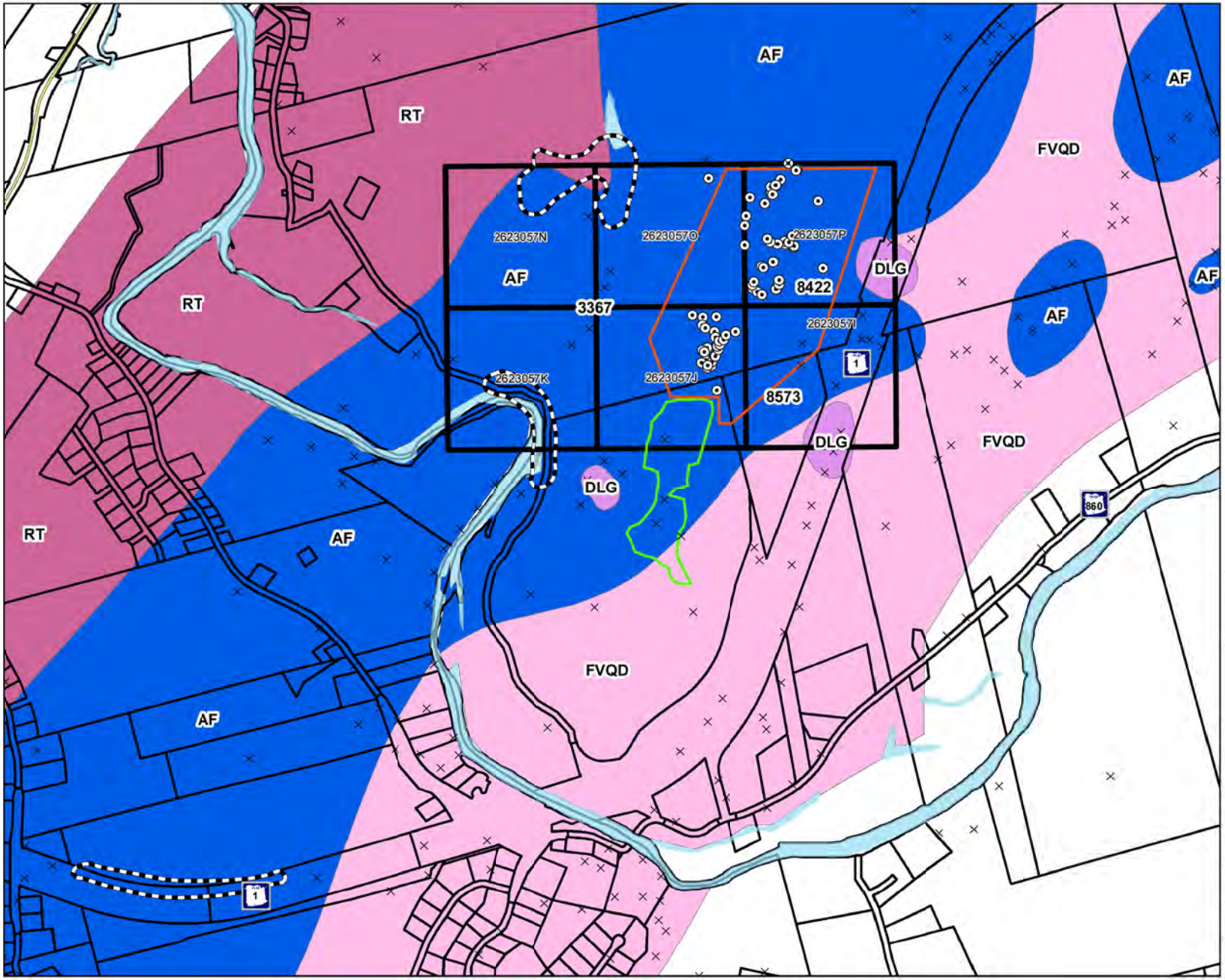
The Ashburn Formation limestone structure locally has sub-vertical bedding striking north-northeast (roughly parallel to the ridgeline). Based on past mapping and drilling programs, these units can pinch out along strike, sometimes disjointed by cross-faults, and are extensively intruded by gabbro. The north face in the existing quarry has about 40% limestone across a 175 m exposure, to a depth of 10 m. This allows for a conservative estimation of resource volume and mine life, but will require additional drilling prior to and during operation, in order to define areas of high calcium limestone. Sagewill is conducting a drilling program in June of 2018 to determine the best area to begin mining.

3.3 Ore Geology

Sagewill intends to target high calcium limestone (>50% CaO) for sale to industrial markets for its chemical properties. In addition to flue gas absorption from oil and coal-fired power plants, high calcium limestone can be used in wastewater treatment systems, and the production of steel, lime, cement, and in the manufacture of paper and paint. It is also used in cattle feed and agricultural lime. The high calcium limestone at the site is massive, exposed on the surface, and is very white; which enhances its applications and sales opportunities.

High calcium limestone of the Precambrian Ashburn Formation is found throughout much of the area bounded by Nauwigawauk/ Bonney Road in the north and French Village/ Hammond River in the south. A number of mapping programs have been carried out to better define the spatial distribution of these rocks and document the quality of limestone present; which indicate the variability of quality (as defined by CaO content). The chemistry of the limestone can vary as a result of interbedded quartzite and argillite, overprinted by the complex structural history of this area. Sagewill has identified that high calcium (~53% CaO) zones are locally present, but achieving a constant mining grade above 50% CaO will require selective quarrying.

In order to develop a robust geological model for the Sagewill quarry a smaller scale shallow drill hole program will be conducted, focusing on the limited area which may be mined in the next few years. The program will generate cuttings rather than core, to target the area in which good quality limestone outcrops occur, to define continuity with depth, and to provide samples for assays. The current HRA quarry provides some insight on the 3-dimensional structure that can be extrapolated, and as the quarry advances new data will become available to guide the optimum direction of future mining.



Legend

- Site Boundary
- Mineral Claims
- Existing Quarry
- Waterbody
- Kings County PID (Lines)
- Road

Geology Key

- Duck Lake Gobbro (DLG)
- French Villiage Quartze Diorite (FVQD)
- Ashburn Formation - Marble (AF)
- Renforth Tonalite - Quartz Diorite (RT)
- White Limestone Outcrop
- Bedrock Outcrop
- Area of Bedrock Outcrop

0 200 400 800
Meters

The generalized bedrock geology map of New Brunswick, compiled at 1:500,000 scale from detailed maps with polygon attributes that indicate lithostratigraphic and intrusive groups,contacts and faults.
Department of Energy and Resource Development (ERD)

CLIENT:
Sagewill Enterprises Ltd.

wood.

PROJECT:
Sagewill Limestone Quarry
French Village New Brunswick

TITLE:
Geology

DATUM:	DWN BY:	DATE:
NAD 83 CSRS	RE	January 2018
PROJECTION:	CHK'D BY:	SCALE:
UTM Zone 20 North	GB	1:12,000
PROJECT NO:	REV NO:	FIGURE NO:
TE181001	A	3.1

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The associated gabbro, and limestone that does not meet the preferred calcium content, can be marketed as common stone for aggregate; however, Sagewill intends for the high calcium limestone to be the primary product. Very little "waste rock" is anticipated, since most quarried material will have a potential market.

3.4 Seismicity

New Brunswick is within the Northern Appalachians Seismic Zone, which contains low level seismic activity, with values ranging from 1.0 - 6.0 magnitude (MN) on the Richter Scale (average ~3.0 MN). The largest recording was 5.7 MN in Miramichi (1982). The most recently "felt" events have occurred as an earthquake "swarm" during February 2016 where lightly felt recurring earthquakes were recorded as high as 3.3 MN near McAdam. There are a number of old geologic fault lines associated with the Kingston Uplift, whose last movement are estimated at approximately 300 million years ago. In summary, the potential for seismic activity in the Study Area is low (Natural Resources Canada, 2016).

3.5 Acid-rock Drainage

The geology associated with the quarry area, including limestone and gabbro, with minor argillite, sandstone, and conglomerate, has a very low potential to generate acid-rock drainage. The high calcium limestone would neutralize acid in mine water at the quarry.

4.0 Air Quality and Noise

4.1 Ambient Air Quality

Air quality in New Brunswick is routinely monitored by the provincial and federal governments at various stations, usually located in or near population centres. Both the air quality standards under Schedule B of the *NB Clean Air Act* and the NB Air Quality Objectives (NBAQOs) established by the Province under the same Act provide Guidelines and Objectives that apply to various components, including Total Suspended Particulate (TSP): 120 micrograms per cubic metre (µg/m^3) per 24-hour averaging period and 70 µg/m^3 per 1-year averaging period. Table 4.1 lists the NBAQOs established under the Provincial *Clean Air Act*.

Table 4.1 Air Quality Guidelines in New Brunswick

Pollutant	Averaging Period			
	1-hour	8-hour	24-hour	1 year
Carbon monoxide (CO)	30 ppm[1]	13 ppm		
Hydrogen sulphide (H_2S)	11 ppb[2]		3.5 ppb	
Nitrogen dioxide (NO_2)	210 ppb		105 ppb	52 ppb
Sulphur dioxide (SO_2)***	339 ppb		113 ppb	23 ppb
Total Suspended Particulate			120 µg/m^3	70 µg/m^3

Source: NBDELG, 2015
1ppm – parts per million
2ppb – parts per billion
** The standards for SO2 are 50% lower in Saint John, Charlotte, and Kings Counties.

In October 2012, most jurisdictions, with the exception of Quebec, agreed to begin implementing a new federal air quality management system (AQMS). AQMS is a comprehensive approach for improving air quality in Canada and is the product of collaboration by the federal, provincial and territorial governments and stakeholders. It includes:

- New Canadian Ambient Air Quality Standards (CAAQS) to set the bar for outdoor air quality management across the country.
- Industrial emissions requirements to set a performance base for major industries.
- A framework for air zone air management within the provinces and territories that enables action tailored to specific sources of air emissions in a given area.
- Regional air sheds that facilitate coordinated action where air pollution crosses a border.
- Improved intergovernmental collaboration to reduce emissions from the transportation sector.

The CAAQS will be established as objectives under the *Canadian Environmental Protection Act 1999*, and will replace the existing Canada-Wide Standards under CCME. Standards for fine particulate matter and ground-level ozone have been developed and work has begun on standards for NO2 and SO2.

The following sections describe each air contaminant for which NBAQOs and / or Canadian Standards are set, and ambient air quality monitoring results for 2015 (NBDELG, 2017).

4.1.1 Carbon Monoxide (CO)

CO is formed from the incomplete combustion of carbon compounds. The NBDELG has set an air quality guideline for CO of 30 parts per million (ppm) for a 1-hour averaging period. NBDELG monitors for CO at three locations throughout the Province: Saint John, Moncton and Fredericton. Due to the relatively small size and density of the population in NB, there were no exceedances of NBAQOs for carbon monoxide in Saint John, the monitoring station located closest to Sagewill, or any of the other provincial monitoring sites in 2015.

4.1.2 Hydrogen Sulphide (H_2S)

This component is used by the Provincial mobile air quality trailer to measure total reduced sulphur (TRS) in industrial areas such as Saint John and the AV Nackawic Mill, where TRS odour is a concern. The NBDELG has set an air quality guideline for H_2S 11 ppb for a 1-hour averaging period and 3.5 ppb for a 24-hour averaging period. Both averaging periods were exceeded several times at Saint John East and Saint John West during 2015.

4.1.3 Nitrogen Oxides (NO and NO_2)

Nitric oxide (NO) is released in the exhaust of internal combustion engines and furnaces. NO is an unstable compound and is readily converted to NO_2, which contributes to the formation of acid rain and is a primary precursor pollutant in the formation of smog. NBDELG has set an air quality guideline of 210 ppb, 105 ppb and 52 ppb per 1-hour, 24-hour and 1-year averaging periods, respectively. NBDELG monitors for NOx at four locations throughout the Province: Saint John, Moncton, Fredericton and Bathurst. No exceedances to the NO_2 standards were recorded during 2015 at the closest monitoring location to Sagewill (Saint John) or at any other station in the Province (NBDELG, 2017).

4.1.4 Sulphur Dioxide (SO_2)

Sulphur dioxide is produced by burning oil and coal for energy production and space heating; each containing sulphur as an impurity in various concentrations. Other potential sources include oil refineries, pulp and paper mills, and vehicles. NBDELG monitors for SO_2 at four locations in Saint John: Forest Hills, Customs Building, Champlain Heights, and Hillcrest. Industries such as Irving Oil also perform monitoring in Saint John at four locations: Midwood, Grandview West, Forest Products and Silver Falls. In 2015, the one hour objective was exceeded on 4 occasions, all occurring at the Grandview West monitoring station. An investigation determined Irving Oil was experiencing some operational issues at the time of the exceedances. Mitigation measures were implemented to minimize the potential for further exceedances (NBDELG, 2017).

4.1.5 Particulate Matter (PM)

Particulate matter (PM) refers to those particulates in the air, such as smoke, soot, and dust that do not settle readily and thereby remain suspended. PM is a broad class of chemically and physically diverse substances that can either be in a solid or liquid state, or in a combination of these two states. PM greater than 10 micrometres (µm) in size creates problems such as visibility reduction, soiling, material damage, and vegetation damage.

Particulate matter becomes a potential human health hazard when the particle size is equal to, or less than, 10 µm in diameter (PM10) (NBDELG, 2001). These particles are typical of dust granules that are invisible to the naked eye as individual specks. Such particles are commonly generated from building materials, combustion, human activities and outdoor sources, including atmospheric dust and combustion emissions from mobile and stationary sources.

Particles of 2.5 µm or less (PM2.5) are small enough to inhale into the lungs and are believed to cause respiratory and cardiovascular problems. These particles are visible as clouds of smoke and are typically high in sulphates, nitrates, carbon and heavy metals, being produced by fossil fuel combustion, vehicle exhaust and industrial emissions (NBDELG, 2001).

As part of the AQMS approach, CCME has also created an Air Zone Management Framework which categorizes provincial regions by existing air quality and management goals. The Project Study Area lies within the Southern Air Zone of NB, which is considered "yellow" and whose mandate with respect to $PM_{2.5}$ levels is to prevent air quality deterioration (CCME, 2012b). In this Zone, threshold values of >10 to 19 µg/m^3 for daily average and >4 to 6.4 µg/m^3 for annual average $PM_{2.5}$ have been established, which are lower than the CAAQs (NBDELG, 2015).

In 2015 the annual average value for $PM_{2.5}$ in Saint John ranged from a low of 5.8 µg/m^3 at the Champlain Heights location to a high of 7.9 µg/m^3 at the Manawagonish location. The daily averages ranged from a low of 14 µg/m^3 at the Champlain Heights location to a high of 20 µg/m^3 at the Lorneville location. All values were below both the CAAQs of 28 µg/m^3 for a 24-hour averaging period and 10 µg/m^3 for an annual averaging period (NBDELG, 2017).

4.1.6 Ozone

Ozone is invisible and odourless at typical ground level concentrations. It is formed through chemical reactions between a variety of "ozone precursor" pollutants, which are released by industrial facilities and motor vehicles. Most of NB's ozone is carried here by air masses originating in the United States and central Canada.

CAAQS has set an air quality standard for ground-level ozone of 63 ppb for an 8 hour averaging periods. NBDELG monitors ground-level ozone at thirteen stations throughout the Province, including Saint John. There were no exceedances to the ground-level ozone 8 hour objective at any of these locations in 2015 (NBDELG, 2017).

4.1.7 Noise

The surrounding landscape is nominally rural residential, with some farming, several transportation corridors and the existing HRA quarry. Typical noise levels in rural areas range from 45 to 65 decibels in the day and 35 to 45 decibels at night. The nearest residences to the east of the site are located on the other side of the Trans-Canada Highway, within about 200 m, and may experience higher daytime and night-time ambient noise levels, combined with secondary highway traffic on Route 860. The nearest residents to the west, about 1 km away, likely experience typical rural sound levels when the quarry is not operating. They have been exposed to the noise emanating from the HRA quarry for almost 19 years, which would include standard quarry operations with heavy equipment and blasting.

5.0 Hydrology

5.1 Climate

The climate of NB is typically continental. This is due to the westerly air flows, dominant in the region, having passed over the interior of the continent and not over a temperature-moderating ocean (Hinds, 2000). The coastal areas of NB experience a large amount of fog that often moves far inland as a result of the abutment of the warm Gulf Stream with the cold Labrador Current (EC, 1990; Hinds, 2000).

5.1.1 Climate Normals for the Project Area

The climate of the Project area is best characterized by long-term meteorological data collected by Environment Canada and Climate Change Canada (ECCC). The station closest to the Project is Saint John Airport (A), with Normals based on data collected between 1981 and 2010 (ECCC, 2018a). Saint John (A) is at an elevation of 108.8 m and is located approximately 10 km to the south of the Project area.

Average temperatures are relatively mild, ranging from 17.1°C in July to -7.9°C in January. The highest daily temperature is 34.4°C and the lowest is -36.7°C.

Total precipitation is 1295.4 mm per year. There is rainfall in every month, ranging from 49 mm in February to 123.7 mm in November. The highest daily rainfall on record was 154.4 mm in November of 1989.

Average wind speed is moderate, ranging from 11.3 km/h in August up to 17.5 km/h in March, and maximum hourly wind speeds from 64 km/h in May up to 111 km/h in January.

5.2 Surface Water

The Study Area falls within the Hammond River watershed. The Hammond River drains into the Kennebecasis River, which eventually drains into the St. John River and then into the Bay of Fundy. There are no protected watersheds located within the Study Area (NBDELG, 2018a).

The average annual precipitation in the Study Area is 1295.4 millimetres (mm), of which approximately 239.5 centimetres (cm) is in the form of snowfall (ECCC, 2018a). High seasonal water flows are generally experienced in April and May as a result of snowmelt. The stream flow typically decreases through the summer as a result of high evaporation and depleting groundwater storage. Flow typically increases in the fall due to lower temperature and reduced evaporation.

Surface water quality in the Study Area is dependent primarily on geology, watershed size, topography and vegetation. The chemical quality of NB watercourses is generally excellent for human consumption. Calcium bicarbonate-type waters predominate, although mixed chemical influences are known to occur in the Province (Environment Canada, 1989). Total Dissolved Solids (TDS) concentrations in the lower Saint John River Basin are typically low to moderate, ranging from 17 to 115 milligrams per litre (mg/L) (Environment Canada, 1989).

5.3 Groundwater

This subsection describes the groundwater (hydrogeology) components of this document. An overall discussion of the Project location geology is provided along with information on the availability, use and quality of groundwater in the general vicinity of the Project.

5.3.1 Project Location Physiography and Groundwater Geology

The Project is located within the Caledonian Highlands of the NB Physiographic Regions, near the sub-region transition between the Central Plateau and the Anagance Ridges. Generally, this region is underlain by undifferentiated stony morainal and colluvial deposits, described as a blanket of stony lodgment till up to three m in thickness. Morainal sediments, veneer and glaciofluvial deposits are found as well as occasional bedrock outcrops. Ice contact deposits, greater than 2 m in thickness, can also be found along rivers (Rampton, et al. 1984).

The Caledonian Highlands are the remnant of an older mountain-forming episode. The underlying rocks are of metamorphic, sedimentary and igneous origin and range in age from Pre-Cambrian to Silurian. The landscape has gone through several cycles of uplift and erosion and, as such, it is an old landscape (Pronk & Allard, 2003). Closer to the Project area, the underlying bedrock ranges in age from stratified rocks associated with the Mississippian age (320 to 360 million years ago (Ma)) to intrusive rocks associated with the Hadrynian age (548 to 1000 Ma ago) to the stratified rocks associated to the Helikian age (more than 1000 Ma ago), the Province's oldest rocks (McLeod, M.J., Johnson, S.C. and Ruitenburg, A.A., 1994).

The thin overburden layer above the indured rocks provide irregular surface relief and hilly to mountainous topography. Geologic structure forces the main drainage to follow a northeast-southwest direction.

5.3.2 Groundwater Availability and Well Yields

As a generalization, groundwater availability in this region is significantly higher in unconsolidated sands and gravels (found along the major rivers) than in the bedrock (Saint John Planning Region, 1977). Available information suggests yields suitable for one or two-family dwellings are anticipated. Higher yields may be available when drilled wells intersect favorable geologic structures such as faulted or highly fractured zones.

The geology in the immediate vicinity of the Project includes thin morainal deposits at the surface and an absence of deep sand and gravel deposits, which suggests that groundwater will be limited to bedrock aquifers. Well yields will be low, unless flow from fractured bedrock connected to productive aquifers can be found.

The search of the NB Online Well Log System (OWLS) well data base for a radius of 1.5 km from the proposed Project provided information for 51 wells. Using the reported well log information, the wells were categorized into two types of rocks: intrusive rocks such as granite (the older types rocks) and sedimentary (stratified bedrock such as sandstone). Forty-nine percent of the wells were drilled in intrusive rocks while forty-five percent were drilled in sedimentary rocks. Wells drilled in intrusive rocks show a minimum yield of 2 litres per minute (Lpm), a maximum of 68 Lpm and an average of 22 Lpm, while wells drilled in sedimentary rocks yield a minimum of 6 Lpm, a maximum of 114 Lpm and an average of 31 Lpm. The average well depth for both types of rock was 64 m, with a range from 30.5 to 121.9 m. The remaining six percent of wells were drilled either in overburden or in unidentified bedrock. The average bedrock level is 3.84 m below ground surface (NBDELG, 2018c).

The largest user of groundwater in the immediate area of the Project is the Town of Quispamsis. The Town operates a Protected Wellfield (NBDELG, 2018b) along Route 1 between Quispamsis and Rothesay, approximately 5 km from the Project (Figure 2.1). The wellfield includes two operating wells and one stand-by well, serving approximately 155 homes and 11 commercial buildings (Town of Quispamsis, 2017). Wood estimates that the use of groundwater likely ranges between 50 to 100 m^3/day. Wellfield protection areas were legislated in June 2016.

5.3.3 Groundwater Quality

Mandatory testing for water quality of all newly drilled or redrilled domestic water wells in New Brunswick was introduced under the "Potable Water Regulation" of the *Clean Water Act* in September of 1994. The standard tests required under the "Potable Water Regulation" analyse the water for both inorganic and bacteriological substances.

The Province maintains a database of these results and has used 10,500 samples analysed between 1994 and 2007 to produce the New Brunswick Groundwater Chemistry Atlas (New Brunswick Department of Environment (NBENV), 2008). The database can also be searched for these results, and more current results, by region in NB using the OWLS. The water quality test results provided are in aggregate form and do not identify the individual well from which the sample was taken, but queries can be submitted to view results for specific areas. Using a property identification number (PID) central to the Project's proposed footprint (PID 00196626) a search of the database displays records for 51 wells drilled within 1.5 km of the PID's perimeter between 1994 and 2016, though only 21 of these display sample analysis results (NBDELG, 2018c). It should be noted that PID 00196626 is a large property that extends beyond the limits of the planned quarry footprint, and most of the buildings with potential wells appear to be on the opposite side of Route 1 and/or the Hammond River.

The New Brunswick Department of Health has adopted the Guidelines for Canadian Drinking Water Quality (GCDWQ) established by Health Canada (Health Canada, 2017) to assess groundwater quality (New Brunswick Department of Health, 2018). Groundwater quality data was available for 21 samples collected from wells within the Study Area. The percentage of samples in compliance with the GCDWQ compared against the provincial database is presented in Table 5.1.

Table 5.1 Summary of Selected Groundwater Quality Parameters

Parameter	*Percentage Samples in Compliance in New Brunswick	**Percentage Samples in Compliance Within Study Area
Arsenic	94.1	100
Boron	100	100
Barium	98.6	100
Cadmium	99.9	100
Chloride	96.7	100
Fluoride	95.0	100
Iron	71.2	85.7
Manganese	60.2	95.2
Sodium	96.6	100
Nitrate	99.4	100
Lead	97.3	95.2
Sulphate	99.4	100

Selenium	98.9	100
Uranium	97.9	88.2
pH	86.3	90.5
Zinc	99.9	100

Sources: *NBENV, 2008.
**NBDELG, 2018c

Comparison of Study Area results against those for the Province as a whole show that the water chemistry in the Study Area is quite good for those with wells drilled since 1994. Drill reports for the 51 records show well depths ranging from 30.5 to 121.9 m. The average bedrock level is 3.84 m with the well drillers' logs commonly recording clays, sands, fill, hardpan and gravels as the overburden types; limestone, shales, conglomerates, sandstones and siltstones being the common bedrock types encountered in the subsurface Study Area (NBDELG, 2018c).

In 2006, NBENV launched a program called "Know Your H_2O" to promote drinking water quality awareness. During the period of July 2006 to November 2007, all private well owners could submit a water test for total coliform bacteria and E. coli at no cost. It was determined during this program that one third (35.6%) of the private wells sampled yielded results above the GCDWQ for coliform while 4.4% had E.coli (NBENV, 2009). According to OWLS for the 21 wells with analytical results within the 1.5 km area studied, the results were very comparable: 33.3% of the newly drilled wells had Total Coliform and 9.5% of them had E. coli. Turbidity, which can harbour bacteria, was above the 1.0 nephelometric turbidity units (NTU) Guideline in 61.9% of those wells (NBDELG, 2018c).

6.0 Biology

The following sections describe the terrestrial and aquatic habitats in the Study Area. Vegetation, wetlands, and waterbodies are illustrated in Figure 6.1.

6.1 Vegetation and Wetlands

More than half of the proposed development area has been recently clear-cut. The remaining forest is mainly mature to over mature hardwood, including gray birch (*Betula populifolia*), white birch (*Betula papyrifera*), red maple (*Acer rubrum*), and sugar maple (*Acer saccharum*), with smaller patches of mature to over mature softwood, including eastern cedar (*Thuja occidentalis*), red spruce (*Picea rubens*), white spruce (*Picea glauca*) and balsam fir (*Abies balsamea*).

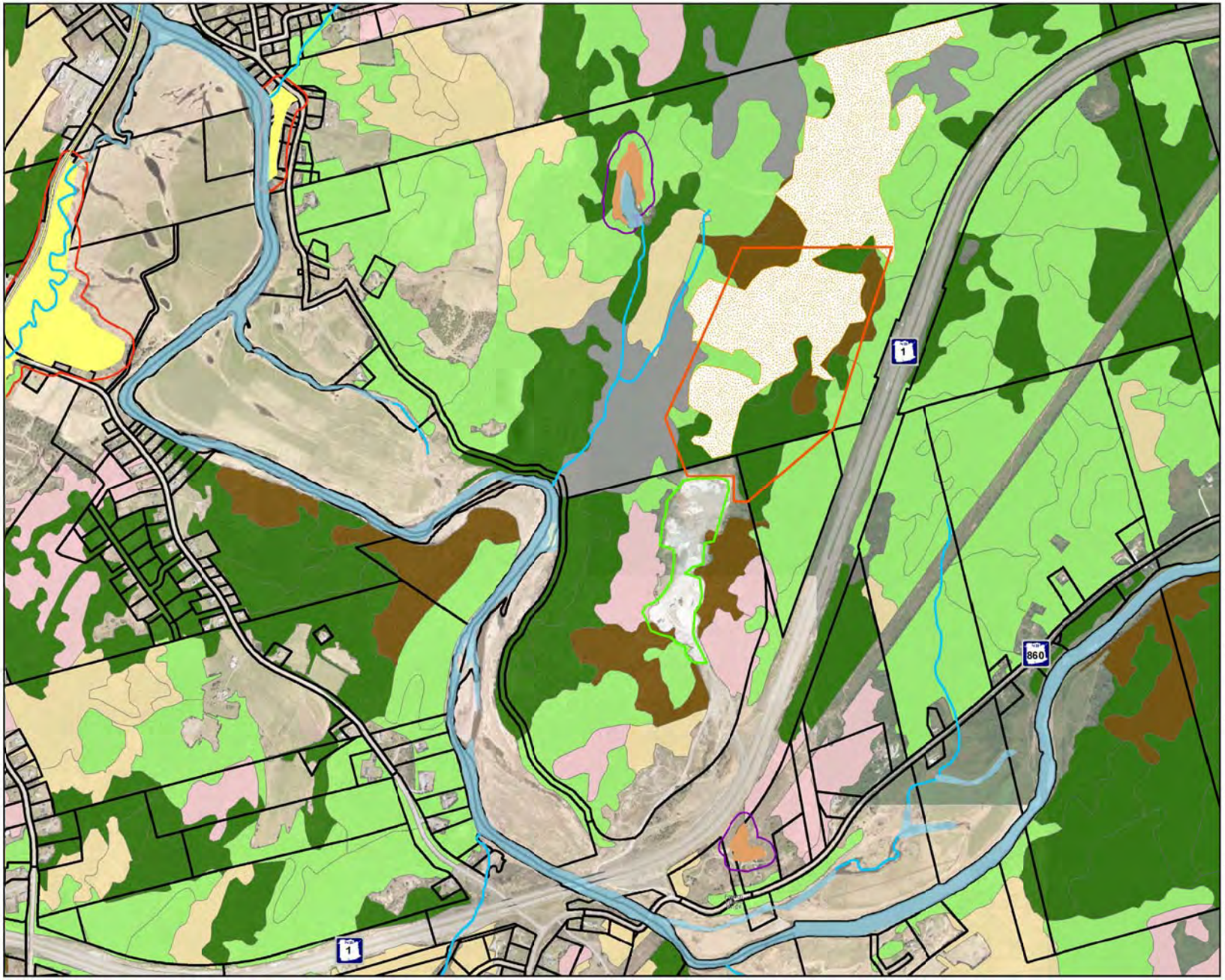
A report of species at risk known to occur in the Study Area was obtained from the Atlantic Canada Conservation Data Centre (ACCDC), and is included in Appendix A. According to the report, there are no legally protected plant species (nationally or provincially) within 5 km of the site. The report identified 13 locally present plant species with Provincial status of "May Be At Risk" or "Sensitive", including:

- *Calypogeia neesiana* (Nees' Pouchwort – a moss)
- *Anomodon viticulosus* (no common name – a moss)
- *Didymodon ferrugineus* (no common name – a moss)
- *Agalinis paupercula var. borealis* (Small-flowered Agalinis)
- *Astragalus eucosmus* (Elegant Milk-vetch)
- *Orobanche uniflora* (One-Flowered Broomrape)
- *Symplocarpus foetidus* (Eastern Skunk Cabbage)
- *Allium tricoccum* (Wild Leek)
- *Cypripedium parviflorum var. makasin* (Small Yellow Lady's-Slipper)
- *Spiranthes lucida* (Shining Ladies'-Tresses)
- *Barbarea orthoceras* (American Yellow Rocket)
- *Symphyotrichum boreale* (Boreal Aster)
- *Carex garberi* (Garber's Sedge)

Most of these species occur in wetlands and shorelines; which are not present in the site. Only the mosses and the One-flowered Broomrape may have suitable habitat within the quarry Site Boundary. Their occurrence would be even less likely now, since the majority of the development area has been subject to recent timber harvesting.

NB wetlands have been given specific protection under both the *Clean Environment Act* and the *Clean Water Act*. NBDELG requires a permit for any alteration within 30 m of the bank of a watercourse or wetland. Provincially-regulated wetlands nearest the Study Area are illustrated on Figure 6.1 (Service New Brunswick (SNB), 2018). The closest of these is approximately 400 m northwest of the site, associated with the small lake. There are no wetlands within the Site Boundary, or within 30 m.

Figure 6.1 Vegetation, Wetlands and Waterbodies



Legend

- Site Boundary
- Road
- Kings County PID (Lines)
- Waterbody
- Provincially Significant Wetland
- Regulated Wetlands
- Provincially Significant Wetland 30m Buffer
- Regulated Wetlands 30m buffer
- Watercourse
- Recent Clear-Cut
- Existing Quarry

Forest Classification

- Young Hardwood
- Mature Hardwood
- Old Hardwood
- Old Softwood
- Mature Softwood
- Young Softwood

Wetland polygons compiled from aerial photography with attributes that indicate wetland type, vegetation, and year of photography. To support the WAWA program at Department of Environment and Local Government and alert primary users to the location of regulated wetlands and possible restrictions on land development.

0 200 400 800
Meters

CLIENT:
Sagewill Enterprises Ltd.

wood.

PROJECT:
Sagewill Limestone Quarry
French Village New Brunswick

TITLE:
Vegetation, Wetlands and Waterbodies

DATUM:	DWN BY:	DATE:
NAD 83 CSRS	RE	January 2018
PROJECTION:	CHK'D BY:	SCALE:
UTM Zone 20 North	GB	1:12,000
PROJECT NO:	REV NO:	FIGURE NO:
TE181001	A	6.1

Path: I:\PROJECTS\TE181001_Sagewill_Enterprises_Limestone_Quarry_French_Village_NB\MXD\20180109_TE181001_VegWetWater_Figure6_1.mxd User: dale.mccoy Date: 1/9/2018

6.2 Wildlife

6.2.1 Migratory Birds

The majority of bird species in Canada are protected federally under the *Migratory Birds Convention Act* (MBCA); others are provincially protected under the *New Brunswick Fish and Wildlife Act*. Avian Species at Risk (SAR) are further protected by the federal *Species at Risk Act* (SARA) as well as the provincial *New Brunswick Species at Risk Act* (NBSRA).

A review of existing data from various sources was conducted in order to provide information on birds potentially breeding in and near the Project area, including avian SAR and Species of Conservation Concern (SOCC). Data sources consulted include the NB Department of Energy and Resource Development (NBDERD) list of *General Status of Wild Species* (NBDERD, 2018), the Maritime Breeding Birds Atlas (MBBA) (BSC et al., 2018) for information on species potentially nesting in or near the Project area, the Atlantic Canada Conservation Data Centre (ACCDC, 2018) for information on species at risk and SOCC within 5 km of the Project area, and the Important Bird Areas (IBA) of Canada database (IBA, 2018) for information on areas of particular importance for birds.

According to Environment and Climate Change Canada's (ECCC) general avoidance information for migratory birds, the Project site is located in breeding Zone C3 and in this zone, the regional nesting period during which most migratory birds covered under the MBCA breed extends from mid-April to late August (ECCC, 2018b), although it is recognized that some avian species nest outside of this period, including corvids, owls, crossbills and waxwings.

NBDERD's *General Status of Wild Species* (NBDERD, 2018) reports that there are 407 extant bird species known to occur in the Province, of which 143 are considered accidental (Table B.1 in Appendix B). Of the species that regularly occur in the Province during at least part of their life cycle (breeding, wintering and/or migration), 12 species are considered At Risk, 12 may be At Risk and 48 are considered Sensitive. Within the MBBA 2nd Atlas (BSC et al., 2018), which was compiled over the period of 2006 to 2010, the Study Area lies within Region #12, Saint John, in Square #20KR73 (French Village). Breeding evidence was recorded for a total of 152 bird species in the Saint John region. In Square #20KR73, while the survey effort (12.25 hours) was below the target survey effort of 20 hours/square, breeding evidence was reported for 59 species. Of these, nine species were confirmed to be breeding based on observed evidence; seven were probable breeders; and the rest were considered to be possibly breeding. Species observed within Square #20KR73 during the second MBBA are listed in Table B.2 in Appendix B.

According to the ACCDC report (Appendix A), there have been 63 reports of 25 SOCC birds within 5 km of the Project. The avian SOCC reported by ACCDC include 8 SAR listed under the federal SARA Schedule 1 and/or NBSRA. The habitat requirements for these avian SAR, and their potential to occur in the Project area, is discussed in Table 6.1. It should be noted that, although there is potential habitat for some of these species in the Project area, no designated critical habitat for avian SAR (as defined in SARA and NBSRA species recovery plans, where available) is present within the Study Area.

Table 6.1 Avian SAR Recorded Within 5 km of the Project Location

Species	Status	Habitat	Potential to Occur in Project Area
Peregrine Falcon (*anatum/tundrius* pop'n)	SARA: Special Concern NBSRA: Endangered	Found in a wide variety of habitats with suitable cliffs or platforms for nesting. Constructs nest on cliff ledges or platforms ranging from about 8 to 400 m high, though cliffs 50 to 200 m high are preferred.	Potentially present during the breeding season; suitable nesting habitat available.
Common Nighthawk	SARA and NBSRA: Threatened	Variety of open habitats, including coastal sand dunes and beaches, logged or slash / burned areas of forest sites, woodland clearings, grassland habitat, farm fields, open forests, rock outcrops, and flat gravel rooftops.	Potentially present during the breeding season; suitable nesting habitat available.
Chimney Swift	SARA and NBSRA: Threatened	More concentrated in urban areas where there are large concentrations of chimneys for nest sites and communal roosts. Nests primarily in chimneys and other artificial sites; occasionally uses hollow trees.	Potentially present during the breeding season; suitable nesting habitat nearby.
Olive-sided Flycatcher	SARA and NBSRA: Threatened	Along forest edges and openings with tall snags for foraging and singing.	Potentially present during the breeding season; suitable nesting habitat available.
Eastern Wood-Pewee	SARA and NBSRA: Special Concern	Deciduous and mixed forests, usually near forest clearings and edges such as riparian habitats.	Potentially present during the breeding season; suitable nesting habitat available.
Barn Swallow	NBSRA: Threatened SARA: Threatened	Requires open areas (fields, meadows) for foraging and open structures such as barns for nesting; typically found near aquatic habitats, as a source of mud is required for nest construction.	Potentially present during the breeding season; suitable nesting habitat nearby.
Bank Swallow	SARA: Threatened	Nests along rivers, streams, lakes, and coasts where it burrows in banks, cliffs and bluffs. May also use artificial sites such as sand and gravel quarries and road cuts.	Potentially present during the breeding season; suitable nesting habitat available.
Canada Warbler	SARA and NBSRA: Threatened	Most abundant in moist, mixed forests with a well-developed understory, dense nest site cover. Often near open water. Typically nests on or near the ground, often on slopes, knolls, in earthen banks, or rocky areas.	Potentially present during the breeding season; suitable nesting habitat available.
Bobolink	SARA and NBSRA: Threatened	Grasslands and pastures; agricultural fields. Nests on ground, beneath vegetation.	Potentially present during the breeding season; suitable nesting habitat nearby.

Geographic information system (GIS) digital datasets were supplied by NBDERD to derive potential habitat types. GeoNB (SNB, 2016) was used to map NB regulated wetlands while in-house data was used to update edge area to include activity that has occurred since 2013, such as forestry. From available mapping, seven broad habitat types were identified within the Project footprint and surrounding 5 km (the Study Area) (Figure 6.1):

- Young hardwood (<30 years);
- Mature hardwood (30 - 90 years);
- Old (over-mature) hardwood (>90 years);
- Young softwood (<30 years);
- Mature softwood (30 - 90 years);
- Old (over-mature) softwood (>90 years); and
- Recent clear cut.

In order to determine the amount of habitat potentially affected by the proposed Project within the Study Area, the total area in square metres ($m^{2)}$ was calculated for each habitat type. The Project footprint of the Sagewill Quarry property consists of approximately 384,925 m^2 (0.385 km^2) of potential migratory bird habitat, much of which has been recently clear cut. Table 6.2 summarizes the areas of each habitat type within the 5 km radial Study Area; note that the area of clear cut overlaps with the forest habitats. Other than clear cut, the prevalent habitat types within the proposed Project footprint are old hardwood (38%) and mature hardwood (37%).

Table 6.2 Migratory Bird Habitat Present Within the 5 km Radial Study Area

Habitat Type	Study Area (m^2)	Surficial Project Footprint (m^2)
Young Hardwood	8,400,611.68	0.00
Mature Hardwood	20,922,658.29	140,789.72
Old (over-mature) Hardwood	1,296,823.68	144,690.71
Young Softwood	11,520,100.95	0.00
Mature Softwood	17,398,949.49	80,582.48
Old (over-mature) Softwood	821,637.22	9,287.38
Recent Clear cut	400,362.69	179,352.59
Total	**60,360,781.32**	**384,925.93**

The nearest Important Bird Area (IBA) is the Lower Saint John River (Sheffield / Jemseg), which extends 25 km along the Saint John River, from 5 km northeast of the Town of Oromocto to 25 km east of Oromocto and is within approximately 22 km of the proposed Project area to the northwest. This IBA features extensive marshes and backwaters that provide breeding habitat for the yellow rail (SARA and NBRSA: Special Concern), as well as Atlantic Canada's only breeding population of greater scaup and largest breeding concentration of black tern.

6.2.2 Mammals

NBDERD's *General Status of Wild Species* (NBDERD, 2018) reports that there are 52 species of mammals known to occur in the Province, and a further seven which are extinct, extirpated or unverified (Table B.1 in Appendix B). Of these 52 species, one (Canada lynx) is considered to be At Risk, two species (Gaspe shrew and long-tailed shrew) may be At Risk and four are considered Sensitive: big brown bat, little brown bat

(little myotis), northern long-eared bat (northern myotis) and eastern pipistrelle (tri-coloured bat). The Canada lynx is listed as Endangered under the NBSRA, and the little brown bat, northern long-eared bat and eastern pipistrelle are listed as Endangered under SARA.

The ACCDC report (Appendix A) states that a bat hibernaculum has been reported within the 5 km radial Study Area, but due to the sensitive nature of such features, the coordinates were not provided in the report. ACCDC also reports one (presumably historic) record of the extirpated woodland caribou within the 5 km Study Area.

6.2.3 Amphibians and Reptiles

NBDERD's General Status of Wild Species (NBDERD, 2018) reports that there are 16 species of amphibian and 7 reptile species known to occur in the Province (Table B.1 in Appendix B). Of these, one (wood turtle) is considered to be At Risk and one is considered Sensitive (dusky salamander). No terrestrial reptiles or amphibians are listed under the NBSRA. The wood turtle is listed as Threatened and the snapping turtle is considered an SOCC under SARA.

The ACCDC report (Appendix A) showed no records of reptile or amphibian SOCC within the 5 km Study Area.

6.2.4 Invertebrates

NBDERD's *General Status of Wild Species* (NBDERD, 2018) maintains lists of butterfly and odonate (dragonfly and damselfly) species in NB. According to these lists, there are 80 butterfly and 131 odonate species known to occur in the Province (Table B.1 in Appendix B). Of these, one (Maritime ringlet) is considered to be At Risk, 15 (4 butterflies and 11 odonates) may be At Risk, and 13 (one butterfly and 12 odonates) are considered Sensitive. The cobblestone tiger beetle (*Cicindela marginipennis*), Maritime ringlet (a butterfly) and skillet clubtail (an odonate) are listed as Endangered under SARA, while the monarch butterfly and pygmy snaketail (an odonate) are considered to be SOCC. The Maritime ringlet is listed as Endangered under the NBSRA.

The ACCDC report (Appendix A) showed one record of an invertebrate SOCC, the saltmarsh hydrobe, within the 5 km Study Area; this aquatic snail is restricted to brackish habitats and is therefore unlikely to occur in the Project area itself.

6.3 Aquatic Life

The main stem of the Hammond River is 73.5 km long and drains into the Kennebecasis River north of Nauwigewauk, NB; approximately half way between Quispamsis and Hampton. In addition to the main stem the 513 km^2 watershed contains 125 km of major tributaries and many minor tributaries (Hammond River Angling Association, nd). Lands surrounding the watershed are largely forested with areas of agriculture, residential, commercial, and industrial areas (NBDELG, 2007).

Water quality within the watershed ranges between excellent and fair, with poorer water quality reported in areas with a higher degree of development. In general, water quality met the guideline for key indicators such as dissolved oxygen, coliforms, nitrates, and pH (NBELG, 2007).

A number of recreational fish species reside in the Hammond River, including Atlantic salmon (*Salmo salar*), brook trout (*Salvelinus fontinalis*), smallmouth bass (*Micropterus dolomieu*), smelt (*Osmerus mordax*), striped bass (*Morone saxatilis*), and sturgeon (*Acipenser oxyrinchus oxyrinchus*).

The federal *Fisheries Act* protects fish that are part of commercial, recreational or aboriginal fisheries as well as fish that support such a fishery. Section 36 (3) states that no person shall permit the deposit of a deleterious substance of any type in water frequented by fish, or in any place under any conditions where the deleterious substance may enter any such water.

The Outer Bay of Fundy population of Atlantic salmon (*Salmo salar pop. 7*) is known to be present in the Hammond River. COSEWIC designates the Outer Bay of Fundy Atlantic salmon as Endangered, although it does not have SARA status (SARPR, 2016). In its "General Status of Wildlife Report", NBDERD lists anadromous Atlantic salmon as Sensitive (assessed in 2006) (NBDERD, 2018).

Recreational fishing continues to be an important part of the Hammond River system and is vigorously pursued by many residents and non-residents alike.

7.0 Site History (Archaeological Resources)

An Archaeological Impact Assessment (AIA) is one component of an EIA. [1] The objectives of an AIA are to identify, inventory and evaluate all sites of archaeological, historical, and architectural significance within the Project Study Area (focusing on the Project footprint) and to assess the potential effects of the Project on these archaeological and heritage resources. These objectives are accomplished via a four-phase process:

- Phase 1: Background desktop review (documentary research, regulator consultation);
- Phase 2: Field examination (visual surface survey, informational interviews);
- Phase 3: Field evaluation (subsurface archaeological testing); and
- Phase 4: Significance determination, impact assessment, and mitigation.

This four-phase process is approached sequentially and involves decision points along the way. While these steps are initially addressed in a linear fashion, they are iterative as circumstances commonly arise during the course of investigations that require previous phases to be revisited. Therefore, the specific methodology used or recommended for each phase is based upon the results obtained in the preceding phase.

The present archaeological investigations include only a desktop review (Phase 1). However, at a minimum, a Phase 2 field examination will also be necessary in order to comply with regulatory requirements for "preliminary archaeological investigations". The field examination for this Project has yet to be conducted. Should archaeological resources be identified as a result of Phase 1 and Phase 2 activities, or should it be determined that there is potential for archaeological resources within the Project impact area, additional archeological investigations may be recommended in the form of Phase 3 field evaluation testing and/or construction archaeological monitoring (Phase 4). However, the present investigations include only Phase 1 investigations, the first component of "preliminary archaeological investigations".

7.1 Methodology

7.1.1 Phase 1: Background Desktop Review

The Phase 1 documentary research included the following elements:

- Reviewing present day and historic aerial photographs and topographic maps;
- Reviewing previous archaeological surveys conducted in the area;
- Reviewing documentation on existing identified heritage sites in the vicinity;
- Reviewing the New Brunswick Register of Historic Places;
- Reviewing the Canadian Register of Historic Places;
- Reviewing the Directory of Designations of National Significance of Canada;
- Conducting a review of archaeological literature sources;
- Identifying any Nationally or Provincially designated historic sites in the area;
- Conducting a review of historical literature sources;
- Reviewing geological surficial and bedrock mapping of the area; and
- Procuring and reviewing ASNB GIS mapping for the Project area.

[1]Prior to 2012, AIAs were referred to as Heritage Resource Impact Assessments (HRIA). This change in terminology is due to a provincial regulatory change resulting from the presentation of revised regulatory guidelines (ASNB, 2012).

7.1.2 Phase 2: Field Examination

The objective of the field examination (visual surface survey) is to obtain first-hand exposure to the Project impact area's geography and topography to aid in the early identification of potential archaeological resource locations. The field examination involves a visual examination of the surface of the Project impact area and vicinity; with particular attention to subsurface exposures, watercourse shorelines and erosional faces, forest clearings, and other areas indicated as having elevated potential from Phase 1 investigations and archaeological potential modelling. In accordance with Provincial requirements (ASNB, 2012), this surficial survey will include all the accessible portions of the Project area.

7.2 Results of Phase 1: Background Desktop Review

Watercourses, lakes, and ocean shorelines were the primary transportation routes of both the prehistoric (pre-1604) and the historic past. The Indigenous peoples and European settlers of NB utilized the river systems of NB as transportation routes and the shorelines as settlement areas. Therefore, shorelines of the Province's rivers, lakes, and the coast have high potential for archaeological resources from both the prehistoric and historic periods. The Project area does not include any mapped watercourses or water bodies. The nearby Hammond River, however, a significant tributary of the Kennebecasis River, has been used both in prehistoric and historic times for transportation, habitation, and food procurement purposes.

There are documented registered archaeological sites located along the shorelines of the Kennebecasis and Hammond Rivers, which indicate both prehistoric and historic use of these watercourses. For example, upriver from French Village at a bridge crossing of Hammond River (at Hillsdale), an archaeological assessment identified a prehistoric site (circa (1000 BC to AD 1600) on the west side of the river (BjDj-3) and a historic site (circa 1812) on the east side (BjDj-2) (AMEC, 207; AMEC, 2008a). Also, upriver from the Project area, another Indigenous archaeological site (BjDj-9) was identified along the shoreline of the North Branch Hammond River (AMEC, 2008b). The identification of these archaeological sites upriver from the Project area and the nearby shoreline of Hammond River provide documented evidence that this water system has been used in both prehistoric and historic times.

There are numerous historical references to the presence of Indigenous peoples in the nearby Sussex area, when the United Empire Loyalists (Loyalists) arrived in the late 1700s. The significant numbers of Indigenous Maliseet in the area resulted in the New England Company opening and operating a Provincial "Indian School" in Sussex Vale (present-day Sussex Corner), from the 1790s to the 1820s (University of New Brunswick Archives, 2007; Thomson, 1984). Reportedly, Indigenous "encampments" were along the shorelines of the rivers in this area up until the late 1800s, and the Maliseet were known to travel up and down the waterways of the Kennebecasis, Anagance, and Petitcodiac Rivers (Aiton, 1967). Therefore, there is also potential for historic Indigenous archaeological resources ("Protohistoric") in the vicinity of the Kennebecasis River, and possibly the Hammond River.

Historically, the land on which French Village is located was granted by the French in 1689 to Sieur de Brenil. However, there does not appear to have been any settlement in the area until the mid-1700s, following the Acadian Expulsion in 1755 (Ganong, 1899). While occupied, likely since circa 1767, the land in this area was not granted until 1787 (PANB, 2018). The principal properties on which the proposed Project mine site is located were granted by the British Crown in 1787 to (from north to south): Francis Violet (210 acres), Henry Darling (180 acres), and Andrew Sherwood (170 acres). The properties presently owned by HRA and NBDTI were also granted in 1787, to Gabriel Fowler (104 acres) and Charles and John Blanchard and John Robichaud (203 acres). At that time, the principal transportation route was the watercourse (Hammond River) and all properties radiated from the river shoreline, to allow every landowner access. Historic

habitation sites would have also been situated near the shoreline of the river. Thus, the Project area, which is located well inshore from Hammond River, may have been used historically for farming or logging, but not specifically for habitation.

Soon after 1787, the Acadian inhabitants of French Village moved away, making way for the influx of United Empire Loyalists (Loyalists), who moved into the area (Violet pers. comm., 2018). Again, the Loyalists inhabited the areas by the shoreline of Hammond River, where people, to this day, still dwell. Historic aerial photographs of the Project area, dating back to 1945 and progressing to the present day, indicate that there has been very little development in this general area. Prior to 1962, there are only indications of minor trails and very small clearings within the Project area. The 1976 aerial photograph (#522066) of the area shows that the power line, to the east, had been constructed since the 1962 photograph was taken. The 1994 aerial photograph (#511203) shows the presence of Route 1, to the east of the Project area, which had been constructed since 1994 aerial photograph was taken. Other than the quarrying activities associated with HRA, to the south of the Project area, there are no other visual indications of cultural development within the immediate vicinity of the Project area. Neither the Canadian nor the New Brunswick Registers of Historic Places identify any registered historic places in the French Village area (CRHP, 2018; NBRHP, 2018).

While there is elevated potential for archaeological and heritage resources along the shores of the Hammond River, the Project impact area is well away from these shorelines. There are no documented heritage or archaeological resources located within the Project impact area. In addition, there are no mapped watercourses and no indications of prehistoric or historic transportation routes (including prehistoric portage routes) or habitation sites within the Project area. Therefore, based on the Phase 1 research, there is low potential for undocumented heritage or archaeological resources within the Project Area. However, in accordance with provincial regulatory requirements, a Phase 2 Field Examination is required in order to fulfill provincial AIA requirements for the Project EIA.

8.0 Socio-economic Setting

The following sections describe the socio-economic setting of the Study Area.

8.1 Population and Labour Force

The proposed Project is located in the community of French Village, Kings County, NB. This region lies within the Parish (PAR) of Hampton 2016 Census subdivision (Statistics Canada, 2017) which comprises the Study Area's socio-economic component of the EIA. The Kings County 2016 Census Division includes French Village, as well as the communities of Quispamsis, Hampton and Rothesay. The total area encompassed by Hampton Parish is 121.3 square kilometres (km^2) within the 3484 k^2 of Kings County.

The major commercial centre nearest French Village is the City of Saint John, approximately 20 km southwest of the Sagewill quarry property. The smaller Town of Quispamsis is located approximately 12 km southwest of the Sagewill footprint and provides some commercial needs, but not to the extent that the City does. Table 8.1 shows the population of Hampton PAR, the nearby Town of Quispamsis and Kings County as compared against the Province of NB as a whole (Statistics Canada, 2017) as per the 2016 census. Most residents of the PAR speak English only (84%) while 16% speak both official languages. Occupations most reported by census participants were in trades, transport, equipment operators and related occupations (22%) as well as sales and service (also 22%).

Hampton PAR experienced a population increase (2.7%) between 2011 and 2016; likewise, the Town of Quispamsis grew by 1.7%. Kings County and the Province as a whole, however, decreased by 1.0% and 0.5%, respectively.

Table 8.1 Census Population for Study Area

Municipality	Area (km^2)	2011	2016	% Change
Hampton (PAR)	121.3	2734	2809	2.7
Quispamsis (Town)	57.2	17941	18245	1.7
Kings County	3484.2	69665	68941	-1.0
Province of NB	71,388.8	751,171	747,101	-0.5

Statistics Canada, 2016 Canadian Census.

8.2 Local Economy

Saint John is the main industrial and commercial centre for the area. In the areas adjacent to the Study Area there is little in terms of industry and commerce compared to the nearby urban centres. Therefore, it is expected that a large number of people in this region commute to work. The median 2015 employment income for working residents of Hampton parish (PAR) was $35,401.

8.3 Cultural and Social Characteristics

The Study Area is rural in nature. Being that French Village has a large proportion of natural forest, as well as the Hammond River and several tributaries, it is likely that local residents utilize these resources for recreational activities such as hiking, four wheeling, snowmobiling (winter), and fishing. Although GeoNB records show there are no known trails in the Study Area that are recognized by the NB Federation of Snowmobile Clubs (NBFSC) Trail Network or the NB ATV Federation (NBATVF).

French Village is a predominantly residential community whose centre is approximately 2.5 km from the Project area. There are traditional farming communities within a small portion of the Study Area, many of which are located along the shores of the Hammond River. The Hammond River #2 covered bridge was removed in early 2018 and replaced by a steel modular bridge. There are few business and cultural features in the area, such as a scrap metal depot and an Anglican church. Most retail, services and healthcare are accessed in nearby Quispamsis and the City of Saint John.

8.4 Transportation Network

8.4.1 Road Transportation

The Study Area is traversed by Route 1 as well as secondary and tertiary roads. The existing HRA quarry has an unpaved access road that intersects with French Village Road (Route 860), to the south (Figure 2.1). Route 1 can be accessed via Route 860 to the north or south. The Hammond River #2 covered bridge on French Village Road was recently replaced by a steel modular bridge capable of bearing weights of up to 22 tons. The secondary highway to the west (Route 100) can be accessed via Stock Farm Road, just south of the bridge, in French Village.

There is existing quarry related traffic already present, so no further road modifications will be needed to accommodate the small number of additional trucks that would be associated with the low production scenario (15,000 t/y) by Sagewill. If the Sagewill quarry evolves to a high production scenario (320,000 t/y), then a larger truck configuration would be used and the existing routes will not be adequate. In that case, a direct connection to the TransCanada Highway (Route 1) would be proposed, based on designs previously contemplated in 1999 (KML, 1999). More detail on traffic issues is provided in the traffic impact study in Appendix D.

8.4.2 Rail

The Sussex Subdivision of the Canadian National Railway (CN) crosses the Study Area, somewhat parallel to Route 100, in a southwest – northeast heading approximately 3 km west of the quarry site. This section of the CN rail runs from Saint John to Moncton, NB. Rail transport of Sagewill Quarry product is a possibility, and there are existing facilities in Saint John to facilitate this option.

8.4.3 Shipping

Port Saint John is Eastern Canada's largest port by volume and has a diverse cargo base, handling an average of 28 million metric tonnes of cargo annually, including dry and liquid bulks, break bulk, and containers. With global connections to 500 ports worldwide, Port Saint John is easily connected to central Canadian inland markets by rail and road (https://www.sjport.com/).

8.5 Use of Land by Indigenous People

The nearest Indigenous Peoples community is the Maliseet Oromocto First Nation. The Maliseet traditional land use area includes the majority of the Saint John River watershed and associated tributaries, including the Hammond River. The Project is located in the south portion of the traditional lands in an area of Low Traditional Land use Occurrence (MSES, 2017).

The Project is located on private land and is not accessible to the public. Historically, Indigenous Peoples generally used lands closer to the shore of the Hammond River, and there is no known past use of the site for occupation or subsistence.

9.0 Environmental and Socio-economic Sensitivities

This section presents a list of sensitive environmental and economically and socially valuable resources that may be impacted by the Sagewill Quarry development. Based on the above description of the existing environment (both ecological and socioeconomic), and the potential interaction of quarry activities with identified resources, an issues scoping/pathway analysis was conducted and is presented in Table 9.1.

The resulting list of potentially impacted Valued Environmental Components (VECs) include:

- Ambient Air Quality;
- Noise;
- Groundwater Resources;
- Species At Risk;
- Migratory Birds;
- Archaeological Resources;
- Local Economy; and
- Traffic Circulation.

These VECs will be carried forward into Part 2 of the Mining Plan in the sections following. Based on a detailed description of the quarry operation in Sections 10.0 and 11.0, the predicted impacts are discussed in Section 12.0, and mitigation measures are described that will minimize or eliminate negative effects.

Table 9.1 Issues Scoping / Pathway Analysis Summary Matrix - Valued

Environmental Resources	Environmental Components	Pathway of Concern		Possible Pathway	VEC		Rationale for Inclusion/Exclusion as Valued Environmental Component (VEC)
		Yes	No		Yes	No	
Atmospheric Environment	Ambient Air Quality	X		Dust Equipment emissions	X		Included as a VEC – Dust may exceed PM limits without mitigation.
	Noise	X		Equipment Operation Blasting	X		Included as a VEC – Blasting noise could disturb nearest residents; requires monitoring plan.
Hydrology	Climate		X	Extreme precipitation Severe weather		X	Excluded as a VEC – extreme weather events will not impact quarry operation. Site drainage and erosion control will contain runoff.
	Surface Water		X	Acid rock drainage (ARD). Site runoff		X	Excluded as a VEC – No ARD potential for site geology. Site runoff/spills will be contained within the Site Boundary. Nearest waterbody is 110 m from the Site Boundary in forest terrain. No special mitigation required
	Groundwater Resources	X		Blasting vibration Accidental release of hazardous materials	X		Included as a VEC – Blasting could impact nearby residential wells; requires monitoring plan.
Biological Environment	Vegetation / Forest Resources	X		Site clearing during quarry lifetime		X	Excluded as a VEC – Site to be restored to forested condition at end of quarry life.
	Wetlands		X	No possible pathway identified		X	Excluded as a VEC – No wetlands within 350 m of the Site Boundary.
	Species at Risk	X		Forest/vegetation clearing in quarry footprint	X		Included as a VEC – there is a small potential for plant or bird species of special status to be present in the remaining forest areas within the Site Boundary; requires confirmatory site visit.
	Wildlife	X		Forest/vegetation clearing in quarry footprint		X	Excluded as a VEC – Site to be restored to forested condition at end of quarry life.
	Migratory Birds	X		Forest/vegetation clearing in quarry footprint	X		Included as a VEC – there is potential for migratory birds to be present in vegetated areas within the Site Boundary; requires confirmatory site visit. Mitigation is required.
	Fish, Fish Habitat, and Fisheries Resources		X	No possible pathway identified		X	Excluded as a VEC – No possible pathway (nearest waterbody is 110 m from Site Boundary).
	Designated Areas and Other Critical Habitat Features		X	No possible pathway identified		X	Excluded as a VEC – No possible pathway (none identified in close proximity to the Project.
Site History	Archaeological Resources	X		Stripping overburden	X		Included as a VEC – There is low potential to encounter archaeological resources; requires confirmatory site visit.
Socio-Economic Setting	Local Economy	X		Local employment and spending	X		Included as a VEC – Quarry operations will provide benefits to local and provincial economy.
	Existing Land Use	X		Quarry operation		X	Excluded as a VEC – Site to be restored to forested condition at end of quarry life.
	Traffic Circulation	X		Trucking product to markets	X		Included as a VEC – Increased truck traffic and heavier trucks used for high production volumes may impact traffic circulation or require road system modifications.
	Use of Land By Indigenous People		X	No possible pathway identified		X	Excluded as a VEC – No possible pathway. Site has low historic / archaeological resource potential.

PART 2 - MINING PLAN

10.0 Mine Site Description

The following subsections describe each component of the proposed development and operations of the Sagewill Limestone Quarry.

10.1 Ore Reserves

Although there has been limited verification drilling in the proposed quarry footprint, geological evidence is sufficient to infer minimum total tonnage, and quality continuity. It should be noted that an Inferred Resource cannot be used to estimate mine life, so the calculations of mine life reported later should only be thought of as examples of what may be expected if certain conditions are met. Once a drilling program has been completed, the resource estimate in the explored block can be upgraded to an indicated resource to which modifying factors can be applied to generate a mining reserve.

The local Ashburn Formation includes both calcitic ($CaCO_3$) and dolomitic ($CaMgCO_3$) limestone. Within the proposed quarry area, Sagewill has located over 60 bedrock outcroppings of white limestone (Figure 3.1); which typically indicates high calcium content, and lab results for 13 limestone samples collected in 2002, 2016, and 2017 have shown percent calcium oxide (CaO) from 50.79 to 54.42% (Appendix C).

Based on the width of the current HRA quarry face, and the apparent distribution of surface outcrops of white limestone, it could be assumed that 175 m represents the optimum width of good quality rock along the 800 m strike of the target limestone formation. If quarried to a depth of 30 m, this would yield a total of 11,340,000 tonnes (assumes specific gravity of 2.7). However, this is likely optimistic, based on geological reports that limestone in the general area often represents < 50% of the total lithology and the corroborating visual estimate from the current HRA quarry that it is ~40% of the total face. At the surface, limestone appears to be more abundant north of the existing quarry, but depth is unproven, so a conservative approach has been used to estimate a minimum ore reserve. The actual amount may be much larger.

Given the complex structural relationship with the gabbro, the high calcium limestone will need to be mined selectively; therefore, it has been conservatively assumed that ~25% of the face may be practically mineable. Other assumptions include the potential for the existence of minable limestone extending 800 m to the northern limit of the lease to a depth no less than 30 m. Therefore, a conservative total yield of high calcium limestone may be 2,835,000 tonnes.

Since the remaining gabbro and non-high calcium limestone is also marketable, these should be included in an estimate of mine life using all products. Mining of the quarry to produce all rock types within the 11.34 million tonne total quantity, at a rate of 320,000 tonnes per year (t/y), would give a mine life of 35 years.

The selective mining case, using high calcium limestone only, at a rate of 320,000 t/y to generate 2.8 million tonnes, would give a mine life of 8.5 years. As stated above, the actual amount may be much larger.

In 2018, initial production will be 15,000 tonnes of limestone, which could be ramped up to full production as markets are developed. This approach would obviously extend the actual mine life.

10.2 Mining Methods

Sagewill intends to hire a local quarrying company to work its claim. The quarry will use a simple drill and blast method of production. Since the resource is exposed at the surface and there is an existing quarry face, Sagewill can begin mining at the existing north face of the HRA quarry and will generally advance northward along the strike of the limestone bedding, with a working face 10 m in height. If selective mining is conducted, the width will vary. The maximum width will be approximately 175 m.

The contractor will provide their own equipment, including trucking. Standard quarry machinery will be used, such as an excavator, off-road rock truck, crusher/wash-plant, various conveyors, front loaders, and weigh scales. Mining equipment will generally be powered by diesel generators. Contractors working on the Sagewill claim areas will be required to follow the environmental mitigation measures described in the Environmental Management Plan and Reclamation Plan (EMP&RP) and requirements of the Provincial operating approval. These documents would be part of any contract tender.

Blasting will be conducted by a certified contractor with a blasting permit, using an approved Blast Monitoring Plan. Blasting patterns and procedures will be used that minimize shock or instantaneous peak noise levels, where possible. It is expected that the details of drilling and blasting, such as optimum hole spacing, hole diameter, and powder factor for these rocks, etc., will be known by the contracted blasting company so will not have to be researched and optimized through experimentation.

Seasonally appropriate preparation (clearing and earthworks) of the planned quarry footprint would be conducted shortly in advance of the work, minimizing the area of disturbed overburden at any one time. Tree clearing would be done in winter, to avoid impacts on actively nesting birds. Topsoil will be stored separately for reuse in site reclamation. Overburden stockpiles would be windrowed along the east and west edges of the Site Boundary and stabilized in a manner which minimizes dust and run-off from leaving the site.

10.3 Mine Site Layout

It is currently assumed that the proposed quarry layout will generally follow the highest concentration of surface outcrops of white limestone (Figure 3.1) and will have an approximate area of 175 m wide and 800 m long. The precise layout will be determined following a shallow drilling program in June 2018 to identify the best location to begin quarrying. Figure 3.1 shows the maximum site boundary, within which site activities may take place. Areas directly adjacent to the quarry footprint will include overburden stockpiles, seasonal staging areas for mobile equipment, crusher/screening plant, office, and product stockpiles. After initial quarry development, mobile equipment and product stockpiles may be located on the finished quarry floor.

A detailed mine site layout will be provided to regulators prior to commencement.

11.0 Mining Operations

A separate Environmental Management Plan & Reclamation Plan (EMP&RP) has been developed in conjunction with this Mining Plan. The EMP&RP is a living document that will evolve during the mining operation and be reviewed annually and revised appropriately over time (unlike this Mining Plan). The EMP&RP includes details related to protection of environmental features, emergency response, regulatory compliance, and final abandonment and site reclamation.

11.1 Development Timeline

Sagewill is planning to commence quarrying in mid- to late-2018 if / when commercial contracts are obtained, with an initial production volume of 15,000 t/y that may be increased up to 320,000 t/y (over 8 months), depending on market opportunities. As stated in Section 10.1, the estimated timeline is based on assumed conditions. Table 11.1 shows a tentative Project schedule, based on the use of all quarry products (including gabbro and non-high calcium limestone). This is based on a total extraction of about 8 million tonnes of material.

Table 11.1 Project Timeline

Project Phase	Start	End
Obtain Mining Lease and Environmental Approvals	June 2018	Aug 2018
Initial Quarry Development (150,000 tonnes resource / 15,000 tonne 2018 production)	Aug 2018	Oct 2018
Full Operation (320,000 t/y) (seasonally, May to Dec)	2019	2044
Phase 1 – 1st 10 m bench, advanced 100 m per year	2019	2027
Progressive Reclamation (Phase 1) (contour and stabilize abandoned quarry areas)	May 2028	June 2028
Phase 2 – 2nd 10 m bench, advanced 100 m per year	2028	2035
Progressive Reclamation (Phase 2) (contour and stabilize abandoned quarry areas)	May 2036	June 2036
Phase 3 – 3rd 10 m bench, advanced 100 m per year	2036	2043
Mine Decommissioning (remove all equipment & waste, contour final quarry faces to safe angle)	Oct 2043	Dec 2043
Final Reclamation (restore overburden/top soil and revegetate)	May 2044	July 2044

11.2 Mining Sequence

Based on the relatively simple approach of working the quarry from south to north, it is sensible to talk in terms of tonnes per metre of advance of the quarry face as this has direct application to the quarry footprint, how it will be developed, planned equipment placement and product storage.

Taking the "all products" case from Section 10.1 above as the example of how the quarry is most likely to be developed, the current 175 m wide face would be advanced northwards using phased 10 m benches, adding progressively deeper benches (2nd and 3rd benches) at a later time. To achieve production of 320,000 t/y (approx. 2,000 tonnes per day, 5 days / week for 8 months of the year) would require the 10 m deep, 175 m wide quarry face to be advanced ~100 m per year. It is expected that total quarry width will vary, depending on geology, and this will influence the rate of advance of the quarry face.

Considering the selective mining case, in which 15,000 tonnes of good quality limestone would be mined each year, and assuming that ~25% of total width (i.e. ~44 m) of the existing quarry would be advanced as a 10 m bench, that section of the quarry face would step 12.5 m north each year; a small incremental increase of the footprint.

Sagewill currently plans to commence mining with an "initial quarry development" that will target and prepare for extraction a total resource of 150,000 tonnes of high calcium limestone, from which the currently planned first year's production of 15,000 tonnes will be taken. The Likely dimensions of this area will be approximately 1 hectare, including an ultimate quarry floor about 5,600 m^2. The rest of the developed area will be used to locate the crushing and screening plant, to minimize distance travelled by rock truck and generate storage area for the products. Future resource areas will be developed according to market opportunities, with quarry advances either as a complete face targeting both main rock types, or selectively for limestone alone.

11.3 Ore Processing Plan

There is no processing required for the high calcium limestone, beyond crushing to contract specifications. Material sold as aggregate will be washed. Quality control will also be held in accordance with contracts specifications.

11.4 Water Management Plan

11.4.1 Surface Water Runoff

The site will be contoured to prevent runoff from leaving the site. If necessary, a perimeter ditch will be used to intercept site drainage and direct it back to the quarry. The quarry footprint will be graded so that site runoff is collected at a sump pit; where it can infiltrate the ground. If aggregate washing is included in quarry operation, the sump pit will also be used to settle and reuse wash-water.

11.4.2 Potable Water

For initial quarry development, potable water will be brought to the site. If quarry production is expanded significantly, an on-site water well will be developed.

11.4.3 Mine Water

Based on experience at the existing HRA quarry, it is not expected that mine water will accumulate significantly, and is expected to drain naturally by infiltration. If aggregate washing is included in quarry operation, an on-site water well will be developed as a source of process water, not to exceed 50 m^3 per day.

11.4.4 Water Balance and Loadings

During initial quarry development, no significant accumulation of mine water is expected, and dewatering will not be required. If aggregate washing is included in quarry operation, a closed system will be designed to address water recirculation. The design of this system will be provided to regulators for review and approval prior to installation, including water balance calculations.

11.5 Waste Management Plan

11.5.1 Air Emissions

Air emissions from the site will include engine exhaust from 5 - 6 heavy vehicles and the crusher plant generator, as well as dust. Vehicles and generators will be kept in good operating condition. Idling will be minimized to the extent possible. Dust from operations will be controlled by the use of water on roadways and working areas, and low speed limits for trucks. Areas of bare ground and overburden stockpiles could also generate dust; therefore, disturbed areas will be kept to the smallest size possible and bare ground and stockpiles stabilized with vegetation as soon as possible.

11.5.2 Tailings Management

Production of chemical limestone will not generate tailings. If aggregate washing is included in quarry operation, fines will need to be removed periodically from the sump pit and may be stockpiled with overburden for use in final site reclamation.

11.5.3 Waste Rock Storage

Relatively little waste rock is expected to be produced, since the associated gabbro and non-high calcium limestone is also marketable. Any waste rock that is generated will be used on-site to the extent possible for grading, or stored within the quarry for use in final contouring during site reclamation.

11.5.4 Water Treatment

No site run-off or process water will leave the site. Water treatment will be limited to settling of site run-off by a sump pit and infiltration to the ground. Due to the generally basic chemistry of the target geology, there is no risk of acid-rock drainage.

11.5.5 Solid Waste Disposal and Sewage

All solid waste will be placed in appropriate temporary storage, for later disposal off-site at an approved waste receiver. No waste will be disposed of on-site. Good housekeeping practices will ensure that blowable trash (i.e., food wrappers, plastic, etc.) will be collected and placed in garbage bins.

There will not be an on-site sewage system. Sewage facilities will be provided by "blue box" style portable johns, to be maintained by subcontractor and cleaned out regularly. All sewage will be removed from the site and disposed of at an approved waste receiver.

11.5.6 Hazardous Products

Hazardous waste will include limited on-site storage of fuel, and common industrial maintenance products such as cleaners, grease, and paint. All hazardous materials will be stored in secondary containment, including sealed liners capable of holding 120% of the stored volume.

11.6 Environmental Monitoring

Environmental monitoring will include:

- Noise and vibration measurements during blasting, according the Blast Monitoring Plan.
- Daily site inspection, during operation, to ensure site run-off is contained and erosion control devices (silt fence, drainage system) is still effective.
- Continuous vigilance by all workers of possible dust concern, to be addressed by the application of water if needed.

11.7 Physical Stability

Quarry walls of 10 m height are expected to be generally stable, without special measures. The selected contractor will demonstrate sufficient experience and qualifications to design quarry walls that are safe for work.

11.8 Progressive Reclamation

As indicated above, the quarrying sequence will include progressive reclamation, including final contouring and stabilization for areas that will no longer be mined. This includes portions of the quarry associated with the completion of each bench (Phases 1 and 2). More detail is provided in the EMP&RP.

11.9 Emergency Preparedness Plan

Site emergencies could include accidental spills of fuel or other hazardous material, equipment fire, or worker injury. External emergencies could also influence mining operations, such a forest fire or severe weather. The EMP&RP includes measures for reacting to possible emergency situations, as well as the communication and reporting requirements. A detailed site-specific emergency preparedness plan will be developed by the contractor for review by Sagewill, to ensure it is compliant with the EMP&RP.

11.10 Site Security and Safety

The existing access road to the HRA quarry has a locked gate. The existing logging road on the Meadow Brook Farms property (within the claim area) will be barred at an appropriate distance from the mining activities, and clearly marked with signage to indicate the potential danger. No person will be allowed to enter the site unattended other than a trained member of the quarry workforce. All persons in the quarry will wear appropriate personal protective equipment at all times, unless in a designated safe area. If during production high quarry walls pose a danger to 3rd parties, additional fencing and signage will be installed along the dangerous sections to warn of accidental falls. A detailed site-specific safety plan will be developed by the contractor for review by Sagewill to ensure it is compliant with the EMP&RP, the Provincial Approval to Operate and Provincial health and safety regulations. During the closed winter season, the quarry access will remain barred and potentially dangerous areas will be identified with temporary signage and snow-fencing.

11.11 Temporary Shutdown Procedure

Once operations commence, significant shutdowns are not anticipated beyond the regular seasonal winter closure (January to April). During the winter closure, and any other pause in mining exceeding one month, the site will be made ready for a period of inactivity, including disposal of all waste, removal / lockdown of stored hazardous materials, stabilization of all disturbed areas, inspection of site drainage control measures, and installation of temporary barriers and warning signs.

In the event that the quarry remains inactive for 3 years, and the restart of regular operations is not reasonably foreseeable, then the Reclamation Plan will be revised in consultation with NBDERD. The revised reclamation schedule would address the likelihood of permanent mine closure and the necessity of abandonment and final reclamation.

12.0 Environmental Impacts and Associated Mitigation

12.1 Environmental

12.2 Ambient Air Quality

As identified in Section 4.1.1, the regional air quality in the Study Area is relatively good. The Sagewill Quarry operation will generate some combustion-related air emissions from several heavy vehicles on-site and diesel generators. Overall, these emissions will be small and are not expected to have any effect outside the Site Boundary, but should nevertheless be minimized to the extent possible by regular equipment maintenance and selection of lower emission vehicles and generators when possible.

The overburden stripping associated with exposing the bedrock within the quarry footprint as well as exposed dirt in the access road and other mine development areas will be a potential source of fugitive dust (PM), which may cause fugitive dust to exceed PM limits or cause nuisance. This would be exacerbated on dry, windy days in the summer. PM is a regulated contaminant; which requires mitigation to limit concentrations in the local air shed. Dust could also become a nuisance to nearby residents.

Dust will be controlled on the access road and working surfaces by water spray / water truck. Low vehicle speeds will be maintained. All on-site workers will be vigilant of increasing dust clouds and inform the site manager when water needs to be applied.

Overburden stockpiles will be stabilized with vegetation as soon as possible following stripping to protect them from wind. Temporary stockpiles may be covered by tarps in high wind.

12.2.1 Noise

The existing acoustic environment of the Study Area is described in Section 4.1.2. The potential for most quarrying noise to impact the nearest permanent residences is considered low. Where the residences are approximately 1 km from the Site Boundary, based on a standard sound wave attenuation of -6 dBA per doubling of distance, the quarry noise can reasonably be expected to reduce -40 dBA, even without considering the intervening forest. Typical loud heavy machinery generates noise levels from 98 - 108 dB which would be reduced to 58 - 68 dBA at the receptors. This would be noticeable but approximately within the high range of normal ambient daytime sound levels. Taking the forest screen, and intervening terrain into account, that is likely to be much lower.

Intermittent blasting may produce higher instantaneous noise levels at residences, which would be monitored according to the Blast Monitoring Plan. Standard blasting activities by a certified contractor, in accordance with regulatory requirements, is unlikely to cause a significant noise impact.

For public exposure in rural settings, such as the Project area, the Province does not have specific guidelines for environmental noise (with the exception of specific industries, such as oil and gas). Health Canada has not set threshold values for noise, but recommends that mitigation measures be employed if levels of 75 decibels (dB) are exceeded for more than a year (Health Canada, 2010). Therefore, no recommended limits are likely to be exceeded.

The nearest residents to the west are also the current landowners where the Sagewill quarry is proposed. The landowner is already familiar with noise levels from the existing HRA quarry, and has not expressed concern over the proposed new quarry during direct discussions. Therefore, nuisance factor is not expected to be an issue, provided standard quarrying methods are used.

Impacts on wildlife are expected to be negligible, given the presence of the existing quarry which has operated since 1999. Any wildlife that use the area would be habituated to the quarry noise and relatively nearby highway traffic noise. In addition, over 50% of the proposed quarry footprint has already been clear-cut.

12.2.2 Groundwater Resources

Groundwater resources within the Study Area have been described above in Section 5.3. Based on the mining methods and mining operations presented in Sections 10.0 and 11.0, there are no anticipated adverse effects on groundwater. Normal operational activities were considered, including blasting and the on-site storage of petroleum hydrocarbons for use with equipment and vehicles.

It is understood that intermittent blasting will be conducted by a certified contractor, with a blasting permit and adherence to a Blast Monitoring Plan. It is estimated that the production of 320,000 t/y will require an annual open pit face advance of approximately 100 m for the 175 m wide and 10 m high pit face. It is understood that intermittent blasting of low charge will be required to meet this production rate. Applying basic ground vibration propagation theories, it is anticipated that ground vibrations due to the small and intermittent blasts will be more than sufficiently dampened prior to reaching nearby wells 1 km from the Project.

As per accidental spills or leaks of petroleum hydrocarbons used as fuel for equipment and vehicles, all spills will be reported and cleaned up. In addition, the distance between the Project working area and nearby wells (1 km) provides a substantial buffer from migration of dissolved hydrocarbons in groundwater, since the more mobile portions of hydrocarbon plumes can reach a stable, or a shrinking state or even be exhausted in less than 300 to 400 m (API 1998) due to natural processes.

12.3 Species-at-Risk

Vegetation clearing during quarry development could impact previously unmapped plant SAR or SOCC. As described in Section 6.0, the likelihood of plant SAR to occur within the quarry footprint is low, since a large portion of the site has been recently clear-cut. Most previously reported plant SAR in the area are associated with wetlands and shorelines, which do not occur within the Site Boundary (Figure 6.1). There are a few reported species in the surrounding area that could be present in the remaining forest areas within the maximum Site Boundary, particularly One-Flowered Broomrape (*Orobanche uniflora*), and three mosses. The forest habitats are mixed and mature or old in age, so there is some potential for previously unreported species to be present.

Wildlife SAR and SOCC also have a relatively low potential to be present due to the current clear-cut condition of much of the site, the absence of wetlands or watercourses, and the operation of the existing HRA quarry since 1999. Should wildlife SAR / SOCC incidentally occur within the quarry development area, it is expected they would simply move away into adjacent available habitat.

Bird SAR / SOCC are addressed in the following section under Migratory Birds.

To address the potential for unreported plant SAR and other incidental wildlife to be present within the Site Boundary, Sagewill will conduct a confirmatory site survey in June 2018 and report findings to regulators. If SAR or sensitive habitat is identified, Sagewill will develop site specific mitigation in consultation with regulators.

12.4 Migratory Birds

As described in Section 6.2, there are forest areas within the Site Boundary including mature and old aged hardwood and softwood (Figure 6.1). Migratory birds are protected under the MBCA. Vegetation clearing within the quarry development area could impact migratory birds during the nesting season.

The primary mitigation to minimize or eliminate risk of impacting migratory birds is to schedule clearing activities to occur outside the sensitive nesting window of May to September (i.e., clear in winter to the extent possible).

To address the potential for nesting birds to be present within the Site Boundary, Sagewill will conduct a confirmatory site survey in June 2018 and report findings to regulators. If nesting migratory birds or sensitive habitat is identified, Sagewill will develop site-specific mitigation in consultation with regulators.

12.5 Archaeological Resources

As identified in Section 7.0, there is a low potential for archaeological resources to be present within the Site Boundary. Even so, stripping overburden from the quarry footprint and construction of a new access road could disturb previously unmapped resources. Therefore, in accordance with provincial regulatory requirements, a Phase 2 Field Examination is required in order to fulfill provincial AIA requirements for the Project EIA.

Sagewill will conduct the confirmatory site survey (by a licensed Archaeologist) in June 2018, and report the results to the regulator. If archaeological resources are identified within the quarry footprint, Sagewill will develop mitigation in consultation with the regulator.

12.6 Local Economy

The Sagewill Quarry will provide significant benefits to the local and provincial economy, including relatively high wage employment, local spending on equipment and supplies, tax revenue to the Province, and potential usage of regional transportation services (port and rail).

It is estimated that the Project may inject approximately $500,000 to $10 Million per year to the local economy during operation, depending on market opportunities.

In order to maximize benefits to the local economy, Sagewill's policy will be to prefer selection of local contractors, equipment suppliers, and transportation services (port, rail), and to coordinate with national and provincial agencies to optimize market access and opportunities.

12.7 Traffic Circulation

As identified in the traffic impacts assessment in Appendix D, the increased trucking volumes under both high volume (320,000 t/y) and low volume (15,000 t/y) production scenarios are expected to produce negligible impacts on traffic patterns and road safety. Should the low production volume condition occur, no new roadway construction will be required to accommodate the increased trucking volumes. Alternatively, if the new quarry produces significant volumes, new on-off ramps will be constructed to provide direct access to Route 1. In all cases, the roadways are currently designed, or will be designed, to accommodate the appropriate vehicle.

Table 12.1 Summary of Potential Impacts and Mitigation

Valued Environmental Components (VEC)	Potential Impact	Mitigation
Ambient Air Quality	Overburden disturbance may cause fugitive dust to exceed PM limits or cause nuisance. Local air quality may be impacted by vehicle and diesel generator exhaust.	• Control dust on access road and work areas with the use of water. • Maintain low vehicle speeds on access road and work areas. • Stabilize overburden stockpiles with grass and cover temporary piles to prevent particulate release. • Maintain equipment in good condition to limit particulate exhaust releases. • Comply with Provincial Approval to Operate.
Noise	Blasting may cause short term, high intensity noise at nearest residences.	• Blasting activities will be conducted by a certified contractor in accordance with the Blast Monitoring Plan and in compliance with the Provincial Approval to Operate.
Groundwater Resources	Blasting could impact nearby residential wells. Contamination of local groundwater could occur from accidental spill.	• Blasting activities will be conducted by a certified contractor in accordance with the Blast Monitoring Plan and in compliance with the Provincial Approval to Operate. • Store all fuel and industrial chemicals (cleaning, grease, paint, etc.) in secondary containment with at least 120% capacity of the stored fluids. • Maintain readiness for accidental spill response and have a supply of suitable absorbent material on-site. • Follow emergency preparedness and reporting requirements in the EMP&RP and the Provincial Approval to Operate.
Species at Risk	Vegetation clearing during quarry development may impact previously unmapped plant SAR.	• Conduct confirmatory site survey prior to quarry development, and if SAR are identified within the Project footprint, develop site-specific mitigation in consultation with regulators.
Migratory Birds	Vegetation clearing within the quarry development area could impact migratory birds during the nesting season.	• Conduct a confirmatory site visit to identify the presence of sensitive migratory bird populations and, if found, develop mitigation in consultation with regulators. • Schedule clearing activities to occur outside the sensitive nesting window of May to September (i.e., clear in winter to the extent possible). • Comply with MBCA stipulations.
Archaeological Resources	Stripping overburden from quarry footprint and construction of new access road may disturb previously unmapped resources.	• Conduct confirmatory site survey by a licensed Archaeologist and, if archaeological resources are identified within the quarry footprint, then develop mitigation in consultation with regulators.

Valued Environmental Components (VEC)	Potential Impact	Mitigation
Local Economy	Quarry operation will provide employment and spending benefits to the local and provincial economy.	• None required; maximize benefits to local economy through selection of local contractors, equipment suppliers, and transportation services (port, rail), and coordination with national and provincial agencies to optimize market access and opportunities.
Traffic Circulation	Truck traffic related to high volume production scenario (320,000 t/y), using 40 tonne configurations, cannot be accommodated by the existing road network.	• If the Sagewill Quarry is developed for a high-volume scenario, the road system would be modified for direct access to Route 1.

13.0 Conclusion

The Sagewill Quarry will add significant value to the local and Provincial economy for up to 35 years (or longer), including relatively high paying jobs, local spending, and tax revenue.

Potential negative environmental impacts are relatively minor (mainly dust and noise), and can be mitigated to insignificance through implementation of the EMP&RP (under separate cover), and compliance with the Provincial Approval to Operate.

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