GHD

Sporting Mountain Quarry Expansion

EA SUPPLEMENTAL INFORMATION

Nova Construction Co. Ltd.

24 August 2022

→ **The Power of Commitment**

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1. Introduction

Nova Construction Co. Ltd. ('Nova') is proposing to expand their Sporting Mountain Quarry ('Quarry') located at 795 Morrison Road, in Seaview, Richmond County, Nova Scotia. The property (PID 750441566) is 6.4 kilometres (km) north of the community of River Bourgeois, and 8.4 km west of the Village of St. Peter's. Access to Morrison Road is via Highway 104 at River Bourgeois to Sporting Mountain Road (NTS Map: 11D15; Latitude: 45° 41' 56", Longitude: 60° 58' 22" or UTM Zone 20 NAD 83 [CSRS]: 657810E, 5062589N [Figure 1]). The site is accessed by way of a 0.5 km deeded right-of-way.

The Quarry has operated under the Nova Scotia Department of Public Works exemption for a highway project from July to December 2015. An Industrial Approval (IA) (2016-096419) to operate, construct, and reclaim a quarry less than 4 hectares (ha) was granted by Nova Scotia Environment and Climate Change (NSECC) in 2016 allowing Nova to operate the Quarry for future highway and private projects in the region. Operations at the Quarry to date have included the construction of an access road, logging of the quarry area, grubbing and removal of surficial overburden, blasting, crushing, stockpiling, and trucking of aggregate in accordance with the IA.

Nova had planned to expand to the quarry to 10.0 ha to continue meeting local demand for construction aggregate, however with efforts to reduce the footprint and potential effects to the environment with respect to wetlands and lynx, the proposed footprint has been reduced to less than 9 ha (Figure 2).

1.1 Purpose of this Report

An Environmental Assessment Document was submitted to NSECC for review and approval on July 6, 2020. On August 25, 2020, the Minister responded with a request for more information related to water resources and wildlife habitat. Information is required to be submitted before August 25, 2022. GHD and McCallum Environmental Limited conducted field work in 2021 and 2022 in response to the Information Request (IR), which is reported herein.

1.2 Scope and Limitations

This report: has been prepared by GHD for Nova Construction Co. Ltd. and may only be used and relied on by Nova Construction Co. Ltd. for the purpose agreed between GHD and Nova Construction Co. Ltd.

GHD otherwise disclaims responsibility to any person other than Nova Construction Co. Ltd. arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

Accessibility of documents

If this report is required to be accessible in any other format, this can be provided by GHD upon request and at an additional cost if necessary.

2. Additional Information Requirements

2.1 Water Resources Assessment

In consultation with Nova Scotia Environment, Sustainability and Applied Science Division, provide additional details for the water resources assessment with accompanying discussion and analysis of potential effects to surface water resource quality and quantity, wetlands and "groundwater quality and quantity, that includes the following:"

Information Request 1a)

"A groundwater monitoring study completed for all phases of the project using an industry-standard permanent monitoring well network established to assess the water table location, vertical and horizontal hydraulic gradients, hydraulic conductivities for shallow and deep groundwater flow regimes, groundwater flow directions, baseline water quality and to monitor for downgradient water quality and quantity effects, including effects of groundwater recharge and groundwater-surface water interactions on nearby watercourses and wetlands."

Response:

Sporting Mountain Quarry is underlain by the Sporting Mountain Pluton (age ca. 620 Ma) which consists of granodiorite varying randomly to monzogranite and tonalite. There are no significant overburden deposits within the working area of the quarry.

In December 2021, Logan Drilling Inc. installed four monitoring wells at the Quarry. The locations of the wells are shown on Figure 2 (following text) and the well completion details are provided in Table 1. Table 2 provides the manual groundwater elevations measured at the Quarry in 2022.

Table 1 Monitoring Well Completion Details

Well ID	Northing	Easting	Top of Riser Elevation	Ground Surface Elevation	Depth to Top of Well Screen	Depth to Bottom of Well Screen	Top of Well Screen Elevation	Bottom of Well Screen Elevation
			(m AMSL)	(m AMSL)	(m bgs)	(m bgs)	(m AMSL)	(m AMSL)
MW1	24540977.745	5062202.917	154.43	153.51	16.8	19.8	136.7	133.7
MW2	24541174.010	5062207.806	151.78	150.73	16.8	19.8	133.9	130.9
MW3	24541011.131	5062420.361	161.33	160.33	18.3	24.4	142.0	135.9
MW4	24541130.665	5062595.323	161.88	160.96	18.3	24.4	142.7	136.6

Notes:
m AMSL: metres above mean sea level
m bgs: metres below ground surface

Table 2 Groundwater Elevations

Well ID	Top of Riser Elevation	20-Jan-22		14-May-22		23-Jun-22	
		Depth to Water	Groundwater Elevation	Depth to Water	Groundwater Elevation	Depth to Water	Groundwater Elevation
	(m AMSL)	(m btor)	(m AMSL)	(m btor)	(m AMSL)	(m btor)	(m AMSL)
MW1	154.43	2.38	152.0	2.71	151.7	3.76	150.7
MW2	151.78	0.72	151.1	1.14	150.6	1.90	149.9
MW3	161.33	2.99	158.3	3.21	158.1	3.22	158.1
MW4	161.88	3.89	158.0	4.67	157.2	4.21	157.7

Notes:
m AMSL: metres above mean sea level
m bgs: metres below ground surface
m btor: metres below top of riser

The depth to ground water, based on manual groundwater measurements ranges from 0.72 metres (m) below top of riser (btor) at MW2 to 4.67 m btor at MW4. In May 2022, GHD installed pressure transducers in the four monitoring wells to facilitate collecting continuous groundwater elevation data. Appendix A contains a hydrograph showing the continuous and manual groundwater elevation measurements collected in May and June 2022. As shown on Figure 2 the groundwater elevation are highest at MW3, ranging from approximately 158 to 159 m AMSL, and lowest at MW2, ranging from approximately 149 to 151 m AMSL.

Figure 3 provides groundwater elevation contours based on the manual groundwater elevation measurements collected on May 14 and June 23, 2022. Based on these contours there is a component of groundwater flow north of the quarry, between monitoring wells MW3 and MW4, that is directed east to southeast. Beneath the existing quarry the groundwater flows south then southeast. The horizontal hydraulic gradient in this area is 0.02.

In June 2022 GHD completed single well response tests (slug tests) in the monitoring wells. The tests were completed by inserting a solid slug into the well below the water level, causing an almost instantaneous rise in the water level in the well. The rate of the water level falling back to the static water level was recorded using the pressure transducer. The process was then repeated when the slug was removed, providing an instantaneous drop in the water level followed by a slower recovery period. The test in MW2 was not successful but the results of the other single well response tests are presented in Table 3, below.

Table 3 Single Well Response Test Results

Well ID	Falling Head	Rising Head	Geometric Mean
	(m/sec)	(m/sec)	(m/sec)
MW1	1.7E-06	1.2E-06	1.4E-06
MW3	5.7E-05	5.4E-05	5.2E-05
	4.3E-05	5.6E-05	
MW4	1.7E-05	1.7E-05	1.7E-05
		Geometric Mean	1.6E-06

Notes: m/sec: metres per second

Figures 4 and 5 provide a cross section location map and two cross sections through the quarry. The groundwater elevations prior to dewatering the quarry (May 14, 2022) and after the quarry is dewatered (June 23, 2022) are shown as are the corresponding water levels in the quarry.

In May 2022, Nova initiated a program to pump the standing water from the quarry. The groundwater elevations measured during the pumping are provided in the hydrograph in Appendix A. Prior to pumping there were some slight increases in the groundwater elevations associated with precipitation events. However, the magnitude of the increase appears dampened in MW1 and MW2 versus MW3 and MW4. Nova began pumping to dewater the quarry on May 16, 2022. The notes with respect to pumping are provided in Table 4. Except for the period from noon on May 24th to noon on May 26th, when the pump was shut down for maintenance, Nova pumped water continuously from the quarry until June 1, 2022. The water level in the quarry decreased from approximately 152 m AMSL prior to the dewatering to approximately 142 m on June 1, 2022. North of the quarry, groundwater elevations measured at MW3 and MW4 remained relatively constant and do not appear to have been impacted by dewatering the quarry. The groundwater elevations at monitoring wells MW1 and MW2 decreased approximately 2 m during the dewatering and continued to decrease after the pump was shut down. This suggests that the groundwater in the bedrock surrounding the quarry was still flowing into the pit and had not reached an equilibrium state. The decreasing groundwater elevations continued until a precipitation event caused an increase in groundwater elevations on June 10, 2022. The recharge was apparent at all four monitoring wells and continued during additional precipitation events that occurred later in June.

Table 4 Pumping Information

Date	Pump Start Time	Pump Stop Time	Total Hours Pumping
Monday, May 16, 2022	3 p.m.	12 a.m.	9
Tuesday, May 17, 2022	24 hours		24
Wednesday, May 18, 2022	24 hours		24
Thursday, May 19, 2022	24 hours		24
Friday, May 20, 2022	24 hours		24
Saturday, May 21, 2022	24 hours		24
Sunday, May 22, 2022	24 hours		24
Monday, May 23, 2022	24 hours		24
Tuesday, May 24, 2022	12 a.m.	12 p.m.	12
Wednesday, May 25, 2022	Generator Maintenance (pump off)		0
Thursday, May 26, 2022	12 p.m.	12 a.m.	12
Friday, May 27, 2022	24 hours		24
Saturday, May 28, 2022	24 hours		24
Sunday, May 29, 2022	24 hours		24
Monday, May 30, 2022	24 hours		24
Tuesday, May 31, 2022	24 hours		24
Wednesday, June 1, 2022	12 a.m.	5:30 a.m.	5.5
Thursday, June 2, 2022	5:30-6:00 a.m. and 9:30-9:45 a.m.		0.75
Friday, June 3, 2022	5:30-6:00 a.m. and 9:30-9:45 a.m.		0.75

GHD has used the information recorded during the quarry dewatering to estimate the amount of groundwater entering the quarry when it was dewatered. On June 1, 2022, at 5:30 a.m., the pump was shut down. Nova then observed the water level in the quarry increased by approximately 0.076 m by 4 p.m. that afternoon. GHD used this information and the area of the standing water in the quarry on June 1, 2022 to estimate the rate that groundwater was entering the quarry, as follows:

$$Recharge\ Rate = A \times d / t$$

Where:

- A = Area of Standing Water (square metres [m^2]) = 170 m^2
- d = change in water depth (m) = 0.076 m
- t = time (min) = 630 min

Recharge Rate = 170 m^2 x 0.076 m /630 min = 13 m 3/ 630 m = 13,000 Litre (L)/630 min

Recharge Rate = 21 L/min

GHD collected groundwater samples for groundwater quality analysis in January 2022. The data are provided in Table A.1 in Appendix A where they are compared to NS Tier II Pathway Specific Standards (PSS) for groundwater discharging to surface water and Canadian Drinking Water Quality Guidelines (CDWQGs). These groundwater quality data represent baseline conditions. None of the NS Tier II PSS were exceeded and manganese was the only parameter that had a concentration that was greater than a CDWQG, and the elevated concentration was limited to the sample from MW1. Manganese naturally occurs in Nova Scotia groundwater. The project area is in an area of medium relative risk of manganese in water wells (Kennedy, 2021).

Information Request 1b)

"Informed through the results of the groundwater monitoring study, provide an assessment of potential effects to water resources should excavation within 1 m of the measured maximum annual water level, or below, be occurring or proposed for the project."

Response:

There was no drawdown associated with the dewatering of the quarry observed in the monitoring wells MW3 and MW4, located north of the quarry. Similarly, as shown in the hydrograph provided in Appendix A, there was no drawdown observed in the monitoring wells and piezometers installed in the adjacent wetlands during the dewatering event. This is consistent with the relatively low hydraulic conductivity values which indicate a very limited radius of influence of the dewatering. Drawdown was observed at MW1 and MW2, located south of the quarry, during the dewatering but it continued after the dewatering ended and only ceased when a precipitation event occurred. The groundwater south of the pit will be subject to limited draw down (less than 10 m) and will be confined to the immediate vicinity of the quarry. Based on these observations there will be no impact to any groundwater users and the potential impact to surface water will be insignificant.

GHD also evaluated the potential impact of dewatering the quarry on the surrounding groundwater by using the hydraulic conductivity, the proposed drawdown, and the Sichardt equation for unconfined aquifers to estimate the radius of the zone of influence of the quarry. The Sichardt equation is as follows:

$$R=3000\, s \sqrt{K}$$

Where:

- R = radius of influence (m)
- K = hydraulic conductivity (m/sec)
- S = drawdown (m)

Using the geometric means of the hydraulic conductivity measured at each monitoring well location results in the following radii of the zone of influence:

Table 5 Zone of Influence Radii

Well ID	Hydraulic Conductivity Geometric Mean (m/sec)	Drawdown (m)	Zone of Influence Radius (m)
MW1	1.4E-06	10	36
MW3	5.2E-05	10	217
MW4	1.7E-05	10	124

The Sichardt equation is empirical and is not conservative, however, GHD has incorporated a conservative estimate of drawdown by assuming it is 10 m. The water level in the pit decreased by approximately 10 m during dewatering. This will induce some drawdown in the groundwater surrounding the quarry, but it is less than the 10 m that occurs in the pit water and the amount of drawdown will decrease with distance from the quarry. In other words, the impact of dewatering on groundwater elevations will decrease as distance from the pit increases.

Information Request 1c)

"A baseline wetland hydrology study for Wetland 2 (WL2 as identified in the EA Registration Document) conducted in tandem with the groundwater monitoring study. This wetland has been identified as a 'Wetland of Special Significance' per the NS Wetland Conservation Policy, due to the presence of Blue Felt Lichen."

Response:

It should be noted that blue felt lichen (*Degelia plumbea*) was not identified within WL2. Due to the scale of a figure included within the EARD (Figure 9 of the EARD Biophysical Report [Appendix E]), a blue felt lichen point appears to be within WL2, however, it exists in upland habitat adjacent to the wetland. Suitable Canada warbler habitat and observations of Canada warbler were made within WL2; therefore, it is believed that NSECC will classify WL2 as a Wetland of Special Significance (WSS; refer to the response in Section 2.2 to request 2d for additional details regarding Canada warbler).

The methods to complete the wetland hydrology study in WL2 were proposed to NSECC and approved by Ian Bryson (former NSECC Wetland Specialist) on September 23, 2021. The wetland hydrology study was completed in conjunction with a groundwater monitoring study. Both studies provide an understanding of potential effects of groundwater-surface water interactions on WL2 from quarry development. Please note that Nova has developed a revised expansion area and now WL2 will be avoided (including a 30 m buffer), therefore, no direct impacts within the wetland are proposed.

The wetland hydrology study was initiated on September 22, 2021, to collect baseline data prior to quarry expansion. During quarry expansion, wetland monitoring will be completed every 3 years when the quarry is active. If the quarry is inactive during the scheduled monitoring year, monitoring will be postponed until the next operational year. Monitoring includes the installation of piezometers and shallow monitoring wells as well as the completion of vegetation plots (5 m x 5 m) and general visual observations. Additional details related to all aspects of wetland monitoring are provided below.

Piezometers and Shallow Monitoring Wells

Three sets of piezometers and shallow monitoring wells (SMW) were installed as nested pairs in WL2 on September 23, 2021. Both piezometers and SMWs were equipped with level loggers. The three nested pairs of wells were established within WL2, surrounding the revised expansion area (Table 6 and Figure 6). Note that the SMW well IDs are similar to groundwater monitoring well IDs; however, they are spatially different.

Table 6 Piezometer and Shallow Monitoring Well Locations

Wetland ID	Well Type[1]	Well ID	Easting (UTM 20)	Northing (UTM 20)
WL2	SMW	MW1	657759	5062802
	Piezometer	P1	657758	5062803
	SMW	MW2	657813	5063058
	Piezometer	P2	657815	5063057
	SMW	MW3	657941	5062944
	Piezometer	P3	657941	5062943

[1] SMW = Shallow Monitoring Well

The SMWs will be used to record the hydroperiod of the wetland to assess the seasonal water level trends that result from changes in hydrological inputs, outputs, and storage. Piezometers will be used to measure groundwater levels and pressure gradients (i.e., recharge/discharge) in relation to the water table, obtained from monitoring wells. Field data will be used to calculate and assess vertical and horizontal hydraulic gradients within WL2.

SMWs are constructed of 2” PVC pipe that is slotted (i.e., perforated) below grade. They are installed by hand to a depth of 1 m or refusal. The subsurface end of the PVC is capped with a pointed drive point and the above surface end is capped with a j-plug. Piezometers are installed to a depth equal to or greater than the well in the underlaying mineral strata (if deep histosols are present), as is possible, to capture the groundwater flux at the base of the wetland soil profile. Piezometers are constructed out of PVC, but with a slotted intake (i.e., 20 centimetre [cm]) only at the base of the pipe. All piezometers are capped with a j-plug to ensure surface or rainwater does not impact groundwater measurements.

Solinst leveloggers were deployed in each of the SMWs and piezometers from September 22, 2021, to December 2, 2021, and April 11, 2022, until present (i.e., removed for the winter to prevent damage caused by freezing). The leveloggers were labeled with the established location and were attached to the j-plug cap with a string. A measurement of the length from the top of the monitoring well to the bottom of the levelogger was recorded as the levelogger depth. Each levelogger was then lowered into the monitor well.

The leveloggers were set to collect data hourly. The software used to set and download the data is Levelogger 4.3.3. The data reading provides a pressure calculation in centimetres of water above the levelogger sensor. The data reading was compensated for barometric pressure using the data wizard tool in conjunction with barometric data collected by a Solinst barologger located in one of the wells.

Relative ground water depth (RGWD) is calculated as a function of the well height less the levelogger depth plus the compensated data reading. Data was retrieved from each logger in December 2021 and May 2022 allowing the relative ground water average for the growing season (June 1 to September 30) to be calculated. The relative groundwater average will be compared to future wetland monitoring events.

All pipes are surveyed to georeference water levels in metres above sea level (masl). Elevation from a common datum (e.g., sea level) is necessary to calculate hydraulic gradients between and within wetlands.

Vegetation Plots

Vegetation plots (VPs; 5 m x 5 m) were established within WL2 (Table 7 and Figure 6). The VPs are located within natural, undisturbed wetland habitat. The VPs are staked at each corner to ensure consistency during future sampling events. Absolute percent cover estimates were completed within the VPs for the herbaceous, shrub, and tree stratums.

Table 7 Vegetation Plot Locations

Wetland ID	VP ID	VP Centroid Location (UTM Zone 20)	
		Easting	Northing
WL2	VP1	657764	5062809
	VP2	657827	5063057
	VP3	657953	5062942

Characteristics of wetland substrates were recorded within each sampling quadrat, including percent cover of water, muck, moss, and exposed stone or mineral soil (adding up to 100 with the exception of when standing water was observed and substrate was visible through standing water).

The Prevalence Index (PI) for each VP was calculated using the species-specific wetland indicator ranking of the NSECC 2011 Wetland Plant Indicator list and the respective absolute cover of each species per strata. PI uses the methodology described by the U.S. Army Corps of Engineers (2012). It serves as a tool to evaluate change in vegetation communities (Spieles *et al*, 2006). The PI identifies with a numerical value the overall wetness or dryness of the plant community. The higher the number, the drier the plant community. Vegetation is considered hydrophytic where the PI value is less than or equal to three.

During future monitoring events, MEL will determine the relative percent difference (RPD) of the PI. Year to year change in the PI greater than 30 percent is considered an indicator of change, warranting further investigation. This threshold is considered conservative and should be reviewed in the future as more duplicate analysis becomes available.

The following expression is used to calculate RPD:

$$RPD = 100 * |X_1-X_2|/((X_1+X_2)/2))$$

where X_1 and X_2 are the two measurements being compared from year prior and current year respectively and the “| |” symbol means *absolute value*, so negative values becomes positive.

General Visual Observations

General visual observations were completed within WL2 at two locations (Table 8 and Figure 6) to visually assess overall vegetative composition, vegetation health, and presence of invasive species or Species at Risk (SAR). General visual observations also included a general overview of hydrology and other pertinent information (i.e., drainage characteristics, evidence of flooding/drying etc.). The presence of additional wetland stressors (siltation/sedimentation, ground disturbance/rutting, etc.) were also recorded for comparison of overall wetland health to baseline observations.

Table 8 General Visual Observation Plot Locations

Wetland ID	General Visual Observation Plot ID	General Visual Observation Plot Location (UTM Zone 20)	
		Easting	Northing
WL2	GenObs1	657800	5062868
	GenObs2	657883	5063009

The General Visual Observation methodology includes the following:

- Hydrological information
  - Surface and sub-surface hydrological indicators.
  - Precipitation amounts from the previous 1-5 days.
- Vegetative information
  - Photos of unaltered wetland extents indicating vegetative composition and condition.
  - Presence of invasive/exotic plants.
  - Notes on dying and/or stressed vegetation.
- Other wetland observations
  - Presence of siltation/sedimentation.
  - Flooding.
  - Drying.
  - Ground disturbance such as rutting or scouring.
  - Artificial channelization.
- Photograph log
  - Captured at the wetland edge facing the disturbed area in order to track changes in disturbance.
  - Photograph locations will remain consistent between visits and monitoring years.

Refer to Appendix B for a sample General Visual Observation data sheet. Results of baseline wetland monitoring will be used to compare to future monitoring events. These baseline results have not been included in this information package, but are available on request.

Information Request 1d)

“Water balances developed to represent all the planned phases of the project, including appropriate considerations for quarry floor infiltration, groundwater-surface water interactions, groundwater inflows into the existing quarry, and with consideration of the results of the groundwater monitoring study.”

Response:

A water balance assessment was completed for the proposed Project as described in the technical memorandum provided in Appendix C. The water balance assessment included estimated changes to total streamflow in drainage areas supplying watercourses WC1 and WC2 under four scenarios. Streamflow volumes were calculated as the sum of the surface runoff and baseflow volumes. Surface runoff volumes were assumed to equal the total precipitation less evapotranspiration and infiltration. Baseflow volumes were assumed to equal infiltration volumes when the pit is flooded, and the water table is at equilibrium. The basis of this assumption is that the groundwater flow divide follows the catchment boundaries and the water infiltrated within the catchment area appears as baseflow at the corresponding assessment point. It is assumed that there are no or minimal losses of groundwater to a deep aquifer system that crosses the catchment boundaries. In operating conditions, groundwater will be drawn into the pit, resulting in a reduction in baseflow in the adjacent watercourses.

Baseflow volume reductions in the watercourses adjacent to the pit were determined using the average estimated groundwater inflow rate to the pit and the zone of influence of the expanded pit on the surrounding water table. A pit inflow rate of 21 L/min was determined from the groundwater monitoring program. The average annual pit inflow rate is estimated to increase to 30 L/min when the quarry is at full development. A zone of influence radius was estimated to be approximately 200 m to the north of the pit and 40 m to the south of the pit based on observations from the groundwater monitoring program. Baseflow volume reductions were estimated as the percentage of the zone of influence that is comprised by the catchment multiplied by the groundwater inflow rate.

Information Request 1e)

"Additional details regarding the site water management plan for all the planned phases of the project, with the intent of clearly outlining what is proposed and the effectiveness of the proposed actions in mitigating impacts and alterations to nearby water resources. Details are to include, but not be limited to: considerations for the potential impacts associated with planned operations (e.g., times of site shut-down and restart, pumping requirements on site), plans/figures that provide sufficient detail to illustrate what is being proposed (e.g., sediment control ponds, drainage ditches) and provide confidence in their feasibility and effectiveness, and details that consider the results of the assessments (e.g., potential need to manage groundwater inflows)."

Response:

Four site conditions were analyzed in the water balance assessment completed for the Project: baseline, operating, dormant, and reclamation. Water management for the Project was considered for each of these site conditions. Detailed design of water management infrastructure will be provided as part of the IA application.

Under operating conditions, the quarry will be completely dewatered to allow for Project activities to occur within the quarry footprint. Water collected in the quarry under operating conditions will be pumped to two settling ponds located northeast and southeast of the quarry extents before entering WC2. Project operations are driven by market demand which could be seasonal on an annual basis; however, blast and crush operations have been occurring every 2-3 years between April and November. The quarry will be completely dewatered prior to Project operations and will be allowed to flood following the end of operations.

Dormant conditions consider the quarry between operating periods and before reclamation, with the quarry flooded to create a pit lake. Reclamation conditions are representative of the quarry after recontouring and revegetating disturbed areas of the property. Two overflow channels will be constructed to direct water from the pit lake to the two settling ponds located to the northeast and southeast during dormant and reclamation conditions.

The northeast and southeast settling ponds will be constructed according to the Nova Scotia Erosion and Sediment Control Handbook (Nova Scotia Department of Environment, 1988). According to the handbook, the volume of a settling pond must be at least 190 cubic metres (m^3) for every hectare under development. The drainage areas supplying runoff to the northeast and southeast settling ponds are approximately 1.9 ha and 5.4 ha, respectively. Therefore, the minimum settling pond volume required by the handbook is 361 m^3 for the northeast pond and 1,331 m^3 for the southeast pond once the quarry is fully extracted. Detailed design of the settling ponds and overflow channels will be completed as part of the IA application.

Information Request 1f)

"An assessment of potential impacts to surface water quality and fish and fish habitat related to any active pumping used as a part of water management for the project and residual blasting contamination. This

assessment is to consider the results of the other assessments (e.g., potential impacts associated with discharges of groundwater to surface water resources)."

Response:

Surface water runoff and groundwater inflow collected in the quarry will be directed to two settling ponds located northeast and southeast of the quarry, as presented in Figure 3 of the water balance analysis memorandum (Appendix C). The two settling ponds will serve to minimize the concentration of total suspended solids (TSS) to within acceptable limits and will consequently reduce the concentration of any metals constituent that may be present, prior to discharge to the surrounding environment.

Residues produced from blasting have the potential to result in increased levels of nitrate and nitrite within site discharge. Previous blasts within the existing quarry do not appear to have resulted in water quality impacts; the concentration of nitrate plus nitrite was below the laboratory detection limit in surface water samples collected in 2019 and 2020 from the existing settling pond discharge and in WC1. Furthermore, the concentration of nitrate plus nitrite in groundwater samples collected from on-site monitoring wells was lower than the NS Tier II PSS for surface water.

Considering the results of previous sampling events, blasting residues are not anticipated to result in impacts to surface water quality within WC2. Surface water in the vicinity of the Project will be monitored according to terms and conditions identified in any IA issued and the Pit and Quarry Guidelines (NSECC 1999).

Information Request 1g)

"Additional baseline fish and fish habitat studies and assessment as appropriate, based on the results of the assessments."

Response:

Additional baseline fish and fish habitat studies were completed by McCallum Environmental Limited (MEL) biologists on September 23 and 24, 2021. Fish and fish habitat studies comprised fish collection (electrofishing) and detailed fish habitat characterization of all delineated watercourses within the Study Area.

<u>Fish Collection</u>

Electrofishing surveys were completed with the goal of determining fish species presence within the Study Area. Due to the intermittent nature of the streams, electrofishing was performed opportunistically in all wetted areas of the channel. As a result, the entire wetted length of both delineated watercourses within the Study Area were electrofished (Figure 7). Fish collection was completed under Fisheries and Oceans Canada Fishing License # 341208.

Electrofishing was completed using guidance from a MEL Standard Operating Procedure (SOP) for Fish Collection (Appendix D). The methods and data collection forms outlined in the SOP were developed using the following sources:

- A review of fish sampling methods commonly used in Canadian freshwater habitats (Portt et al., 2006)
- New Brunswick (NB) Aquatic Resources Data Warehouse, the NB Department of Natural Resources and Energy, and the NB Wildlife Council (2002, updated 2006)
- Fisheries and Oceans Canada's Interim Policy for the Use of Backpack Electrofishing Units (2003)

Fisheries and Oceans Canada's Interim Policy for the Use of Backpack Electrofishing Units (2003) was reviewed and followed by all members of the electrofishing crew. This document provides a detailed list of standard equipment, safety, training, and emergency response procedure requirements for electrofishing. Each electrofishing crew consisted of two individuals, one of which (the crew lead) was a qualified person as defined under the DFO Interim Electrofishing Policy. The crew lead was responsible for operating the backpack electrofisher according to their training and the Policy, and for communicating safety policies and electrofishing procedures to the second crew member.

Fish were sampled within open sites (i.e., without the use of barrier nets) using a Smith-Root Backpack Electrofisher (HT-2000) with unpulsed direct current (DC) and a single pass – an open site was employed to ensure the greatest likelihood of capturing any fish present. The operator waded upstream to eliminate the effects of turbidity caused by bottom sediment and probed the anode into fish habitat within the site. A second crew member walked behind the operator to net any stunned fish using a D-frame landing net (1/8" mesh). If fish were captured, they were held in a live well containing ambient stream water and an aerator (i.e., bubbler), and the live well was kept out of the sun. Captured fish were checked regularly for signs of stress. At the conclusion of the pass, fish in the live well were identified to species and measured for length and weight. After recuperating, all fish were released back into the sampled reach.

Details of the electrofishing locations and survey dates are provided in Table 9. Electrofishing locations are shown on Figure 7.

Table 9 ***Electrofishing Survey Details***

Electrofishing Location	Stream Order	Survey Dates	Upstream Coordinates (UTM)		Downstream Coordinates (UTM)		Reach Length (m)
			Easting	Northing	Easting	Northing	
WC1R1	1	Sept 24, 2021	657662	5062443	657583	5062501	100
WC1R2			657654	5062604	657662	5062501	100
WC1R3			657726	5062753	657654	5062604	180
WC2R1		Sept 23, 2021	657969	5062931	658001	5062829	104

<u>Fish Habitat Assessments</u>

Detailed fish habitat characterization was completed using guidance from the MEL Standard Operating Procedure for Fish Habitat Assessments in the lotic environment (Appendix E). The methods outlined in the SOP were derived from the following sources:

- The Nova Scotia Fish Habitat Assessment Protocol: A Field Methods Manual for the Assessment of Freshwater Fish Habitat (NSLC, 2018).
- DNR/DFO – New Brunswick Stream Habitat Inventory Datasheets.
- Standard Methods Guide for the Classification and Quantification of Fish Habitat in Rivers of Newfoundland and Labrador for the Determination of Harmful Alteration, Disruption and Destruction of Fish Habitat (DFO, 2012).
- Reconnaissance (1:20,000) Fish and Fish Habitat Inventory (RIC, 2001).
- The US EPA Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish (Barbour et al., 1999).
- The Canadian Aquatic Biomonitoring Network Field Manual, Wadeable Streams (EC, 2012).

To support fish habitat assessments, each surveyed watercourse was delineated into individual reaches defined by discrete homogeneous units (e.g., riffle, run, pool, flat, etc.) as determined in the field in an upstream to downstream direction. Each habitat type contains discrete gradient, substrate types, water depth, and velocity ranges which have been determined using the described biological 'preferences' outlined in Grant and Lee (2004), whenever possible. In smaller, first-order streams, habitat types were often found to be extremely short and variable. For efficiency in the field, when individual habitat types were less than five metres in overall length, they were grouped together into one reach containing multiple smaller habitat units. The upstream and downstream ends of each reach were recorded with handheld GPS device.

For each reach (i.e., homogenous section of watercourse), a detailed fish habitat survey was completed which included water quality measurements, designation of substrate and cover types, riparian habitat descriptions, and barrier assessments. Cross-sectional measurements (transects) were established to describe morphological (i.e., channel and wetted widths, bank heights) and flow characteristics (i.e., velocities and depths) within the reach. Transect measurements were recorded at every 50 m length of reach – for example, if a reach was 150 m in total length, three transects were established within the reach. If multiple habitat types (<5 m in length) were grouped together to form a reach, transects were established within each habitat type represented within the reach. The amount of transects and transect locations were selected and modified as needed in the field based on specific habitat features observed, or limitations related to access, wadeability, and safety concerns.

During the fish habitat characterisation, a determination of limitations for fish movement and access was also completed in part to evaluate each watercourse to determine whether it is considered a fisheries resource. According to Bourne et al. (2011), and Fullerton et al. (2010), the ability of fish to pass barriers can be difficult to define and measure, as it combines the physical characteristics of a barrier with fish physiology in a dynamic environment. Parameters such as the species of interest and their swimming capability, the variability in stream flow, length of the barrier, slope, drop height, and outflow pool are all to be taken into consideration when determining the potential for fish to pass a barrier. Throughout baseline watercourse mapping and fish habitat surveys, an assessment of potential limitations for fish movement and access was completed. If a potential limitation is encountered, biologists recorded the type of limitation, height and length of the limitation, depth of water, along with an estimate of slope where relevant. The contiguity and spatial relationships of discontinuous pools are also described, when present, with the intent of understanding a fish's ability to move from one step-pool or isolated pool to another. If a potential limitation for fish movement and access is anthropogenic in nature (i.e., improperly installed culverts), it was noted as such, but not considered a permanent barrier due to its potential for being removed and reinstating fish passage.

Results - Fish Collection

Electrofishing surveys resulted in a total of two species and nine individual fish captured within WC1: one juvenile American eel, and eight brook trout (parr and adults). All fish were captured downstream of the underground section of WC1. No fish were captured in WC2. The results of the electrofishing surveys are presented on Figure 7.

Table 10 presents a summary of fish species captured through all electrofishing surveys within the Study Area. Individual data for fish captured at each sampling site within the Study Area are presented in Appendix F, and representative photos of each species captured are presented in Appendix G (Photos 35-36).

Table 10 Fish Species Captured within the Study Area

Common Name	Scientific Name	SARA	COSEWIC	NSESA	SRank	Total Catch		Size (mm)
						Total #	% Catch	
American eel	*Anguilla rostrata*	-	Threatened	-	S3N	1	11	120
Brook trout	*Salvelinus fontinalis*	-	-	-	S3	8	89	79-158
Total						9		

American eel have been assessed as threatened by COSEWIC (2012) and are ranked as S3N by the ACCDC. American eels are not currently protected under SARA or NSESA. During the 2021 field program, one juvenile American eel was captured in WC1.

Brook trout are considered provincially vulnerable by the ACCDC (S3) but have not been assessed by COSEWIC nor are they currently listed under SARA or NSESA.

Results – Detailed Habitat Assessments

For detailed fish habitat assessments, each habitat type has been characterized via surveys using standard methodologies to gather key measurements such as reach length (m), reach wetted and channel widths (m), reach slope (%), stream substrate composition (% composition), water depths (m), water velocities (m/s), cover (%), and riparian habitat. The data was used to determine the overall habitat area within each reach as well as the habitat suitability based on measured stream substrate, water depths, and water velocities (habitat parameters) for each fish species identified or potentially residing within the Study Area.

A summary of key fish habitat characteristics within each linear watercourse surveyed, and the fish species and life stages they support, are presented in Table 11. Delineated watercourse habitat reaches are presented on Figure 7 and representative photos of the watercourses are presented in Appendix G (Photos 1-34).

Table 11 Summary of Key Diagnostic Features of Fish Habitat

Water-course	Reach	Stream Order	Flow Type[1]	Reach Characteristics										Fish Support[6]					
				Channel Width (m)[2]	Wetted Width (m)[2]	Reach Length (m)	Dominant Habitat Type	Other Habitats Present	Slope (%)[3]	Average Velocity (m/s)	Average Depth (m)	Dominant Substrate	Cover (%)[4]	Confirmed Species (2020-2021)[7]	Probable Species[5]	Spawning	YOY	Juvenile	Adult
1	1	1	I	0.7-1.5	0-0.95	122	Riffle	No	2	0.05	0.04	Boulder/Muck	29	BKT, EEL	CRC	-	-	-	-
	2	1	I	0.7-2.1	0.5-1.8	231	Flat	No	1	0.05	0.14	Muck	35			-	-	EEL, BKT, CRC	EEL. BKT, CRC
	3	1	I	1.1	0.5	14	Riffle-Run	No	3	0.05	0.10	Boulder	25			-	-	EEL, BKT, CRC	EEL, BKT, CRC
2	1	1	I	0.8-1.45	0.55-0.65	106	Riffle-Run	No	3	0.05	0.06	Rubble/Muck	29	None	None[7]	-	-	-	-

[1] Perennial (P) – A stream that flows continuously throughout the year, Intermittent (I) – Streams that go dry during protracted rainless periods when percolation depletes all flow, Ephemeral (E) – A watercourse that flows during snowmelt and rainfall runoff periods only (AT, 2009).
[2] Ranges are provided for reaches measured through multiple transects.
[3] Slopes were estimated based on overall habitat type (DFO, 2012).
[4] Cover is calculated as a sum of all available cover types present (large woody debris, boulders, undercut banks, deep pools, overhanging vegetation, emergent vegetation, and submergent vegetation).
[5] Probable species presence determined for watercourses based on direct aquatic connectivity with another fisheries resource with confirmed species presence and habitat suitability (as described in the EARD; 2020).
[6] Fish support determined through habitat suitability of all confirmed or probable species. Probable species not brought forward if suitable habitat not identified through detailed habitat evaluation. Species codes: American Eel (EEL), Brook Trout (BKT), Creek Chub (CRC).
[7] Determination only applicable to delineated habitat within Study Area. Watercourse may support fish downgradient of the Study Area.

Water quality results are reported and discussed as it relates to the chemical characteristics required for suitable fish habitat. Summaries of water quality measurements are presented in Table 12 for sampling conducted *in situ* during detailed habitat assessments.

Table 12 ***Summary of In-situ Water Quality Measurements recorded during September 24, 2021 Fish and Fish Habitat Field Program***

Site	Water Temp (ºC)	pH	DO (mg/L)	Conductivity (µS/cm)
WC1R1	13.8	5.87	6.33	62
WC1R2	14.7	5.99	13.35	74
WC1R3	15.3	6.01	9.27	78
WC2	11.8	6.08	10.01	70

Summary of Fisheries Resources

WC1 is a first-order, intermittent, headwater stream that originates from pockets of surface water that collect within the southern-most extent of WL2. The watercourse flows southwest, eventually exiting the Study Area at its southwestern corner (Figure 7). As part of the 2021 field program, fish collection and detailed habitat descriptions were completed. The watercourse was delineated into three homogenous fish habitat reaches during detailed habitat mapping (Figure 7). During the 2021 assessment, flow was mostly stagnant with water confined to residual pools and flats.

Reach 1 is a 122 m long, slightly entrenched riffle. The reach contains a significant amount of treefall which prevented the surveyors from safely accessing the watercourse. As such, the watercourse was described where access could be achieved. Average channel and wetted widths are 1 and 0.48 m, respectively, and average water depth is 4 cm. Substrate in this reach is dominated by boulder, with rubble, cobble, and gravel present in lesser amounts and embedded in organic muck. A moderate amount of cover is provided by a mixture of overhanging vegetation and large woody debris. At the end of the reach, the watercourse channel disperses into upland habitat, with no contiguous surface flow observed for approximately 25 m. This feature is consistent with what was observed in 2019, as described in the EARD (2020). No fish were captured above this feature during the 2021 field program.

Downgradient, the channel reforms as a flat, which continues for 230 m (Reach 2). Abundant cover is provided by deeper pools, large woody debris, and some undercut banks. Average channel and wetted widths are 1.1 and 0.9 m, respectively, while average water depth is 14 cm (maximum 42 cm). Substrate in this reach is highly dominated by muck, with a mix of boulder, rubble, cobble, and gravel embedded within.

Reach 3 begins as the watercourse increases in gradient, transitioning into a sequence of riffle-runs. The reach was assessed for 14 m prior to the watercourse exiting the Study Area boundary. Channel width is 1.1 m, and wetted width is 0.5 m. Large woody debris, boulders, and overhanging vegetation make up a moderate amount of available cover. Substrate is dominated by boulders, but rubble and cobble are also present and underlain by muck substrate.

As a result of 2021 electrofishing surveys, one juvenile American eel and eight brook trout (parr and adult life stages) were captured within WC1. All fish were captured below the underground section of WC1 (Figure 7).

As outlined in Table 11, habitat for juvenile and adult American eel is found throughout the WC1 with soft bottom substrate (muck) and various cover types present through all reaches. Reach 2 and 3 provide suitable habitat for juvenile and adult brook trout through suitable water depths, habitats, and cover types. Reach 1 does not support fish habitat as the evaluation of the barrier to fish passage has remained consistent with the description provided in the EARD and is further supported by the results of electrofishing efforts. No suitable brook trout spawning or young of year habitat was observed along the assessed reaches of WC1, largely due to the lack of clean, rocky substrate available for spawning and rearing. Overall, fish habitat within the channel and passage through the channel is limited by the intermittency of flow. Although in-situ water quality sampling was limited (one-time event), the relatively low temperatures measured at the time of the assessment (September 24th) suggest potential groundwater inflow – a source of thermal refugia for cold-water species like brook trout. Water quality within WC1 is generally considered suitable for overall fish productivity.

WC2 is a first-order, intermittent, headwater stream that originates from pockets of surface water that collect within the southeast extent of WL2 (Figure 7). The watercourse flows southeast, before dechannelizing into a swamp east and beyond the Study Area boundaries. As part of the 2021 field program, fish collection and detailed habitat descriptions were completed. The watercourse within the Study Area was mapped as one homogenous habitat reach (Figure 7). During the 2021 assessment, flow was mostly stagnant with residual water confined to flatter areas. The 2021 assessment was confined to the area of the watercourse residing within the Study Area boundary.

Reach 1 is a moderately entrenched channel that forms a sequence of riffle-runs. Average channel and wetted widths are 1.1 and 0.6 m, respectively, and average water depth is 6 cm. Moderate instream cover is provided mainly by large woody debris. Substrate is composed of a rocky mix of rubble, boulder, and cobble embedded in organic muck. As described in the EARD, the watercourse disperses into a swamp east of the Study Area. The characteristics of the swamp remained consistent during the 2021 evaluation, and no evidence of available fish passage through the swamp was identified. No evidence of channelized water or other forms of hydrologically connectivity (i.e., sheet flow) were observed through the wetland during both the low flow (July 2019, September 2021) and high flow (November 2019) assessments. In addition, there were no hydrological indicators of surface flow during seasonal high flow events, as made evident by the absence of surface scouring, the absence of trim lines and water marks, the presence of a thick moss as ground cover, and the presence of dense vegetation. The watercourse was not assessed downgradient of the swamp. Furthermore, no fish were captured in WC2 during the 2021 electrofishing surveys. Consistent with previous evaluations, Reach 1 does not support fish. No fish were captured in WC2 during the 2021 electrofishing surveys.

Effects Assessment

In support of the discussion below, the reader is referred to the Water Balance Assessment (Appendix C).

The predicted changes in water being sourced to each aquatic feature can have implications to the viability of fish or habitat conditions. The Pathways of Effects diagram developed by DFO outlines potential impacts to fish and fish habitat as a result of changes to timing, duration, and frequency of flow (DFO, 2010). Effects may include:

- Changes to water quality including increases in temperature and changes to contaminant, sediment, and nutrient concentrations;
- Fish passage issues including changes to migration patterns or displacement or stranding of fish; and,
- Changes to habitat structure, cover, and food supply (DFO, 2010).
- The probability of these impacts to fish and fish habitat increases with increasing alteration to the natural flow regime. When applicable, changes in surface water runoff have been compared to thresholds outlined in the DFO Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada (DFO, 2013):
- Cumulative flow alterations <10% in amplitude of the actual (instantaneous) flow in the river relative to a “natural flow regime” have a low probability of detectable impacts to ecosystems that support fisheries.

- Cumulative flow alterations that result in instantaneous flows <30% of the mean annual discharge (MAD) have a heightened risk of impacts to fisheries.

As stated in the Framework, “for Canadian rivers and streams, the expert consensus is that cumulative flow alterations of less than +/- 10% of the magnitude of actual (instantaneous) flow in the river relative to a “natural flow regime” have a low probability of detectable negative impacts to ecosystems… In addition, there was consensus amongst workshop participants that cumulative flow alterations that result in instantaneous flows less than 30% of the Mean Annual Discharge (MAD) have a heightened risk of impacts to ecosystems that support fisheries” (DFO, 2013).

As part of the effects assessment, a review of the predicted changes in monthly runoff was completed to determine if quarry expansion would likely result in an alteration of flow in exceedance the thresholds outlined by DFO (2013). If flows fall below 30% MAD naturally and is then exacerbated by Project flow reductions, or if the flow is increased or reduced by more than 10% based on Project activities, the resulting alteration can be considered to have a heightened risk of impacts to fisheries and therefore could have a significant negative effect on fish and fish habitat. Alterations that do not exceed these thresholds are considered to have a low probability of detectable impacts to ecosystems that support fisheries.

One key limitation identified by DFO (2013) is that the determinations of effects to fish and fish habitat are not well understood in intermittent, seasonal, or ephemeral watercourses. The in-stream flow needs for watercourses which naturally lack flow at certain times of the year are not well understood, and guidance is lacking to determine effects to fish habitat in these systems. Both WC1 and WC2 are considered intermittent, having been observed to dry up during summer low-flow periods. As a result, the determination of effects to these systems have been informed by known physical parameters of the watercourse, known or expected fish usage, and predicted alterations in the natural flow regime.

A summary of the Water Balance Assessment (Appendix C) and a discussion of potential effects to fish and fish habitat are provided in the following paragraphs. When discussing the results of this water balance it should be noted that this quarry will be developed over the course of approximately 30 years. In addition, reclamation will occur throughout the course of the quarry’s life span. As such, the operating and dormant conditions represent the worst-case scenario in terms of overall development.

Watercourse 1

- WC1-US: A reduction in mean annual streamflow of 1.28% during operating conditions (monthly range from -9.92% to 0%), followed by no changes in monthly streamflow during dormant or reclamation conditions.
- WC1-DS: A reduction in mean annual streamflow of 1.30% during operating conditions (monthly range from -9.33% to 0%), followed by a mean annual reduction of 0.11% (monthly range from -0.11% to 0%) and 0.16% (monthly range from -0.16% to 0%) during dormant and reclamation conditions, respectively.

As an annual average, WC1 is expected to experience a minor and temporary reduction in streamflow. Predicted decreases calculated for both POIs (WC1-US and WC1-DS) are comparable. In operating conditions, WC1-US will experience a reduction in mean annual streamflow of 1.28% (maximum monthly reduction of 9.92%) compared to baseline conditions caused by water table drawdown into the empty pit. There are no impacts to streamflows at this assessment point in dormant and reclamation conditions when the pit is flooded, and the groundwater table is stabilized. In operating, dormant, and reclamation conditions, WC1-DS will experience reductions in mean annual streamflow of 1.30% (maximum monthly reduction of 9.33%), 0.11% (maximum monthly reduction of 0.11%), and 0.16% (maximum monthly reduction of 0.16%) during operation, dormant, and reclamation conditions, respectively, compared to baseline conditions. These reductions are caused by water table drawdown into the empty pit during operating conditions and by slight changes in land cover during the dormant and reclamation scenarios.

Monthly changes in streamflow, as presented in Attachment 1 of the Water Balance Assessment (Appendix C), were reviewed to assess potential impacts of a reduction in flow, specifically during low flow conditions. Reductions during seasonal low flow periods have the potential to result in more exaggerated impacts, compounded by lower water levels and higher water temperatures. For both WC1-US and WC1-DS, the greatest reduction in runoff is anticipated to occur in June (9.92% and 9.33% reductions, respectively), followed by September (4.22% and 4.04%, respectively). For both WC1-US and WC1-DS, there are no predicted changes in streamflow during the typical summer low flow period (July-August). Neither June nor September coincides with sensitive life stages (egg and fry immobility) for either species confirmed within WC1; American eel do not spawn in freshwater, while brook trout eggs hatch in early spring (NSDAF, 2005). All other months were relatively consistent with the predicted change in annual runoff from baseline conditions.

Overall, the predicted decrease in streamflow to WC1 during operating conditions is considered a negligible to low magnitude of impact to fish and fish habitat, unlikely to result in detectable changes to fish habitat or affect the ability of fish to use the habitat to carry out one or more life processes. No spawning or young of year habitat was identified within the delineated area of WC1, and passage is seasonally limited from downstream habitats based on observations of non-contiguous surface flow during late September field assessments. A monitoring program will be developed to detect potential changes to fish habitat. One aspect of this monitoring program will be to ensure water temperatures within the stream, which may potentially be buffered by groundwater discharge, are not significantly impacted by water table drawdown into the empty pit (and therefore potentially impacting temperature-sensitive species like trout). If impacts are detected through monitoring, appropriate measures can be applied to mitigate the effects.

<u>Watercourse 2</u>

- WC2-US: A 29.81% mean annual increase in streamflow during operating conditions (monthly range of 0% to 37.3%), followed by a 27.03% increase in mean annual streamflow during dormant and reclamation conditions (monthly range of 0% to 27.03%).
- WC2-DS: A 13.36% mean annual increase in streamflow during operating conditions (monthly range of 0% to 38.74%), followed by no changes in monthly streamflow during dormant and reclamation conditions.

As previously noted, the channel of WC2 begins within the Study Area and shortly thereafter disperses into a swamp to the east of the Study Area. No watercourse channel was observed within this wetland, nor was any evidence of hydrological connectivity observed through the wetland. No fish were captured in WC2 as a result of electrofishing surveys. As such, the portion of WC2 within the Study Area is not considered to support fish. There is no NSECC mapped watercourse that drains out from this wetland – the closest mapped watercourse lies approximately 1.2 km southeast of the Study Area. No fish or fish habitat assessment was completed immediately downgradient of this swamp in what is expected to be a continuation of the first order stream, which is observable via aerial imagery (Figure 7).

Predicted changes in streamflow to WC2 outside of the Study Area is based on a GHD-generated watercourse line. A predicted flow path for WC2 downstream of assessment point WC2-US was produced using PCSWMM software and a 1 m digital elevation model (DEM) collected from the Nova Scotia Data Locator Elevation Explorer. This predicted flow path was verified by manual methods via GIS. To support the effects assessment, the WC2 line as predicted in the WBA (Appendix C) downgradient (i.e., southeast) of the swamp is conservatively assumed to support fish and fish habitat.

In operating conditions, there will be a 29.81% mean annual increase (monthly maximum increase of 37.3%) in streamflow at the WC2-US assessment point. In dormant and reclamation conditions there will be a 27.03% mean annual increase in streamflow (monthly maximum increase of 27.03%) compared to baseline conditions. These increases in streamflow are attributed to the overflow/pumped water from the expanded pit via the northeast settling pond. WC2 at the WC2-DS assessment point will experience an increase in mean annual streamflow of 13.36% (monthly maximum of 38.7%) under operating conditions due to groundwater inflows to the quarry discharged at the southeast settling pond. No changes in streamflow are predicted at this assessment point under dormant and reclamation conditions.

Unmitigated, WC2 may experience a permanent increase in streamflow to approximately 150 m of potential fish habitat, which is the length of the predicted watercourse upstream of WC2-DS. Downstream of WC2-DS, the WBA shows that predicted stream flows within the watercourse increase during operations but return to baseline conditions during dormant and reclamation periods.

These permanent and temporary increases in streamflow along the predicted length of WC2 exceed the DFO (2013) thresholds for 10 out of 12 months of the year, with no changes predicted during operating conditions at either POI during July and August. It is anticipated that these increases could have detectable, negative effects on fish and fish habitat within WC2. For example, increased streamflow may cause changes in channel morphology and deposition of eroded material, which may reduce the availability of suitable habitats. However, it should also be noted that an increase in streamflow may improve fish habitat in this intermittent watercourse by improving passage and access to habitat within the watercourse. Accessibility has been documented as a limiting factor to fish habitat within first-order streams in the Study Area; therefore, greater streamflows may be beneficial to fish provided mitigations are in place to ensure the stability of the channel. Additionally, it is expected that the off-site swamp east of the Study Area may provide water retention services, storing excess water from the upstream reach of WC2.

Impacts to WC2 resulting from increases in streamflow will be mitigated through use of the northeast and southeast settling ponds. Instantaneous peak flows will be attenuated as water is held and then discharged more gradually through the pond outlets. The settling ponds will be sized to ensure that these predicted flow increases are mitigated. A monitoring plan will be implemented to ensure that this mitigation strategy is effective. To support the proposed monitoring plan, WC2 will be assessed downgradient of the off-site swamp to confirm that a channel exists, and if so what fish and/or fish habitat it may support.

Mitigation

Impacts to fish and fish habitat will be mitigated through the design and implementation of a surface water management strategy. As noted in the WBA, predicted impacts to WC2 resulting from increases in streamflow will be mitigated through design and implementation of the northeast and southeast settling ponds. Instantaneous peak flows will be attenuated as water is held and then discharged more gradually through the pond outlets. The original quarry settling ponds to the southwest of the pit will remain in place and can be used to mitigate reductions in streamflow to WC1, if required.

Monitoring

The Proponent will design and implement a Surface Water Monitoring Program. The Surface Water Monitoring Program will include monitoring locations for water quality and quantity to identify effects associated with predicted changes in streamflow and fish habitat provisions in watercourses within and outside of the Study Area, to ensure that potential adverse impacts to aquatic life does not occur. Details of the monitoring will be outlined in a Surface Water Monitoring Program as part of the IA amendment process.

Summary

Potential effects to fish and fish habitat as a result of changes in streamflow are predominantly temporary and concurrent with quarry operations (30 years). Permanent changes to flow are limited to the upstream reaches of WC2, with streamflow in downstream reaches returning to baseline levels in the dormant and reclamation phases. Furthermore, no fish or fish habitat was identified within the uppermost field delineated reach of WC2 (situated within the Study Area).

Based on the worst-case scenario, the predicted monthly streamflow reductions in WC1 are <10%, and there is no expected reduction during typical summer low flow. Approximately 150 m of WC2 could experience a permanent, detectable increase in streamflow. Unmitigated, this increase in streamflow is predicted to exceed the thresholds outlined by DFO (2013), which may result in adverse effects to fish and fish habitat. However, after mitigation and monitoring measures have been implemented, there are no predicted adverse residual environmental effects of the Project on fish and fish habitat due to changes in streamflow. This is based on the following factors:

- Any potential change would be gradual with quarry development (30 years). In addition, reclamation will occur throughout the course of the quarry's life span.
- The predicted streamflow increases to WC2 are based on an unmapped, topographically-generated channel line, and permanent increases would be restricted to a conservative estimate of 150 m linear length of potential fish habitat.
- Constructed settling ponds will be designed to hold and manage flows into WC2, mitigating the predicted increases as presented in the WBA.
- A Surface Water Monitoring Program will be designed to evaluate the potential changes in surface water runoff to fish and fish habitat. The monitoring program will refine potential effects to fish and fish habitat before the quarry development occurs and will verify whether mitigation measures are effective or if changes to fish habitat during quarry development is occurring.
- The protective mitigation measures and monitoring commitments will ensure impacts to fish and fish habitat do not occur as a result of quarry development. Monitoring and mitigation will employ an adaptive management approach. If required, existing mitigation measures will be adjusted or additional measures will be implemented in response to the findings of the monitoring program.

To support the predictions made in this document and evaluate potential effects to fish and fish habitat as the quarry expands, it is proposed that monitoring of WC1 and WC2 be initiated prior to quarry activities occurring within the contributing drainage area and continue concurrent with future quarrying. The goals of the monitoring program will be to further refine potential effects before the quarry expansion occurs to verify that any observed changes to fish habitat during and/or after the quarry expansion is consistent with refined predictions; and modify mitigation methods where necessary.

Information Request 1h)

"A discussion of proposed mitigation measures and follow-up monitoring programs based on the results of the assessments."

Response:

<u>Surface Water Mitigation and Monitoring</u>

Baseline water quality will be maintained through the use of re-vegetated slopes, drainage ditches and temporary settling ponds to capture, treat and re-direct surface water. Drainage ditches and swales will be utilized to the greatest extent practicable to divert surface water away from disturbed surfaces. Any surface water that comes into contact with disturbed areas will be directed to either the quarry pit or settling ponds. Dewatering will occur through pumping to the surrounding settling ponds, as they are developed. The settling ponds will also capture surface flow and allow for suspended sediment to settle out of the water column. Spill ways will be constructed in the settling ponds to allow treated water to return to the surrounding environment. No direct linkage, other than overland flow, exists or will be developed between the settling pond and the surrounding waterbodies.

Stream flow will be monitored during quarry operations to ensure that adequate water quantity is available to nearby watercourses as compared to baseline flow.

Table 13 provides rationale for the location of proposed monitoring stations and suggested parameters for analysis.

Table 13 Surface Water Monitoring Locations

Sample Location ID	Rationale	Parameters	Frequency
SP-1	To monitor potential contaminants leaving the site to the west	TSS, pH, Field parameters, (DO, pH, Temperature)	Quarterly when discharging
SP-2	To monitor potential contaminants leaving the site to the east	TSS, pH, field parameters	Quarterly when discharging
SP-3	To monitor potential contaminants leaving the site to the east	TSS, pH, field parameters	Quarterly when discharging
SW-1	To monitor water quality from WC1	TSS, pH, Field parameters	Quarterly when discharging
SW-3	To monitor water quality from WC2	TSS, pH, Field parameters	Quarterly when discharging

During quarry expansion, wetland monitoring will be completed every 3 years when the quarry is active. If the quarry is inactive during the scheduled monitoring year, monitoring will be postponed until the next operational year. Monitoring includes the installation of piezometers and shallow monitoring wells as well as the completion of vegetation plots (5 m x 5 m) and general visual observations. Further details of wetland monitoring are provide in response to IR 1c) above.

Groundwater Monitoring

Lowering of the groundwater (GW) table and effecting flow to nearby surface water features is not expected (either temporary or permanent) during the life of the project. The purpose of the groundwater monitoring program is to document baseline groundwater quality and to determine if there are changes in groundwater quantity and quality (e.g. SWI) associated with the Project. Water samples will be analyzed for general chemistry (RCAP-MS), BTEX-TPH and conductivity (Field parameter) as required by conditions of any environmental or industrial approval. It is proposed that samples will be collected semi-annually for the first two years after well installation and then annually thereafter. Water level measurements will be recorded hourly using in well loggers and manual measurements collected twice per year.

Table 14 provides rationale for the location of the installed monitoring wells and suggested parameters for analysis.

Table 14 Groundwater Monitoring Locations

Sample Location ID	Rationale	Parameters	Frequency
MW1	To monitor GW quality/quantity adjacent to WC1 and the quarry laydown area	RCAp-MS, BTEX-TPH, Water levels, Field parameters (Conductivity)	Semi-annually (two times per year)
MW2	To monitor GW quality/quantity adjacent to the laydown area and downgradient of the quarry.	RCAp-MS, BTEX-TPH, Water levels, Field parameters	Semi-annually (two times per year)
MW3	To monitor GW quality/quantity between existing quarry and WL2	Water levels, Field parameters	Automatic levels with semi-annual (two times per year) field parameters
MW4	To monitor GW quality/quantity between the proposed quarry extent and WL2 and WC2	Water levels, Field parameters	Automatic levels with semi-annual (two times per year) field parameters

Water quality samples at MW1 and MW2 are proposed for twice a year in the spring and fall. Water levels will be captured using Leveloggers (e.g., Solinst M5), set to hourly readings, in all four wells. Loggers will be downloaded, and manual level measurements will be taken during quality sampling events. During active quarry dewatering, manual measurements will be taken monthly beginning prior to the start of dewatering activity and commencing one month after water in the quarry has reached equilibrium.

Water quantity impacts are not predicted for domestic wells. Nova will maintain a clear line of communication through their Project Manager for domestic well complaints to be recorded and evaluated in accordance with legislation and NSECC specific requirements.

Locations of SW and GW monitoring locations are shown on Figure 8.

2.2 Wildlife and Wildlife Habitat Assessment

"In consultation with the Department of Lands and Forestry, Wildlife Division, and Environment Climate Change Canada, provide additional details for the wildlife and wildlife habitat assessment with accompanying discussion and analysis of potential effects to wildlife, wildlife habitat and species at risk, that include the following:"

Information Request 2a)

"A detailed methodology and justification for Canada lynx surveys and additional surveys and assessment as appropriate based on consultation with relevant departments."

Response:

Refer to the response for 2b below.

Information Request 2b

"Additional discussion regarding the quality and rarity of habitat within the lynx buffer area established by the province, and justification for non-adherence with the provincial recommended Canada lynx buffer areas."

Response:

Due to similarities in content, responses for IR 2a and 2b are provided herein.

Canada lynx surveys were completed by McCallum Environmental Limited (MEL) in March and May 2019 in lands surrounding the expansion area (EARD). Canada lynx survey protocol referenced in the EARD noted that tracking surveys should ideally be completed 72 hours after a snowfall event with snow depths of approximately 2 – 12 cm. However, due to timing of Project initiation and a lack of suitable weather, Canada lynx surveys could not be completed in these ideal conditions. Rather, tracking surveys were completed after a 27.6 cm snowfall in March and the second survey was completed as a spring pellet group inventory (PGI) survey in May during no snow conditions.

Canada lynx transects were not completed in lands overlapping the expansion area (EARD) as the expansion area was not defined as the time of survey completion. The layout of transects encircled the expansion area (EARD) and since Canada lynx are known to move long distances (Mech, 1977), the transect layout was believed to be effective in identifying sign of local Canada lynx movement in proximity to the Project. Canada lynx transects were designed along existing woods roads surrounding the proposed project as it was anticipated visual sign of lynx would be more prominent in these conditions. The majority of the confirmed and possible Canada lynx sign observed were located on these roads.

The Project Team acknowledge that NSDNRR have developed the lynx buffer areas within this region of Richmond County due to known occurrence of Canada lynx. Comments made by NSDNRR staff as part of the 2019 EA review indicated that "the Department recommends that the quarry expansion boundaries not extend past the previous clear-cut boundaries in order to maintain the integrity, hydrology, and function of the delineated Wetland 2 for species at-risk, such as the Canada Lynx, Canada Warbler, and Blue Felt Lichen; and to maintain the integrity of the unimpacted portion of the Department's identified Lynx buffer". Per the discussions held with Mark McGarrigle (NSDNRR SAR Biologist) and Elizabeth Walsh (NSDNRR Regional Biologist) on May 21, 2021, the Project Team has amended the expansion area to avoid the intact habitat within the lynx buffer and restrict quarry expansion to the clear-cut habitat (as shown on Figure 9). This process will result in the footprint of the Project to respect a 30 m buffer to WL2. Impacts to the Canada lynx buffer have been reduced from 4.95 ha to 1.65 ha. The 1.65 ha is entirely situated in an area of the buffer that has been historically clear-cut. NSDNRR stated that they are aligned with Nova's approach to minimize impacts within the Canada lynx buffer from the revised expansion area (M. McGarrigle; NSDNRR SAR Biologist; Personal Communications; May 21, 2021). Maintaining a 30 m buffer is also protective of Canada warbler habitat, which was also identified in WL2.

The Project Team proposed additional Canada lynx long term monitoring surveys to assess potential Canada lynx activity within the lynx buffer and revised expansion area and to understand potential project interactions with Canada lynx. This information was provided to NSDNRR separately for review on August 2, 2022. Refer to the Canada lynx monitoring plan (Appendix H).

Information Request 2c)

"A detailed methodology and justification for bird surveys, including common nighthawk surveys, and additional surveys and assessment as appropriate based on consultation with relevant departments."

Response:

Migration (spring and fall) and breeding bird surveys took place at 11 point count (PC) locations within and beyond the Study Area in a variety of habitats including closed canopy forests, mature hardwoods, wetlands, and open areas. Common nighthawk surveys occurred at three PC locations situated immediately adjacent the Study Area.

Avifauna surveys were conducted using PC methodology as they are a commonly used survey technique for determining avian species composition (FAO, 2007). Methodology was based on Canada Wildlife Services (CWS) protocols as they relate to survey site selection, survey duration, and season selection. PC locations were chosen to represent major habitat types and are spaced 250 m apart[1] to avoid double counting species observations (Howe, Wolf, & Rinaldi, 1997; EC CWS, 2007).

PC locations were placed prior to the boundaries of the expansion area (EARD) being finalized, therefore, only one PC (PC1) is present within the expansion area (EARD), at the southern extent of the existing quarry footprint. As shown on Figure 10, the location of point counts (and their 250 m separation from each other) encompassed all but 0.52 ha of the revised expansion area. The area not covered by the PCs 250 m separations is all cleared habitat and similar habitat exists within other areas covered by PCs. Given the size of the expansion area, and the close proximity and frequency of PCs, PC surveys were deemed to provide comprehensive coverage and be representative of all habitat types.

The three common nighthawk point count (CONI PC) locations were also placed prior to the boundaries of the expansion area (EARD) being finalized. The PCs exist from 800 m (distance between CONI1 and CONI2) to 1,330 m (distance from CONI 1 to CONI3) apart from each other. CONI PC locations were

[1] Minor overlap in 250 m separation distances at some PC locations was due to adjustment of PC locations in the field. A low potential for double counting birds was determined based on the marginal amount of overlap.

selected because they are on gravel roads, with roadside clearings suitable for nesting habitat, and can be safely accessed via vehicle during the nocturnal survey (MBBA, 2008).

Per the *Common Nighthawk Detection Survey Protocols* (Saskatchewan Ministry of Environment, 2015), CONI PCs are distanced by a minimum of 800 m to provide coverage, while avoiding overlapping observations (i.e., hearing the same individual at multiple locations). CWS has more recently recommended following the Canadian Nightjar Survey Protocol (Birds Canada, 2022) which requires spacing survey stops by 1,600 m, a distance greater than the maximum distance between CONI PCs. As presented on Figure 11, the separation distances between the three CONI PC locations fully encompassed the proposed expansion area, meaning that any common nighthawk activity within the expansion area would have been captured at one of the CONI PCs.

Bird surveys were completed on the following dates and weather conditions:

Table 15 Avian Survey Timing and Weather Conditions

Survey	Date	Survey Conditions		
		Temperature (°C)	Wind (B[1])	Precipitation[2]
Spring Migration	May 5, 2019	2-10	0-2	1
	May 23, 2019	2-10	0-2	1
	June 1, 2019	4-8	3-4*	0
Breeding Bird	June 15, 2019	9-13	0-2	0-1
	June 24, 2019	10	1	0
Fall Migration	September 6, 2019	12-16	1-3	0
	September 26, 2019	14-16	1-3	0, 2 (08:00-09:30)
	October 15, 2019	11-13	2-4*	0-2
Common Nighthawk	June 14, 2019	9	1	1
	June 23, 2019	14	1	0

[1] Beaufort Scale: 0 = <1 knot (calm), 1 = 1-3 knots (light air), 2 = 4-6 knots (light breeze), 3 = 7-10 knots (gentle breeze), 4 = 11-16 knots (moderate breeze).
[2] Precipitation: 0 = none, 1 = haze or fog, 2 = drizzle, 3 = rain, 4 = thunderstorm, 5 = snow, 6 = wind driven dust, sand, or snow.
*Short gusts of Beaufort of 4 were identified during the survey period. Surveys were paused during gusts (i.e., Beaufort >3).

All surveys were completed in acceptable conditions and surveys would have been paused or terminated if windy, noisy, or rainy conditions arose. Short gusts of wind resulting in wind speeds over 4 on the Beaufort scale were observed during the third rounds of spring and fall migration, respectively. During periods with increased gusts of wind, surveys were temporarily paused as noise levels >3 on the Beaufort scale make it difficult to hear or distinguish bird calls. Precipitation was minimal during survey periods except for drizzle during the second round (September 26, 2019) and third round (October 15, 2019) of fall migration.

Information Request 2d)

"A discussion and justification for instances where habitat for Canada warbler will not be avoided or would be affected, including a discussion of conservation allowances if appropriate."

Response:

WL2, WL8, and WL10 have dense shrub layers that may provide suitable breeding habitat for Canada warblers. Furthermore, two Canada warbler were identified (probable breeding evidence) within WL2 (at point count location PC4 [Figure 10]). Due to the presence of suitable habitat and observations of Canada warbler in WL2, it is believed that NSECC will now classify WL2 as a WSS.

The expansion area (EARD) extended into WL2, however, as per discussions held with Mark McGarrigle (NSDNRR SAR Biologist) and Elizabeth Walsh (NSDNRR Regional Biologist) on May 21, 2021, the Project Team has revised the expansion area to avoid WL2 entirely and implement a 30 m setback from the wetland boundary. The revised expansion area does not directly impact WL2, WL8 or WL10. The revised expansion area is located in former clear-cut and a small area of intact mixed wood, upland forest that does not classify as suitable Canada warbler habitat. As such no direct impact or effects to Canada warbler habitat is expected as a result of the Project. Conservation allowances are therefore not expected to be required.

Information Request 2e)

"A discussion and justification for non-adherence with the provincial recommended buffer for blue-felt lichen."

Response:

Thirteen thalli of blue felt lichen (SARA and COSEWIC Special Concern; NSESA Vulnerable; ACCDC S3) were observed in five separate locations across the EA Study Area. Four of these locations exist in the northern extent of the EA Study Area and the remaining observation (BlueFelt1) exists immediately west of the existing quarry along WC1 and between WL1 and WL2 (Figure 12). The habitats that this lichen was found in include upland, swamp (WL11), and on the edge of the existing quarry.

Nova has revised the expansion area which has reduced the footprint proposed for development (12.3% decrease) and redirected potential advancement of the quarry face away from the nearest observations of blue felt lichen (BlueFelt1). The revised expansion area maintains a setback of 100 m, as recommended within the *At-Risk Lichens – Special Management Practices* (NSDNR, 2018), from all but one observation of blue felt lichen, BlueFelt1 (Figure 12). BlueFelt1 is located within the existing Industrial Approval (IA) area and is situated 32 m west of the revised expansion area. These setbacks were deemed as acceptable by NSDNRR (M. McGarrigle, NSDNRR SAR Biologist, May 21, 2021).

Blue felt lichen are sensitive to changes in microclimate (COSEWIC, 2010) and removal of vegetation surrounding blue felt lichen can alter the microclimate by increasing drying effects (COSEWIC, 2010; ECCC, 2020). For this reason, the SMP does not allow for forest harvest within 100 m radius of blue felt lichen (NSDNR, 2018), however, the area between BlueFelt1 and the current quarry operations was historically cleared. Planned operations are proposed to move northeast, and away from BlueFelt1 and no activities will occur closer than they currently are. The revised expansion area will limit quarrying to 18% of the area within 100 m of BlueFelt1, and 100% of the area proposed for quarrying within the 100 m buffer is currently disturbed.

This information was presented to Mark McGarrigle (NSDNRR SAR Biologist) and Elizabeth Walsh (NSDNRR Regional Biologist) on May 21, 2021. As noted above, NSDNRR indicated that they are comfortable with the proposed approach related to encroachment within the 100 m buffer to BlueFelt1 as long as (i) quarry expansion moves away from the blue felt lichen observation and (ii) ensuring WC1 is protected. As described above, quarry expansion will move away from BlueFelt 1. Nova will adhere to a 30 m watercourse setback, surface water monitoring will be completed, and no sedimentation issues are anticipated as stockpiles will remain on the quarry floor and the buffer area is stable and regenerating.

All other observations of blue felt lichen maintain a 100 m buffer.

Refer to the response to Question 2f for details related to the proposed monitoring and Appendix I for the Lichen Management Plan.

Information Request 2f)

"Project specific avoidance and mitigation measures for blue-felt lichen, frosted glass-whiskers, and other species at risk and their critical habitat including follow-up monitoring programs."

Response:

The SAR included within this response are blue felt lichen, frosted glass-whiskers (*Sclerophora peronella*), and Canada lynx.

Blue Felt Lichen

Refer to the response to Question 2e for specific details on the blue felt lichen observations within the EA Study Area and avoidance based on the revised expansion area. Refer to Appendix I for the proposed Lichen Management Plan.

Frosted Glass-whiskers

The Nova Scotia population of frosted glass-whiskers is listed by SARA and COSEWIC as Special Concern, and ACCDC S3S4 (note: frosted glass-whiskers was ranked by the ACCDC as S1? at the time of EARD registration). Multiple individuals were observed in one location along the western EA Study Area boundary, within the heartwood of a yellow birch. The revised expansion area remains beyond the 100 m buffer (NSDNR 2018), therefore, no monitoring for this species is proposed.

Canada Lynx

Refer to the response to Question 2b for specific details on the Canada lynx and Canada lynx habitat within the EA Study Area. Nova is able to avoid intact habitat within the Canada lynx buffer based on the revised expansion area (Figure 9). In addition, a Canada lynx monitoring plan was provided to NSDNRR on August 2, 2022, outlining a proposed survey protocol to be implemented prior to quarry expansion (Appendix H).

Information Request 2g)

"A discussion of proposed mitigation measures and follow-up monitoring programs based on the results of the assessments."

Response:

Refer to Table 16 for a list of mitigation measures and monitoring programs associated with the environmental components addressed within this technical memo. These environmental components include wetlands (specifically, WL2), Canada lynx, SAR lichens, Canada warbler, and fish and fish habitat.

Table 16 Mitigation Measures and Monitoring Programs

Environmental Component	Mitigation Measures	Monitoring Programs	Responses with Additional Detail
WL2	– Avoidance of direct impacts to WL2 via revised expansion area – Maintain a 30 m buffer from WL2 – Follow the NSECC Sediment and Erosion Control Handbook techniques for ensuring there is no potential for impact to wetlands – Complete pre-construction site meetings for all relevant staff/contractors related to working around wetlands and watercourses to minimize unauthorized disturbance – Ensure all wetlands are visually delineated (i.e., flagged) – Implement water management methods to reduce the potential to drain or flood surrounding wetlands – Direct site runoff through natural vegetation, wherever possible – Re-vegetate and progressively reclaim the quarry – Obtain NSECC Wetland Alteration Approval to alter other wetlands proposed for direct impacts (plan to include wetland compensation)	A baseline wetland hydrology study for WL2 has been approved by NSECC (refer to the response to Question 1c).	Question 1c
Canada lynx	– Reducing direct impacts within lynx buffer to areas historically cleared via the revised expansion area – Develop a Wildlife Management Plan – Implement adaptive management depending on findings from monitoring – Minimize noise disturbance to the extent practicable – Educate site staff on Canada lynx – Report observations of Canada lynx to NSDNRR	Canada Lynx Monitoring Plan (refer to Appendix H)	Questions 2a, 2b, 2f, and Appendix H
SAR lichens	– Maintain a 100 m buffer on all observations of blue felt lichen (except BlueFelt1) and frosted glass whiskers – Reducing footprint of impact via the revised expansion area – Expand quarry away from BlueFelt1 – Use of dust suppressants (e.g., water trucks), when required – Implement adaptive management depending on findings from monitoring	Lichen Management Plan (refer to Appendix I)	Questions 1c, 2e, 2f, and Appendix I

Table 16 Mitigation Measures and Monitoring Programs

Environmental Component	Mitigation Measures	Monitoring Programs	Responses with Additional Detail
Canada warbler	– Avoidance of direct impacts to WL2 via revised expansion area – Maintain a 30 m buffer from WL2 – Complete clearing activities outside of the breeding bird window (April 15 to August 31), where practicable. If smaller areas are not able to be cleared during this window, clearing will be completed in consultation with NSDNRR/ ECCC. – Stockpiles will be examined during the nesting season to ensure that ground-nesting birds are not present, and disturbance avoided until after the nesting season – No one shall disturb, move or destroy migratory bird nests. If a nest or young birds are encountered, work shall cease in the immediate area of the nest and NSDNRR will be contacted – Install downward-facing lights on site infrastructure to reduce attraction to birds – Develop a Wildlife Management Plan	NA	Question 2b and 2d
Fish and fish habitat	– Maintain 30 m watercourse setback – Implement sediment and erosion control – Design and implementation of a surface water management strategy. – Design and implementation of the northeast and southeast settling ponds. – The original quarry settling ponds to the southwest of the pit will remain in place and can be used to mitigate reductions in streamflow to WC1, if required.	Surface Water Monitoring Program (to be developed as part of IA amendment process)	Question 1g

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