Ontario Power Generation Inc.

PROPOSED CALABOGIE GENERATING STATION REDEVELOPMENT PROJECT

Terrestrial Environment Technical Support Document

Final

March 2020

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Terrestrial Environment Technical Support Document – Final

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Our Ref.:
351316-000-00010

Date:
March 2020

VERSION CONTROL

Issue	Revision No	Date Issued	Page No	Description	Reviewed by

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EXECUTIVE SUMMARY

Ontario Power Generation (OPG) is proposing to redevelop the existing Calabogie Generating Station (GS). Constructed in 1917, the original station had an installed capacity of 5 megawatts (MW). The existing Calabogie GS is over one hundred years old and was at the end of its life prior to the tornado that hit the GS in September 2018. The GS has not operated since that time. OPG intends to redevelop the site and increase the station's capacity to approximately 11 MW.

The proposed Project is located in the Village of Calabogie, Township of Greater Madawaska, Renfrew County, Ontario. The Project involves the demolition of the existing powerhouse and forebay inlet structure and the construction of a new powerhouse with integral intake structure and tailrace. Other ancillary facilities will also be constructed. The Project may also involve the construction of additional sluiceway capacity.

This TSD provides a terrestrial environmental baseline, as well as an assessment of the potential environmental effects of the proposed Calabogie GS Redevelopment Project on the terrestrial environment and the recommended mitigation measures to minimize these effects. The report also includes an evaluation of natural heritage values to evaluate compliance with federal and provincial legislation and policies.

During proposed Project construction, potential effects on the terrestrial environment may occur due to fugitive dust, combustion emissions, noise, blasting, soil erosion, incidental spills, hazardous materials use, waste generation, vegetation clearing, partial plantation loss, increased human activity and displacement of nesting birds and turtles. Based on an assessment of the available baseline information and potential effects, as well as the implementation of the recommended mitigation measures, it is concluded that effects during construction can be effectively mitigated, and most of them will be localized and short-term.

During the operation of the proposed Project, potential effects on the terrestrial environment may occur due to noise, incidental spills, etc. Based on assessment of the baseline information and potential effects, it is concluded that the operation of the proposed Project will have negligible long-term effects on the terrestrial environment.

Environmental protection during proposed Calabogie Station Redevelopment Project (CSRP) construction and operation will be ensured by adherence to the site-specific Environmental Management Plan, as well as compliance with regulatory standards and guidelines.

The Environmental Management Plan ensures that environmental protection will be achieved during construction by describing government agency requirements, proposed Project commitments and recommended mitigation measures to be undertaken. The Environmental Management Plan will include the Erosion and Sediment Control Plan, Spills Emergency Preparedness and Response Plan, Hazardous Materials Management Plan, Waste Management Plan and Site Rehabilitation Plan.

During construction and operation, an Environmental Compliance Monitoring Program will be implemented to ensure all construction and operation related commitments are met. Details on the Environmental Compliance Monitoring Program is provided in the Environment Report

1 INTRODUCTION

1.1 Regulatory Framework

In Ontario, proposed waterpower facilities are subject to the *Environmental Assessment Act* (*EA Act*). The Ontario Waterpower Association (OWA, 2018) developed the Class Environmental Assessment for Waterpower Projects (OWA Class EA) process which was approved by the Ontario Minister of the Environment and the Lieutenant Governor in Council in 2008. The *EA Act* formally recognizes the OWA Class EA process which outlines the requirements for Environmental Assessment (EA) approval. The proposed Calabogie Station Re-Development Project (CSRP) is being carried out according to the eighth edition of the OWA Class EA.

Under the OWA Class EA, the proposed CSRP is classified as a “Project Associated with Existing Infrastructure”. Provided the requirements of the OWA Class EA planning process are met and a Part II Order request for a “bump-up” to an Individual EA is not made (or denied), a project is considered approved under the *EA Act*.

1.2 Other Environmental Approvals

Other permits, approvals and clearances will be sought as the proposed Project moves into the construction stage. Section 7.2.4 and Table 7.2 of the Environmental Report (ER) identify a range of possible approvals required during construction and or operations; however, specific permits and approvals will likely be required under the provincial *Lakes and Rivers Improvement Act* (*LRIA*), *Environmental Protection Act* (*EPA*) and *Ontario Water Resources Act* (*OWRA*).

1.3 Overview of the Terrestrial Technical Support Documents

This Terrestrial Technical Support Document (TSD) is the product of several years of extensive study and consultation by Beacon Environmental supported by Arcadis. The ER and the associated TSDs were prepared by Arcadis Canada Inc. with the assistance of Ontario Power Generation (OPG), KGS Group and SNC-Sullivan.

Data sources used to document the existing environment included published and unpublished literature, government files, personal communications and field studies. Where possible, existing data sources were used; however, extensive field studies were required to complete the study.

This Terrestrial TSD is organized into five chapters:

- Chapter 1.0 – introduces the proposed Project, outlines the EA process and other environmental approvals, and lays out the various chapters;
- Chapter 2.0 – provides a detailed project description;
- Chapter 3.0 – provides a description of the existing terrestrial environment;

- Chapter 4.0 – provides an overview of terrestrial effects and mitigation measures during construction and operations, and discusses the significance of effects;
- Chapter 5.0 – provides the Summary and Conclusions.
- Chapter 6.0 – provides the References.

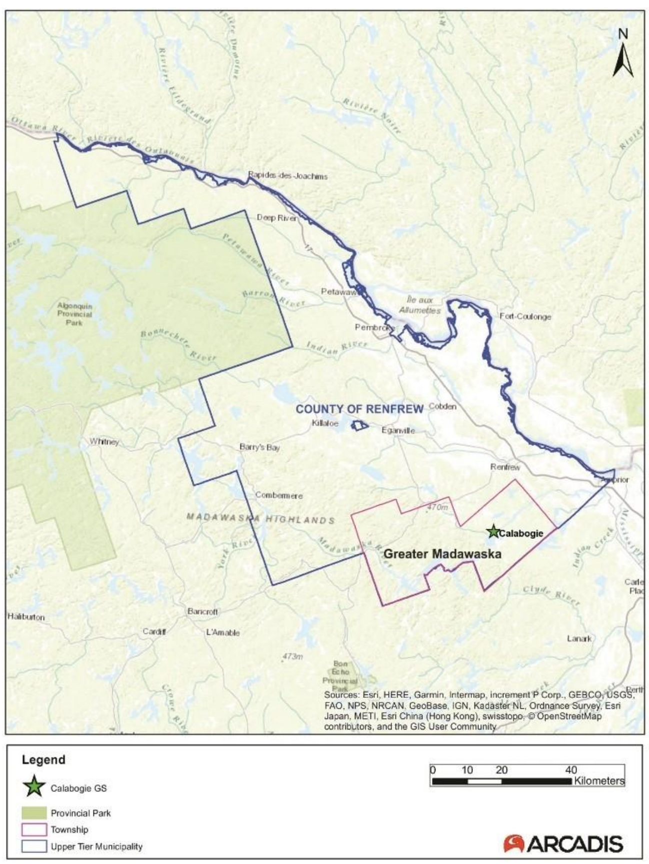
2 PROJECT DESCRIPTION

Ontario Power Generation (OPG) is proposing to redevelop the existing Calabogie Generating Station (GS). Constructed in 1917, the original station had an installed capacity of 5 megawatts (MW). The existing Calabogie GS is over one hundred years old and was at the end of its life prior to the tornado that hit the GS in September 2018. The GS has not operated since that time. OPG intends to redevelop the site and increase the station's capacity to approximately 11 MW. The Project involves the demolition and removal of the existing powerhouse and its structures including the forebay retaining walls and the forebay inlet structure and the subsequent construction of a new powerhouse and forebay embankment, with integral intake structure and tailrace. The Project will be constructed by a joint venture consisting of SNC-Lavalin and M. Sullivan and Son (the Contractor). OPG is advised by KGS Consultants (the Owner's Engineer) and Arcadis (the Environmental Consultant).

2.1 Project Location

The existing Calabogie GS is located within the Village of Calabogie, in the municipality of Greater Madawaska, Renfrew County, Ontario (Figure 2-1). It is located approximately 80 km northwest of Ottawa and 20 km southwest of Renfrew.

Figure 2-1. Location of the Calabogie Generating Station



The Calabogie GS, located on the Madawaska River is approximately 10 km downstream of Barrett Chute GS and 20 km upstream of Stewartville GS, both OPG-owned hydroelectric facilities. Calabogie GS is part of OPG's Eastern Operations Group. The location of Calabogie GS relative to OPG's hydroelectric facilities on the Madawaska, Ottawa and St. Lawrence Rivers is shown on Figure 2-2.

Figure 2-2. Calabogie Generating Station within OPG's Eastern Operations

Source: https://www.opg.com/building-strong-and-safe-communities/our-communities/eastern-ontario/

2.2 Existing Calabogie Generating Station

2.2.1 History and Operations

Calabogie Generating Station was constructed in 1917 with an installed capacity of 4 MW utilizing two quadruple-Francis horizontal turbines operating at a gross head of just under 9 metres. With a maximum total turbine outflow of 66 cubic metres per second (cms), and only limited storage available in Calabogie Lake, the plant is significantly undersized in comparison to either typical mean flows or to both the upstream and downstream hydroelectric stations on the river, which have daily peaking flows up to 458 cms. Over the last 50 years several studies have investigated redeveloping the site or increasing generation at the existing plant.

As noted in the 2009 Madawaska River Water Management Plan:

> *"The Calabogie GS operates as a peaking plant in conjunction with the four other OPG owned GS on the Madawaska River. Although the generating units at the station have limited flow capacity, the units and sluice gates are integrated with the rest of the peaking system on the Madawaska River. Calabogie is a generation bottleneck on the Madawaska River. The small turbine capacity results in frequent spill past the station.*
>
> *The operation of the GS is based on a daily/weekly cycle. The inflow is passed through the GS over a daily or weekly period. Operation of the GS takes into consideration energy demands, recreational opportunities as well as walleye spawning activities."*

The average historical inflow for the period between 1965 and 2017 at Calabogie is approximately 90 m^3/s with a median of 72 m^3/s. The flow duration curve and historic daily discharge record is presented below.

Figure 2-3: Calabogie Flow Duration Curve 1968 - 2018

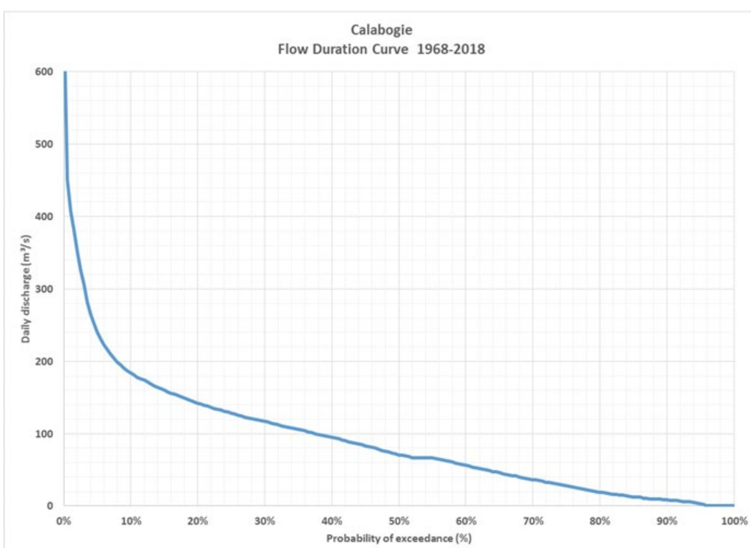
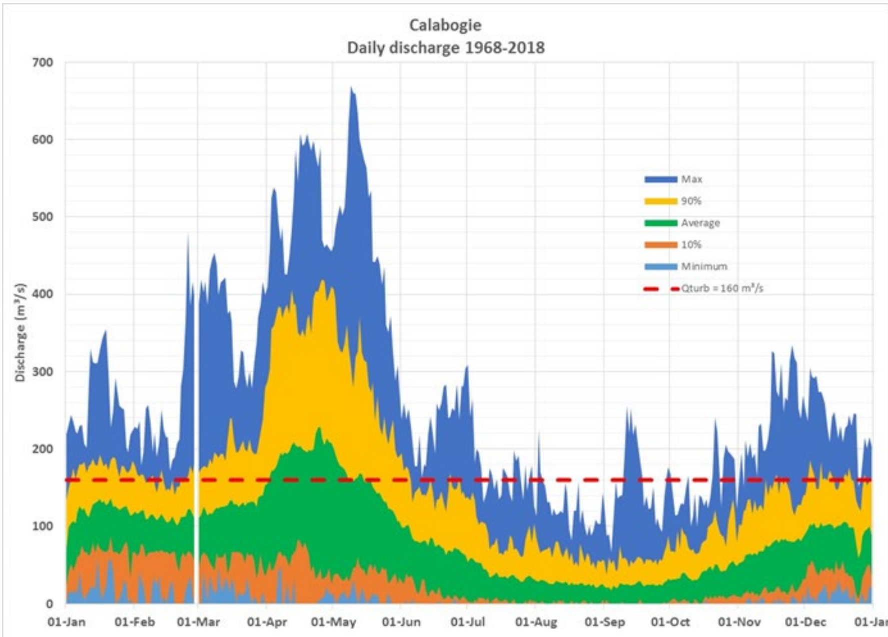


Figure 2-4: Calabogie Daily Discharge 1968 - 2018



The existing Calabogie GS is considered at end of life and OPG intends to redevelop the site with an increased capacity in order to take advantage of the existing water resources.

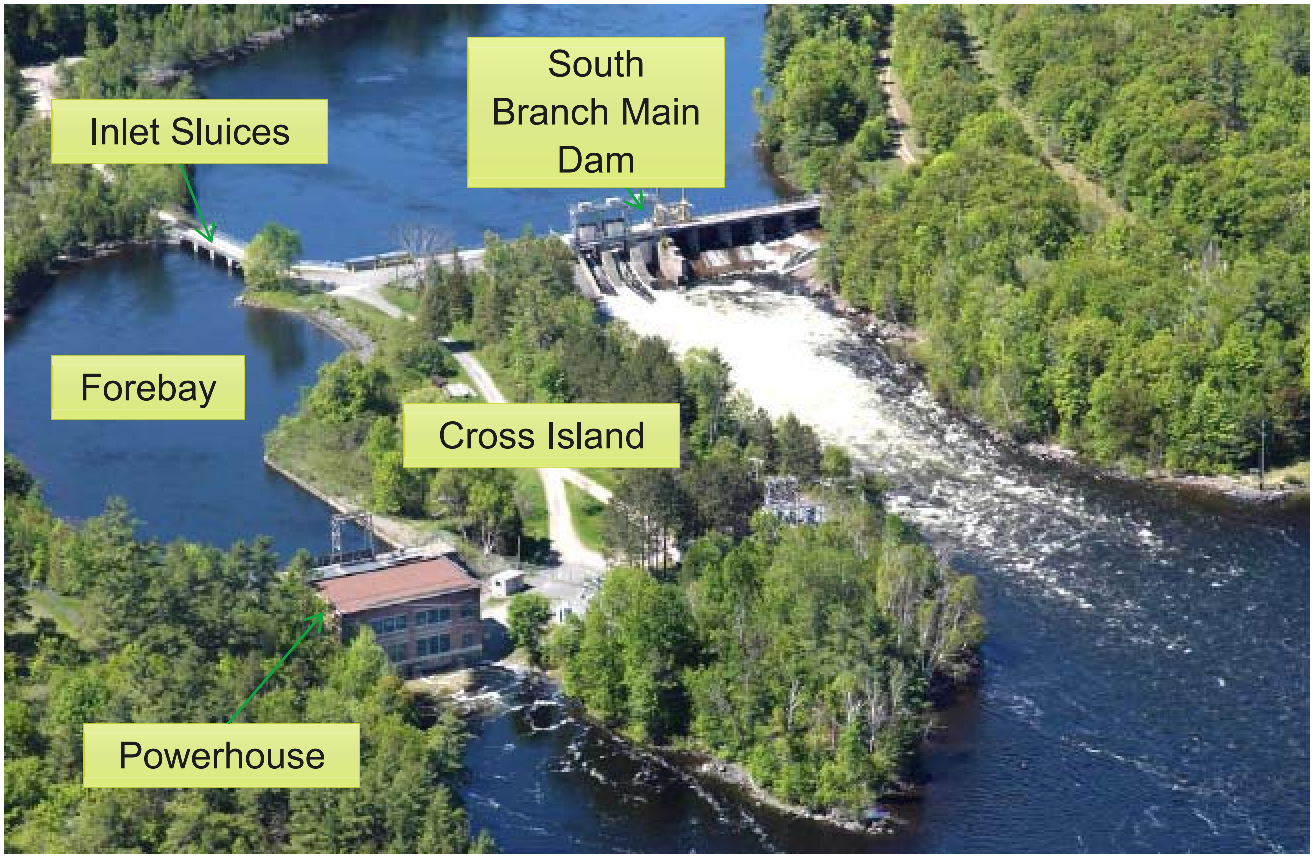
In September 2018, a tornado swept through the Calabogie area that resulted in significant damage to the GS. OPG began immediate repairs to the sluiceway to make it operable but the powerhouse roof was removed, rendering it unsafe. Calabogie GS has not operated since that time and will not be returning to services until completion of the redevelopment project.

2.2.2 Description of the Existing Calabogie Generating Station

While OPG intends to re-develop the power production component of the Calabogie GS, most of the other features and equipment at the site pertaining to water management will remain as is. Figure 2-5 below shows an aerial image of the Calabogie GS and key surrounding features. Figure 2-6 is a colour air photo focusing on the south branches of the River including the South Branch Main Dam.

Figure 2-5. Calabogie Generating Station Site Map

Figure 2-6. Calabogie Generating Station Colour Air Photo: Inlet, South Dam and Powerhouse



As shown in Figure 2-5, the Madawaska River immediately downstream of Calabogie Lake is characterized by three separate channels.

The northernmost channel is the North Channel that connects directly to Calabogie Lake. The North Channel is a natural river channel with flows controlled by the North Channel Sluiceway (owned and operated by OPG). The North Channel is not used for regular water management operations, however there is a compliance minimum flow of 0.8 cms. This flow has not been measured since the replacement of the wooden stop logs with steel stop logs. The 0.8 cms is an estimated flow. During the walleye spawn and incubation period the minimum flow is 5 cms subject to temperature conditions (described in more detail in Table 9.16 of the Madawaska River Water Management Plan).

The middle channel of the Madawaska River is the South Channel Sluiceway. This is the channel used to control the water management operations along with the Calabogie GS. There is no minimum flow requirement in the South Channel Sluiceway.

The southernmost channel of the Madawaska River is the forebay, powerhouse and tailrace of the existing and proposed GS. It is believed that this channel was excavated at the time of the original GS construction.

The Calabogie GS powerhouse is situated about 800 metres downstream of the outlet at Calabogie Lake.

As shown in Figure 2-5, two islands were formed by the three channels in this reach of the Madawaska River, the southern island (Cross Island) which is shown in greater detail and in full in Figure 2-6 and the larger northern island (Calabogie Island).

Cross Island is the hub of the Calabogie GS. It is accessed via Generating Station Lane, a private OPG owned gravel road that is accessible from Lanark Road, which is also known as Renfrew County Road 511 (formerly Highway 511). This road follows the southern channel of the River and then crosses over the entrance to the forebay. The OPG Bridge/Inlet Structure in this location serves two purposes: it first acts as a bridge to Cross Island; and second, it also integrates the inlet structure to the forebay with several sluices that control water flowing to the existing powerhouse. Cross Island also includes a trailer that serves as an office and washroom facilities. A Hydro One Networks Distribution Station (Calabogie DS) is also located on the island and connects to the powerhouse. Except for the eastern tip, Cross Island is largely cleared of trees. Along with all the infrastructures mentioned above, Cross Island included a cul-de-sac type road with parking areas and grassed areas for storage of equipment and materials. The tornado of September 2018 snapped a large percentage of the remaining trees on the island, which were subsequently cleared by OPG.

As shown in Figures 2-5 and 2-6 the South Branch Main Dam connects Calabogie and Cross Islands. The South Branch Main Dam provides the primary water management function at the GS and water in excess of the powerhouse discharge is passed through the dam.

Calabogie Island was also impacted by the September 2018 tornado, but the Island remains largely forest covered. The Island can be accessed by foot across the South Branch Main Dam or by vehicle on an OPG owned private gravel road that is also accessible from County Road 511. Near the South Branch Main Dam, and south of it, the Island has been disturbed by the dam construction and on-going operations. Calabogie Island is also bisected by HONI's connection line to the Calabogie GS. OPG maintains a boat launch with access to the Madawaska River downstream of the South Branch Main Dam sluiceway. The boat launch allows for operations and maintenance activities that need to occur by water on the downstream side of the facility.

Figure 2-5 also shows safety booms placed and maintained by OPG on both the upstream and downstream sides of the River.

2.3 Alternatives Analysis

Over the last 50 years several studies have investigated redeveloping the site or increasing generation at the existing plant. Studies from 1960 through to 2016 considered refurbishment and expansion of the existing plant or complete replacement with generating capacities that ranged from approximately 6 MW to 15 MW.

The latest plant redevelopment options were optimized through a multi-stage refinement process, with an initial optimization by KGS Group for OPG, followed by more detailed project refinement by the Contractor.

While numerous alternatives were considered through the re-development process, three primary alternatives emerged for final consideration. These were:

- Alternative #1 – Refurbishment of the existing powerhouse with minimal civil work.
- Alternative #2 – Refurbishment, expansion and redesign of the existing powerhouse.
- Alternative #3 – Construction of a new powerhouse.

Based on the analysis completed, Alternative #3 was selected as the preferred alternative to complete the Calabogie GS redevelopment. Alternative #3 will make best use of the available water resource at site and will result in the highest estimated annual energy generation. It also better addresses qualitative risk factors than the other alternatives.

Some of the qualitative benefits of this alternative over the other two included the following:

- Alternative #3 allows for the largest addition of green, carbon free capacity and energy to OPG's portfolio. This aligns with OPG's Strategic Direction.
- Alternative #3 is better equipped to manage the possibility of higher water quantities that are expected with future climate change.
- Alternative #3 allows for the safe removal of hazardous materials in the existing powerhouse, including, but not limited to, lead paint and asbestos. The new powerhouse will be free of these designated substances.
- Alternative #3 utilizes traditional turbine equipment, of which OPG has extensive operating experience.
- Alternative #3 with its larger plant flow capacity makes better use of available water in the Madawaska River to use more efficiently the resource and generate more energy and hydroelectric power.
- Alternative #3 with a new powerhouse allows the constructors to optimize design for constructability.
- Alternative #3 allows for optimal design to ensure accessibility and modern equipment. Alternative #3 will also be entirely new, leading to higher degree of reliability of operation with potentially less forced outages due to failures in the immediate future. Following the tornado of September 2018, significant damage occurred to the powerhouse rendering it inoperable and unsafe. Given that Alternative 3 will demolish the existing station, only minimal safe state investment is required to ensure safety and mitigate the risk of environmental spills/releases.

As the above analysis indicates, the preferred option is to construct a new powerhouse together with associated ancillary features. The existing water control facilities for both the north and south channels has been recently upgraded and is not considered part of this project.

2.4 General Layout and Description

2.4.1 General Layout

A new powerhouse will be constructed, approximately 50 metres upstream of the existing powerhouse within the existing forebay. The existing powerhouse will be demolished. The new station will have two horizontal-axis Kaplan type turbines and be rated at approximately 10.7 megawatts while both units are running. Implementation of this alternative will involve the following:

- Construction of a new powerhouse with all new turbine generator equipment.
- Removal of all existing power equipment and demolition of the existing powerhouse.
- Removal of the inlet structure to the forebay and widening of the inlet section, along with excavation in the forebay and tailrace, to allow for increased flow conditions.
- Construction of a new substation and interconnection to the existing transmission line.

The new powerhouse location was selected to be upstream of the existing powerhouse in the forebay to optimize the increased station flow and hydraulic conditions.

The re-developed GS will have the following characteristics:

- Effective Capacity of 10.7 MW;
- Estimated Annual Energy Generation with 98 % of availability – (on the order of 44 GWh to 47 GWh depending on operation);
- Number of Units – 2 horizontal turbines capable of producing approximately 5.4 MW each;
- Station Flow – 160 m^3/s;
- Minimum Operating Flow – 20 m^3/s;
- Average Annual Flow – 90.5 m^3/s; and
- Average head of 8.6 m (range of 6.6 m to 9.9 m).

The proposed site plan for the new GS is shown below in Figure 2-7, while the powerhouse arrangement is presented in Figure 2-8. As already described, the proposed new powerhouse will be located in the forebay approximately 50 metres upstream of the existing one. The proposed undertaking will remove the current bridge and inlet structure over the forebay with access to the new powerhouse and existing sluiceway provided on the east side of the forebay.

Figure 2-7. Proposed Site Plan for the Calabogie GS

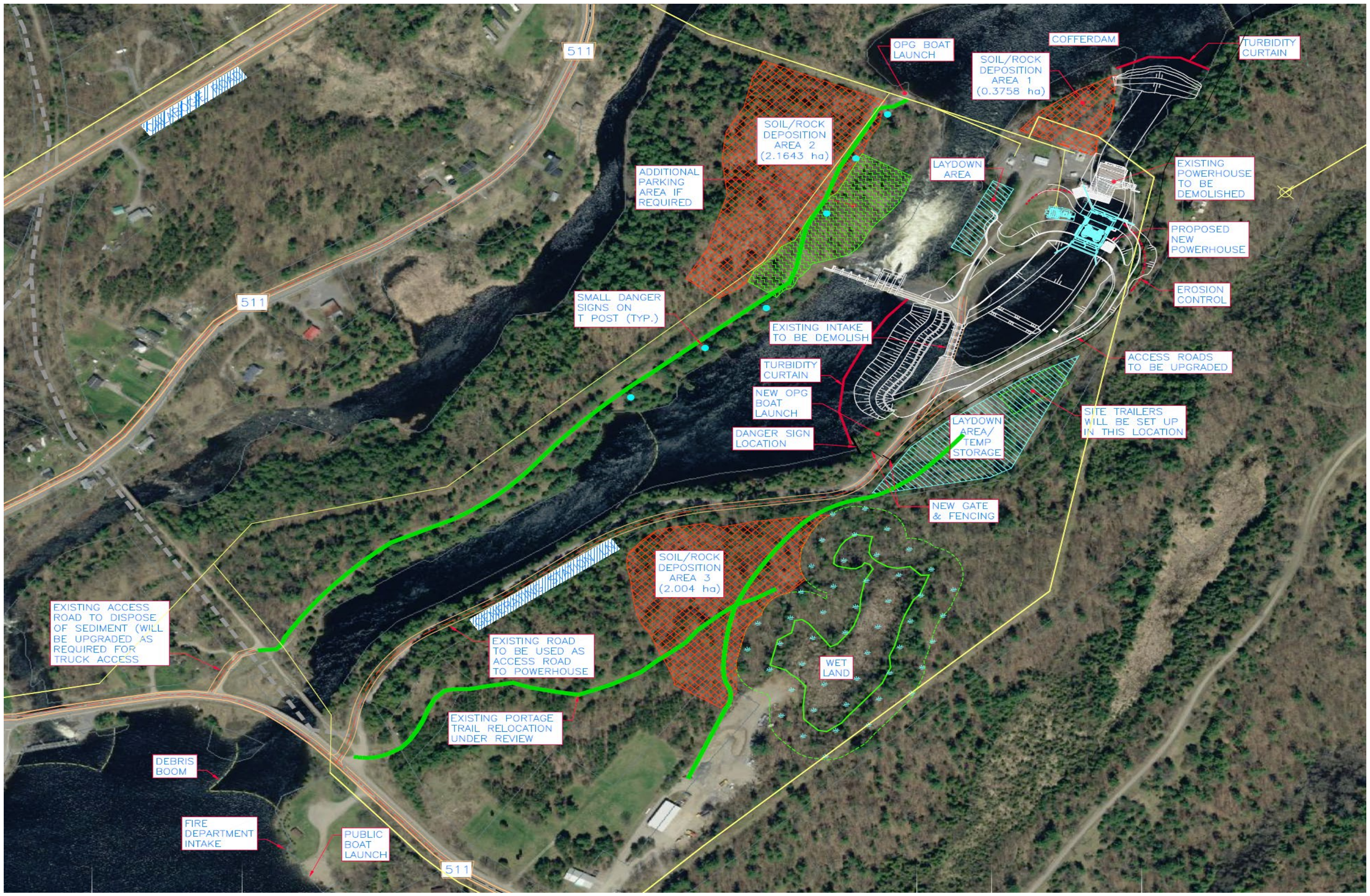


Figure 2-8. Proposed Powerhouse Arrangement for Calabogie

2.4.2 Construction Sequencing

The construction of the new GS will be undertaken sequentially in the following stages as shown below.

Stage #1

In Stage #1 of the demolition and construction, the construction facilities and laydown areas will be set up, site trailers mobilized, access roads upgraded where necessary and the rock and overburn stockpile areas cleared. As of the fall of 2019, the existing inlet structure (located at the bridge) has been closed and the existing forebay channel de-watered. The following summer, the forebay sediment, soil and rock will be excavated in the dry for construction of the new intake forebay channel and new powerhouse substructure. During this time the existing powerhouse will be used as a downstream cofferdam.

While the existing powerhouse overburden is excavated out, hazardous material abatement will be completed within the existing powerhouse. The existing equipment will be removed, preparing for the powerhouse superstructure to be demolished. Throughout all stages of demolition, hazardous and recyclable materials will be separated from general waste and any potential waste requiring specialized treatment.

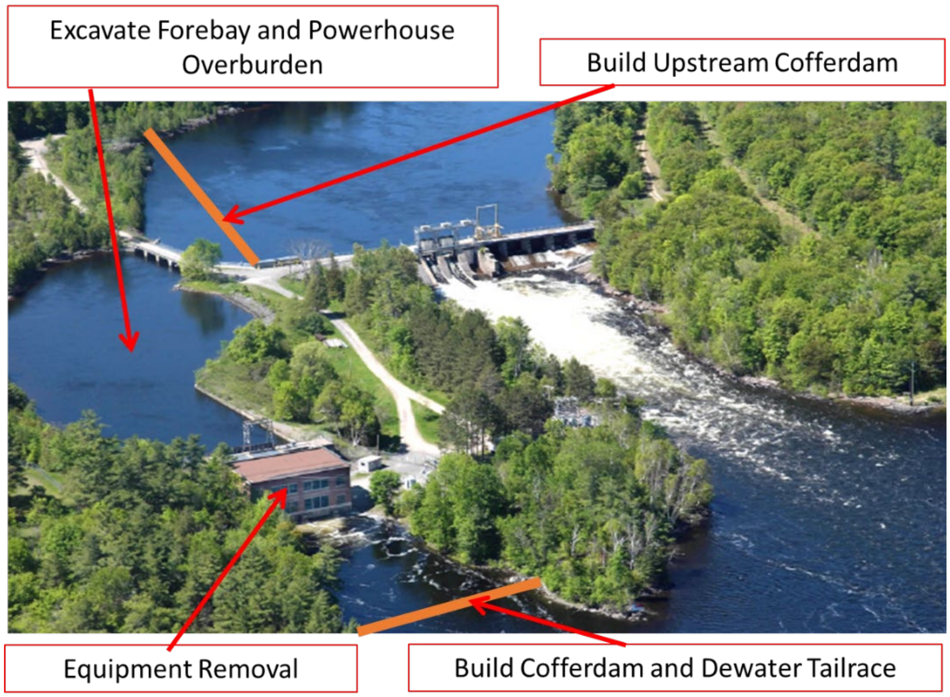
Prior to demolition of the existing Powerhouse, a cofferdam will be constructed downstream of the existing powerhouse and the existing tailrace de-watered. At the same time the downstream cofferdam is constructed, an upstream cofferdam will be constructed upstream of the inlet structure. The section between the upstream cofferdam and the inlet structure will be dewatered allowing overburden excavation to continue preparing for the rock excavation in Stage 2.

The existing inlet structure/sluices will allow the forebay to be isolated and excavation work to begin in the forebay at the start of construction. Following the July 15th fish window, the cofferdam will be constructed upstream of the inlet structure (as shown in Figure 2-9) to allow for removal of the existing inlet structure in the dry and rock excavation to continue. The upstream cofferdam will be constructed from blasted rock that has been excavated to accommodate the new powerhouse. Clean blast rock will be used to construct a 5.8 metres wide cofferdam, with a slope of 1.5H:1V up to elevation 155.17 masl. The upstream face of the cofferdam will be lined with a heavy-duty cofferdam membrane and sealed to the riverbed with a bentonite clay seal. Upon completion of the powerhouse, the liner, blasted rock and overburden will be removed, and the channel will be graded with rockfill.

The downstream cofferdam is required to isolate the downstream side of the construction and allow for the demolition of the existing powerhouse and construction of the new powerhouse and tailrace. The proposed cofferdam is a rockfill dam with an impervious geomembrane on the water side of the cofferdam. Seepage through the cofferdam will be collected and directed to a settling pond prior to discharge back into the river.

The bed material in the area where the downstream cofferdam will be constructed is primarily cobble/boulder/gravel across the main channel with some sand/gravel/cobble and bedrock/boulder/cobble distributed proximate to the river bank.

Figure 2-9. Work Sequence – Stage #1 – Excavation, Removals and Cofferdam Construction

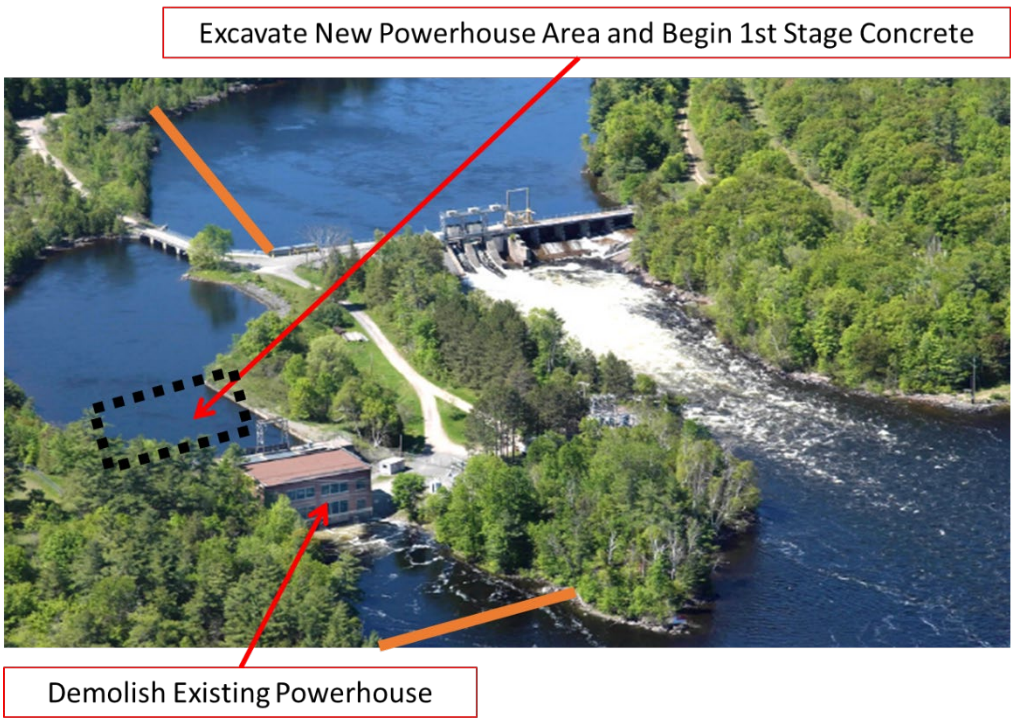


Stage #2

In Stage #2 the existing powerhouse superstructure will be demolished, followed by the existing powerhouse concrete substructure. Rock excavation for the foundation of the new powerhouse will be completed and the left embankment works will start.

Hazardous and recyclable materials will continue to be separated from general waste and any potential waste requiring specialized treatment. First stage concrete work will begin for the new powerhouse and the new embankments within the forebay and downstream of the existing forebay inlet structure will be constructed.

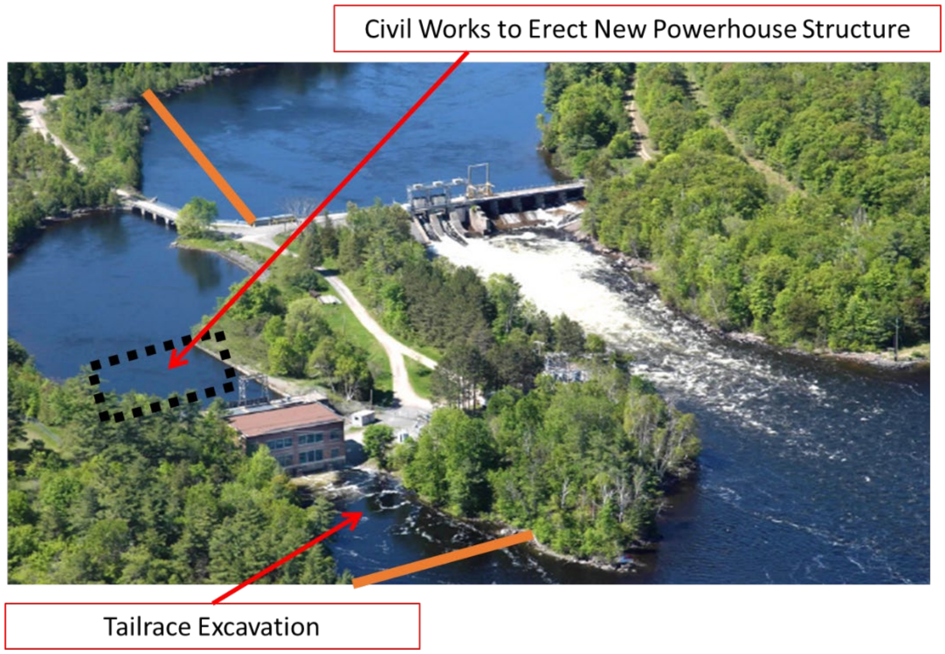
Figure 2-10. Work Sequence – Stage #2 – Powerhouse Demolition and Excavation of New Powerhouse



Stage #3

In Stage #3, the new powerhouse construction will include the remainder of 1st stage concrete works for the new powerhouse, installation of the embedded parts for hydro-mechanical equipment including gates and stoplogs, secondary concrete works, construction of the powerhouse superstructure, installation of the powerhouse crane and enclosure of the powerhouse. On the downstream side, the tailrace will be excavated down to the new elevation. The new substation equipment installation will commence, and the existing substation will be removed.

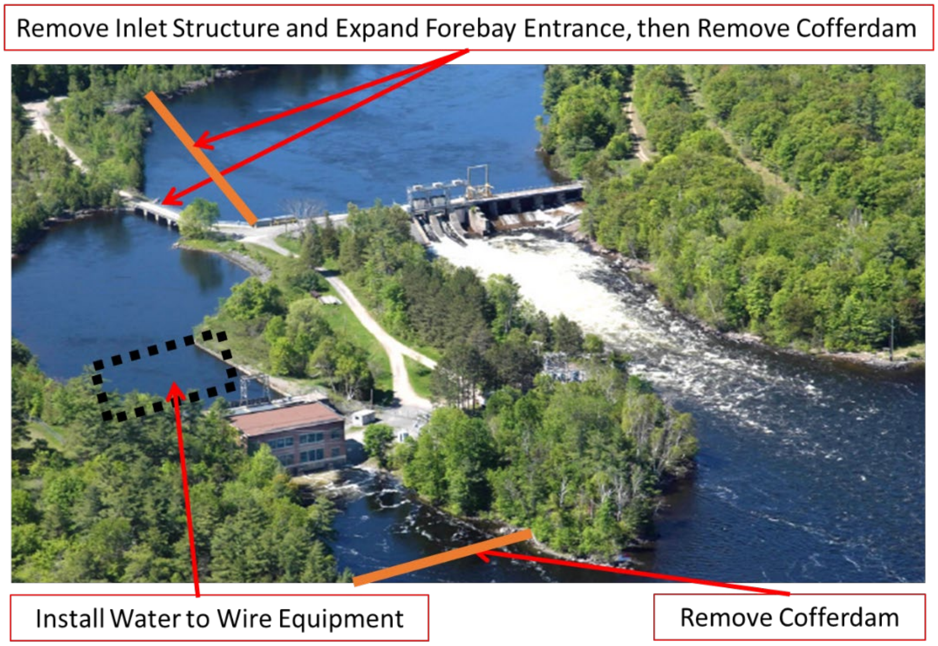
Figure 2-11. Work Sequence – Stage #3 – Construct Powerhouse and Excavate Tailrace



Stage #4

In Stage #4 the associated mechanical and electrical components for the Water to Wire turbines and generators will be installed as well as the balance of plant equipment. Sufficient work will have been completed in the new forebay and new tailrace. The entrance to the new forebay channel will have been widened to improve flow conditions to the new powerhouse and the tailrace will have been excavated as such to produce the required flow conditions specified. Once the existing forebay inlet structure is demolished and removed, the upstream and downstream cofferdams will be removed, and the systems commissioned.

Figure 2-12. Work Sequence – Stage #4 – Remove Inlet Structure and Cofferdams, Finish Powerhouse Installation



Stage #5

In Stage #5 the new units for the GS will be tested, commissioned and finally, put into commercial operation and transferred to OPG for operation.

Figure 2-13. Work Sequence – Stage #5 – Commission New Generating Station

2.4.3 Major Components

2.4.3.1 Forebay and Intake

Once the existing forebay inlet structure is removed, the forebay inlet will be slightly widened in order to improve the hydraulic conditions of the flow to the GS. The anticipated change to the forebay inlet is shown in Figure 2-8.

The existing forebay is shallow and contains simple fish habitat (this was defined as 'simple' due to the absence of shoreline features, bathymetric complexity, absence of aquatic macrophytes or coarse woody debris, and the absence of any unique or limiting habitat) and is shown in Figure 2-14 below.

Figure 2-14. Existing Forebay Substrate

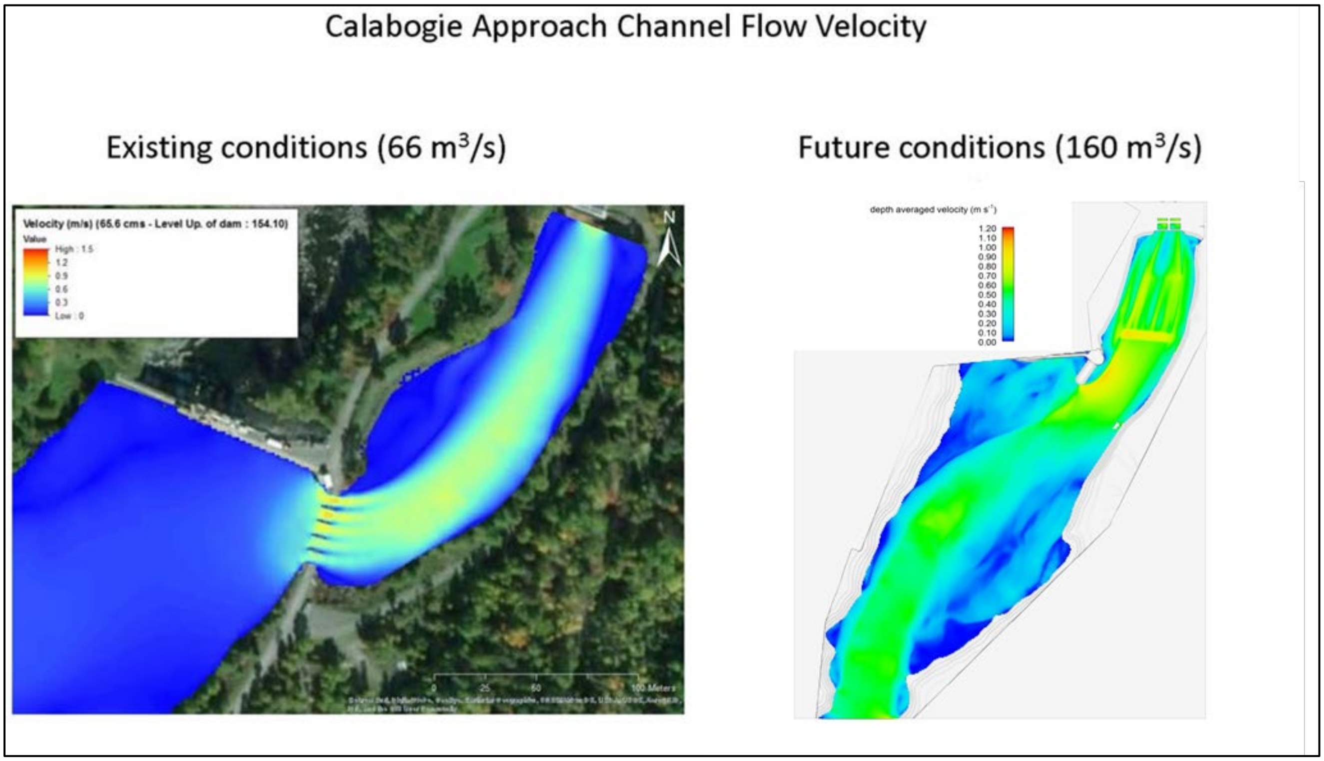
Sediment, soil and excavated rock will be removed from the existing forebay to also improve flow and to allow for construction of the new GS. Forebay hydraulic optimization has dictated the extent of excavation upstream of the new powerhouse. Bedrock will be excavated in vertical cuts and overburden will be sloped and protected against erosion and sloughing. The new intake will have training walls on either side of it to contain the new embankments away from the intake structure. Upon completion of the forebay channel, the embankments will be provided with suitably sized rock protection to ensure bank stability against the forces of erosion and ice action.

The new powerhouse intake will be integrated with the new powerhouse and will be constructed of reinforced concrete. The intake will be equipped with trashracks, suitably sized and with bar spacing to mitigate in as much as possible, fish entrainment. The trashracks will cover the complete area of the turbine water passage intakes. The new trashrack bar spacing will remain consistent with the trashrack spacing at the existing Calabogie GS, with 50 mm clear space between the trashrack bars.

The new trashracks will be periodically cleaned with rakes as well as using mobile crane, with space provided on the intake deck for a future trash rack cleaning machine, however, a trash rack cleaning machine will not be provided at this time. The trashrack slots will also be used interchangably for stoplogs, to provide a means to perform periodic inspections and eventual repairs and servicing of the downstream emergency closure gates in the future. The intake will also include emergency close vertical lift intake gates operated from the intake deck.

The intake and the trashrack of the new powerhouse have been designed to minimize potential entrainment of fish with a trashrack velocity of less than 0.9 m/s (at a distance of 75 mm in front of screen). While the future conditions will increase the plant flows through the new powerhouse from 66 m^3/s to 160 m^3/s, the velocities in the approach channel will be similar with velocities under 1 m/s as demonstrated by numerical flow modelling and as shown in Figure 2-15.

Figure 2-15. Comparison of Velocities – Existing and Proposed GSs



As shown above the proposed velocities in the approach channel at full flow are generally under 1 m/s and will vary along and across the channel between 0.25 and 1.0 m/s.

2.4.3.2 Powerhouse

The proposed new powerhouse will be situated approximately 50 metres upstream of the existing one. The powerhouse will be approximately 25 metres by 45 meters structure and will be 28 metres tall from the invert of the excavation to the top of the superstructure roof. The powerhouse will be excavated to a depth of approximately 12 metres to allow for proper submergence settings of the turbines. Hydraulic passages, both upstream and downstream of the units, will be appropriately sized to maintain machine performance.

It is currently anticipated that the powerhouse structure will be comprised of a cast-in-place concrete substructure and a metal clad steel superstructure. The switchyard will be constructed in close proximity to the new powerhouse on the left side of the new structure. Parking and a laydown area will also be provided in the same general vicinity.

2.4.3.3 Turbines

As previously indicated, the powerhouse will include the installation of two horizontal-axis Kaplan type turbines. Specifically, the turbines will be installed in an open pit, direct drive configuration. Each turbine will be capable of producing approximately 5.4 MW for a combined total capacity of 10.7 MW. The station will be capable of passing a flow of 160 cms with a minimum operating flow of 20 cms. Each turbine runner will have four blades and will operate at 156.5 rpm.

2.4.3.4 Tailrace

The existing channel downstream of the new powerhouse will be excavated to form the new tailrace. This new tailrace will be similar in width to the existing one as shown in Figure 2-8. A series of Figures below portray the existing and proposed tailrace hydraulic conditions (i.e. velocities) under various flow conditions.

The new tailrace channel is anticipated to be in the order of 25 m wide and will connect the powerhouse within the downstream river reach. The upstream portion of the tailrace channel (between the new powerhouse and the existing powerhouse) will be excavated in overburden for the first 5 to 7 m and in bedrock below. The downstream portion of the channel (downstream of the new powerhouse) will be excavated mostly in rock. Limited overburden excavations are expected in this portion of the channel. Bedrock will be excavated in vertical cuts and overburden will be sloped and protected against erosion and sloughing. For the purpose, the area will be dewatered using a downstream cofferdam.

Figures 2-16 and 2-17 depict the existing and proposed Calabogie GS Tailrace hydraulic conditions with no flow (velocity scale (meters per second) is shown in the bottom right of each figure).

Figures 2-18 and 2-19 depict the existing and proposed Calabogie GS Tailrace hydraulic conditions at flows of 66 cms, which is the capacity of the existing powerhouse. These two figures demonstrate that at this flow rate the proposed new powerhouse will eliminate the areas of high velocity that occur under the existing situation and instead disperse more moderate velocities over a wider area.

A tailrace water level survey program will be completed during the detailed design phase of the project to further define the hydraulic conditions downstream of the Calabogie site.

Figure 2-16. Existing Calabogie GS Tailrace Hydraulic Conditions. No Flow

Figure 2-17. Future Calabogie GS Tailrace Hydraulic Conditions. No Flow

Figure 2-18. Existing Calabogie GS Tailrace Hydraulic Conditions. 66 cms Flow (no spill)

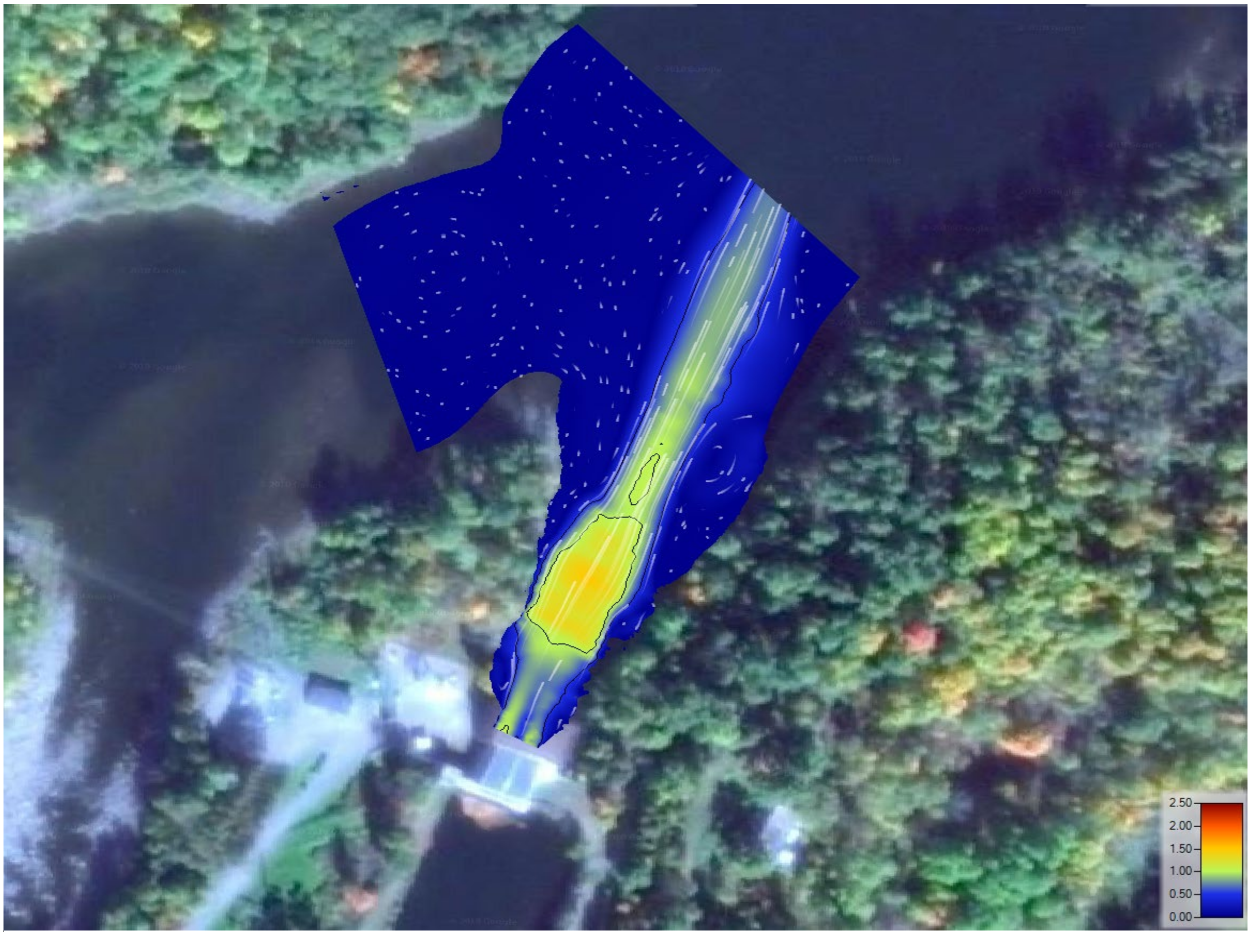


Figure 2-19. Future Calabogie GS Tailrace Hydraulic Conditions. 66 cms Flow (no spill)

Figures 2-20 and 2-21 depict the existing and proposed Calabogie GS Tailrace hydraulic conditions at flows of 160 cms, which is the capacity of the proposed powerhouse. Figure 2-20 representing the existing conditions shows moderate flows at both the tailrace and to a lesser extent through the South Branch Main Dam. Figure 2-21 shows higher velocities through the central portion of the tailrace.

Figure 2-20. Existing Calabogie GS Tailrace Hydraulic Conditions. 160 cms Total Flow: 66 cms Flow through Powerhouse and 94 cms through the South Branch Main Dam

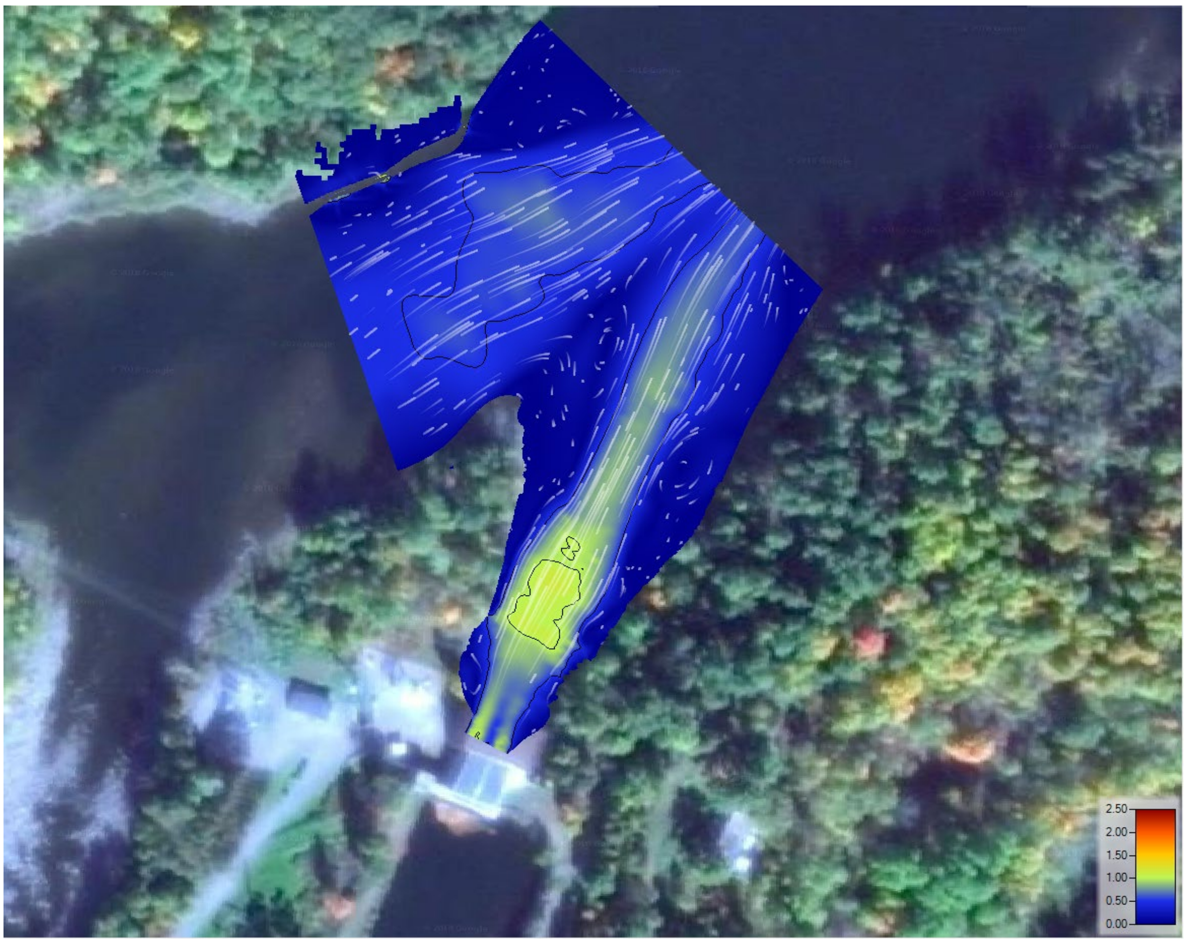
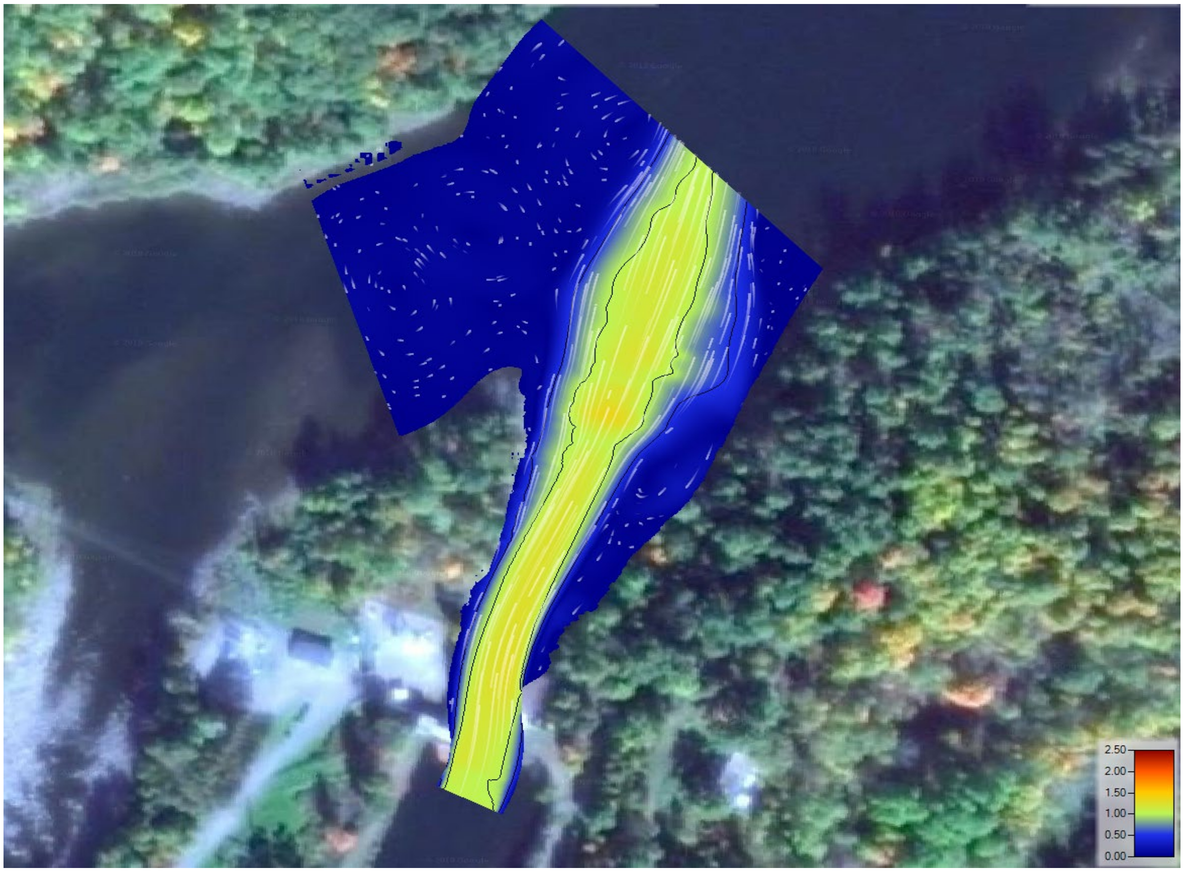


Figure 2-21. Future Calabogie GS Tailrace Hydraulic Conditions. 160 cms Total Flow, All Through the Powerhouse



The construction of much of the new tailrace will be undertaken in the "dry" by using a cofferdam. The tailrace area may require riprap to locally protect against erosion and sloughing of the overburden encountered, however, it is currently envisaged that the bulk of the tailrace excavation will be rock. Portions of the Madawaska River riverbank in the immediate vicinity of the tailrace area may also require erosion protection.

The shift of moving the powerhouse 50 meters upstream will increase the amount of tailrace habitat while reducing the amount of forebay habitat.

OPG will pursue more in-depth discussions with DFO as part of the request for review process and provide all information DFO requires to determine whether an Authorization is required and if so, what off-setting measures would be considered.

2.4.3.5 Structures for the American Eel

OPG is committed to supporting the recovery of American eel in consultation with Indigenous People and in accordance with provincial recovery strategies and policy direction. On the Madawaska River, there are no known occurrences of American Eel, including at or in the immediate area of Arnprior GS, Stewartville GS and Calabogie GS. As such, these facilities are currently compliant with the ESA.

Over time and as recovery strategies advance and succeed, the Madawaska River may become a focus of interest. This will signal that recovery strategies are working. OPG is using this redevelopment project to make the redeveloped Calabogie GS "eel ready".

Eel ready means that the redevelopment will be planned, designed and executed in anticipation of adaptive management strategies that can be applied as circumstances change around the presence of American eel in the vicinity of the station.

Specific measures have been scoped into the design of the station to accommodate potential future needs for upstream and downstream passage, including:

- designing attractive flow at an eel trap/ladder at the plant tailrace;
- including a temporary trap and transport system at the plant tailrace to help monitor for early signs of eels showing up below the station;
- leaving room for permanent upstream and downstream passage infrastructure to be retrofitted on a long-term basis (OPG's research suggests that upstream passage should likely occur in the plant tailrace and that is the proposed location for the temporary trap and transport system. Should eels return to the Madawaska River in this reach of the River, consideration could be given for another location);
- intake velocities and bar exclusion screen layouts designed to facilitate implementation of future effective safe passage of eels downstream through the GS;
- provision for future inclined screen and downstream flow bypass for downstream passage with bar spacing in the screen at a maximum of 19 mm during periods of downstream movement; and,
- early consideration of the pros and cons of operational variations that may support eel passage.

An adaptive management approach will be applied during operations to determine the best course of action to implement or install specific measures to support recovery as circumstances change.

2.4.3.6 Transmission Line

The existing GS is connected to Hydro One's transmission network via a 44 kV transmission line that is connected to the Calabogie GS to the north. The existing transformer yard was extensively damaged during the 2018 tornado.

A new switchyard for the main step-up transformer will be constructed in close vicinity to the new powerhouse and will connect to the HONI transmission line at a pre-determined location.

2.4.3.7 Off-Site Communication

The new Calabogie GS will require a communication link with Stewartville TS for tele-protection signals and with Eastern Operation Control Center [EOCC] for remote SCADA.

To achieve this, a new microwave link between Calabogie GS and Stewartville GS will be constructed. The link will consist of two 150ft Microwave towers, one at each end. The location of the two towers will require the construction of new access roads. Wood poles to carry the power cables and Fiber Optic cables will be constructed to connect the MW towers to their respective Generating stations.

2.4.3.8 Water Control Features

The Ontario Ministry of Natural Resources and Forestry (MNRF) has in place Lakes and Rivers Improvement Act Technical Bulletins that detail the Ministry requirements for the safe operations of dams. The Technical Bulletins were initially issued in 2011. Based on the “Classification and Inflow Design Flood Criteria” Technical Bulletin, Ontario Power Generation (OPG) is evaluating whether additional spill capacity is required at Calabogie GS. While no decision has yet been made on whether any spill capacity alterations will be required for the site, OPG anticipates additional spill capacity will be required and achieved through a combination of channel improvements and constructing additional sluices.

OPG is only at the early stages of assessing the potential additional spill capacity requirements and options. As such, the review of environmental effects associated with the construction of additional spill capacity has not yet been initiated and are not discussed in this Report.

Environmental approval for the work could be considered per Section 8.8 of the OWA Class EA Process, “Addendum Provisions for Environmental Reports.” That assessment work could be carried out as modification to the project or Addendum provision. Alternatively, the approval could be undertaken through a separate process.

2.4.3.9 Other Features

Other features of the Calabogie GS that will remain unchanged from the current situation. Safety devices such as buoys, signage and booms will remain unchanged from the current situation. The existing office and washroom in the trailer are expected to remain but may be re-located closer to the new powerhouse.

2.5 Construction

Figure 2-7 shows the Calabogie site with a variety of construction stage features. These are each described below.

2.5.1 Site Access, Roads and Parking Areas

The primary access road to the site will remain as Generating Station Lane, a gravel road that is sufficiently wide to accommodate passing passenger vehicles. The Lane provides access to Lanark Road/County Road 511.

At this point no modifications are anticipated to the site entrance at County Road 511 (Lanark Road). However, should modifications be required these would be subject to review and approval by the County’s Public Works Department. The Department has indicated that a traffic management plan will be required to describe the proposed traffic and how any impacts can be mitigated. The plan will likely need to ensure that signs are erected on the County Road to advise the other road users of turning traffic and a traffic control person may be needed during periods of high turning movements to/from the site.

A secondary access road currently exists from County Road 511 to Calabogie Island that is labelled as “Calabogie Island Road” on Figure 2-7. This is an existing single lane gravel road that provides access to the north side of OPG’s South Branch Main Dam and to an OPG boat launch that is situated slightly further downstream. This road will be used for two purposes during construction. First, it is anticipated that some or most of the workers will park their vehicles on the island and access the main construction site by walking across the South Branch Main Dam. A parking lot is proposed in close proximity to the South Branch Main Dam to allow for this. This parking lot would be capable of accommodating approximately 50 vehicles. Second, excess rock and sediment are proposed to be placed on Calabogie Island so dump (or tipper) trucks will utilize the road. Imported engineered aggregates will be used to improve the roads should they be considered acceptable.

OPG, SNC-Sullivan and the Township of Greater Madawaska have entered into a Memorandum of Understanding to provide excavated rock from the project and deposit this on adjacent Township lands. This is described in more detail in 2.5.4 and 2.5.5. That arrangement will require SNC-Sullivan to construct a 200 to 300 meter length road on to the adjacent Township lands and also temporarily use the Township access to County Road 511 for the project (see Section 2.5.5).

2.5.2 Laydown and Storage Areas

During construction laydown and storage areas are required in order to facilitate demolition, excavation and construction. Most of Cross Island will be available at various times for temporary laydown and storage areas. Cross Island has historically had large cleared and flat areas that are suitable for such work. With the 2018 tornado the cleared area has expanded. Figure 2-7 shows one laydown area slightly west of the proposed powerhouse, however another large cleared area south of the powerhouse will be used to: allow equipment to work and turn around; park vehicles; store materials and equipment in an environmentally safe fashion; place trailers for worker use; etc.

2.5.3 Cofferdams and In-Water Works

The existing inlet structure/sluices will allow the forebay to be isolated and excavation work to begin in the forebay at the start of construction. Following the July 15th fish window, a cofferdam will be constructed upstream of the inlet structure to allow for removal of the existing inlet structure in the dry and rock excavation to continue. The upstream cofferdam will be constructed from blasted rock that has been excavated to accommodate the new powerhouse. Blast rock will be used to construct a 5.8 metres wide cofferdam, with a slope of 1.5H:1V up to elevation 155.17 masl. The upstream face of the cofferdam will be lined with a heavy-duty cofferdam membrane and sealed to the riverbed with a bentonite clay seal. Upon completion of the powerhouse, the liner, blasted rock and overburden will be removed, and the channel will be graded with rockfill.

A downstream cofferdam is required to isolate the downstream side of the construction and allow for the demolition of the existing powerhouse and construction of the new powerhouse and tailrace. The proposed cofferdam is a rockfill dam with an impervious geomembrane on the water side of the cofferdam. Seepage through the cofferdam will be collected and directed to a settling pond prior to discharge back into the river.

A small amount of tree and vegetation clearing is required on the east end of Cross Island to allow for access to construct this cofferdam. Similar to the upstream cofferdam, the downstream cofferdam will be constructed from blasted rock that has been excavated to accommodate the new powerhouse. Blast rock will be used to construct a 5.8 metres wide cofferdam across the width of the tailrace, with a slope of 1.5H:1V up to elevation 148.00 masl. The downstream face of the cofferdam will be lined with a heavy-duty cofferdam membrane and sealed to the riverbed with a bentonite clay seal. Upon completion of the powerhouse, the liner and blasted rock will be removed, and the area will be graded to align with the tailrace channel profile.

Should any in-water construction activities be required, they will be timed to avoid the spawning and egg incubation period of spring spawning fishes, such as Walleye. The exclusion period is from March 15 to July 15.

2.5.4 Excavation

The construction of the new powerhouse will require a significant amount of sediment and rock to be removed from the construction area. It is estimated that approximately 60,000 cubic meters of sediment/overburden and 66,800 cubic meters of rock would need to be removed. The sediment and rock have been tested. The rock can be re-used and the sediment/overburden will be disposed of on OPG property.

Blasting will be required to remove the rock for the new powerhouse, in the forebay and in the tailrace. A third-party firm will be hired to implement a vibration monitoring program, provide engineered blast designs, and consult in all blasting operations as required.

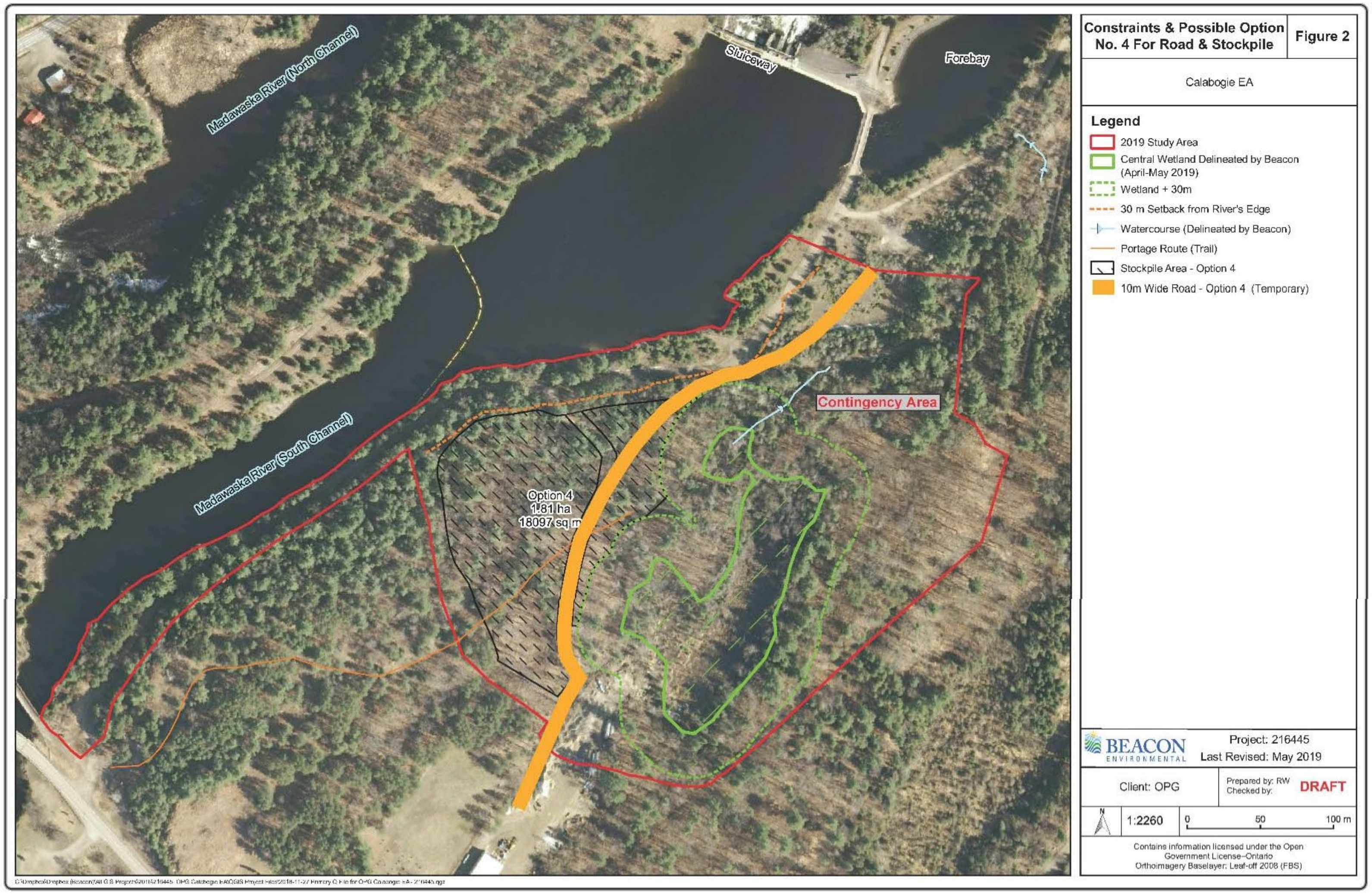
Prior to any blasting or rock excavation, the sediment in the forebay will be excavated down to either rock or the required hydraulic elevations and disposed of on OPG Property. Once the sediment has been removed and blasting is underway, excavation of the rock will begin. The rock will either be used as cofferdam material, stockpiled for later use as embankment treatment, or disposed of on Township Property (see section 2.5.5 Rock and Soil Deposition Areas where this is further discussed).

It is expected that groundwater infiltration or surface water runoff (including cofferdam leakage) could require pre-treatment prior to discharge. To collect water infiltration, sumps will be excavated at key locations of the excavation and pumps will be installed to dewater the area. If necessary, the water will be pumped into settling pond(s), silt treatment bags, and vegetated areas to mitigate any environmental issues that may arise from the dewatering. Should the water require secondary treatment for dissolved metals, proper measures will be taken including necessary permits and approvals.

2.5.5 Rock and Soil Deposition Areas

As previously indicated, an Agreement has been entered into among the Township of Greater Madawaska, OPG and SNC-Sullivan for the latter two to provide the Township with excavated rock for its future use. Excavated rock would be delivered to the rear of the Township's Works Yard which is situated approximately 200 metres away from the excavated area (see Figure 2-22 below). The Township has also indicated that it can take the demolished powerhouse (save for the exterior structure that has lead paint on it) as well. This Project will require Sullivan to construct an approximately 200 to 300 meter long temporary road spanning from OPG to Township property creating a direct access to a storage area at the back of the Township's lands. The Project would also involve decommissioning of this road following completion of the transfer of the rock. Figure 2-22 shows the likely area of rock placement based on archaeological, biological and engineering investigations and consultation with the Township. This area may be slightly further refined. This area is also shown as Area #3 on Figure 2-7.

Figure 2-22. Proposed Road and Possible Rock Placement Areas



As previously indicated, the Township has agreed to take most of the rock associated with the structure along with the demolished powerhouse. However, the Township is only interested in the rock and is not interested in the soil, sediment or co-mingled rock and soil. As such, OPG will still have extra material it will need to deposit on site.

As such, two different areas have been proposed on site to place the remaining excavated rock and soil. The two proposed areas are shown in Figure 2-7. These areas were selected based on their location and physical and environmental conditions. In general, the emphasis has been made to place the material close to the original excavation and/or use and in sites that have been historically disturbed.

Area #1 is located on the northeastern tip of Cross Island. This Area would be used to place the material left over from the downstream cofferdam. This will eliminate most of the need for truck traffic for this material. It is possible that some of the cofferdam material might be used for fish habitat pending further discussions with the DFO. Area #2 is located on Calabogie Island immediately adjacent and northeast of the South Branch Main Dam. This area was previously disturbed by the original construction of the Calabogie GS and is a lower lying area. Given that this is a lower area, excavated material can be placed here with fewer potential concerns with respect to visual effects from residents located on the north side of the North Channel. A section of this area may also be potentially used for parking or other purposes during construction. Both of these areas are considered to be of lower ecological value. The placement of the rock and sediment will occur above the high-water mark to ensure there is no loss of riparian habitat.

OPG has been in recent discussions with the AOO and AOP about minor adjustments to the sediment and rock pile stockpile areas (Areas #2 and #3 in Figure 2-7) to address AOO and AOP questions and concerns. This may include placing the sediment pile beyond 30 meters from the high-water mark.

Following construction, the areas will be revegetated to suit the surrounding environment. This may involve seeding, planting or natural re-generation by placement of topsoil and with an appropriate seeding or planting. Discussions could be held with the AOO and AOP as to possible plantings.

2.5.6 Construction Schedule and Strategy

Construction will be initiated in early 2020 with the intention of the GS being operational in 2023. Vegetation clearing at the site is anticipated to occur in the early months of 2020 ahead of the spring breeding bird season. The placement of cofferdams will adhere to any fisheries windows.

2.6 Proposed Calabogie GS Operations

As outlined in the 2009 Madawaska River Water Management Plan, Calabogie GS operated (prior to the September 2018 tornado) to support the peaking operations of the four other OPG owned GSs on the Madawaska River. The generating units at the station had limited flow capacity (66 m^3/s), but the operation of the units and sluice gates are integrated with the rest of the system on the Madawaska River. Calabogie was a generation bottleneck on the Madawaska River, and the small turbine capacity results in frequent spill past the station.

The operation of the existing plant is based on a daily/weekly cycle, with the inflow passed through the plant over a daily or weekly period. The 2009 WMP notes that operation of the plant takes into consideration energy demands, recreational opportunities as well as walleye spawning activities.

OPG does not propose to alter the existing water management compliance requirements associated with this facility. The redevelopment of Calabogie GS will continue to be operated in full accordance with all of the flow and water level targets and compliance conditions identified in the WMP. Daily flows will remain unchanged, but additional portion of river flow will pass through the plant to generate electricity rather than just passing through the spillway gates.

In terms of mandatory and conditional water level targets, for Calabogie G.S. Table 9.15 of the 2009 WMP defines the following:

Table 2-1. Water Management Plan – Calabogie GS Mandatory and Condition Level Limits

Table 9.15: Calabogie GS Mandatory and Conditional Level Limits

Parameter	Limit Type, Conditions and Notes
Absolute Maximum 154.17 m	Type: Mandatory Maximum level
Absolute Minimum 153.56 m	Type: Mandatory Minimum level
Summer Minimum 153.80 m	Type: Conditional Requirement The specified minimum level is the applicable limit provided the following condition outlined below is fulfilled. 1.The date is within the summer period. The summer period starts on Saturday 00:00 EST of the Victoria Day weekend and ends on the Monday at 24:00 EST of the Thanksgiving Weekend. The summer minimum can be suspended when the following conditions are fulfilled. 1. Declaration of an "Emergency Operating State" by the IESO. 2. IESO requests market participants to seek approval for environmental variances. 3. Implementation of a "3% Voltage Reduction" by the IESO. 4. Within 24 hours after the end of an Emergency Operating State, the level will be returned to the summer minimum level. 5. Walleye spawn/incubation flow limits at Calabogie are not active. 6. OPG will notify MNR once there is a reasonable probability that energy emergency flexibility will be used.
Walleye Spawn & Incubation Maximum 154.05 m	Type: Conditional Requirement The maximum level is applicable provided all the four conditions outlined below are fulfilled. The maximum level is to protect spawning grounds in Constant Creek. 1.The water temperature measured in the Barrett Chute tailrace or an agreed-upon location has reached 6 ^{0}C. 2.MNR has confirmed significant walleye activity at the Barrett Chute spawning shoal. 3.MNR has provided 24 hours notice of the start of the walleye spawning period. 4.The water temperature degree days since the start of the incubation period is less than 205 ^{0}C.
Walleye Spawn & Incubation Minimum 153.80 m	Type: Conditional Requirement The minimum level is applicable provided all the four conditions outlined below have been met. 1. The water temperature measured in the Barrett Chute tailrace or an agreed-upon location has reached 6 ^{0}C. 2. MNR has confirmed significant walleye activity at the Barrett Chute spawning shoal. 3. MNR has provided 24 hours notice of the start of the walleye spawning period. 4. The water temperature degree days since the start of the incubation period is less than 205 ^{0}C.

In terms of mandatory and conditional water flow targets, for Calabogie G.S. Table 9.16 of the 2009 WMP defines the following:

Table 2-2. Water Management Plan – Calabogie GS Mandatory and` Condition Flow Limits

Table 9.16: Calabogie GS Mandatory and Conditional Flow Limits

Parameter	Limit Type, Conditions and Notes
Minimum Flow 0.8 m^3/s	Type: Mandatory Minimum Level Note:This flow has not been measured since the replacement of the wooden stop logs with steel stop logs. The 0.8 m^3/s is an estimated flow.
Walleye Spawn & Incubation 5 m^3/s.	Type: Conditional Requirement The minimum walleye spawn flow is applicable provided all the three conditions outlined below are fulfilled. 1. The water temperature measured in the North Channel at Calabogie or an agreed-upon location has reached 6 ^{0}C. 2. MNR has provided 24 hours notice of the start of the walleye spawning period. 3. The water temperature degree days since the start of the incubation period is less than 205 ^{0}C.This flow limit is an instantaneous flow that must be maintained throughout the walleye spawning period.

The annual variation of the mandatory and conditional limits are shown in Figure 9.08.

OPG will continue to operate the Calabogie GS and the other plants on the Madawaska River in full accordance with all flow and water level targets and compliance conditions in the Madawaska River Water Management Plan.

The Calabogie GS is a generating station on the Madawaska River, located between Barrett Chute GS and Stewartville GS. The existing turbine capacity of Calabogie is lower than the other stations on the Madawaska River, which becomes a constraint in the operation of the system. The present discharge capacity at Calabogie GS is 66 m^3/s, but the upstream and downstream capacity at Barrett Chute GS and Stewartville GS is exceeding 450 m^3/s. Under these conditions, Calabogie Lake is used as a daily reservoir to regulate the discharge and to maximize the energy production.

The average historical inflow for the period between 1965 and 2017 at Calabogie is approximately 90 m^3/s with a median of 72 m^3/s. The Barrett Chute and Stewartville GS are peaking plants whereas the existing Calabogie GS was used to support these operations with combinations of continuous turbine flow and gate operations. These operations modes can cause daily fluctuations of the water elevation at Calabogie Lake and Stewartville headpond. This form of operations for Calabogie GS has existed since peaking plants with larger discharge capacity than Calabogie were commissioned on the river.

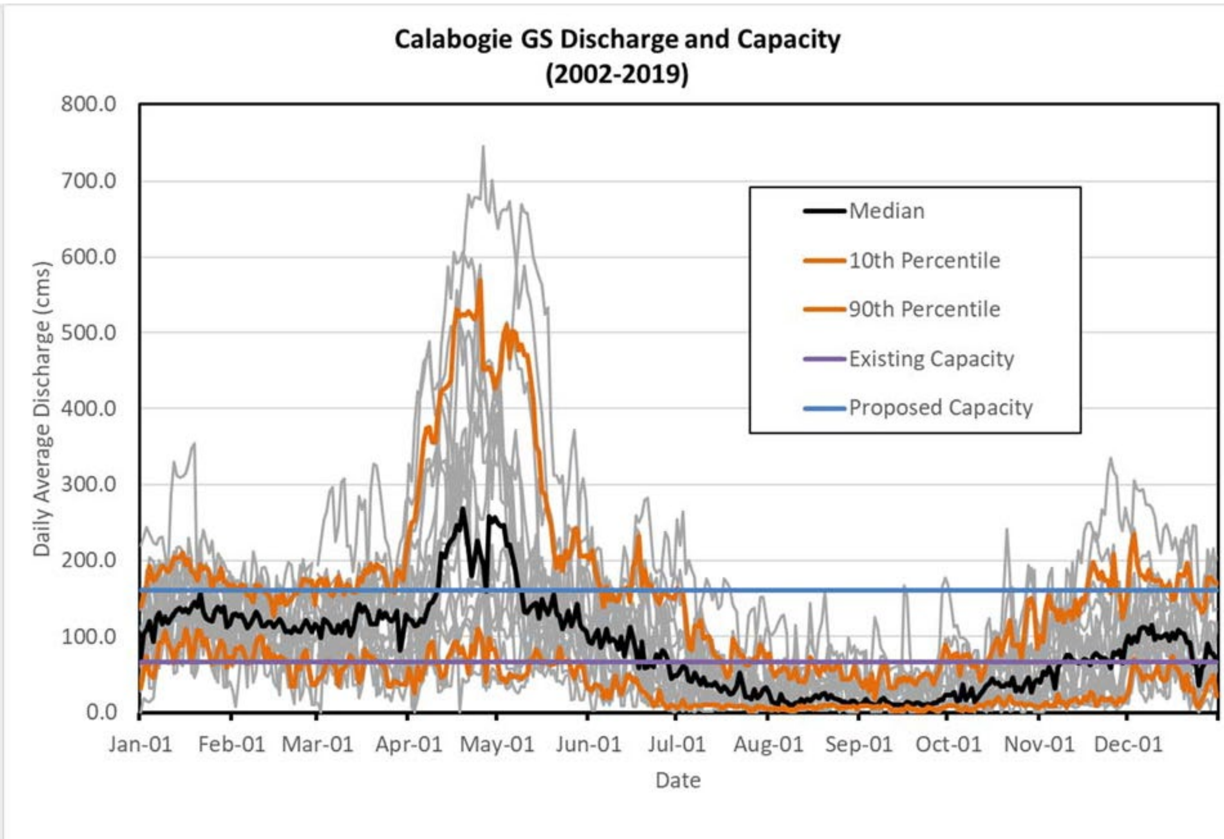
With the redevelopment of the Calabogie GS site and the increase of the generating and discharge capacity, there is the opportunity to more accurately shape the daily discharge from the facility. Regardless of the mode of operation, the turbine discharge capacity at Calabogie GS will remain lower than the discharge capacity at the other adjacent stations on the Madawaska River. Therefore, the priority in the operation of the hydro system will be for the Calabogie GS to continue to support the peaking operation of the downstream power plant at Stewartville with the possibility to minimize the fluctuations in the headpond to the extent practicable.

Figure 2-23 shows the historic total daily discharge (turbine flow & main control dam sluice flow) since the opening of the energy market, where each grey line is one year of data. The discharge past the Calabogie facility often exceeded the existing stations turbine capacity in the November to July period and was passed through sluiceways. The redevelopment will allow a greater amount of water to be passed through the turbines, which will allow OPG to produce more renewable energy from the existing water. The North Channel Control Dam sluiceway conditions will be maintained in accordance with the existing water management plan.

There will still be conditions and situations where a greater range at Stewartville GS is needed to meet Ontario grid requirements and maintain compliance with the other aspects of the Water Management Plan (WMP). However, there may be some conditions where the redeveloped Calabogie GS could match flow patterns at Barrett Chute GS and Stewartville GS to reduce water level fluctuations. If this occurs it will be done in compliance with the WMP. As a result, the redeveloped generating station will allow OPG to reduce the fluctuations in water level in Calabogie Lake and Stewartville more often than the current situation, but the impact will not be substantial.

Given the above, OPG does not plan to propose any formal changes to the compliance requirements in the WMP, however a Minor Amendment will be required to make administrative updates.

Figure 2-23. Calabogie GS Discharge and Capacity 2002 – 2019



There will be no permanent operating staff at the new station. Normal operation of the station and sluiceways will be carried out remotely by OPG. Normal maintenance activities at Calabogie GS will be carried out by OPG staff on an "as-required" basis. They will visit the station regularly.

Annual maintenance and overhauls for the redeveloped plant may require shut down of the units and will normally be scheduled when the flows are lowest and the loss of generation can be minimized. Minor overhauls require the units to be out of service for a minimum of 1 to 2 months and would likely only be required every 10 to 15 years. Major overhauls every 25 to 30 years could require a unit to be out of service for approximately 8 to 12 months. Unlike with the existing station, dewatering of the forebay will not be required to conduct maintenance on the new powerhouse.

2.7 Proposed Decommissioning

Decommissioning involves the permanent removal of the hydroelectric facilities, with the resultant loss of the site as a renewable source of electricity generation. Rather than decommissioning, redevelopment of a facility that is at the end of its designed service life could be a viable option. A number of OPG owned hydroelectric facilities that were built in the early 1900s have been redeveloped in the last 10 years, e.g., Wawaitin GS, Sandy Falls GS and Lower Sturgeon GS on the Upper Mattagami River, and Hound Chute GS on the Montreal River.

Once the Calabogie GS Redevelopment Project has reached the end of its service life in 90 years or more, additional redevelopment, rather than decommissioning, would be an option that should be considered again to further extend the life of this plant.

3 BASELINE TERRESTRIAL ENVIRONMENT CONDITIONS

3.1 Atmospheric Environment

3.1.1 Climate

Based on the Ecoclimatic Region classification system (Ecoregions Working Group, 1989), the proposed project occurs in the Humid High Cool Temperate Ecoclimatic Region that covers most of central Ontario and into Quebec.

Average daily temperature and precipitation data by month for the meteorological station located at Arnprior Grandon from 1981 to 2010 are presented in Figures 3-1 and 3-2 below (Government of Canada, 2019). Daily average annual temperature is 5.7 degrees C.

Figure 3-1. Climate Data 1981 to 2010 Arnprior Grandon – Temperature

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Average (°C)	-11.5	-9.5	-3.3	5.6	12.9	18.1	20.7	19.4	14.5	7.8	0.8	-6.8	5.7
Standard Deviation	3.5	2.6	2	1.9	1.9	1.3	1.2	1.1	1.2	1.5	1.5	3.4	1.1
Daily Maximum (°C)	-6.9	-4.6	1.6	10.8	18.8	23.9	26.6	25.2	19.8	12.3	4.2	-3.2	10.7
Daily Minimum (°C)	-16	-14.3	-8.1	0.4	7	12.2	14.8	13.7	9.3	3.2	-2.7	-10.4	0.8
Extreme Maximum (°C)	12	11	22.8	30.6	33	35	37.2	**38**	33	27	21.1	15	
Date (yyyy/dd)	1995/ 15	1994/ 20	1977/ 30	1976/ 18	1999/ 31	1988/ 14	1977/ 20	Mar-88	Apr-83	1979/ 22	Feb-71	Mar-82	
Extreme Minimum (°C)	-38	-37.2	-31	-17.8	-9	-1.1	4	2	-4	-8.3	-23	-35	
Date (yyyy/dd)	Mar-81	Mar-71	Oct-84	Jan-65	Apr-87	Nov-72	Feb-92	1982/ 21	1991/ 30	1975/ 31	1995/ 29	1989/ 30	

Source: http://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnProv&lstProvince=ON&txtCentralLatMin=0&txtCentralLatSec=0&txtCentralLongMin=0&txtCentralLongSec=0&stnID=4225&dispBack=0

Figure 3-2. Climate Data 1981 to 2010 Arnprior Grandon – Precipitation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall (mm)	19.2	15.9	29.6	57.7	74.8	73.5	90.5	82.1	78.1	70.4	54.4	15.9	662
Snowfall (cm)	37.5	27.9	25.6	5	0	0	0	0	0	3.5	14.1	29.9	143.6
Precipitation (mm)	56.7	43.8	55.2	62.8	74.8	73.5	90.5	82.1	78.1	73.9	68.5	45.8	805.6
Extreme Daily Rainfall (mm)	50	30	38.4	36.3	40.4	50.8	55	76	53	47	40	38.1	
Date (yyyy/dd)	1995/ 15	1997/ 21	1976/ 31	1973/ 27	1976/ 19	1967/ 24	Sep-89	Apr-88	1989/ 22	May-79	1993/ 27	Oct-69	
Extreme Daily Snowfall (cm)	35.6	33	27.9	25.4	0	0	0	0	0	16	32	30.5	
Date (yyyy/dd)	1966/ 30	Mar-72	1977/ 22	Feb-70	Jan-60	Jan-60	Jan-60	Jan-60	Jan-60	1997/ 21	1995/ 27	1973/ 20	
Extreme Daily Precipitation (mm)	50	33	38.4	36.3	40.4	50.8	55	76	53	47	40	38.1	
Date (yyyy/dd)	1995/ 15	Mar-72	1976/ 31	1973/ 27	1976/ 19	1967/ 24	Sep-89	Apr-88	1989/ 22	May-79	1993/ 27	Oct-69	
Extreme Snow Depth (cm)	125	118	118	35	0	0	0	0	0	16	72	117	
Date (yyyy/dd)	Oct-96	1992/ 29	Jan-92	Jan-92	Jan-82	Jan-82	Jan-82	Jan-82	Jan-82	1997/ 22	1995/ 28	1995/ 27	

With respect to frost, reporting at the same Arnprior Grandon Station indicated that the average date of the last spring frost was May 13th, the average date of the first fall frost was September 27th and the average length of the frost free period was 135 days.

3.1.2 Air Quality

The atmospheric environment of the area is typical for a rural semi-natural area of eastern Ontario with no major industrial air emissions nearby.

Hydroelectric generating stations produce no air emissions except for emissions associated with the occasional use of back-up generators.

No field investigations related to air emissions are proposed with respect to the project.

Environmental noise levels will vary according to a number of factors: intensity, kind and number of noise sources; proximity to the noise sources; topography; presence of barriers and absorbers such as vegetation; and meteorological conditions.

Noise levels would increase during the construction period and would be typical of any construction project. Adherence to any local noise by-law, if applicable, would occur.

No specific noise studies are proposed.

3.2 Bedrock Geology

WSP carried out a geotechnical baseline in 2016 of the Calabogie GS and noted the following with respect to the geology of the site.

> *"The regional geology of the site area comprises metasedimentary, metavolcanic, and felsic and mafic plutonic rocks belonging to the Neo to Mesoproterozoic (0.542 – 1.6 Ga) Central Metasedimentary Belt of the Grenville Province.*
>
> *The site area sits along the border of two distinct terranes: the Bancroft Terrane to the north, and the Mazinaw Terrane to the south. Along with the Sharbot Lake, Frontenac, and Elzevir Terrane, these are collectively known as the Grenville Supergroup and constitute a major constituent of the Central Metasedimentary Belt. Both the Bancroft and Mazinaw Terranes contain a variety of metasedimentary rocks, however the Mazinaw shows a greater representation of metavolcanics and different protoliths in comparison to Bancroft Terrane metamorphic rocks.*
>
> *The bedrock geology of the site comprises relatively homogenous mafic gneiss. Regional mapping of the area indicates clastic metasedimentary and mafic to ultramafic plutonic rocks are present to the south and east of the site, respectively."* (p. 5)

Acid base accounting (ABA) was carried out by WSP as part of the geotechnical investigation in 2016 (WSP, 2016). Three samples were completed in the investigation area and it was determined that there was no potential for acid rock drainage.

3.3 Physiography, Overburden and Soils

According to the Ontario Geological Survey Preliminary Map P.1838, Surficial Geology, Renfrew Area, Eastern part Southern Ontario, surficial materials in the vicinity of the site are comprised of primarily bedrock with a thin drift thickness (Golder, Phase II, 2001).

In the area of the GS the overburden and the soils of the site can be characterized as a human disturbed area. WSP in their 2016 site investigations noted the following:

> *"The borehole information indicates that the overburden thickness within the Calabogie GS investigation area (see Figure 3-2 of Appendix A-2) varies from 2.5 m to 7.3 m. It appears that this material is mainly rubble fill that was generated during the construction of the roadway extending from the northern end of the existing forebay inlet dam to the powerhouse. Similar overburden stratigraphy was observed at BH15-5, which is situated along a footpath on a relatively narrow peninsula separating the tailrace from the Madawaska River. The overburden may be subdivided into two distinct layers: a basal boulder and cobble layer comprising blasted country rock (gneissic shot rock) and a thin surficial layer of granular fill material (road base). It is likely that any native overburden was stripped during the construction of the road, within the working areas."* (p. 6)

More detailed information on the soil and rock layers can be obtained by examining the individual borehole logs that are available in Appendix B of the WSP Report.

WSP went on to describe the granular material of the areas as:

> *"The surficial granular material was observed to range from 0.6 m thick at BH15-4 and BH15-5 to 4.6 m thick at BH15-1, and may be described as sand and gravel. The thickness across the majority of the investigation area is inferred to range between 0.6 m and 1.7 m thick. This material makes up the access roadway's driving surface and was encountered in all advanced boreholes. A 0.2 m layer of sand was found above the granular fill at BH15-3, located adjacent to an access road that services the upper deck of the powerhouse.*
>
> *The baseline unit thicknesses for this layer should be taken t 1.0 m."* (p. 6)

Boulders and cobble were encountered at ranges of 1.2M to 5.6M with an average of 3.2M for this layer (WSP, 2016).

Some areas of vegetation on the site occur on areas that were historically disturbed by construction activities. As one moves away from the GS and dams, more natural soils and vegetation are likely encountered.

As previously explained, the construction of the new GS at Calabogie will require a significant amount of sediment and rock to be removed from the forebay area. It is estimated that approximately 16,000 cubic meters of sediment and 47,000 cubic meters of rock would need to be removed.

In the summer of 2018, sediment and soil samples were collected from 13 test pits in the Forebay and in the vicinity of the Powerhouse. Soil sampling was collected from 5 boreholes drilled in various areas across the site. Figure 3-3 shows the various test pits and boreholes at Calabogie and Figure 3-4 shows the excavation at one of the test pits in the forebay.

Figure 3-3. Boreholes and Test Pits at Calabogie

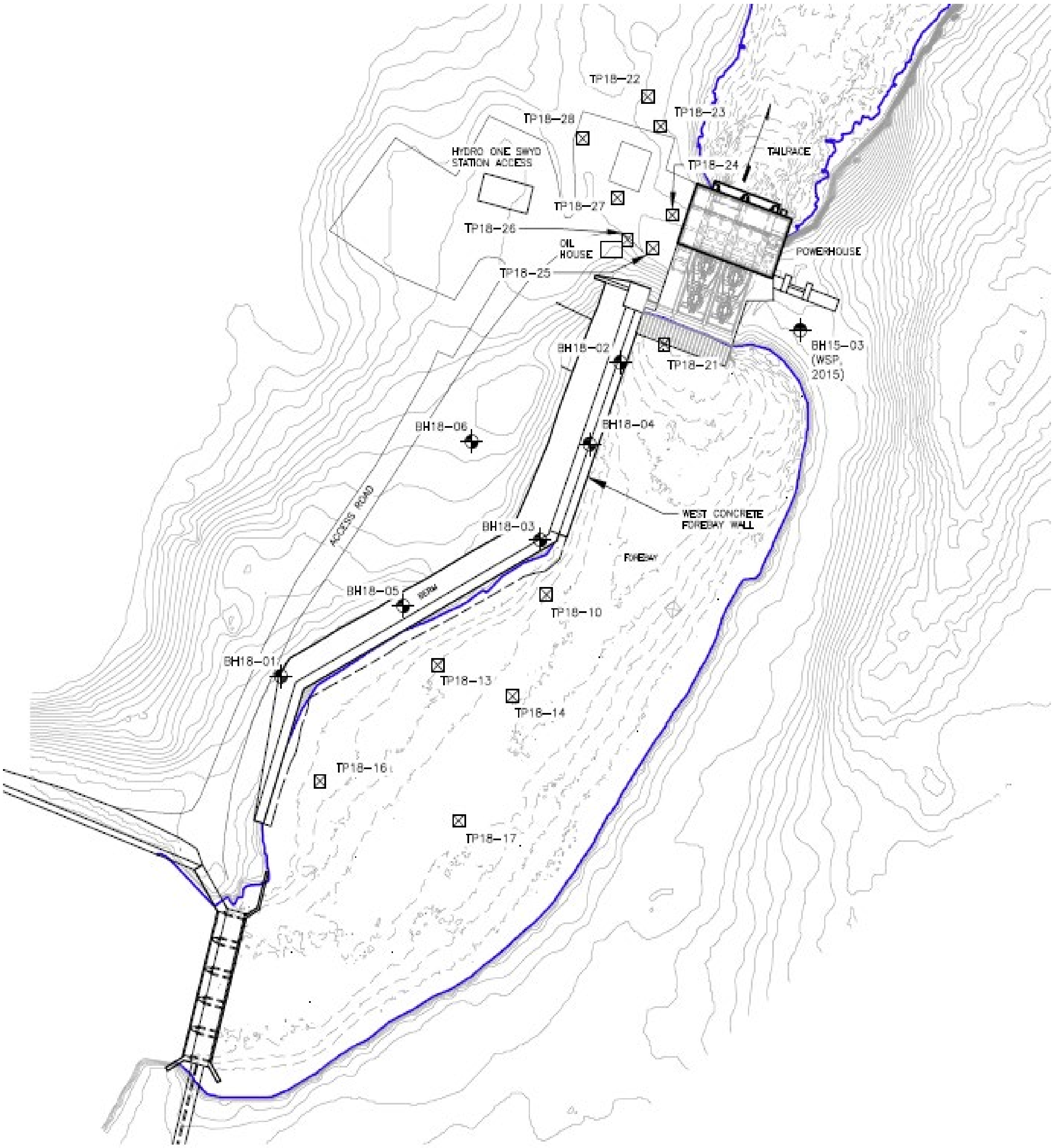


Figure 3-4. Excavator at One of the Test Pits in the Forebay

Laboratory analyses were completed by ALS Canada Ltd. in Ottawa, Ontario, for detection of potential contaminants of concern (PCOC). These were compared to soil and sediment site condition standards of Tables 1 and 8 of O. Reg. 153/04. The Memorandum summarizing the results was prepared October 4, 2018 (please see Appendix B - SNC Lavalin- Calabogie GS Redevelopment FEED Phase – Design Brief – Environmental Investigations).

Some sediment in the bed of the forebay contained concentrations of selected metals that exceed the MoECP Table 3-1 and Table 4-1 site condition standards.

Some soil in the vicinity of the Powerhouse, the forebay retaining wall and in the forebay contained concentrations of selected metals, PHCs and PAHs that exceed MOE Table 3-1 and Table 4-1 site condition standards.

Composite soil sample TCLP leachate analyses suggest that soil and sediment at the site would be classified as solid non-hazardous waste if disposed at a landfill.

It is Arcadis' understanding that the rock is uncontaminated and non-acid generating and, therefore, can be re-used on OPG's property without restrictions. However, because of the exceedances with respect to the sediment it is our understanding that OPG can place the sediment on site but it is recommended that it not be placed within 30 meters of any surface waterbody and that actions may be required to mitigate risks to the environment from the emplaced sediment. MoECP provided concurrence with this approach in an e-mail dated May 6, 2019 (MacLeod, 2019).

OPG is not aware of any other contaminated soils at the Calabogie site.

3.4 Existing Generating Station

The existing GS is known to contain some asbestos as well as lead which is in the paint in the powerhouse. The GS will be demolished in a controlled fashion to prevent these substances from getting co-mingled with materials that can be re-used and to ensure that they are sent to the appropriate disposal facility.

3.5 Desktop Assessment

The following information sources were reviewed as part of the desktop assessment:

a) Provincially Tracked Species Layer (1 km grid) from LIO;
b) Ontario Reptile and Amphibian Atlas (ORAA);
c) Ontario Breeding Bird Atlas (OBBA);
d) Natural Heritage Information Centre (NHIC) Data *via* the Make-A-Map application;
e) Species at risk range maps;
f) High resolution aerial photography of the property (digital orthoimagery, leaf-off, spring 2008); and
g) Natural heritage and physical feature layers from Land Information Ontario (LIO), including wetlands (provincially significant and un-evaluated wetlands), watercourses with thermal regime, as well as other geospatial layers.

The information sources referenced above were reviewed in a Geographic Information System (GIS) mapping environment that assesses the likelihood that species at risk and other significant natural heritage features and functions are present in an area of interest. This system combines the most current information provided by MNRF through the LIO portal with GIS layers from provincial floral and faunal atlases. All relevant layers can then be overlaid on the most recent high resolution orthoimagery. The screening process helps identify areas that can then be targeted (for example, potential habitat) during field assessment to maximize the efficiency and effectiveness of on-site investigations.

3.6 Vegetation

The study area is situated within Ecodistrict 5E-11 (Henson and Brodribb 2005), within the Algonquin Highlands physiographic region (Chapman and Putnam 1984) and within the Lower Madawaska (2KE) tertiary watershed (Phair *et al.,* 2005). According to Phair *et al.,* (2005), no rare vegetation communities have been documented in this watershed.

3.6.1 Ecological Communities

Ecological communities were mapped and described according to the ELC system for Southern Ontario (Lee *et al.,* 1998). For the wetland communities, ecosite classifications from the provincial Ecological Land Classification Working Group (Banton *et al*., 2009; Wester *et al.,* 2015) are also provided. The following paragraphs describe the ELC communities documented in the study area.

Eleven ecological communities were delineated within the study area and are shown in Figure 3-5. Representative photographs of the ecological communities are provided in Appendix A and referenced in the sections below. Photograph locations are shown in Figure 3-6. Most of the photographs were taken prior to September 2018 when a tornado moved through the study area; however, additional post-tornado photographs have been included in Appendix A to illustrate the damage to the treed communities. A list of plant species documented on site is provided in Appendix B.

Anthropogenic and Cultural Communities

Anthropogenic and cultural communities are those that are created or maintained through anthropogenic disturbances. Some anthropogenic land uses eliminate vegetation (e.g., paved parking lots), whereas others such as dirt roads retain large numbers of non-native species along their periphery.

Units 1a-d: Anthropogenic (Ant)

The anthropogenic features as delineated in Figure 3-5 consist of buildings, bridges, gravel/dirt roads, municipal fill area and a hydro corridor (Photographs 1 to 8).

Vegetation growing at the side of the roads was dominated by non-native plants and included the following species: Common Burdock (*Arctium minus*), White Sweet Clover (*Melilotus albus*), Garden Bird's-foot Trefoil (*Lotus corniculatus*), Common Ragweed (*Ambrosia artemisiifolia*), Common Viper's Bugloss (*Echium vulgare*), Common Tansy (*Tanacetum vulgare*), Common Dandelion (*Taraxacum officinale*), Common Mullein (*Verbascum thapsus*) and Common Yarrow (*Achillea millefolium*). A small patch of the non-native invasive European Reed (*Phragmites australis* ssp*. australis*) was also present. Native species growing on the road edges included: Thicket Creeper (*Parthenocissus vitacea*), Riverbank Grape (*Vitis riparia*), Poison Ivy (*Toxicodendron radicans*), Common Milkweed (*Asclepias syriaca*), Wild Lily-of-the-valley (*Maianthemum canadense*), Wild Sarsaparilla (*Aralia nudicaulis*), Common Red Raspberry (*Rubus idaeus*), Spreading Dogbane (*Apocynum androsaemifolium*), Smooth Blackberry (*Rubus canadensis*), Red Clover (*Trifolium pratense*), Wild Carrot (*Daucus carota*), Pearly Everlasting (*Anaphalis margaritacea*), Paper Birch (*Betula papyrifera*), and Large-leaved Aster (*Eurybia macrophylla*). Tree species included: Large-toothed Aspen (*Populus grandidentata*), Trembling Aspen (*Populus tremuloides*), Balsam Poplar (*Populus balsamifera*), American Elm (*Ulmus americana*), White Spruce (*Picea glauca*) and Eastern White Pine (*Pinus strobus*).

Figure 3-5. Ecological Land Classification

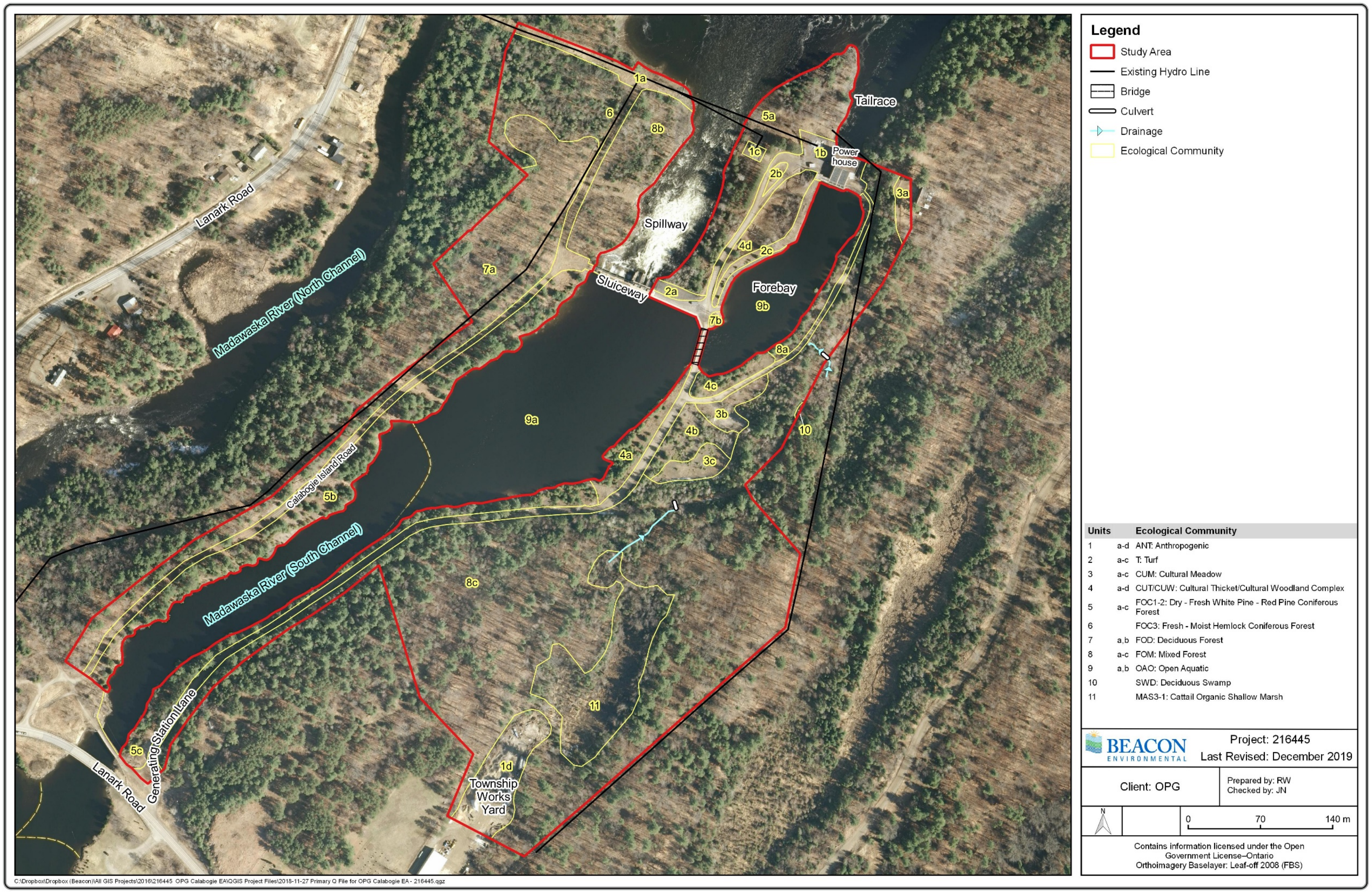
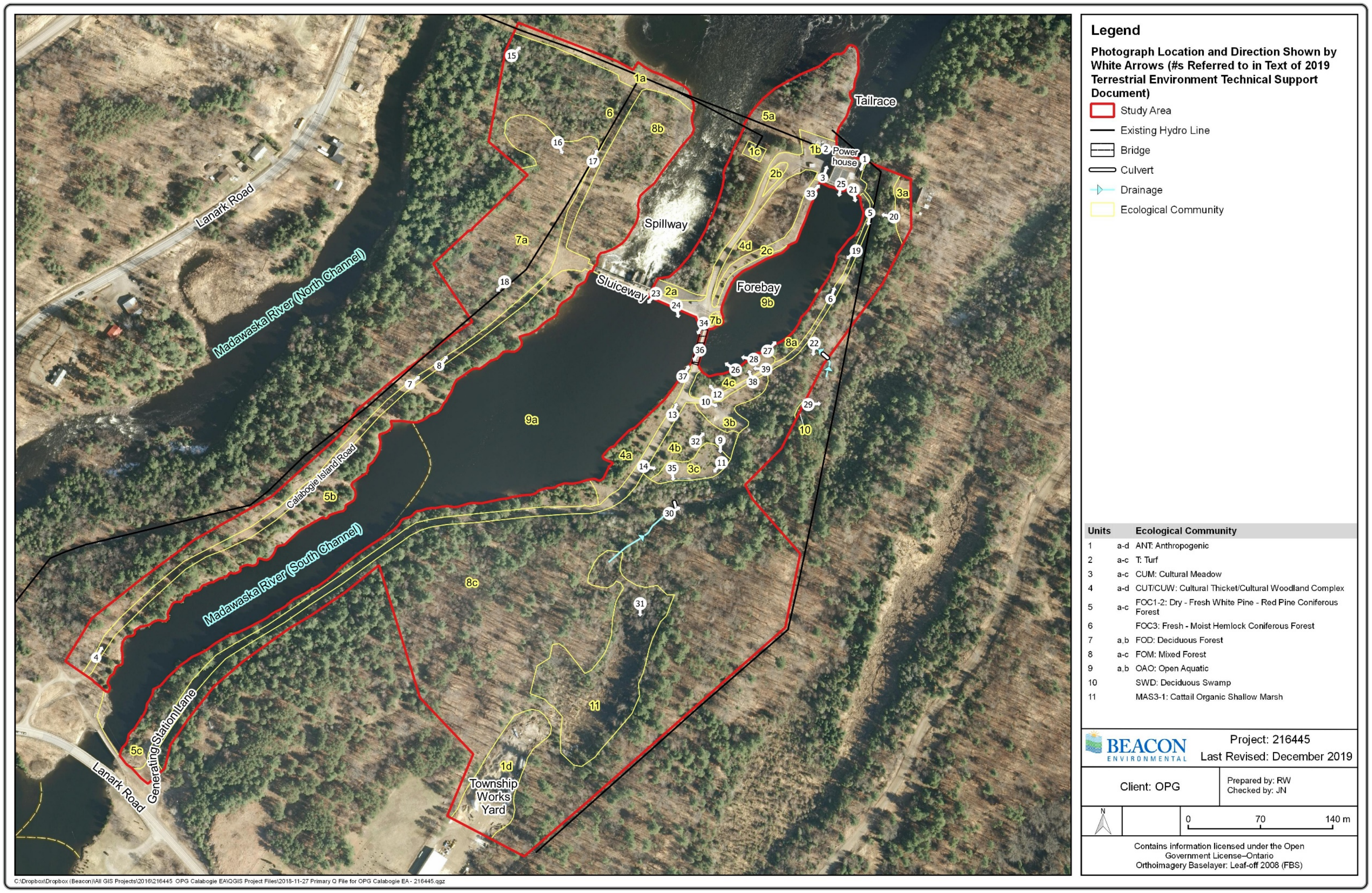


Figure 3-6. Photograph Locations



Units 2a-c: Turf (T)

The areas delineated as turf in Figure 3-5 are lawn or short grasses typically comprising Kentucky Blue Grass (*Poa pratensis*) or similar species.

Units 3a-c: Cultural Meadow (CUM)

The meadow communities are located where gravel and rock fill have been stored (Photographs 9 to 11). Hardy meadow species are present with most of the species being non-native. Species present included: Oxeye Daisy (*Leucanthemum vulgare*), Spotted Knapweed (*Centaurea stoebe*), Common Yarrow, Common Mullein, Creeping Wildrye (*Elymus repens*), Common Crown-vetch (*Securigera varia*), Red Clover, Common Red Raspberry, Yellow Sweet-clover (*Melilotus officinalis*), Garden Bird's-foot Trefoil, Common Plantain (*Plantago major*), Smooth Brome (*Bromus inermis*), Common Viper's Bugloss, Eastern Tall Goldenrod (*Solidago altissima* var. *altissima*) and Bladder Campion (*Silene vulgaris*).

Units 4a-d: Cultural Thicket/Cultural Woodland Complex (CUT/CUW)

Shrub *and* tree cover in these communities vary with Eastern White Pine and/or Eastern White Cedar (*Thuja occidentalis*) dominant. Staghorn Sumac (*Rhus typhina*), Balsam Poplar, Large-toothed Aspen, Paper Birch, White Spruce and American Elm are present in the canopy and sub canopy along with Common Juniper (*Juniperus communis*), Canada Buffalo-berry (*Shepherdia canadensis*), Tufted Vetch (*Vicia cracca*) and Eastern Helleborine (*Epipactis helleborine*) present in the ground layer (Photographs 12 and 13). The vegetation in ELC unit 4b is heavily influenced by the substrate of blast rock which has limited soil formation (Photograph 14).

<u>Forest Communities</u>

Units 5a-c: Dry - Fresh White Pine - Red Pine Coniferous Forest (FOC1-2)

Tree species present in the canopy and sub-canopy of this community (Photographs 4 to 8) included: Eastern Hemlock (*Tsuga canadensis*), Balsam Fir (*Abies balsamea*), Eastern White Cedar, and Eastern White Pine, along with Paper Birch, Yellow Birch (*Betula alleghaniensis*), Sugar Maple (*Acer saccharum*), Northern Red Oak (*Quercus rubra*) and Large-toothed Aspen. ELC unit 5a contained young American Beech (*Fagus grandifolia*), Red Pine (*Pinus resinosa*), Eastern White Cedar, Eastern White Pine, Balsam Fir, Paper Birch, American Basswood (*Tilia americana*), Eastern Hemlock and young Eastern Hop-hornbeam (*Ostrya virginiana*).

Unit 6: Fresh - Moist Hemlock Coniferous Forest (FOC3)

In this community **(Photograph 15)**, Eastern Hemlock, Balsam Fir and Eastern White Cedar were dominant canopy species along with Eastern White Pine, Red Pine and Yellow Birch. This community covers most of the lands west of the study area. Species in the ground layer included Bunchberry (*Cornus canadensis*), Bracken Fern (*Pteridium aquilinum*), Large-leaved Aster, Wild Sarsaparilla and Eastern Leatherwood (*Dirca palustris*).

Units 7a, b: Deciduous Forest (FOD)

Tree species present in the canopy and sub-canopy of this community (Photographs 16 to 18) included: American Beech, Trembling Aspen, Large-toothed Aspen, Paper Birch, Eastern Hemlock, Sugar Maple, Northern Red Oak, Eastern White Pine, Staghorn Sumac and Eastern Hop-hornbeam. Species in the ground layer included: Bunchberry, Smooth Blackberry, Bracken Fern, Large-leaved Aster, Wild Lily-of-the-valley and Spreading Dogbane.

Units 8a-c: Mixed Forest (FOM)

Tree species present in the canopy and sub-canopy of this community (Photographs 19 to 22) included Eastern Hemlock, Balsam Fir, Eastern White Cedar, Eastern White Pine, Red Pine, Yellow Birch, Northern Red Oak, Large-toothed Aspen, Sugar Maple, Paper Birch, American Elm and Eastern Hop-hornbeam. Small stands of Eastern White Cedar are present throughout the community. Species in the ground layer included Bunchberry, Bracken Fern and Large-leaved Aster.

Aquatic and Wetland Communities

Units 9a, b: Open Aquatic (OAO)

Unit 9a is the south channel of the Madawaska River (Photographs 23 and 24). The aquatic community is greater than 2 m in depth and with limited light penetration, aquatic vegetation is generally absent.

Unit 9b is the forebay and also has no aquatic vegetation (Photographs 19, 25 and 26). As part of the required maintenance, the forebay is regularly de-watered and is shown in photographs from August 2018 (Photographs 27 and 28).

Unit 10: Deciduous Swamp (SWD)

Only a small portion of this community extends into the study area (i.e., approximately 50 m^2). Black Ash (*Fraxinus nigra*) and Eastern White Cedar are dominant. One of the tree species present in this community was Swamp White Oak (*Quercus bicolor*). This tree is not rare in Ontario; however, it is infrequently documented in Eastern Ontario. Water from this swamp community (Photograph 29) drains through a culvert and into the study area where it becomes subsurface flowing into historical blast rock fill (Figure 3-5). The ecosite classification from Wester *et al.,* 2015 is G130Tt Intolerant Hardwood Swamp.

Unit 11: Cattail Organic Shallow Marsh (MAS3-1)

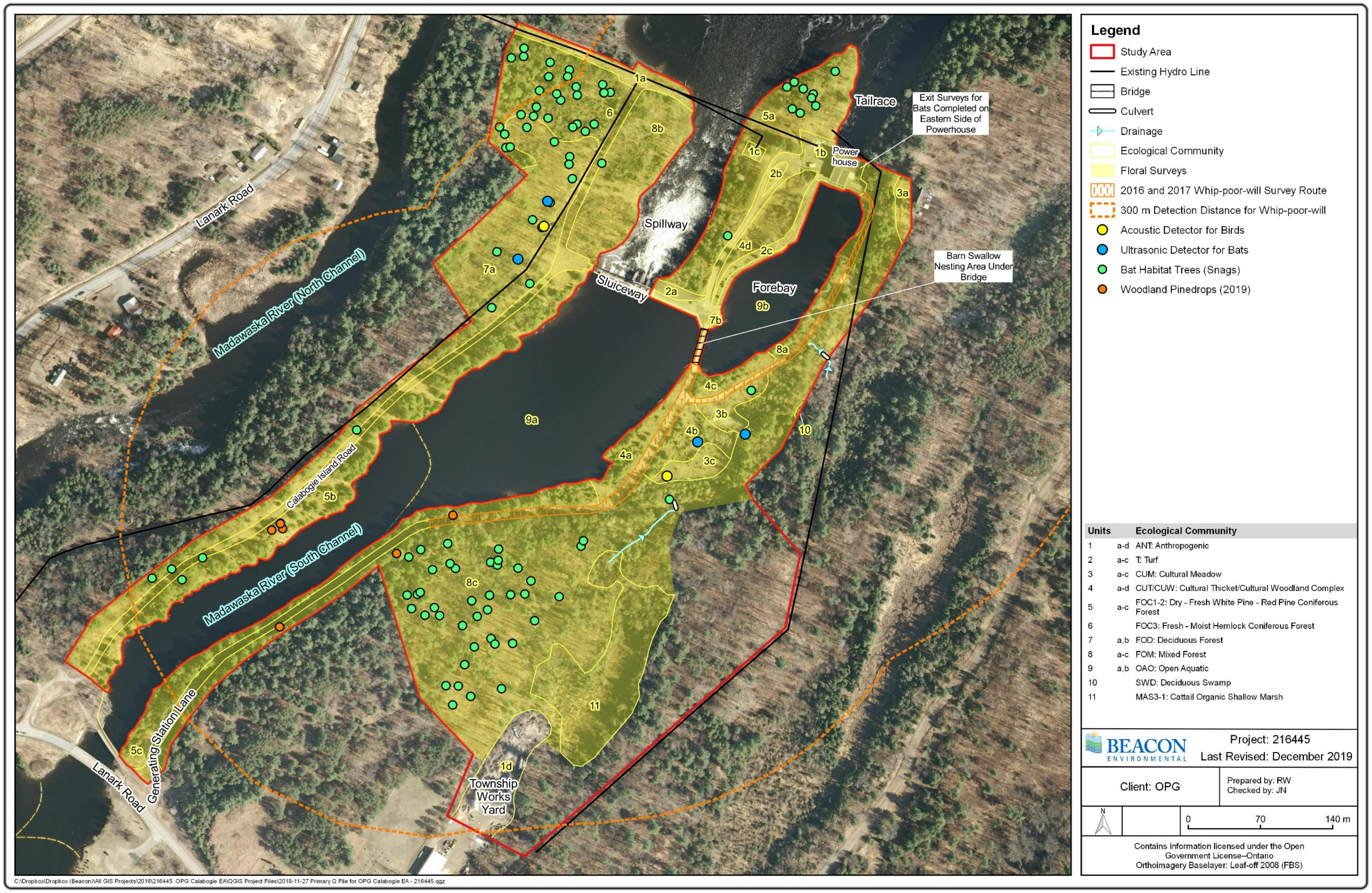
This wetland community is approximately 1.2 ha in area and is dominated by Broad-leaved Cattail (*Typha latifolia*) and Narrow-leaved Cattail (*Typha angustifolia*) (Photograph 30). There are areas of pooled water and numerous standing dead trees. Eastern White Cedar, Black Ash and spruce occur throughout. Additional species documented include: Silver Maple (*Acer saccharinum*), Red-osier Dogwood (*Cornus sericea*), Sensitive Fern (*Onoclea sensibilis*), Reed Canary Grass (*Phalaris arundinacea*) and American Elm. Water flows from this wetland along a drainage that flows into a culvert (Photograph 31), becoming subsurface flowing into historical blast rock fill (Figure 3-5). The ecosite classification from Wester *et al.,* 2015 is G149N Organic Shallow Marsh.

3.6.2 Flora

Floral surveys were completed on July 25, 2017; August 24, 2018; and June 6, 2019. A list of the vascular plant species documented within the floral survey area shown in Figure 3-7 is provided in Appendix B. A total of 85 vascular plant species were identified. Except for one species (see below), all the vascular plants documented are considered S5 (common, secure), S4 (Common) or SE5 (non-native) in the provincial S-Rank classification. No plant species considered to be species at risk (endangered, threatened or special concern) were documented during the surveys. Native species accounted for 74% of the species recorded in the study area.

Woodland Pinedrops (*Pterospora andromedea*), a provincially rare plant (S2: “usually between 5 and 20 occurrences in the province, or few remaining hectares”) was documented in several locations (multiple stalks at each location) along Generating Station Lane and Calabogie Island Road during the August 2018 surveys (Figure 3-7). MNRF staff have also previously documented this plant along Generating Station Lane. During the August site visit, the proposed laydown areas, stockpile area and haul road were surveyed and Woodland Pinedrops were not observed in these areas. The conditions in these latter areas suggest that Woodland Pinedrops is unlikely to be present (i.e., the ecological communities and species compositions are different). However, along the laneways where conditions are suitable, it is possible that Woodland Pinedrops may be present in additional locations because the species does not produce above-ground inflorescences every year. As such, the proposed mitigation measures have been tailored to respond to any newly documented locations of Woodland Pinedrops as the project goes forward.

Figure 3-7. Terrestrial Surveys



3.7 Wetlands

The wetlands within the study area have not been evaluated by the MNRF and as such are not designated as provincially significant wetlands. The Grassy Bay Provincially Significant Wetland is located approximately 1.3 km upstream of the study area at the eastern end of Calabogie Lake. Balmer Lake Provincially Significant Wetland (also known as Springtown Marsh) is approximately 7.3 km downstream of the study area. Given OPG's intent to comply with existing water compliance requirements, it is not anticipated that the project will have any adverse effects on these provincially significant wetlands (see Section 4.8).

3.8 Wildlife and Wildlife Habitat

Based on an assessment of habitat potential for species at risk completed in 2015 (Beacon, 2016), several wildlife surveys have been conducted at the Calabogie site since 2016. The timing and location of these surveys are shown in Table 3-1 and Figure 3-7, respectively. Surveys conducted in 2016 focused on species at risk deemed most likely to occur on site, whereas the scope of surveys conducted in 2017 and 2018 was expanded to include additional species.

Table 3–1. Summary of Terrestrial Field Investigations

Survey/Assessment Type	Date(s)
Eastern Whip-poor-will (*Antrostomus vociferus*), auditory surveys at dusk with Common Nighthawk (*Chordeiles minor*) secondarily assessed during the surveys)	Two surveys in 2016 timed according to peak activity periods for Whip-poor-will following lunar cycle for 2016: June 13 and June 20 Two surveys in 2017 timed according to peak activity periods for Whip-poor-will following lunar cycle for 2017: June 6 and June 17
Bat exit surveys for Little Brown Myotis (*Myotis lucifugus*) and Tri-colored Bat (*Perimyotis subflavus*) at generating station, (visual and auditory with active detectors)	Two surveys in 2016: June 20, July 21 Two surveys in 2017: July 24, 25
Barn Swallow (*Hirundo rustica*) nesting survey (visual and auditory)	June 9, 2016 June 7, 17, 2017 May 15, May 29, June 26, 2018
Deployment of two remote ultrasonic detectors to survey for bats	June 2017 June 2018
Deployment of remote acoustic detector to survey for Eastern Whip-poor-will and other birds	June 6 to June 17, 2017 May 29 to June 25, 2018
Dawn breeding bird surveys (visual and auditory)	Two surveys in 2017: June 7, 17 Two surveys in 2018: May 29, June 26
Bat habitat assessment for maternity roosts (snag trees) during leaf-off conditions	May 3, December 12, 2018 April 24, 2019
Turtle surveys (basking, visual)	May 15, 29, 2018

Incidental observations of wildlife species, including mammals were made during field investigations that were primarily for other purposes. Evidence for the presence of a species or use of an area was determined from visual and/or auditory observation (e.g., song, call) and observations of nests, tracks, burrows, browse, skins, and scats.

3.8.1 Mammals

Targeted surveys for mammals other than bats were not conducted; however, evidence of mammal activity in the study area was documented during the other field investigations. Evidence of White-tailed Deer (*Odocoileus virginianus*), Coyote (*Canis latrans*), Raccoon (*Procyon lotor*), Woodchuck (*Marmota monax*) and Red Squirrel (*Tamiasciurus hudsonicus*) was documented. Additional terrestrial small mammals such as Deer Mouse (*Peromyscus maniculatus*) and Meadow Vole (*Microtus pennsylvanicus*) are almost certainly present in the area of study.

Bats

Three provincially endangered bat species were considered to have potential to occur in the study area: Little Brown Myotis, Northern Myotis (*Myotis septentrionalis*) and Tri-colored Bat. To assess the likelihood of adversely affecting these species, three types of surveys for bats and bat habitat were completed from 2016 to 2019 (Table 3-1). The first type of survey conducted was an exit survey to determine if any bats were roosting on the eastern side of the generating station (Photograph 1; Figures 3-6 and 3-7). Exit surveys were conducted on four nights over two years (Table 3-2) following MNRF's guideline *Use of Buildings and Isolated Trees by Species at Risk Bats - Survey Methodology* (MNRF, 2014).

Table 3–2. Bat Exit Surveys

	Survey 1 (2016)	Survey 2 (2016)	Survey 1 (2017)	Survey 2 (2017)
Date	June 20	July 21	July 24	July 25
Time (start–finish)	21:20–22:40	21:00–22:30	20:50–22:30	20:45–22:30
Temperature (°C; start–finish)	23.0–22.0	22.0–20.0	15.0–16.0	19.5–16.5
Wind (Beaufort scale; start–finish)	1–1	1–0	2–0	0–0
Cloud cover (%; start–finish)	25–25	0–0	100–100	0–0
Precipitation	None	None	*intermittent precipitation (spitting)	None

***Note:** although there was light precipitation during this survey it was evident that bat emergence was not suppressed because the number of bats visible and audible on the acoustic detectors that night was higher than during any other survey (additional discussion below).

Exit surveys were completed by two ecologists with experience conducting bat surveys and using two active bat detectors (Echo Meter Touch and EM3 from Wildlife Acoustics), as well as two white-light flashlights/head lamps to watch for emerging bats. Given that only the eastern side of the generating station was being surveyed as shown in Figure 3-7, the assessment should be considered a thorough evaluation of the presence/absence of bats at this location.

No bats were visually detected exiting from the eastern side of the generating station, nor did the acoustic equipment suggest that bats had exited while the surveyors were present. During the July 25, 2017 survey, a bat was observed flying around inside the generating station at dusk. When the bat exited through the window, the acoustic equipment indicated that the individual was a Hoary Bat (*Lasiurus cinereus*). Because the large windows are often left open to allow heat to escape and the lights stay on all night, it seems likely that bats may enter occasionally to forage on insects.

Although no bats were detected emerging from the generating station, the handheld acoustic detectors did detect six bat species foraging somewhere within the detection range of the equipment. Because the amount of acoustic data recorded during the exit surveys was relatively small, all of the samples were manually processed using Kaleidoscope Pro software (Wildlife Acoustics) in addition to using the most recent auto-ID classifiers from Wildlife Acoustics. Manual processing was completed by a trained Beacon staff member. All of the noise files recorded were run through a second round of processing using the most recent auto-ID classifiers from Wildlife Acoustics. Once confirmed or re-classified as noise files, these files were not examined manually given that bats were not observed emerging from roosting areas on or adjacent to the building.

The following species were detected following the manual analysis of acoustic data collected during the exit surveys: Little Brown Myotis, Tri-colored Bat, Hoary Bat, Eastern Red Bat (*Lasius borealis*), Silver-haired Bat (*Lasionycteris noctivagans*) and Big Brown Bat (*Eptesicus fuscus*). Of the six species of bats detected, the Little Brown Myotis and Tri-colored Bat are endangered provincially and federally, whereas the other four are considered to be not at risk.

During the exit surveys, bats were observed foraging over the forebay, particularly on the night of July 24, 2017 when large numbers of caddis flies were hatching and flying above the water. Numerous bats were observed foraging over the water and the acoustic detector indicated that five bat species were present.

As indicated in Table 3-1, the second type of bat survey conducted involved the deployment of remote ultrasonic bat detectors to determine if any of the endangered bat species were present in areas where tree clearing could be required to support the proposed redevelopment. Two passive detectors were deployed south of the generating station in 2017 and two detectors were deployed in 2018 in a different area west of the sluiceway (Figure 3-7). The remote detectors used were Wildlife Acoustics SM4BAT units equipped with SMM-U1 ultrasonic microphones. The detectors were mounted on trees (Photograph 32) and set to record at sunset for five hours over approximately two weeks beginning at the start of June in 2017 and 2018. This deployment period provided more than ten nights of data recorded under suitable weather conditions (i.e., air temperature ≥10°C, less than 5.4 m/sec, and minimal precipitation) and thus satisfies the requirements laid out in the relevant MNRF protocol (MNRF, 2017).

Recordings from the detectors were analyzed by a trained Beacon staff member and completed using Kaleidoscope Pro software. A combination of auto-identification and manual analysis was applied to make species determinations. All unclassified files (No ID Files) were manually reviewed for call frequency to determine if unclassified calls fell within the 40 kHz *Myotis* species and Tri-Coloured Bat range. If the call did not fall within the approximate 40 kHz range, it was not analyzed further as it is unlikely that the call was made by one of the endangered bats. Furthermore, a random selection of noise files was reviewed to ensure that the batch filters applied functioned as intended.

Table 3-3 below provides the results of the analyses at each of the detector locations.

Table 3–3. Acoustic Bat Monitoring Results Summary

Detector #	ELC Unit	Big Brown Bat or Silver Haired Bat	Eastern Red Bat	Hoary Bat	Eastern Small-footed Myotis	Little Brown Myotis	Northern Myotis	Tri-coloured Bat	Unidentified 40 kHz Call (likely *Myotis*)
17-85	4b	X	X	X		X	X	X	X
17-86	8c	X	X	X		X		X	X
18-85	7a	X		X		X			X
18-86	7a	X	X	X		X	X		X

Note: unidentified 40 kHz calls are in the frequency range of the endangered *Myotis* species.

The analysis showed that there was bat activity at all four detectors. One of the endangered bats, Little Brown Myotis, was detected at all four detectors and overall three of Ontario's four endangered bat species were present. The Tri-coloured Bat was only detected in 2017 in the area east of the South Channel (Figure 3-7). Based on the time of day and high number of bat detections (known as hits or passes) at detector 18-86, it is likely that there is a roost tree close to this location. The third endangered bat detected, Northern Myotis, only registered at two detectors and the number of hits was low. Further discussion of the results in relation to potential habitat (i.e., snag trees with roosting potential) is provided below.

Bat Habitat Assessment

Surveys to identify candidate maternity roost for the endangered bat species Little Brown Myotis and Northern Myotis were undertaken during leaf-off conditions on May 3 and December 12, 2018 and April 24, 2019. Candidate maternity roost habitat was identified in accordance with guidance documents provided by the MNRF (2017). As per the guidance document, the following treed ELC communities were considered to potentially contain maternity roost habitat for Little Brown Myotis and Northern Myotis:

- Deciduous Forests (FOD);
- Mixedwood Forests (FOM);
- Coniferous Forests (FOC);
- Deciduous Swamp (SWD);

- Mixedwood Swamps (SWM); and
- Coniferous Swamps (SWC).

The following characteristics were recorded for each tree/snag deemed to have the potential to function as maternity roost habitat:

- Location (geospatial coordinates);
- Tree species;
- Approximate tree height;
- Diameter beast height (DBH);
- Number of habitat features (cavities, knot holes, woodpecker holes);
- Peeling bark (%);
- Height of habitat features;
- Decay class;
- Height class;
- Canopy cover for habitat features; and
- Date-time.

All of the ELC communities were of a size and composition that could be assessed over the three days of fieldwork. ELC unit 5c was not assessed because tree clearing was not likely to be considered.

The bat habitat surveys documented 100 potential bat maternity roost trees/snags (Figure 3-7). Based on the size of the ELC communities, the calculated snag densities range from 0.69 per ha for ELC Unit 5b to 28.57 per ha for ELC Unit 6. According to the MNRF's (2016) guidelines, ELC communities with snag densities equal to or greater than 10 snags per ha are considered high quality potential maternity roost habitat.

3.8.2 Terrestrial Avifauna

Based on an assessment of habitat potential for species at risk completed in 2015 (Beacon, 2016), two provincially threatened bird species were considered to have the potential to occur within or adjacent to the Calabogie study area: Barn Swallow and Eastern Whip-poor-will. Targeted surveys for these species were therefore conducted as summarized in Table 3-1 and described in detail below.

<u>Barn Swallow</u>

Surveys for Barn Swallow were conducted in 2016, 2017 and 2018 (Table 3-1), and involved searching for the species (visual and auditory), as well as searching for nests in areas identified as having potential for nesting. When Barn Swallows were observed, the behaviour of individuals flying and perching close to a potential or confirmed nesting area was observed to determine likelihood of nesting and possible location of nests. Surveys were conducted during ideal conditions with temperatures within 5°C of normal, no precipitation, wind less than 5.4 m/sec. Although surveys were conducted from 08:00 to 10:00, observations of Barn Swallow behaviour occurred throughout the day.

In all three years, Barn Swallows were confirmed to be nesting under the bridge (Photograph 26) as shown in Figure 3-7. On June 9, 2016 a Barn Swallow nest could be seen under the bridge and it had at least four eggs. Behavioural observations suggested that there was a single nest under the bridge in 2016.

In 2017, observations of Barn Swallow behaviour at the bridge suggested that there were two nests under the bridge as four adult Barn Swallows were seen on several occasions during the May and June surveys. Barn Swallow activity was not observed near the generating station or trash racks. However, in August 2017 the OPG plant group documented an active Barn Swallow nest at the Gauge House which is outside of the area of study. Barn Swallows are known to regularly have two broods in one year in Ontario, but this does not occur every year and varies depending on location in Ontario (COSEWIC, 2011). The nestling Barn Swallows observed on the nest at the Gauge House would have either been a second brood of young or a replacement brood (i.e., if the first brood did not fledge).

The OPG Eastern Operations needed to remove the Gauge House, and therefore several requirements were triggered under the provincial *Endangered Species Act* (ESA) specific to removal and replacement of Barn Swallow nests. As part of this effort, a survey to search for additional nests at the Calabogie site was completed by the plant group in September 2017. These visual surveys documented two nests under the bridge and two nests under the trash racks. The first finding that there were two nests under the bridge corresponds with the observations earlier in the season of four adult Barn swallows at the bridge. However, no Barn Swallow activity had been documented in the previous two years at the trash racks. As such, additional focus was placed on the trash racks during the 2018 Barn Swallow and general breeding bird surveys.

On May 15, 2018 six Barn Swallows were observed flying around and under the bridge suggesting that potentially three active nests were being built or used under the bridge. Examination of the nests under the trash racks indicated that one of the nests was being used by an Eastern Phoebe (*Sayornis phoebe*) (Photograph 33) and the other nest was not occupied. As in the previous two years there was no Barn Swallow activity observed at the trash racks. During the June 26, 2018 survey, six Barn Swallows were observed flying under and around the bridge; however, at least one of the individuals was a fledgling (Photograph 34). Nests could not be seen under the bridge through the grating by Beacon staff; however, it is Beacon's understanding that the OPG plant group was able to see two nests under the bridge in approximately mid-June 2018, but that at the end of June these nests were no longer visible and so it is possible that they fell off into the water. Based on these observations it seems likely that there were two to three nests occupied under the bridge in May and June 2018 and that young were successfully fledged from the first brood; however, no Barn Swallows reared second broods in 2018 under the bridge as the nests were lost. The trash racks were again examined on June 26 and an Eastern Phoebe was again back on the same nest and there were no nestlings present suggesting the adults were preparing for a second brood. No Barn Swallow activity was observed at the trash racks.

Eastern Whip-poor-will

In 2016 and 2017, surveys for Eastern Whip-poor-will were conducted following protocols provided by the MNRF (2016) and a Canadian Nightjar Survey Protocol (Knight, 2017). The surveys were conducted during the primary, recommended survey periods in June as per MNRF (2016) during ideal conditions (moon

> 50% illuminated, low noise, temperatures between 13 and 22°C, no precipitation, wind less than 5.4 m/sec, moon above the horizon and not obscured by clouds). Survey details are provided in Table 3-4.

Table 3–4. Eastern Whip-Poor-Will Surveys

	Survey 1 (2016)	Survey 2 (2016)	Survey 1 (2017)	Survey 2 (2017)
Date	June 13	June 20	June 6	June 17
Time (start–finish)	20:00–22:30	22:40–23:30	21:40–22:30	04:50–05:50
Temperature (°C; start–finish)	13.0–12.0	22.0–21.0	10.5–9.5	18.0–22.0
Wind (Beaufort scale; start–finish)	1–1	1–2	0–0	0–1
Cloud cover (%; start–finish)	0–0	25–0	0-0	50–90
Lunar Cycle	moon waxing, 63% illumination	moon full, 100% illumination	moon waxing, 92% illumination	moon waning, 50% illumination
Moon Visibility	unobscured by clouds and above horizon	unobscured by clouds and above horizon	unobscured by clouds and above horizon	unobscured by clouds and above horizon
Precipitation	None	None	None	Short rain shower near end of survey

In 2017 and 2018, a remote acoustic detector for birds (SM4 Unit from Wildlife Acoustics) was mounted on trees (Photograph 35) in the locations shown in Figure 3-7. The acoustic detector was set to record audio during dawn and dusk. In 2017, these recordings were used to provide additional coverage with respect to detecting any vocalizing male Eastern Whip-poor-wills. In 2018, the SM4 detector was deployed in a different location as shown in Figure 3-7 and on-site surveys were not completed. Given that Whip-poor-will vocalizations can be detected from a distance of approximately 300 m, the coverage of the site in 2016 and 2017 was very thorough. Additionally, MNRF's (2016) protocol infers a detection distance of 500 m and so the consideration of a minimum detection distance of 300 m is conservative and is based on Beacon's experimentation with call distances for this species. A 300 m detection distance is shown on Figure 3-7 for illustration purposes. For these reasons, the deployment of the acoustic detector in 2018 in the western portion of the study area without on-site surveys was deemed a precautionary approach given the extent of the coverage the previous two years.

No vocalizations of Eastern Whip-poor-will were detecting during the on-site surveys conducted in 2016 and 2017, and no vocalizations of the species were detected from the audio recordings obtained from the SM4 units deployed in 2017 and 2018. These findings provide conclusive evidence that the species was not breeding within the study area.

General Dawn Breeding Bird Surveys (Visual and Auditory)

General surveys for breeding birds were conducted in 2017 and 2018 in the early mornings in appropriate weather conditions. Roving methods were used, and all birds seen or heard within or adjacent to the study area were documented. Survey details are presented in Table 3-5.

Table 3–5. Breeding Bird Surveys

	Survey 1 (2017)	Survey 2 (2017)	Survey 1 (2018)	Survey 2 (2018)
Date	June 7	June 17	May 29	June 26
Time (start–finish)	07:40–09:20	04:50–08:50	07:45–10:00	06:30–09:05
Temperature (°C; start–finish)	14.0–16.0	18.0–22.0	14.0–16.0	8.0–12.0
Wind (Beaufort scale; start–finish)	0–0	0–1	0–1	0–0
Cloud cover (%; start–finish)	0–0	5–90	10–0	0–10
Precipitation	None	None	None	None

A total of 47 species of birds were documented in the two study areas during the breeding bird surveys (Appendix C). Based on the habitat types present, as well as observations of bird behaviour, 42 species can be expected to breed or potentially breed within the study area. The most numerous species were the commonly encountered Red-eyed Vireo (*Vireo olivaceus*) and Song Sparrow (*Melospiza melodia*).

No additional endangered or threatened species were documented (i.e., other than the Barn Swallow). One species designated special concern on the provincial SARO List was documented: Eastern Wood-pewee (*Contopus virens*). However, the area where this species was heard was north of the 2018 study area. The evening surveys completed for Eastern Whip-poor-will and bats also provided opportunities to survey for Common Nighthawk (special concern provincially), but none were heard or observed.

Twenty of the bird species documented (Appendix C) are listed as area sensitive in the MNRF's Significant Wildlife Habitat Technical Guide (2000). In general, bird species considered to be area sensitive exhibit higher reproductive success in habitats with little or no fragmentation. For example, species that breed in forests/woodlands and are considered area sensitive will have higher reproductive success when their breeding territories are located greater than 200 m from the edge of the treed habitat. These edges are often created by roads and other development activities but can also be the result of a natural transition to non-treed communities such as prairie or rock barrens. With the exception of the two merganser species which are not likely breeding within the study area, all the area sensitive species documented during the surveys use treed or forested habitats for breeding. The observed number of area sensitive bird species that use forested habitats is expected given the extent of forest around the Calabogie site.

3.8.3 Amphibians and Reptiles

Targeted surveys for amphibians were not conducted as suitable breeding habitat was not present within the initially conceived study area (note, ELC Wetland Unit 11 was not initially part of the study area and was only added following the addition of the sub-project described in Section 4.7.2). Multiple amphibian species were documented breeding in ELC Unit 11 in 2019, including: Spring Peeper (*Pseudacris crucifer*), Wood Frog (*Lithobates sylvaticus*), Northern Leopard Frog (*Lithobates pipiens*), Green Frog (*Lithobates clamitans*) and American Toad (*Anaxyrus americanus*). Gray Treefrog (*Hyla versicolor*) was also documented on site and other amphibian species, including salamanders, are also likely present. None of the amphibians potentially present are of provincial conservation concern. Targeted surveys for snakes were not conducted as no endangered or threatened snakes have the potential to occur at the site. During other on-site investigations, two Northern Watersnakes (*Nerodia sipedon*) were observed near the bridge. Additional snake species such as Eastern Milksnake (*Lampropeltis triangulum*) and Eastern Gartersnake (*Thamnophis sirtalis*) are likely to occur on site and in the general area.

Given the potential for turtles to occur in the study area, basking surveys were conducted on May 15 and 29, 2018 under ideal conditions (MNRF, 2015). Basking surveys were completed for the south channel, forebay and downstream of the spillway. Basking surveys were conducted using binoculars from onshore vantage points that provided good views of the limited number of potential basking areas. The conditions during the May 15 survey (14:50 to 16:45) were excellent as it had rained in the morning and thus when the survey started the sun had just come out and it was 18 C, with 0% cloud cover, Beaufort = 1. For the May 29 survey from 09:00 to 10:30 the temperature was 16 C, 0% Cloud cover, Beaufort = 1. It had been assumed that Blanding's Turtle (*Emydoidea blandingii*), a provincially endangered turtle, had the potential to occur in the study area, but that surveys may not reveal its presence in this part of the river-wetland system because the species occurs at low densities in this part of its geographic range and the study area provides limited basking opportunities (i.e., floating woody debris and hummocks are largely absent from the river and ELC Wetland Unit 11 was not initially part of the study area). Only two basking surveys were conducted because a Blanding's Turtle was observed moving over land on June 11, 2018 at the northeastern edge of the study area, thus confirming presence of the species. Additionally, two Snapping Turtles (*Chelydra serpentina*) and a Snapping Turtle nest excavated by a predator (Photographs 36 and 37), were observed within the study area in 2018. The Blanding's Turtle and the Snapping Turtles were not observed during the basking surveys; however, seven Northern Map Turtles (*Graptemys geographica*) were observed basking on exposed rocks just downstream of the spillway in late June. The only turtle species likely to occur in the area that was not observed was the Midland Painted Turtle (*Chrysemys picta marginata*); however, it should be assumed that this species occurs in the general area and therefore has the potential to be present within the study area. Although turtles can and do nest along the existing gravel roads on site, there are no areas of highly probable nesting habitat so mitigation strategies for turtles will entail a broad approach to protection rather than protecting a specific area.

3.8.4 Endangered and Threatened Species

Table 3-6 provides a summary of the provincially endangered and threatened species that were considered to potentially occur on or adjacent to the study area based on the background review that was completed and described in Section 3.5.

Table 3–6. Endangered and Threatened Species

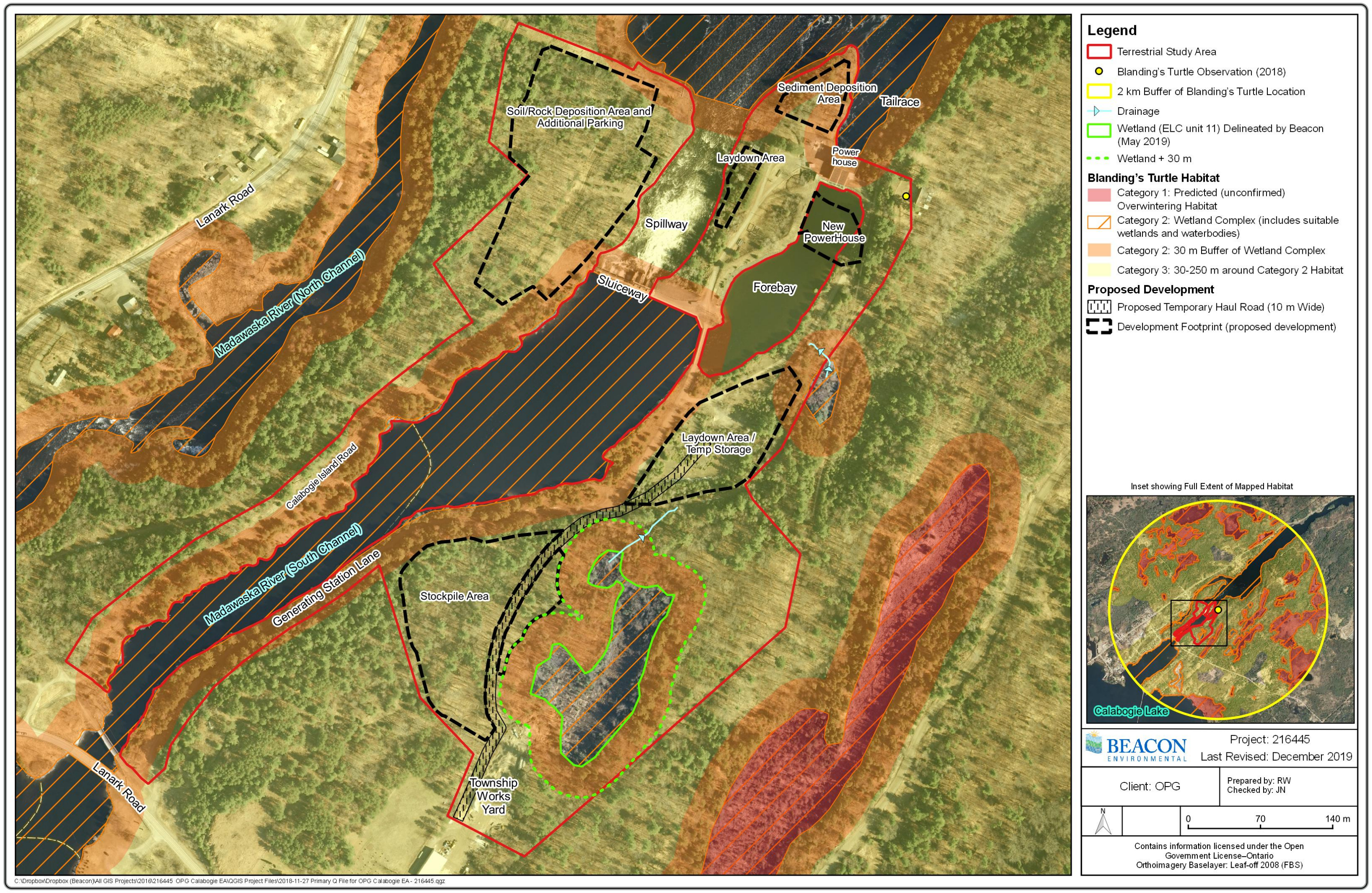
Common Name	Scientific Name	Status on SARO List	Were Species and/or Habitat Documented during On-site Assessment?
Blanding's Turtle	*Emydoidea blandingii*	THR	Yes, species observed in study area. Based on the location of this observation, habitat mapping has been completed following MNRF's *General Habitat Description for the Blanding's Turtle* and is provided in Figure 3-8. The figure shows the wetlands and waterbodies within 2 km that are considered to have potential for overwintering based on physical characteristics. Wetlands and waterbodies within the study area were examined directly, whereas those outside the study area were assessed from 2008 and 2014 leaf-off orthoimagery (DRAPE). The study area was reviewed for potential nesting or overwintering sites for Blanding's Turtle from a habitat-based perspective. ELC wetland unit 11 is not considered to be suitable overwintering habitat (Category 1) for Blanding's Turtle. This determination is based on insufficient water levels in spring 2008 and 2014 (assessment from orthoimagery) and 2019 (site visit). That said, as a precautionary measure this wetland is being provided a 30 m buffer to avoid adverse effects (see Section 4.8.2). The forebay is not considered to be Category 1 or 2 habitat as it is regularly drained as part of required operations.
Barn Swallow	*Hirundo rustica*	THR	Yes, species and nests observed in study area.
Bank Swallow	*Riparia*	THR	No, species not detected during breeding bird surveys.
Bobolink	*Dolichonyx oryzivorus*	THR	No, species not detected during breeding bird surveys.
Eastern Meadowlark	*Sturnella magna*	THR	No, species not detected during breeding bird surveys.
Chimney Swift	*Chaetura pelagica*	THR	No, species not detected during breeding bird surveys.
Northern Myotis	*Myotis septentrionalis*	END	Yes, species detected using remote acoustic monitoring and trees (snags) suitable for roosting documented within study area. Species was not observed emerging from powerhouse during exit surveys.

Common Name	Scientific Name	Status on SARO List	Were Species and/or Habitat Documented during On-site Assessment?
Little Brown Myotis	*Myotis lucifugus*	END	Yes, species detected using remote acoustic monitoring and trees (snags) suitable for roosting documented within study area. Species was not observed emerging from powerhouse during exit surveys.
Tri-colored Bat	*Perimyotis subflavus*	END	Yes, species detected using remote acoustic monitoring and trees (snags) suitable for roosting documented within study area. Species was not observed emerging from powerhouse during exit surveys.
American Ginseng	*Panax quinquefolius*	END	No, species not observed during floral surveys or other site visits.
Butternut	*Juglans cinerea*	END	No, species not observed during floral surveys or other site visits.
Pale-bellied Frost Lichen	*Physconia subpallida*	END	No, suitable habitat is absent.

SARO: Species at Risk in Ontario List (Ontario Regulation 230/08)
END: Endangered
THR: Threatened

Five species subject to regulations under the provincial ESA were documented to occur within the study area. These were: Blanding’s Turtle, Barn Swallow and three bats (Little Brown Myotis, Northern Myotis and Tri-colored). Mitigation and protective requirements for these species are provided in Section 4.

Figure 3-8. Blanding's Turtle Habitat Mapping and Proposed Development



3.8.5 Species of Conservation Concern

Table 3-7 lists the species of conservation concern that are designated special concern on the provincial SARO list and that were documented in the study area. These species are not subject to the protective requirements under Sections 9 and 10 of the ESA.

Table 3–7. Special Concern Species (Provincial)

Common Name	Scientific Name	Status on SARO List	Were Species and/or Habitat Documented during on-site Assessment?
Snapping Turtle	*Chelydra serpentina*	SC	Yes, species documented during site visits.
Northern Map Turtle	*Graptemys geographica*	SC	Yes, species documented during site visits.
Eastern Wood-pewee	*Contopus virens*	SC	Yes, species documented during breeding bird surveys.

SARO: Species at Risk in Ontario List (Ontario Regulation 230/08)
SC: Special Concern

In addition to these three special concern species, Woodland Pinedrops is considered a species of conservation concern because of its provincial rarity rank of S2. Mitigation measures to protect this species are provided in Section 4.

4 EFFECTS ASSESSMENT AND RECOMMENDED MITIGATION MEASURES

The available environmental baseline information and site-specific vegetation including incidental wildlife observations, provided the basis for an assessment of potential construction and operational effects of the proposed project on the terrestrial environment (e.g., due to vegetation clearing, soil erosion, noise, blasting, increased human activity).

Recommended mitigation measures for the potential effects on the terrestrial environment considered best industry practices and various sources such as OWA (2012b) "Best Management Practices Guide for the Mitigation of Impacts of Waterpower Facility Construction", standard environmental construction guidelines, e.g., Cheminfo (2005), DFO Ontario Operational Statements, as well as government agency and other organization consultation.

The selection and application of measures to mitigate potential effects of proposed construction and operation are based on the following five principles:

1. Avoidance of sensitive areas, where practicable, through siting of facilities;
2. Appropriate timing of construction activities, whenever practicable, to avoid sensitive time periods, e.g., vegetation clearing outside migratory bird nesting periods;
3. Construction in wetlands or areas too wet to access should be undertaken during frozen or dry conditions;
4. Implementation of conventional, proven mitigation measures during construction, e.g. OWA (2018) Class Environmental Assessment for Waterpower Projects Appendix B – Examples of Typical Mitigation Measures; Environment Canada "Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities" (Cheminfo, 2005); MNR (1988) "Environmental Guidelines for Access Roads and Water Crossings"; EPRI (2002) "Best Management Practices (BMPs) Manual for Access Road Crossings of Wetlands and Waterbodies", OWA (2012b) "Best Management Practices Guide for the Mitigation of Impacts of Waterpower Facility Construction" and Hydro One (2008) "Environmental Guidelines for the Construction and Maintenance of Transmission Facilities"; and
5. Development of environmental enhancement/compensation measures to offset the unavoidable effects of construction and operation.

The significance of potential impacts was based on their magnitude, duration and extent after the implementation of recommended mitigation measures.

4.1 Atmospheric Environment

4.1.1 Climate

Climatic data of relevance to construction activities include the occurrence of wet soils after prolonged wet weather events, the flooding of excavated areas after a period of heavy rainfall and the generation of fugitive dust emissions due to high winds during dry conditions. Soil moisture levels are anticipated to be low during frozen conditions in the winter and the dry summer months.

During periods of excessive rainfall or saturated soil conditions, construction activities will be monitored to ensure that gullying and erosion does not occur and that excavated soils do not migrate off the work area. Eroded areas will be stabilized as soon as sufficiently dry conditions prevail and, where appropriate, excavated soils will be stabilized by the use of silt fencing enhanced with straw bales to be deployed prior to excavation. Additional information on mitigation of soil erosion is provided in Section 4.4.

Erosion associated with high winds, resulting in soil loss and nuisance dust, should be reduced or eliminated by stabilizing spoil piles with straw mulch. Dust generation will be controlled by watering dusty roads and the construction sites (Cheminfo, 2005).

The average date of the last spring frost is May 13th and last date of the first fall frost is September 27th (see 3.1.1) and therefore, revegetation/reseeding should occur within this May 13th to September 27th period.

The implementation of the proposed mitigation measures should reduce the effect of inclement weather and is predicted to result in no net effects on the terrestrial environment affected by construction of the proposed Project.

4.1.2 Air Quality

The construction of the proposed project will result in typical combustion and dust emissions.

Construction activities have the potential for short-term effects on air quality in the vicinity of the site. Emissions are primarily exhaust emissions (and associated odour) from construction equipment and fugitive dust due to disturbance of dry fine-grained soils. As with any construction site, these emissions will be of relatively short duration and unlikely to have any effect on the surrounding airshed.

During construction, exhaust emissions from construction equipment and fugitive dust emissions will have localized, short-term and transitory effects on the surrounding airshed. Typical combustion emissions include nitrogen oxides (NO_x), CO, SO_2, volatile organic compounds (VOCs) and particulate matter (PM). NO_x can affect vegetation negatively by causing damage or death to leaves, altered photosynthesis, stunting, spindly growth, reduced fruit set and/or reduced yield (Taylor *et al*., 1975). CO is not readily taken up by vegetation (Bennett and Hill, 1975; Mudd, 1975). Soil microorganisms appear to be the major sink for CO (Bennett and Hill, 1975). Sulphur is an essential element for plant metabolism because it is an important component of amino acids, proteins and some vitamins; however, under acute SO_2 levels, foliage symptoms range from chlorosis to necrosis (Malhotra and Blauel, 1980). Elevated VOC levels can also result in foliage chlorosis and necrosis (Malhotra and Blauel, 1980). PM generally does not damage vegetation, possibly because the particles would be removed by rain before any adverse effect could occur (Lerman and Darley, 1975).

During construction, the practices and procedures outlined in the Cheminfo (2005) document "Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities", prepared in conjunction with the Construction and Demolition Multi-Stakeholder Working Group for Environment Canada, will be followed, including:

- plans to minimize dust generation through planning, site layout and the proper use of materials, tools and equipment;
- use of wind fencing;
- compacting disturbed soil;
- activity scheduling;
- storage piles management;
- minimization of drop heights;
- barriers to prevent dispersion of materials;
- avoidance of blasting where feasible;
- work practices for loading debris;
- avoidance of prolonged storage of debris; and
- proper techniques for the use of materials that include VOCs.

The DBC and subcontractors will be required to maintain equipment in good working condition to minimize combustion emissions to the extent practicable (Cheminfo, 2005). To reduce fugitive dust emissions, effective dust suppression techniques, such as on-site and road watering, will be used.

The application of the recommended mitigation measures should minimize combustion emissions and limit fugitive dust emissions to the work area. As a result of the low concentrations of the atmospheric pollutants generated during construction, no adverse effects on terrestrial vegetation due to these emissions are anticipated.

Reseeding (if required) will be undertaken as soon as conditions permit after construction to reduce potential dust generation.

It is anticipated that a concrete batch plant will not be required as concrete can be sourced by local suppliers. Should a plant be required, emissions from the batch plant will need to meet the requirements of the ECA issued by the MOE under the *Environmental Protection Act*.

The existing GS is known to contain some asbestos as well as lead which is in the paint in the powerhouse. The GS will be demolished in a controlled fashion to prevent these substances from getting co-mingled with materials that can be re-used and to ensure that they are sent to the appropriate disposal facility.

There will be no atmospheric emissions from the proposed powerhouse during operation. As ambient air quality will not be affected during the operation of the Project and monitoring is not deemed necessary.

4.1.3 Environmental Noise

The construction of the proposed project will be a source of short-term local noise. All work is expected to be completed using conventional construction methods. Construction activities such as site grading, site preparation, pile driving, blasting and foundation work will be sources of noise generation. All of these activities, which are expected to take approximately 24 months, will require the use of various pieces of heavy equipment including bulldozers, front-end loaders, small trucks, backhoes, bobcats, dump trucks, compactors, ready-mix concrete trucks and cranes. Other construction activities, such as those related to the placement of the facility components (e.g., generator) and activities inside the building (once built) are expected to generate less noise.

The proposed project will be constructed using standard construction BMPs (e.g., Cheminfo, 2005). Sound emission standards for various equipment are set according to the date of manufacture of the equipment as defined by the MOE in the NPC-115 publication, listed in the MOE (1978) Model Municipal Noise Control By-Law. This document stipulates specific sound emission standards for various pieces of construction equipment. An environmental management plan will be prepared by the DB contractor which will address the subject of noise.

The primary form of mitigation of noise is adherence to the Township of Greater Madawaska's Noise By-Law. The nearest human receptors to the construction site are residences approximately 200 meters on the west side of the River. Construction noise will be partially mitigated by the noise associated with the Madawaska River and local traffic.

Potentially susceptible wildlife receptors to noise include amphibians, reptiles, birds and mammals. The construction disturbance should be sufficiently local that there will be little to no permanent displacement of wildlife. However, noise and disturbance associated with construction activities will likely cause susceptible wildlife to vacate the area on at least a temporary basis. No permanent displacement of wildlife is anticipated.

The behavioural response of wild birds to noise is variable. The response varies with species, sex, group, size, season, activities engaged in prior to disturbance, previous exposure to the noise source and distance from the noise source (Fitchko and Lang, 1999). Some species may be very sensitive and may abandon their nests because of anthropogenic noise or activities. Other species habituate to anthropogenic noise or activities, yet others may be attracted to them.

Kaseloo (2004, 2006) reported that a number of studies have indicated that road noise has a negative effect on bird populations (particularly during breeding) of a variety of species. This effect is based on increased bird densities with distance from the road with the effect distances increasing with increased traffic densities. Traffic noise has not been explicitly established as the primary causal factor for avoidance by these species. Moreover, not all species have shown this effect and some species show the opposite response, with increased numbers near roads. As indicated by Kaseloo (2004), there are large gaps in the existing knowledge of the impact of noise on wildlife populations with the need to determine why noise, the presumptive cause, has such variable effects and if the effect is attributable to noise alone or if other factors and/or interactions are present.

While a bird's first reaction to a new noise source appearing in a new ecological niche may be fear and avoidance, if its other sensory systems (optical, chemical) are not stimulated, the organism quickly learns to ignore the noise source (Busnel, 1978). However, avoidance of noise should occur if the organism is approached or chased by humans. For example, it is well known that flocks of crows and gulls will follow a tractor and tilling implement to feed on worms and insect larvae exposed by tilling, ignoring the noise from the tractor; however, they leave immediately if the driver stops the engine and walks away from the tractor.

Drilling activities to facilitate blasting will generate noise and vibration similar to any general construction operation. Potential effects due to noise and vibration will be minimized by proper maintenance and operation of drill rig equipment. In addition, noise baffling equipment can be provided, as recommended by the blasting engineer.

The abrupt loud noise associated with blasting may startle wildlife, including reptiles, birds and bats. In a review of the effects of sonic boom on wildlife, Bell (1972) and Cottereau (1978) reported that wild animals may show behavioural startle when they first experience a sonic boom; however, their reaction is usually slight and they seem to adapt readily to further boom. Lynch and Speake (1978) studied the effect of sonic booms on the nesting behaviour of Wild Turkey (*Meleagris gallopavo silvestris*) and reported that sonic booms did not cause abnormal behaviour that would result in decreased productivity. Additional information on the effects of blasting is provided in the Project Description in Chapter 2.

Some wildlife species will vacate the area temporarily to avoid noise and disturbance associated with construction activities, whereas others may become habituated to human activities and associated noise. No mitigation is recommended, with the exception of those provided for migratory birds and bats during their nesting and active seasons respectively.

During powerhouse operation, the noise level within the station will be mitigated by the powerhouse walls and rapidly attenuate with distance from the station. It is expected that noise levels will be similar to the existing situation. Local resident wildlife are already habituated to the noise emanating from the station.

4.2 Geology

The construction of the new powerhouse will require a significant amount of sediment and rock to be removed from the forebay area. It is estimated that approximately 16,000 cubic meters of sediment and 47,000 cubic meters of rock would need to be removed.

Blasting will be required to remove the rock for the new powerhouse and in the forebay. A third-party firm will be hired to implement a vibration monitoring program, provide engineered blast designs, and consult in all blasting operations as required.

Prior to any blasting or rock excavation, the sediment in the forebay will be excavated down to either rock or the required hydraulic elevations and disposed of on site.

Once the sediment has been removed and blasting is underway, excavation of the rock will begin. As previously explained in Chapter 1, OPG is made an arrangement with the Township of Greater Madawaska for the Township to receive the rock which it plans to use for road construction and maintenance. Small amounts of rock will also be used cofferdam material or stockpiled for later use as embankment treatment, or disposed of on site.

Groundwater infiltration into this excavated area is expected and the anticipated flow rate along with the duration of construction, a Permit to Take Water could be required. To combat the water infiltration, sumps will be blasted into key areas of the excavation and pumps will be installed to dewater the area. If necessary, the water will be pumped into settling pond(s), silt treatment bags, and vegetated areas to mitigate any environmental issues that may arise from the dewatering. Should the groundwater require secondary treatment for dissolved metals, proper measures will be taken.

Explosives used in construction will be closely controlled in accordance with all government regulations, and their use restricted to authorized personnel who have been trained in the use of explosives in a manner so as to minimize impacts on the environment. Appropriate government agencies and the local residents and business operators will be informed of the blasting schedule in advance of construction, as well as just prior to the detonation program. All necessary permits will be obtained by the DBC, who will also comply with all legal requirements in connection with the use, storage and transportation of explosives, including, but not limited to, the *Canada Explosives Act* and the *Transportation of Dangerous Goods Act*. The DBC will be required to retain a consulting engineer with technical expertise in blasting to provide advice on maximum loading of explosives for all blasting, as well as an engineering report indicating recommended charges and blasting methods to be used at specific locations. All blasting will occur in such a way as to be in compliance with federal regulations and directions. Minimization of the physical effects of blasting will be ensured by following the recommendations of the blasting engineer and the DFO blasting guidelines, “Guidelines for the Use of Explosives in or near Canadian Fisheries Waters” (Wright and Hopky, 1998). Excess rock will be removed for suitable use or disposal. Sampling and analysis of bedrock indicated that it is not acid generating (see Aquatic Environment TSD).

A site development plan will be prepared by the DBC, including planning considerations; site and design considerations; site development scheduling; selection of construction equipment; and site development details.

No effects on geology are anticipated beyond footprints already described. As these effects are localized relative to overall geology in the area, no mitigation measures are required beyond those set out in the Site Development Plan.

No effects on geology are anticipated as a result of the operation of the proposed project therefore, no mitigation is required.

4.3 Physiography

As the proposed project is occurring at the already existing Calabogie Generating Station there is a negligible alteration to the site.

As the effects of site development are expected to be negligible on overall physiography, no mitigation measures are required beyond those set out in the Site Development Plan.

No effects on physiography are anticipated as a result of the operation of the proposed Project; therefore, no mitigation is required.

4.4 Soils

Soils on the proposed Project site are highly disturbed from previous work at the site which has been going on for over one hundred years.

During construction, soil erosion generally results from precipitation and runoff, or wind action on the disturbed terrain surfaces as a result of the removal of vegetative cover, alteration of topography and improper restoration. All construction work should be conducted so as to avoid unnecessary disturbance of the ground by the placement or excavation of materials, the disruption of established natural surface and subsurface drainage, or the disturbance of natural vegetation cover that is to be preserved.

During periods of excessive rainfall or saturated soil conditions, construction activities will be monitored to ensure that gullying does not occur on the any slopes near the Madawaska River and that excavated soils do not migrate off the work area. Exposed areas will be stabilized as soon as sufficiently dry conditions prevail and, where appropriate, excavated soils will be stabilized by the use of silt fencing enhanced with straw bales, stockpile covers, berms, controlled compaction, etc.

Erosion associated with high winds, resulting in soil loss, will be reduced or eliminated by stabilizing spoil piles with straw mulch or more stable materials.

Erosion and sediment control will be an integral component of the construction planning process. All personnel involved with the proposed works will be briefed on erosion and sediment control. In general, the following guidelines will be applied in the development of the Erosion and Sediment Control Plan:

- fitting of proposed works to the terrain (i.e., using the natural topography of the land in the placement and organization of the construction site);
- timing of grading and construction activities to minimize soil exposure;
- retention of existing vegetation where feasible;
- restriction of the use of heavy construction equipment to within the approved work areas to minimize soil disturbance and vegetation destruction;
- storage of stripped soil at upland locations with a minimum of 5 m from the edge of the Madawaska River;

- implementation of erosion control measures, e.g., rip-rap berms underlain by filter geotextile, straw bales used as filters, silt fencing along the shoreline and/or mulching for interim stabilization;
- diversion of runoff away from exposed areas;
- minimization of the length and steepness of slopes;
- maintenance of low runoff velocities;
- design of drainage works, such as ditches and outfalls, to handle concentrated runoff;
- retention of sediment on site;
- routine inspection and maintenance of erosion and sediment control measures; and
- revegetation of disturbed areas by seeding and/or planting following construction as soon as seasonal conditions permit.

The site-specific Erosion and Sediment Control Plan will be part of a broader Environmental Management Plan for the proposed Project.

After construction, the disturbed sites will be rehabilitated. A Site Rehabilitation Plan including planning considerations, soil stabilization and re-vegetation (using only native vegetation and planting of tree species typical of the specific ecosite) will be prepared for the proposed Project.

The implementation of the Erosion and Sediment Control Plan and the Site Rehabilitation Plan during construction and rehabilitation will obviate or minimize potential effects on soils.

Incidental spills of oil, gas, diesel fuel and other liquids to the environment could occur during construction. In addition, sanitary and other wastes will be generated during construction. Fuelling and lubrication of construction equipment should be carried out in a manner that minimizes the possibility of releases to the environment. Measures for containment and cleanup of contaminant releases should be followed to minimize contamination of the natural environment, e.g., placement of fuel tanks and generators on plastic sheets bermed around the edges, and use of suitable hydrocarbon absorbent material for cleanup and approved landfill or other disposal. Any spills with the potential to create an impact to the environment should be reported to the MOE as required by provincial spills legislation. Interim sanitary waste collection and availability of treatment facilities should be arranged for the duration of the construction period. All construction waste, washwater and wastewater should be disposed of in accordance with regulatory requirements.

As previously explained in Chapter 2 the soils of the areas to be excavated for the project has been tested. Laboratory analyses were completed by ALS Canada Ltd. in Ottawa, Ontario, for detection of potential contaminants of concern (PCOC). These were compared to soil and sediment site condition standards of Tables 3-1 and 4-1 of O. Reg. 153/04. Some sediment in the bed of the forebay contained concentrations of selected metals that exceed the MOE Table 3-1 and Table 4- site condition standards. Some soil in the vicinity of the Powerhouse, the forebay retaining wall and in the forebay contained concentrations of selected metals, PHCs and PAHs that exceed MOE Table 3-1 and Table 4-1 site condition standards.

Composite soil sample TCLP leachate analyses suggest that soil and sediment at the site would be classified as solid non-hazardous waste if disposed at a landfill. Because of the exceedances with respect to the sediment it is our understanding that OPG can place the sediment on site but it is recommended that it not be placed within 30 meters of any surface waterbody and that actions may be required to mitigate risks to the environment from the emplaced sediment. This has been confirmed with the MoECP. As previously indicated OPG plans to place this excess soil and sediment on Calabogie Island (see Chapter 2, Project Description).

A Hazardous Materials Management Plan, Waste Management Plan and a Spills Emergency Preparedness and Response Plan will be developed by the DBC for the proposed Project as part of the broader Environmental Management Plan. The implementation of these pollution prevention plans will obviate or minimize the environmental effects of accidental releases to the natural environment.

The operation of the hydroelectric facility is not expected to have an effect on property soils. Therefore, no mitigation is required.

4.5 Vegetation

Eleven different ecological communities were delineated within the study area. For those communities that are vegetated and are going to be affected by construction activities, BMPs for vegetation management and retention as described above for soils will be implemented. Additional measures to protect vegetation are provided in Section 4.7.

A Fire Protection Plan should be developed by the DBC. This Plan will provide an inventory of available fire suppressant equipment, response plans and contingency plans. This could be part of an overall Emergency Response Plan.

4.5.1 Rare Plant Species

Woodland Pinedrops occurs in several locations along Generating Station Lane and Calabogie Island Road (Figure 3-7). Additional measures to protect this plant in the event that road widening or maintenance is required are provided in Section 4.7.

4.5.2 Standard Vegetation Clearing Construction Practices

Less than 10 hectares of land will need to be cleared of vegetation (Table 4-1). The vast majority of any vegetation clearing associated with the project will be temporary in nature and the area naturalized following its use. Table 4-1 identifies the proposed land use, the ELC community in which it is located and identifies the potential loss of vegetation and whether it should be considered a permanent or temporary loss.

The Soil/Rock Deposition Area is an area to place excavated soil and sediment and perhaps rock. This area was identified for placement prior to negotiations with the Township on potentially giving the rock to the Township. As such, the temporary loss area shown below is likely larger than what is actually required. The Additional Parking Area is the area proposed for worker's vehicles during the construction stage and following construction topsoil would be added and the area re-vegetated. The Road Upgrades would be for a widening of roads to the site. Generating Station Lane may or may not be widened. Most of the

Laydown Area/Temporary Storage Area occurs in areas previously disturbed by construction activities as does most of the Infrastructure Associated with the New Powerhouse. The Temporary Haul Road will be used to transport excavated rock to the adjacent Township lands. The "stockpile" area would be for the Township to store the excavated rock until it has been depleted.

Table 4–1. Vegetation Removal

	Proposed Land Use	ELC Community	Permanent Loss (ha)	Temporary Loss (ha)
	Soil/Rock Deposition Area and Additional Parking Area	Forest		4.08
	Sediment Deposition Area	Forest		1.14
	Road Upgrades (if Required)	Forest	0.14	
	---	CUT/CUW: Cultural Thicket/Cultural Woodland Complex	0.07	
	Laydown Area/Temp Storage	Forest		0.73
	---	CUT/CUW: Cultural Thicket/Cultural Woodland Complex		0.21
	---	CUM: Cultural Meadow		0.31
	Infrastructure Associated with New Powerhouse	CUT/CUW: Cultural Thicket/Cultural Woodland Complex	0.26	
	Temporary Haul Road	Forest		0.36
	Stockpile for Township (Primary Area)	Forest		1.80
Total			**0.47**	**8.63**

Vegetation clearing will adhere to standard construction practices as listed below:

- Vegetation clearing should not be conducted during the migratory bird nesting season (see Section 4.7);
- Vegetation clearing should be restricted to the minimum necessary for construction activities;
- Physically delineate the limits of clearing and construction with flagging or staking, ahead of construction, to avoid unnecessary disturbance to surrounding vegetation;
- Sediment control measures be maintained in good working order until vegetation has been established on the exposed soils;
- Brush and trees should be felled into the area to be cleared to prevent damage to adjacent vegetation;
- Branches overhanging the cleared area should be cut (pruned) cleanly and stubs shall not be dressed;

- Use best management practices to ensure that trees being retained adjacent to construction areas are not damaged;
- OPG is of the opinion that it retains the rights to the forest resources on its lease and therefore any merchantable and non-merchantable timber can be sold by it on the open market or used for other purpose. OPG has had discussions with the Algonquins of Ontario and the AOO has indicated that the wood should be offered for utilization by individuals rather than chipped. Alderville FN has also indicated a potential interest in the wood. OPG will make offers for the wood to be directed to parties for utilization should there be interest;
- All remaining slash material will either be burned or chipped according to OPG's objectives and in accordance with any burning restrictions;
- Chipped material should be spread so as to lower the incidence of forest fire; and
- Slash material should not be stored near any water bodies.

It should also be noted that phragmites was identified on the Calabogie GS site but not in the development footprint of the project (near the boat launch). As a result of discussions among AOO, AOP and OPG, OPG has committed to removing and monitoring it in this location.

To protect the rare plant, Woodland Pinedrops, along Generating Station Lane and Calabogie Island Road, any road widening should:

- Avoid all locations of the plant if possible;
- Physically delineate the limits of a buffer (protection zone) around the plants with flagging and staking;
- Determine the size of the protection zone based on local conditions (e.g., current growing conditions, topography, current road location); and
- If all plants cannot be retained, then retain the plants and locations with the highest long-term viability (e.g., farthest from vehicle travel and/or disturbance).

OPG will ask the DBC to follow the Ontario Provincial Standard (OPS201) definition of "Close cut clearing", i.e., the cutting of all standing trees, brush, bushes and other vegetation at original ground level and the removal of felled material and windfalls.

Relative to the forest cover in Ecodistrict 5E-11 and along the Madawaska at Calabogie, the permanent loss of 0.47 ha and temporary loss of 6.47 ha of forest/woodland is negligible or low in magnitude, duration and extent.

4.6 Wetlands and Areas of Natural and Scientific Interest

The wetlands within the study area have not been evaluated by the MNRF and as such are not designated as provincially significant wetlands. Nevertheless, development will be set back appropriate distances from the wetland and mitigation measures will be implemented to protect vegetation and wetland function. The Grassy Bay Provincially Significant Wetland is located approximately 1.3 km upstream of the study area at the eastern end of Calabogie Lake. Balmer Lake Provincially Significant Wetland is approximately 7.3 km downstream of the study area. There are no Areas of Natural and Scientific Interest within a distance where they would be affected by activities within the study area.

Given OPG's intent to comply with the water management plans, it is not anticipated that the project will have any adverse effects on these provincially significant wetlands. Regarding the potential for fluctuating water levels on Calabogie Lake to have effects on the flora and fauna within the Grassy Bay Provincially Significant Wetland, the following discussion is provided.

The new generating station will have an increased maximum total turbine outflow over the existing GS (160 m^3/s versus 66 m^3/s). This increased capacity will allow OPG to put through almost 2 ½ times more water. However, given the variety of other requirements and compliance ranges that OPG is required to follow, the possible effects on water levels in Grassy Bay would be limited to slightly quicker drawdowns occasionally. That is, water levels could be lowered to the minimum more quickly in any one day. The daily minimum and maximum water levels will not change. Additionally, these quicker draw downs will not occur every day because other factors in the system affect the water compliance requirements (as per the Madawaska River Water Management Plan). No seasonal changes are anticipated as OPG will continue to operate the Calabogie GS and the other plants on the Madawaska River in full accordance with all flow and water level targets and compliance conditions in the Madawaska River Water Management Plan, including the summer conditions.

4.7 Wildlife

The potentially and occasional quicker drawdowns are not expected to have any negative effects on the wildlife likely to be present in Grassy Bay (including Blanding's Turtle, other turtles and amphibians). For example, turtles do not nest or hibernate in the zone between the daily low and high-water marks and these habitat features are the most sensitive. Turtles do, however, bask in the sun on structures at the surface of the water such as rocks, woody debris and vegetation. Beacon has observed turtles basking on rocks down river from the Calabogie spillway that are only available to the turtles (i.e., rocks are above the surface of the water) when the water is not flowing through the spillway. When these basking rocks are not available because water levels are higher, the turtles bask above the water line along the shoreline or use floating woody debris. In fast flowing areas of the river, woody debris and floating vegetation mats are absent and basking habitats for turtles are very limited (e.g., the South Channel). In contrast, woody debris and floating vegetation mats are present along the periphery of Grassy Bay and thus the availability of basking habitat for turtles should not be affected by quicker draw downs. Regarding amphibians, the species breeding in Grassy Bay are not expected to be negatively affected by the quicker drawdowns given that the egg masses of most species are resistant to short term emergence from water. No adverse effects on Northern Map Turtles downstream of the spillway are expected as this species regularly occurs in fast flowing river systems and no areas of potential entrapment have been noted. If turtles move up the spillway when the gate is closed and are then present when the sluice gate is opened, they will be flushed into the area where they were observed basking in 2018.

As per the regulations under the federal *Migratory Birds Convention Act* it is necessary to ensure that breeding birds and/or their nests, eggs or young are not disturbed, damaged or destroyed. Therefore:

- Vegetation clearing should be avoided during the migratory bird nesting season (April to the end of August) (however, it is OPG's intention to clear trees before April 1 to meet the bat cavity tree window); and

- If minor vegetation clearing needs to occur during the migratory bird nesting season or if clearing needs to occur in highly disturbed areas with simple vegetative structure, then a qualified avian ecologist should examine the area to be affected to ensure that no nests, eggs or nestlings or indications of nesting are present. However, in almost all circumstances a high risk of nesting birds will occur from May to July inclusive.

4.7.1 Proposed GS Construction and Road Traffic

The potential effects of environmental noise on wildlife are presented in Section 4.1.3.

As previously explained in the Project Description in Section 2, worker traffic is expected to be directed to the Road on Calabogie Island. The road to the Calabogie GS is to be devoted to large construction equipment and deliveries of equipment and materials. Both roads are less than 400 meters in length and traffic speeds are limited to 20 km/hour for safety purposes which also reduces the likelihood of vehicular-animal incidents. Given the presence of turtles in the study area, including the threatened Blanding's Turtle, specific mitigation measures are recommended in Section 4.8.2 to minimize the adverse effects of vehicular traffic on wildlife.

OPG has also agreed to monitor any wildlife mortality caused by construction traffic and alter practices if any patterns has been observed.

4.7.2 Proposed Road Construction and Deposition

OPG has indicated that it will have to excavate approximately 47,000 cubic meters of rock from the forebay to construct the new powerhouse at the Calabogie GS. In discussions with the Township it was realized that this rock could be used by the Township for future road works. The intention of this sub-project is to deliver the excavated rock to municipally owned lands adjacent to the rear of the Township's Works Yard (Figure 2-22). The Township has also indicated that it can take the demolished powerhouse (except for the exterior structure that has lead paint on it) as well. This will require Sullivan to construct a temporary road to and from the stockpile/storage (Figure 2-22).

4.7.3 Proposed Project Operation

Once construction of the proposed Project is completed, any displaced animals could reoccupy the habitat created on the rehabilitated areas, and the habitat not directly affected by construction activities. The steady noise from the proposed Project powerhouse during operation is not expected to elicit an adverse reaction from wildlife due to habituation.

4.8 Endangered and Threatened Species

As indicated in Sections 3.8.4, five species subject to regulations under the provincial ESA were documented to occur within the study area.

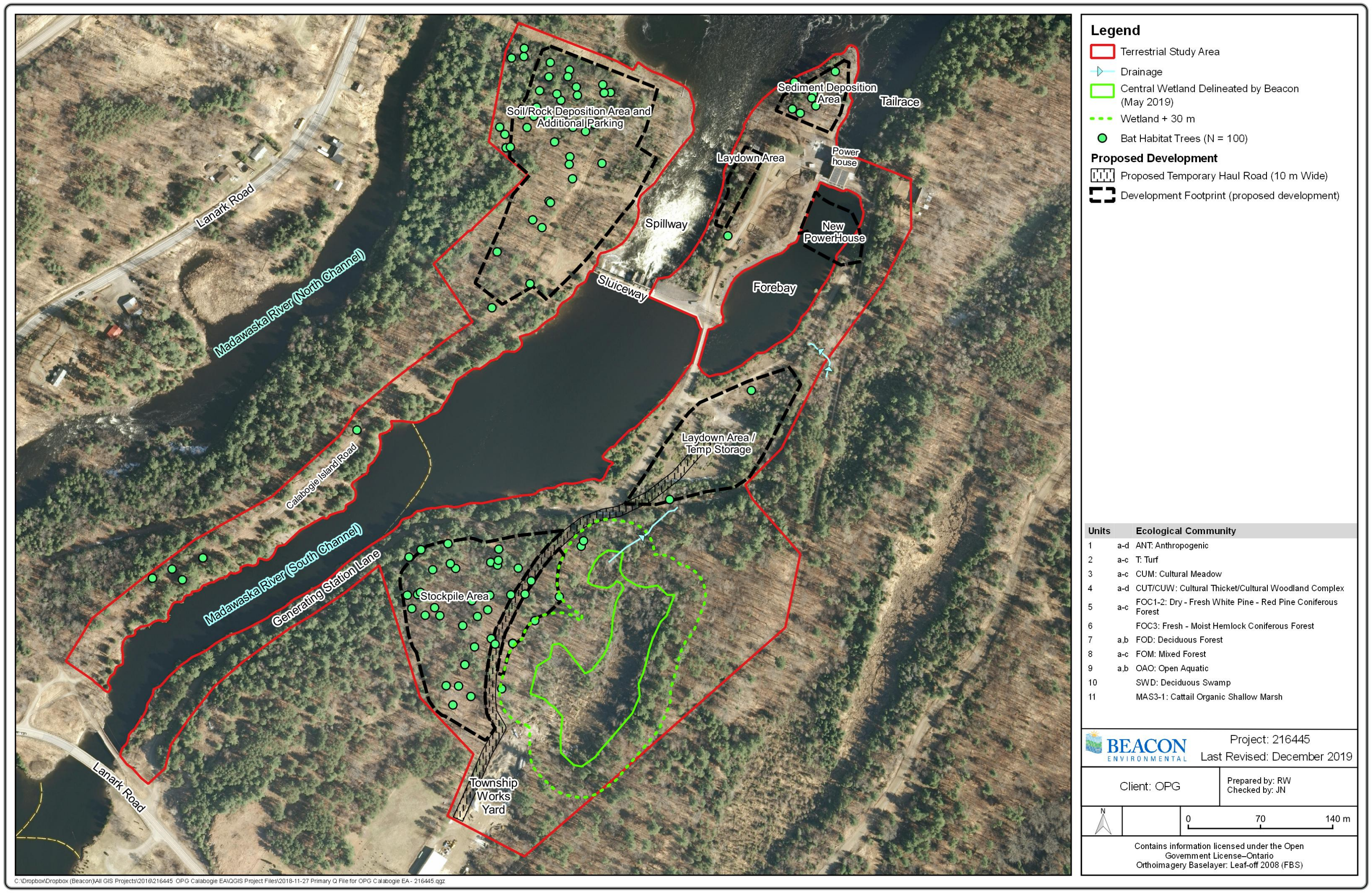
4.8.1 Bats (Little Brown Myotis, Northern Myotis, Tri-colored Bat)

Three endangered bat species were confirmed by acoustic surveys to be present within the study area and habitat for these species was documented in several locations. As shown in Figure 4-1, bat habitat trees would be removed in several locations. As such, the following is recommended to avoid adverse effects on individuals of the species as per Section 9 of the ESA:

- Any removal of potential bat habitat trees should be completed outside of the active season for bats (no habitat tree removal between April 1 and October 1).

Based on comments received by MECP as part of the EA review process it is our understanding that "No authorizations [specific to bats under the ESA] would be required if trees were cleared outside of the bat active season (April 1 to October 1)." If these activities cannot be completed during this timing window and tree clearing is proposed between April 1 and October 1, then MECP must be contacted to obtain further direction prior to removal of any trees.

Figure 4-1. Bat Habitat Trees that will Potentially be Removed



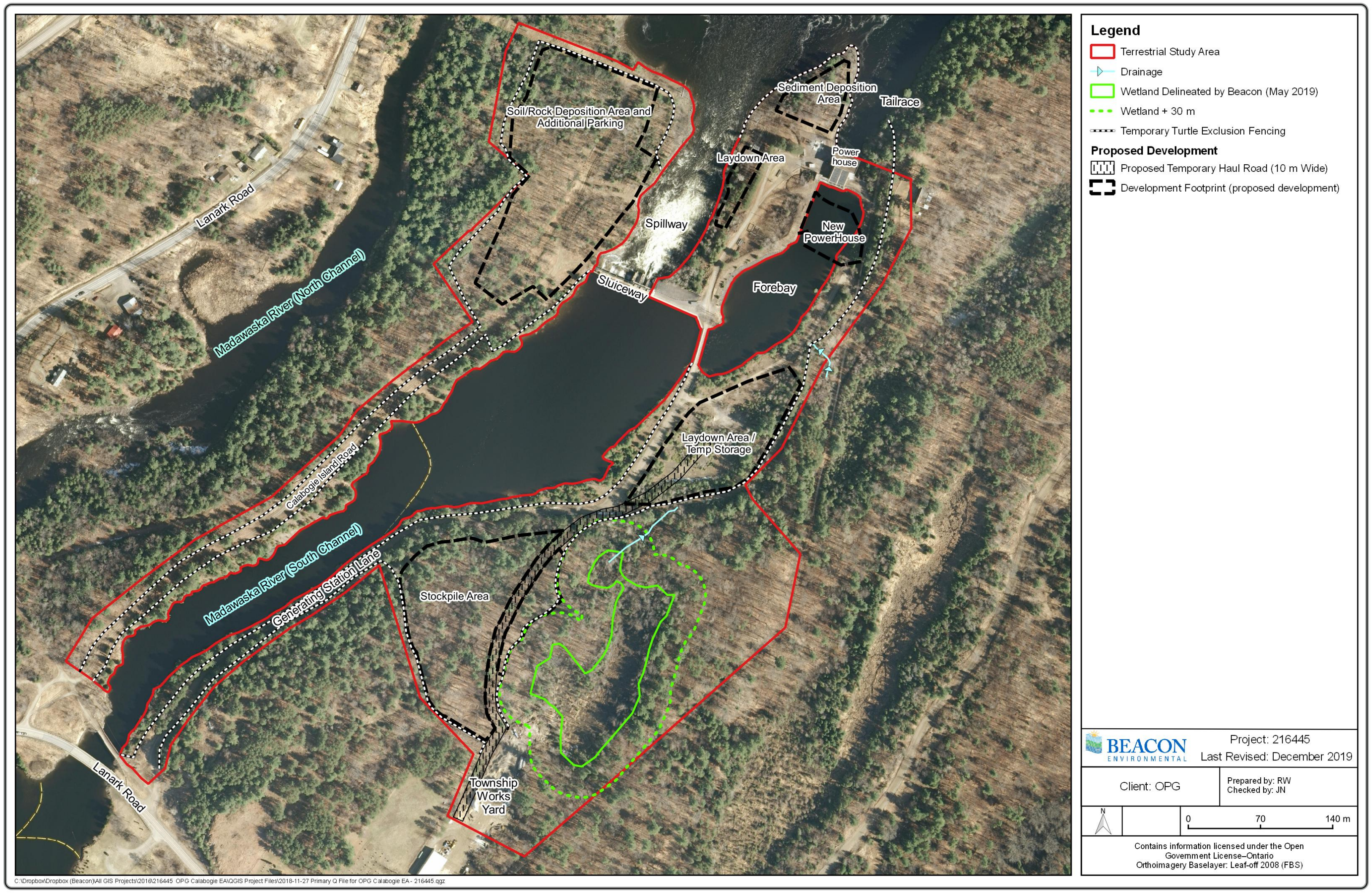
4.8.2 Blanding's Turtle

Blanding's Turtles make regular overland movements between wetlands/waterbodies and to and from nesting areas. These movements can be up to 2 km and can occur anytime during the turtle's active season but are more likely during the nesting season. These behavioral characteristics make it difficult to exclude Blanding's Turtles from all work areas that have the potential to injure or kill individuals (i.e., roads and areas where motorized vehicles are operating). That said, mitigation measures that combine species at risk training for on-site workers with temporary exclusion fencing can substantially reduce the likelihood of adverse effects on Blanding's Turtle. The following mitigation measures are recommended:

- Qualified Professional to provide species at risk training for OPG staff and all workers that will be on-site;
- Develop and adhere to site-specific response protocols for turtles and other wildlife encounters;
- Incorporate "tailgate" education material for species at risk developed by Pembroke MNRF; and
- Erect three turtle/snake crossing awareness signs (one on Generating Station Lane, one on Calabogie Island Road, and one on the temporary haul road);
- Erect temporary exclusion fencing as shown in Figure 4-2 to prevent turtles from moving into areas of active construction and motorized vehicle traffic;
- Exclusion fencing to be installed can double as sediment fencing but must meet the specifications recommended in the most recent version of MNRF's guidance document *Reptile and Amphibian Exclusion Fencing*;
- Exclusion fencing can only be put in once the ground is thawed. Therefore it is OPG's intention to install the fencing soon after the ground has thawed or by mid-April; and
- The haul road and deposition area should be 30 metres from the boundary of wetlands so that the development footprints are outside of Category 2 Blanding's Turtle habitat.

Based on the implementation of these mitigation measures along with the location of the proposed development footprint as shown in Figure 3-8 (overlaid on Blanding's Turtle habitat mapping) and Figure 4-2 (exclusion fencing), it is our opinion that the proposed activities will achieve avoidance under the ESA with respect to Blanding's Turtle and thus not require an authorization.

Figure 4-2. Temporary Turtle Exclusion Fencing



4.8.3 Barn Swallow

Barn Swallow has a species-specific provision (Section 23.5 of O. Reg. 242/08) under the ESA. Because of previous work at the Calabogie site, an artificial nesting structure has already been constructed and established in the study area (Photograph 38). Sufficient nesting cups (Photograph 39) have been established in this structure to accommodate Barn Swallows that will be displaced from the bridge as per the regulation. These activities by OPG at Calabogie also necessitated a Notice of Assessment be submitted for Barn Swallow.

To ensure compliance with the ESA with respect to Barn Swallow it is recommended that Section 23.5 of the O. Reg. 242/08 be reviewed in its entirety. Key requirements in that regulation are as follows:

- give the Minister notice of the activity by submitting a notice of activity form available on the Registry;
- If any part of the activity is to be carried out during the barn swallow active season, the person must ensure that barn swallow are excluded from any part of the building or structure that is the object of the activity by doing the following before the barn swallow active season begins:
    - removing from the building or structure any existing barn swallow nests that may be impacted by the activity, and
    - installing tarps and netting or taking other such measures to prevent barn swallow from accessing any part of the building or structure that is the object of the activity;
- provide reports to the Ministry as per the timing and details provided in Section 23.5 of the O. Reg. 242/08.

It is our understanding that the Barn Swallow has been registered for this site under the ESA and that mitigation to exclude the species from former nesting locations will be put in place. As such, based on comments received by MECP as part of the EA review process no authorizations will be required.

4.9 Species of Conservation Concern

The mitigation measures provided above for plants, birds, and endangered and threatened species will prevent adverse effects on the species of conservation concern present in the study area.

5 SUMMARY AND CONCLUSIONS

This TSD provides a terrestrial environmental baseline, as well as an assessment of the potential environmental effects of the proposed project on the terrestrial environment and the recommended mitigation measures to minimize these effects. The report also includes an evaluation of potentially significant natural heritage values to evaluate compliance with federal and provincial legislation and policies.

During proposed Project construction, potential effects on the terrestrial environment may occur due to fugitive dust, combustion emissions, noise, blasting, soil erosion, incidental spills, hazardous materials use, waste generation, vegetation clearing, partial plantation loss, increased human activity and displacement of nesting birds and turtles. Based on an assessment of the available baseline information and potential effects, as well as the implementation of the recommended mitigation measures, it is concluded that effects during construction can be effectively mitigated, and most of them will be localized and short-term.

During the operation of the proposed Project, potential effects on the terrestrial environment may occur due to noise, incidental spills, etc. Based on assessment of the baseline information and potential effects, it is concluded that the operation of the proposed Project will have negligible long-term effects on the terrestrial environment.

Environmental protection during proposed project construction and operation will be ensured by adherence to the site-specific Environmental Management Plan, as well as compliance with regulatory standards and guidelines.

The Environmental Management Plan ensures that environmental protection will be achieved during construction by describing government agency requirements, proposed Project commitments and recommended mitigation measures to be undertaken. The Environmental Management Plan will include the Erosion and Sediment Control Plan, Spills Emergency Preparedness and Response Plan, Hazardous Materials Management Plan, Waste Management Plan and Site Rehabilitation Plan.

During construction and operation, an Environmental Compliance Monitoring Program will be implemented to ensure all construction and operation related commitments are met. Details on the Environmental Compliance Monitoring Program is provided in the Environment Report.

Table 5-1 summarizes potential construction and operation effects, the recommended mitigation/remedial measures to minimize or obviate these effects and the net effects.

Table 5–1. Summary of Potential Effects and Recommended Mitigation/Remedial Measures

Effect	Recommended Mitigation/Remedial Measure	Net Effect
Construction		
Air quality/fugitive dust	• Use of well-maintained equipment to minimize combustion emissions. • Use of water trucks and/or sprinklers (e.g., Cheminfo, 2005).	Negligible effect
Noise	• Use of well-maintained equipment and noise silencers (as required).	Negligible effect
Blasting	• Adherence to blasting engineer recommendations.	Negligible effect
Soil erosion	• Adherence to Erosion and Sediment Control Plan.	Negligible effect
Incidental spills of oil, gasoline and other liquids during construction	• Adherence to Spills Emergency Preparedness and Response Plan.	Negligible effect
Hazardous materials/ waste	• Adherence to Hazardous Materials Management Plan and Waste Management Plan. • Waste disposal in accordance with regulatory requirements.	Negligible effect
Vegetation clearing	• Adherence to standard construction practices. • Implementation of the Site Rehabilitation Plan.	Negligible effect
Traffic	• Monitor numbers of wildlife killed or injured via road traffic. Increase worker education if problem is warranted.	Negligible Effect
Harm rare plant, Woodland Pinedrops	• Avoid all locations of the plant if possible. • Physically delineate the limits of a buffer (protection zone) around the plants with flagging or staking. • Determine the size of the protection zone based on local conditions. • If all plants cannot be retained, then retain the plants and locations with the highest long-term viability.	Negligible effect
Increased human activity	• No harassment of wildlife. • No fishing, hunting or recreational ATV use.	Negligible effect
Disturbance, damage or destruction of bird nests, eggs or young	• Use of well-maintained equipment and noise silencers (as required) • Vegetation clearing should not be conducted during the migratory bird nesting season.	Negligible effect

Effect	Recommended Mitigation/Remedial Measure	Net Effect
Harm/harass endangered Blanding's Turtle and/or damage/destroy habitat	• Qualified Professional to provide species at risk awareness training for OPG staff and all workers that will be on-site. • Develop and adhere to site-specific response protocols for turtles and other wildlife encounters. • Incorporate "tailgate" education material for species at risk developed by Pembroke MNRF. • Erect three turtle/snake crossing awareness signs (one on Generating Station Lane, one on Calabogie Island Road, and one on the temporary haul road). • Erect temporary exclusion fencing as shown in Figure 4-2 to prevent turtles from moving into areas of active construction and motorized vehicle traffic. • Exclusion fencing to be installed can double as sediment fencing but must meet the specifications recommended in the most recent version of MNRF's guidance document *Reptile and Amphibian Exclusion Fencing.* • The haul road and deposition area should be 30 metres from the boundary of wetlands so that the development footprints are outside of Category 2 Blanding's Turtle habitat.	Negligible effect
Harm/harass threatened Barn Swallow	• Follow Section 23.5 of provincial O. Reg. 242/08	Negligible effect
Harm/harass endangered bat species and/or damage/destroy habitat	• Any removal of potential bat habitat trees should be completed outside of the active season for bats (no habitat tree removal between April 1 and October 1). • No authorizations specific to bats under the ESA would be required if trees were cleared outside of the bat active season (April 1 to October 1). If these activities cannot be completed during this timing window and tree clearing is proposed between April 1 and October 1, then MECP must be contacted to obtain further direction prior to removal of any trees.	Negligible effect
Operation		
Noise	• Ambient noise levels will be localized.	Negligible effect
Incidental spills of oil, gasoline and other liquids during operation	• Adherence to Spills Emergency Preparedness and Response Plan.	Negligible effect

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7 ACRONYMS AND ABBREVIATIONS

Acronyms

~	Approximately
$	Dollar
=	Equals
≥	Greater than or equal to
>	Greater than
<	Less than
≤	Less than or equal to
-	Minus
#	Number
+	Plus
A	Abundant or Abundant to Common
ACNBC	Associate Committee on the National Building Code
AES	Atmospheric Environment Service
AMEC	AMEC Earth & Environmental
AoC	Area of Concern
ATV	All-terrain vehicle
Beacon	Beacon Environmental
BMP	Best Management Practice
B.P.	Before present
c.	Chapter
C	Common
CEAA	*Canadian Environmental Assessment Act*
CEAA 2012	*Canadian Environmental Assessment Act, 2012*
cf.	confer (compare with)
Cheminfo	Cheminfo Services Inc.

CLI	Canada Land Inventory
CO	Carbon monoxide
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
COSSARO	Committee on the Status of Species at Risk in Ontario
CR	Conservation Reserve
CRP	Coral Rapids Power Inc.
CWS	Canadian Wildlife Service
DBC	Design Build Contractor
DFO	Department of Fisheries and Oceans
Dr.	Doctor
EA	Environmental Assessment
EA Act	*Environmental Assessment Act*
EBR	Environmental Bill of Rights
Ed.	Editor
e.g.	For example (exempli gratia)
ELC	Ecological Land Classification
EMF	Electric and magnetic fields
EPRI	Electric Power Research Institute, Inc.
ER	Environmental Report
ESA	*Endangered Species Act*
et al.	And others (et alia)
etc.	And so on (et cetera)
F	Frequent
FSL	Full Supply Level
Golder	Golder Associates Limited
GPS	Global Positioning System
GS	Generating Station
H	Horizontal
Hydro One	Hydro One Networks Inc.
ICNIRP	International Commission on Non-Ionizing Radiation Protection
i.e.	That is (id est)

IESO	Independent Electricity System Operator
Inc.	Incorporated
KGS Group	Kontzamanis, Graumaun, Smith, MacMillan Inc.
LP	Limited Partner
L/V	Landform/vegetation
Max.	Maximum
MeHg	Methylmercury
MNR	Ontario Ministry of Natural Resources
MOE	Ontario Ministry of the Environment
MoU	Memorandum of Understanding
N	North
na	Species not listed or no status provided
NA	Not applicable
NHIC	Natural Heritage Information Centre
NO_x	Nitrogen oxides
NRVIS	Natural Resources Values Information Centre
NW	Northwest
O	Occasional or Occasional to Infrequent
OBM	Ontario Base Map
OGS	Ontario Geological Survey
OMMAH	Ontario Ministry of Municipal Affairs and Housing
OPG	Ontario Power Generation Inc.
OWA	Ontario Waterpower Association
OWA Class EA	Class Environmental Assessment for Waterpower Projects
pers. comm.	Personal communication
PM	Particulate matter
PPCRA	*Provincial Parks and Conservation Reserves Act*
Project	New Post Creek Hydroelectric Project or New Post Creek Project
PTTW	Permit-To-Take-Water
R	Rare
ROW	Right-of-way

S	South or Scarce
S1	Critically imperiled – due to extreme rarity (often five or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the Province
S1S2	Critically imperiled to imperiled
S2	Imperiled – because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the Province
S2?	Imperiled, rank uncertain
S2S3	Imperiled to vulnerable
S3	Vulnerable – due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
S3?	Vulnerable, rank uncertain
S3S4	Vulnerable to apparently secure
S4	Apparently secure – uncommon but not rare with some cause for long-term concern due to declines or other factors
S4?	Apparently secure, rank uncertain
S4S5	Apparently secure to secure
S5	Secure – common, widespread and abundant in the Province
SAR	Species at risk
SARA	*Species at Risk Act*
SARO List	Species at Risk in Ontario List
S.C.	Statutes of Canada
SH	Possibly extirpated (historical) – species occurred historically in the Province, and there is some possibility that it may be rediscovered. Its presence may not have been verified in the past 20 to 40 years.
SIA	System Impact Assessment
SNA	Not applicable – a conservation status rank not applicable because the species is not a suitable target for conservation activities
SNR	Not ranked, conservation status not yet assessed
SO_2	Sulphur dioxide
sp.	One species
spp.	Two or more species

ssp.	Subspecies
SW	Southwest
THg	Total mercury
TSD	Technical Support Document
V	Vertical
var.	Variety
VC	Very common
VOCs	Volatile organic compounds
W	West
WMP	Water Management Plan
WMU	Wildlife Management Unit
USFWS	United States Fish and Wildlife Service

Measurement Units

°	Degree
‘	Minute
“	Second
cm	Centimetre
dBA	A-weighted sound pressure level
°C	degree Celsius
°F	degree Fahrenheit
GWh	gigawatt-hour
h	Hour
ha	hectare
km	Kilometre
km^2	square kilometre
km/h	kilometre per hour
kV	Kilovolt
L	Litre
m	Metre
m.a.s.l.	metre above sea level
mm	Millimetre
m^2	square metre

m^3	cubic metre
m^3/s	cubic metre per second
MW	Megawatt
µg/g	microgram per gram
NMm^3	net merchantable cubic metres
%	Percent
rpm	revolution per minute

8 GLOSSARY

Alluvium	Material deposited by rivers.
Amphibole	A group of double chained inosilicate minerals whose basic chemical unit is the tetrahedron (SiO_4); they are common rock forming minerals and are found in most igneous and metamorphic rocks.
Anode Cathodic Protection	Technique use to control corrosion of a metal surface by making it a cathode of an electrochemical cell by connecting the metal to be protected with another more easily corroded metal to act as the anode of the electrochemical cell.
Anthropogenic	Man-caused; due to man's activities.
Argillaceous	Describing rocks or sediments containing particles that are silt- or clay-sized, <0.625 mm in size.
Avifauna	Birds.
Basalt	A fine-grained, dark-coloured volcanic rock, the extrusive equivalent of gabbro.
Bedload	The solid debris transported in a stream on or near its bed; because this material is too heavy to be carried in suspension, it is moved by rolling, sliding or saltation (sudden jumps) along the bottom.
Biotite	Common rock-forming mineral of the mica group
Breccia	A clastic rock composed of broken, angular rock fragments larger than 2 mm in diameter and enclosed in a fine-grained matrix.
Bulkhead	A steep or vertical wall retaining an embankment, often used to line shorelines, maintain embankment stability and absorb the energy of waves and currents.
Cambrian Period	The oldest period of the Paleozoic Era; it began about 600 million years ago and lasted perhaps 100 million years; during this time, the seas teemed with primitive invertebrate fish.
Canal	A channel dug or built to carry water.
Capacity	The greatest load which a unit, station or system can supply (usually measured in kilowatts, megawatts, etc.).
Cenozoic Era	The most recent geologic era which began with the end of the Cambrian Period, about 70 million years ago.
Cervid	Pertaining to the deer family (Cervidae).
Chlorophyll	A class of pigments found in all photosynthetic organisms; chlorophyll molecules are the principal sites of light absorption in the light reaction of photosynthesis.
Chlorosis	Loss or reduction of green plant pigment or chlorophyll; generally, yellowing.

Clastic	Rock typically composed of broken rock fragments, e.g., conglomerate and sandstone.
Cofferdam	A temporary dam made of concrete, rockfill, sheet-steel piling, timber/timber-crib or other non-erodible material and commonly utilized during construction to exclude water from an area in which work is being executed.
Conglomerate	A clastic sedimentary rock consisting of more or less rounded rock particles at least 2 mm in diameter, embedded in a fine-grained matrix of sand or silt.
Crepuscular	Appearing (active) in twilight.
Crest gate (control gate)	The gate that controls water flow into a hydroelectric dam.
Dam	A concrete or earthen barrier constructed across a river and designed to control water flow or create a reservoir.
Deciduous Forest	In the Northern Hemisphere, this forest type occurs to the south of the coniferous forest and is dominated by broadleaved deciduous hardwood trees typically with a five- to six-month growing period.
Diabase	Fine-grained intrusive igneous rock of a composition similar to basalt, but is slightly more coarse-grained.
Dike	The vertical veins of igneous rock that form when magma enters and cools in fractures found within the crust.
Draft tube	The flared passage leading vertically from a water turbine to its tailrace.
Dyke	Embankment against flooding.
Ecodistrict	A subdivision of an ecoregion based on distinct assemblages of relief, geology, landform, soils, vegetation, water and fauna; an ELC system mapping unit usually mapped at a scale of 1:500,000 to 1:125,000.
Ecological Land Classification (ELC)	The Canadian classification of lands from an ecological perspective; an approach that attempts to identify ecologically similar areas.
Ecoregion	An area characterized by a distinctive regional climate as expressed by vegetation; an ELC system mapping unit usually mapped at a scale of 1:3,000.000 to 1:1,000,000.
Ecosite	A landscape area consisting of typical, recurring associations of vegetation types and substrate types combinations; an ELC system mapping unit usually mapped at a scale of 1:50,000 to 1:10,000.
Electric and Magnetic Fields (EMF)	Electric fields are produced by voltage and increase in strength as the voltage increases. Magnetic fields result from the flow of current through wires or electrical devices and increase in strength as current increases.
Endangered	A species facing imminent extirpation (no longer existing in the wild in Canada, but occurring elsewhere) or extinction (no longer exists).

End (Terminus) Moraine	Ridge of till deposited at the terminus of a glacier.
Ericaceous	Plants belonging to the Heath (Ericaceae) family; require acidic soil with pH less than 7
Esker	A long, narrow ridge of poorly stratified glaciofluvial sand and gravel, usually deposited by a subglacial stream between banks of ice.
Extirpation	Elimination of a species in the wild of a particular area (e.g., Canada), but occurring elsewhere.
Feldspar	A group of common aluminum silicate minerals that contains potassium, sodium or calcium; the most important group of rock-forming minerals, making up about 60% of the rocks in the earth's crust.
Feldspathoid	A mineral chemically similar to feldspar but containing less silica.
Felsic Igneous	An igneous rock having abundant light-coloured minerals (quartz, feldspars, feldspathoids, muscovite) in its mode.
Ferro-humic Podzols	Well and imperfectly drained soils that have developed under coniferous and mixed-forest vegetation and intermediate moisture conditions and usually found in cold to temperate climates on acid parent materials.
Fluvial	Of watercourses.
Forb	A herbaceous flowering plant that is not a graminoid (rushes, grasses and sedges).
Forebay	The part of a dam's reservoir that is immediately upstream from the powerhouse.
Freshet	High flows caused by snow melt, runoff, heavy rains and/or high inflows.
Gabbro	A coarse-grained plutonic rock containing plagioclase feldspar, most commonly labradorite.
Garnetiferous	Exhibiting a common crystal structure but varying in occurrence and also in chemical and physical properties.
Generator	A machine that changes water power, steam power, or other kinds of mechanical energy into electricity.
Geotechnical	Concerned with the physical properties of soil, rock and groundwater usually in relation to the design, construction and operation of engineered works.
Glaciofluvial	Of glacial watercourses.
Glaciolacustrine	Of glacial lakes.
Gleysol	An order of soils developed under wet conditions and permanent or periodic reduction.
Gneiss	A coarse-grained metamorphic rock commonly composed of quartz and feldspar, with lesser amounts of mica.

Graminoid	Includes rushes (Juncaceae), grasses (Poaceae) and sedges (Cyperaceae).
Granite	Medium to coarse grained igneous rock that is rich in quartz and potassium feldspar.
Granodiorite	A plutonic rock consisting essentially of quartz, sodic plagioclase and lesser amounts of hornblende and biotite.
Granulite complex	Metamorphic rock formation composed of equal-sized interlocking grains.
Head	The difference in elevation between the water surface at the intake and tailrace.
Headpond	The reservoir from which the hydroelectric facility draws water flow for generation.
Headwater	The section of a river or stream with the highest elevation above sea level.
Herb (Herbaceous)	A non-woody vascular plant.
Hibernacula	A protected area with stable non-freezing temperatures, such as a burrow, where snakes survive the winter.
Holocene Epoch	The last (recent; postglacial) epoch of the Quaternary Period; it began at the end of the Pleistocene Epoch, about 10 million years ago and continues to the present.
Hornblende	Dark green to black rock-forming mineral of the amphibole group found in both igneous and metamorphic rocks.
Hydraulic	Of water conveyed through a pipe or channel.
Hydric	Containing water.
Igneous	Rocks formed from the solidification of molten magma either beneath (intrusive igneous rock) or at (extrusive igneous rock) the earth's surface.
Intake	A structure which regulates the flow of water into a water-conveying conduit.
Ion	An atom that is either negatively or positively charged.
Labradorite	A plagioclase feldspar that is the major constituent of gabbro and basalt.
Lacustrine	Of lakes.
Lentic	Slow flowing or still water, e.g., in ponds and lakes.
Lithification	Process by which sediments are consolidated into sedimentary rock.
Lotic	Flowing water, e.g., in streams and rivers.
Luvisols	Well and imperfectly drained soils that have developed under deciduous or mixed forest cover in moderate and cool climates.
Mafic	Rock that is rich in calcium, magnesium and iron content.

Magma	Molten or fluid material generated from rock deep within the earth that may force its way upward into the crust (as igneous rock) or onto the surface (as lava).
Marsh	Standing or slow-moving water with emergent plant cover >25%, permanently flooded, intermittently exposed, or seasonally flooded.
Mesozoic Era	The era of geologic time from the end of the Paleozoic, 225 million years ago, to the beginning of the Cenozoic, about 70 million years ago (called the “Age of Reptiles”).
Metamorphic	A rock that forms from the recrystallization of igneous, sedimentary or other metamorphic rocks through pressure increase, temperature use, or chemical alteration.
Metamorphism	A process that produces a change in the chemistry, structure or mineralogic composition of solid rock, usually due to temperature and/or pressure changes.
Metasedimentary	Metamorphosed sedimentary rock (despite metamorphism, the original sedimentary rock protolith can be recognized).
Metavolcanic	Metamorphosed volcanic rock (despite metamorphism, the original igneous rock protolith can be recognized).
Mica	Silicate mineral that exhibits a platy crystal structure and perfect cleavage.
Migmatite	A rock of both metamorphic and igneous origin that exhibits characteristics of both rocks, probably formed through the heating (but not melting) of rocks in the presence of abundant fluids.
Mixwoods Forest	A mixture of coniferous and deciduous forests.
Moraine	A landform generally composed of till and created by glacial action.
Muscovite	A mineral, hydrous potassium aluminum silicate, a member of the mica group of minerals and commonly known as white mica.
Necrosis	Death of living tissues, characterized by browning and drying.
Organic	Soils that have developed from accumulations of organic materials such as grasses, reeds, rushes, sedges, mosses and ferns.
Outwash	Detritus and waste materials carried away by the water of melting glaciers.
Overburden	The soil, rock and other material which lies on top of the underlying mineral or other deposit, e.g., bedrock
Paleozoic Era	The era of geologic time from the end of the Precambrian, 600 million years ago, to the beginning of the Mesozoic Era, about 225 million years ago; the beginning of Paleozoic time, which marks the start of the first accurate records in geologic history, is characterized by the appearance and development of the major types of invertebrates.
Passerines	Perching birds (of the Order Passeriformes).

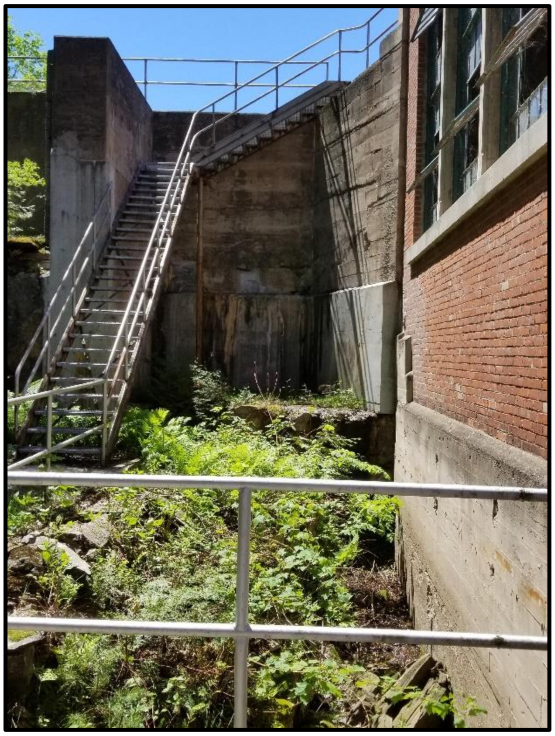
Peat	Partly decomposed plant material; refers to soil containing >30% organic matter by weight.
Pegmatite	An extremely coarse-grained igneous body closely related genetically to large masses of fine-grained plutonic rocks; it may be present as a vein or a dike in the granular igneous rock, but more commonly is found completely enclosed within the neighbouring country rock.
Peneplain	A low almost featureless surface reflecting a base level of erosion.
Penstock	A structure associated with a hydroelectric station, designed to carry water from the intake to the turbine.
Perennial	Continuing, enduring or growing through the year or through many years.
pH	Indicates the balance between the acids and bases in water and is a measure of the hydrogen ion concentration in solution.
Photosynthesis	The process which takes place in green plants by which simple sugars are manufactured from carbon dioxide, water and mineral nutrients with the aid of chlorophyll within the plant cells in the presence of light.
Pier	As part of a hydroelectric station, an abutment extending from the station, either upstream or downstream, and lending foundation support and directionality to water passed through the structure.
Plagioclase	A type of feldspar that is rich in sodium and calcium.
Pleistocene Epoch	The earliest epoch of the Quaternary Period; it began 2 to 3 million years ago and lasted until the Holocene Epoch, approximately 10,000 years ago and was a time of widespread continental glaciation.
Pluton	Any rock of molten origin that forms a large body within the earth's crust when it solidifies.
Pneumatic	Involving the mechanic properties associated with air or other gas pressure.
Powerhouse	A primary part of a hydroelectric facility where the turbines and generators are housed and where power is produced by falling water rotating turbine blades.
Precambrian	Encompasses the time between the origin of the earth and the appearance of complex forms of life about 600 million years ago, and is believed to be equivalent to as much as 90% of the earth's 405-billion-year history.
Proglacial Lake	Formed either by the damming action of a moraine or ice dam during the retreat of a melting glacier, or one formed by meltwater trapped against an ice sheet due to isostatic depression of the crust around the ice.
Protolith	Pertaining to the previous mineralogical composition/structure.
Pyroxene	One of a group of minerals closely related in structure, chemical composition and physical properties; the pyroxenes are inosilicates in which the SiO_4 tetrahedrons are linked into chains by sharing oxygens.
Qualified Professional	A person with particular expertise who is trained or qualified in a specific area.

Quartz	A mineral: an oxide of silicon which is abundant and widespread occurring as an important constituent in many igneous, sedimentary and metamorphic rocks.
Quaternary Period	The second and youngest period of the most recent Cenozoic Era (also called the Age of Mammals); the Quaternary Period began 2 to 3 million years ago and consists of two epochs, the Pleistocene and the Holocene (known also as Recent).
Reservoir	A body of water collected and stored in an artificial lake behind a dam.
Rhizome	Prostrate root like stem emitting roots; rootstock.
Riparian	Of or on a river bank.
Runner	An enclosed water wheel that transforms the static and kinetic energy of the water into useful work.
Sandstone	A type of sedimentary rock that contains a large quantity of weathered quartz grains.
Sedimentary	Rock formed by the deposition, alteration and/or compression and lithification of weathered rock debris, chemical precipitates, or organic sediments.
Sluice	An open channel designed to divert excess water which could be within the structure of a hydroelectric dam or separate of the main dam (see spillway).
Sluice gate	Gate used to regulate the flow of water through an opening usually used to pass water over or around dams.
Sodic	Containing sodium.
Special Concern	A species with characteristics that make it particularly sensitive to human activities or natural events.
Species	A group of closely related individuals which can and normally do interbreed to produce fertile offspring.
Sphagnum	Moss.
Spillway	A passageway, or channel, located near or at the top of a dam through which excess water is released or “spilled” past the dam without going through the turbine(s); as a safety valve for the dam, the spillway must be capable of discharging major floods without damaging the dam while maintaining the reservoir level below some predetermined maximum level.
Stop log	A gate (sometimes made from squared lumber) which can be placed into an opening to shut off or regulate the flow of water.
Swamp	Wooded mineral wetland or peatland.
Tailrace	A channel through which the water flows away from a hydroelectric plant following its discharge from the turbine(s).
Tailwater	The water from a generating station after it has passed through the turbine.

Talus	A sloping heap of loose rock fragments lying at the foot of a cliff or steep slope.
Terrestrial	Belonging, living on or growing in the earth or land.
Threatened	A species likely to become endangered if limiting factors are not reversed.
Till	Material derived from bedrock and overlying unconsolidated material and deposited directly by glacial ice with its characteristics dependent on the source rocks.
Trash rack	Bar screen with larger space openings installed to prevent logs, stumps and other larger solids from penetrating the intake.
Turbine	A mechanism in an electrical generation facility which converts the kinetic and potential energy of water (in the case of hydroelectric turbines) into mechanical energy which is then used to drive a generator converting mechanical to electrical energy.
Varved	Characterized by a pair of thin sedimentary layers, one thicker and one thinner, deposited within a one-year period.
Vascular	Made up of vessels or ducts for conveying water.
Weir	A dam in the river to stop and raise the water.

APPENDIX A

Photographs



Photograph 1. East Side of Generating Station Where Bat Exit Surveys were Conducted (2018-05-29).

Photograph 2. West Side of Generating Station (2015-11-21).

Photograph 3. Crow or Raven Nest on Southwest side of Generating Station (2017-04-26).

Photograph 4. Laneway North of South Channel (2018-08-24).

Photograph 5. ELC Unit 8a After Tornado (2019-04-24).

Photograph 6. ELC Unit 8a After Tornado (2019-04-24).

Photograph 7. Laneway North of South Channel (2018-08-24).

Photograph 8. Laneway North of South Channel After Tornado. Area Shown is Close to Photograph 7 Location (2018-12-12).

Photograph 9. Cultural Meadow Community (2015-11-12).

Photograph 10. Cultural Meadow Community Regularly Disturbed for Gravel and Equipment Storage (2017-06-17).

Photograph 11. Cultural Meadow Community Where Historical Blast Rock Fill Has Limited Succession (2015-11-12).

Photograph 12. Cultural Thicket Community (2017-06-17).

Photograph 13. Looking North to Bridge (2017-06-17).

Photograph 14. ELC Unit 4b Where Soil Formation Has Been Limited by the Blast Rock Substrate (2017-07-25).

Photograph 15. ELC Unit 6 (2018-12-12).

Photograph 16. ELC Unit 7a (2018-08-24).

Photograph 17. ELC Unit 7a (2018-08-24).

Photograph 18. ELC Unit 7a After the Tornado (Trees Felled by Winds on the Right) (2018-12-12).

Photograph 19. ELC Unit 8a (2015-11-12).

Photograph 20. ELC Unit 8c (2017-07-25).

Photograph 21. ELC Unit 8a with Forebay in the Foreground (2017-04-26).

Photograph 22. Wetland drainage before it flows under blast rock in ELC Unit 8c (2019-04-24).

Photograph 23. ELC Unit 9a, South Channel of Madawaska River (2017-04-26).

Photograph 24. ELC Unit 9a, South Channel of Madawaska River (2017-04-26).

Photograph 25. ELC Unit 9b, Forebay (2017-04-26).

Photograph 26. ELC Unit 9b, Forebay (2017-06-07).

Photograph 27. Forebay De-watered for Maintenance, Looking Towards Trash Racks and Generating Station (2018-08-24).

Photograph 28. Forebay De-watered for Maintenance, Looking Towards Bridge (2018-08-24).

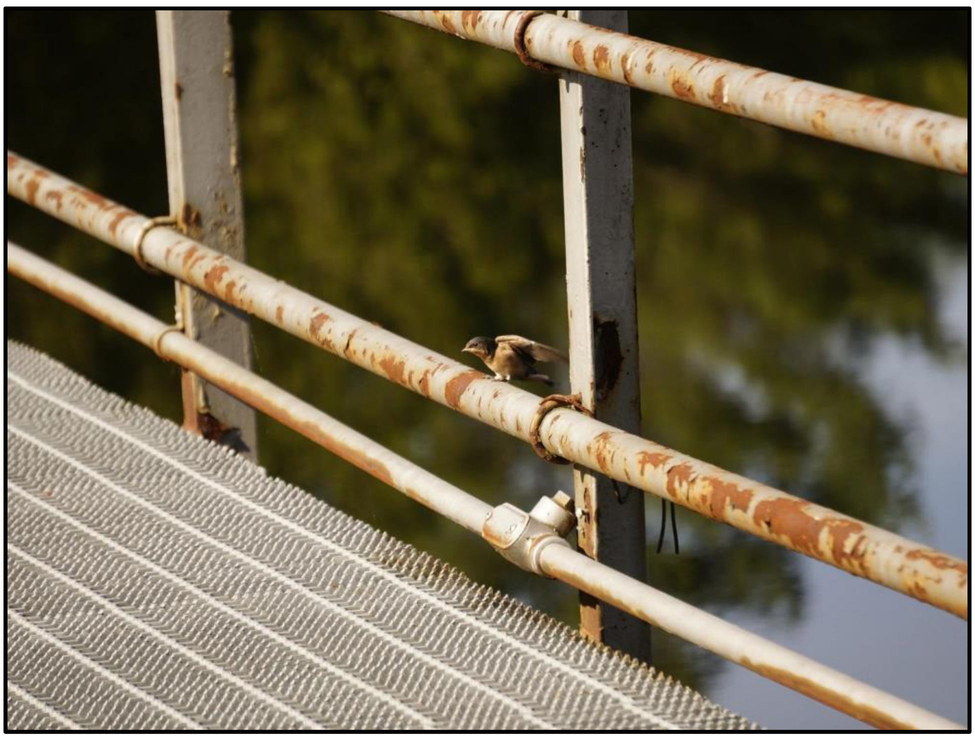
Photograph 29. Part of ELC Unit 10 Beyond Study Area That Drains into Study Area (2019-04-24).

Photograph 30. ELC Unit 11 (2019-04-24).

Photograph 31. Drainage from Wetland (ELC Unit 10b) Flowing into Culvert (2019-04-24).

Photograph 32. Wildlife Acoustics SM4BAT Unit Equipped with SMM-U1 Ultrasonic Microphone Mounted on Tree to Monitor Bat Vocalizations (2017-06-17).

Photograph 33. Eastern Phoebe on Nest Under Trash Racks (2018-06-26).



Photograph 34. Fledgling Barn Swallow (2018-06-26).

Photograph 35. SM4 Unit from Wildlife Acoustics Mounted on Tree to Monitor Bird Vocalizations (2017-06-17).

Photograph 36. Snapping Turtle Nest Excavated by a Predator (2018-06-26).

Photograph 37. Snapping Turtle Egg Shells at Nest Excavated by a Predator (2018-06-26).

Photograph 38. Barn Swallow Condo with Capacity for Approximately 10 Nest Cups (2018-05-15).

Photograph 39. Nest Cup in Barn Swallow Condo. Mud Added to Stimulate Nesting (2018-05-15).

APPENDIX B

List of Flora

Appendix B

Vascular Plants

Scientific Name	Common Name	COSEWIC	SARO	SRank
Abies balsamea	Balsam Fir			S5
Acer negundo	Manitoba Maple			S5
Acer rubrum	Red Maple			S5
Acer saccharinum	Silver Maple			S5
Acer saccharum	Sugar Maple			S5
Acer spicatum	Mountain Maple			S5
Achillea millefolium	Common Yarrow			SE
Actaea pachypoda	White Baneberry			S5
Ambrosia artemisiifolia	Common Ragweed			S5
Anaphalis margaritacea	Pearly Everlasting			S5
Apocynum androsaemifolium	Spreading Dogbane			S5
Aralia nudicaulis	Wild Sarsaparilla			S5
Arctium minus	Common Burdock			SE5
Asclepias syriaca	Common Milkweed			S5
Betula alleghaniensis	Yellow Birch			S5
Betula papyrifera	Paper Birch			S5
Bromus inermis	Smooth Brome			SE5
Carex arctata	Drooping Woodland Sedge			S5
Centaurea stoebe	Spotted Knapweed			SE5
Cornus canadensis	Bunchberry			S5
Cornus rugosa	Round-leaved Dogwood			S5
Cornus sericea	Red-osier Dogwood			S5
Daucus carota	Wild Carrot			SE5
Dirca palustris	Eastern Leatherwood			S4
Echium vulgare	Common Viper's Bugloss			SE5
Elymus repens	Creeping Wildrye			SE5
Epipactis helleborine	Eastern Helleborine			SE5
Erythronium americanum	Yellow Trout-lily			S5
Eurybia macrophylla	Large-leaved Aster			S5
Eutrochium maculatum	Spotted Joe Pye Weed			S5
Fagus grandifolia	American Beech			S4
Fraxinus americana	White Ash			S4
Fraxinus nigra	Black Ash			S4
Juniperus communis	Common Juniper			S5
Leucanthemum vulgare	Oxeye Daisy			SE5
Lotus corniculatus	Garden Bird's-foot Trefoil			SE5
Lysimachia borealis	Northern Starflower			S5
Maianthemum canadense	Wild Lily-of-the-valley			S5
Melilotus albus	White Sweet-clover			SE5
Melilotus officinalis	Yellow Sweet-clover			SE5
Monotropa uniflora	Indian-pipe			S5
Oenothera biennis	Common Evening Primrose			S5
Onoclea sensibilis	Sensitive Fern			S5

Scientific Name	Common Name	COSEWIC	SARO	SRank
Ostrya virginiana	Eastern Hop-hornbeam			S5
Oxalis montana	Common Wood-sorrel			S5
Parthenocissus vitacea	Thicket Creeper			S5
Phalaris arundinacea	Reed Canary Grass			S5
Phragmites australis ssp. australis	European Reed			SE5
Picea glauca	White Spruce			S5
Pinus resinosa	Red Pine			S5
Pinus strobus	Eastern White Pine			S5
Plantago major	Common Plantain			SE5
Poa pratensis	Kentucky Bluegrass			S5
Populus balsamifera	Balsam Poplar			S5
Populus grandidentata	Large-toothed Aspen			S5
Populus tremuloides	Trembling Aspen			S5
Pteridium aquilinum	Bracken Fern			S5
Pterospora andromedea	Woodland Pinedrops			S2
Quercus bicolor	Swamp White Oak			S4
Quercus macrocarpa	Bur Oak			S5
Quercus rubra	Northern Red Oak			S5
Rhus typhina	Staghorn Sumac			S5
Ribes cynosbati	Prickly Gooseberry			S5
Rubus canadensis	Smooth Blackberry			S5
Rubus idaeus	Common Red Raspberry			S5
Sambucus racemosa	Red Elderberry			S5
Securigera varia	Common Crown-vetch			SE5
Shepherdia canadensis	Canada Buffalo-berry			S5
Silene vulgaris	Bladder Campion			SE5
Solidago altissima var. altissima	Eastern Tall Goldenrod			S5
Tanacetum vulgare	Common Tansy			SE5
Taraxacum officinale	Common Dandelion			SE5
Thuja occidentalis	Eastern White Cedar			S5
Tilia americana	American Basswood			S5
Toxicodendron radicans	Poison Ivy			S5
Trifolium pratense	Red Clover			SE5
Trillium erectum	Red Trillium			S5
Trillium grandiflorum	White Trillium			S5
Tsuga canadensis	Eastern Hemlock			S5
Typha angustifolia	Narrow-leaved Cattail			SE5
Typha latifolia	Broad-leaved Cattail			S5
Ulmus americana	American Elm			S5
Verbascum thapsus	Common Mullein			SE5
Vicia cracca	Tufted Vetch			SE5
Vitis riparia	Riverbank Grape			S5

COSEWIC: Committee on the Status of Endangered Wildlife in Canada
SARO: Species at Risk in Ontario List
SRank: Subnational Rank for Ontario
Status and Ranks are from the Natural Heritage Information Centre (NHIC) and are current to February 2019

APPENDIX C

List of Breeding Birds

Appendix C

Breeding Birds

Common Name	Scientific Name	Conservation Status
Common Merganser	*Mergus merganser*	AS
Red-breasted Merganser	*Mergus serrator*	AS
Osprey	*Pandion haliaetus*	
Ruffed Grouse	*Bonasa umbellus*	
Wild Turkey	*Meleagris gallopavo*	
Rock Pigeon	*Columba livia*	
Ruby-throated Hummingbird	*Archilochus colubris*	
Belted Kingfisher	*Megaceryle alcyon*	
Yellow-bellied Sapsucker	*Sphyrapicus varius*	AS
Northern Flicker	*Colaptes auratus*	
Pileated Woodpecker	*Dryocopus pileatus*	AS
Eastern Wood-pewee	*Contopus virens*	Special Concern (SARO & COSEWIC)
Eastern Phoebe	*Sayornis phoebe*	
Great Crested Flycatcher	*Myiarchus crinitus*	
Blue-headed Vireo	*Vireo solitarius*	AS
Red-eyed Vireo	*Vireo olivaceus*	
Blue Jay	*Cyanocitta cristata*	
American Crow	*Corvus brachyrhynchos*	
Barn Swallow	*Hirundo rustica*	Threatened (SARO & COSEWIC)
Black-capped Chickadee	*Poecile atricapillus*	
Red-breasted Nuthatch	*Sitta canadensis*	AS
White-breasted Nuthatch	*Sitta carolinensis*	AS
Brown Creeper	*Certhia americana*	AS
Veery	*Catharus fuscescens*	AS
Hermit Thrush	*Catharus guttatus*	AS
American Robin	*Turdus migratorius*	
Cedar Waxwing	*Bombycilla cedrorum*	
Nashville Warbler	*Oreothlypis ruficapilla*	
Yellow Warbler	*Setophaga petechia*	
Chestnut-sided Warbler	*Setophaga pensylvanica*	
Magnolia Warbler	*Setophaga magnolia*	AS
Black-throated Blue Warbler	*Setophaga caerulescens*	AS
Yellow-rumped Warbler	*Setophaga coronata*	
Black-throated Green Warbler	*Setophaga virens*	AS
Blackburnian Warbler	*Setophaga fusca*	AS
Pine Warbler	*Setophaga pinus*	AS
Western Palm Warbler	*Setophaga palmarum palmarum*	
Black-and-white Warbler	*Mniotilta varia*	AS
American Redstart	*Setophaga ruticilla*	AS

Common Name	Scientific Name	Conservation Status
Ovenbird	*Seiurus aurocapilla*	AS
Northern Waterthrush	*Parkesia noveboracensis*	AS
Common Yellowthroat	*Geothlypis trichas*	
Scarlet Tanager	*Piranga olivacea*	AS
Chipping Sparrow	*Spizella passerina*	
Song Sparrow	*Melospiza melodia*	
White-throated Sparrow	*Zonotrichia albicollis*	
Common Grackle	*Quiscalus quiscula*	

AS: Area Sensitive; as per Ministry of Natural Resources and Forestry (MNRF). 2000. Significant Wildlife Habitat Technical Guide (Appendix G). 151 pp plus appendices

SARO: Species at Risk in Ontario List
COSEWIC: Committee on the Status of Endangered Wildlife in Canada

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