



Natural Environment Report

Cumberland Quarry

Severn Aggregates Limited

21 March 2025

➔ The Power of Commitment



Project name		Cumberland Quarry -Natural Environment Report Update- ZBA					
Document title		Natural Environment Report Cumberland Quarry					
Project number		12659220					
File name		12659220 NER DRAFT Cumberland Quarry					
Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
S4	Final	Ed Kellaway, Emma Northey, Candice Talbot, Stacey Zwiers	Chris Ellingwood		Amanda Smith		March 21, 2025

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1. Introduction

GHD Limited (GHD) was retained by Severn Aggregates Limited (the 'Client') to complete a Natural Environment Report (NER) for the Cumberland Quarry project (the 'Project') located on Lots 12, 13 and 14, Concession 11, Severn Township, County of Simcoe (the 'Site'). A Natural Environment Technical Report (NETR) Level 1 and 2 (NEA, 2017) and Bat Habitat Assessment Letter (GHD, 2020) were previously completed for the Project and submitted to the Ministry of Natural Resources (MNR). The NETR report was submitted to MNR in 2017, and a thorough agency review was completed. Agency consultation and site meetings were held as part of our related application under the Aggregate Resources Act (between 2017 and 2020).

The Client is preparing a planning application for approvals under the Planning Act (zoning bylaw amendment and Official Plan amendment) to permit the proposed licensed aggregate operation on these lands. A complete planning submission, that includes supporting documentation, such as the NER report, is being made to Township of Severn and County of Simcoe.

This NER is based on the information contained in the project NETR Level 1 and Level 2 (NEA, 2017), including all ecological field data.

Since the original NETR submission in 2017 for the ARA application, several environmental policies and legislation changes have occurred. Therefore, this NER was updated to reflect these changes including the current Provincial Planning Statement (2024), Ontario Wetland Evaluation System (2023), Township of Severn Official Plan, County of Simcoe Official Plan (Feb. 2023), DFO Fish and Fish Habitat Protection Policy (August 2019) and the Endangered Species Act. The assessment of habitat and impacts on Species at Risk (SAR), has been updated based on the latest status lists (federal and provincial) for the SAR documented on Site.

The site plans were prepared as part of the ARA application and include the technical recommendations from the previous NETR report. These plans have been used to support the NER impact assessment, along with the associated recommendations and mitigation measures.

This report has been prepared to reflect the current provincial and municipal policies and guidelines as they relate to the natural environment. The report was informed by a review of the updated planning and hydrogeology report, and the operational and rehabilitation plans that were part of the ARA application. This includes updated rationale on the buffers from the natural features and reference to the applicable Official Plans and provincial policies, as well as new OWES policies. The Bat Habitat Assessment Addendum (2020) and amphibian survey data, previously submitted as an addendum, have been incorporated into the updated NER report appendix. Figures were also updated to current templates and revised accordingly.

1.1 Scope and Limitations

This report: has been prepared by GHD for Severn Aggregates Limited and may only be used and relied on by Severn Aggregates Limited for the purpose agreed between GHD and Severn Aggregates Limited as set out in section 1 of this report.

GHD otherwise disclaims responsibility to any person other than Severn Aggregates Limited arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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

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

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 1 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

1.2 Site Location and History

The proposed aggregate license is for a limestone quarry on Lots 12, 13 and 14, west half of Concession 11, Township of Severn in Simcoe County, located north of Orillia fronting off Nichols Line (**Figure 1**). The “Site” (Cumberland Quarry) is the entire subject property that is to be licensed under the Aggregate Resources Act (“licensed area”). The proposed licensed area encompasses approximately 138 hectares.

The Site is owned by 1662947 Ontario Inc. (Severn Aggregates Limited) and the present uses are the restoration of farmlands with forestry management taking place from time to time. Severn Aggregates Limited (the applicant) has entered into an Exclusive Agreement with the Land Ownership to pursue licensing of the property to extract and market the limestone resource contained within the Site.

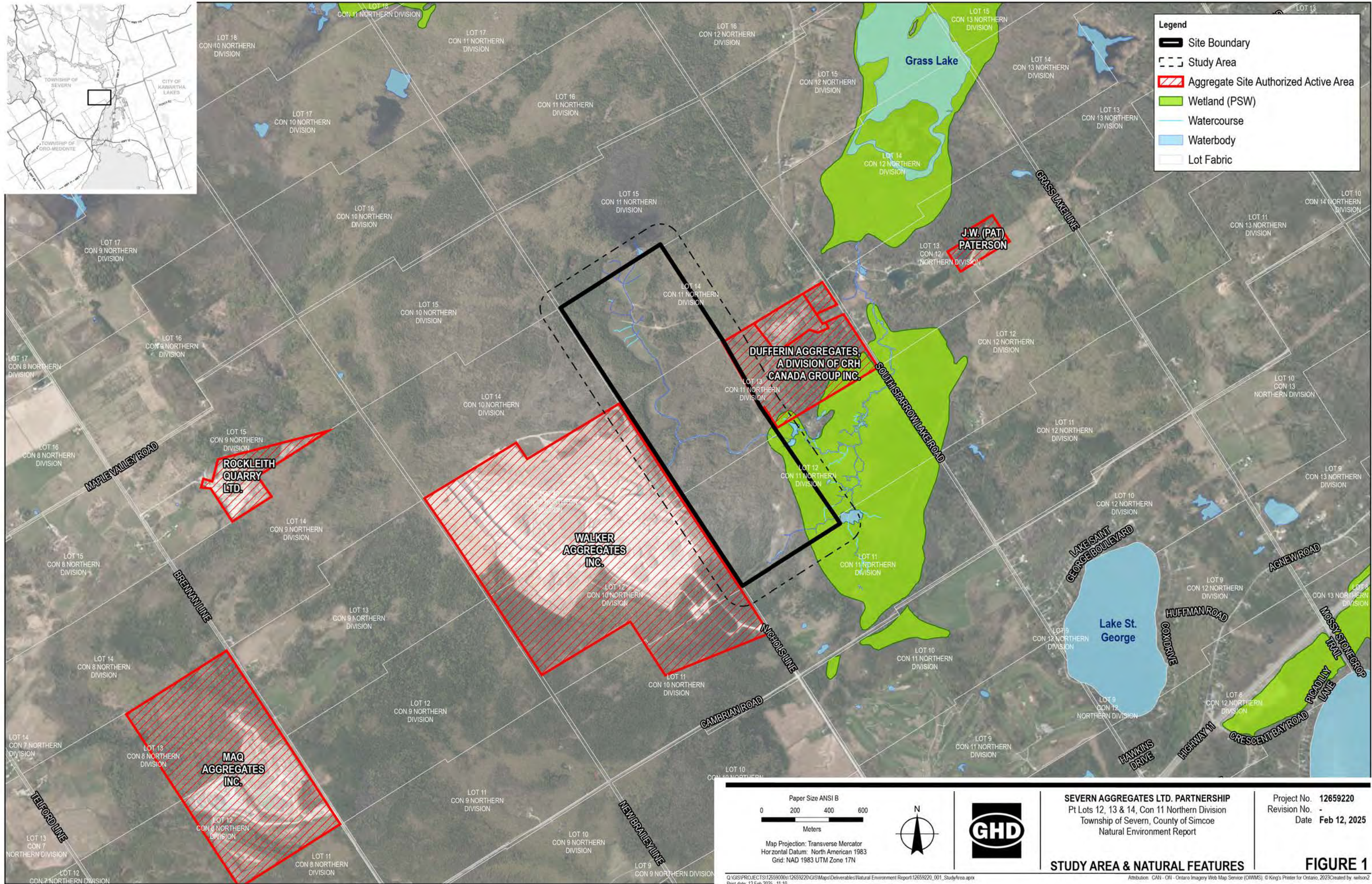
Nichols Line is designated as an “Existing Major Haul Route” in the Township of Severn Official Plan and provides direct access to Highway 11.

Severn Aggregates Limited submitted a related application under the Aggregate Resources Act (ARA) for a quarry below water with a maximum annual tonnage of 500,000 tonnes. It is intended that existing agricultural and forestry uses will be maintained until extraction phases in those areas occur and rehabilitation will return the land to these uses post-extraction.

1.3 Study Area

The “Study Area” for the identification of significant species and natural heritage features extended 120 m beyond the boundary of the proposed “licensed area” or Site as per the requirements of the PPS and Planning Act and local Official Plans. The search for significant species was also extended to 10 km from the licensed area to determine if other features or Species at Risk are present in the surrounding area that could find similar suitable habitat on the property. Additionally, a desktop background review for significant natural features was extended to a 5-kilometer radius to determine the presence of other features in the surrounding area. This 5-kilometer distance also encompasses a larger subset of Species at Risk records, which may assist in determining if similar habitats are present on the Site.

The Study Area did not include lands owned by Severn Pines Quarry and the active licensed quarry extraction area to the west as those are on private property.



1.4 Adjacent Land Use Description

The proposed quarry is situated in a rural landscape with existing licensed quarry operations on both sides, as well as wetlands and forested areas.. The lands immediately adjacent to the southeast consist of the Grass Lake Provincially Significant Wetland, while those to the west contain the existing quarry operation. Some rural housing and farms are located on South Sparrow Lake Road to the east and Brennan Line to the west. Lake St. George is also located 1.7 km southeast. According to Schedule A South Land Use of the Township of Severn, the area surrounding the Site is designated as 'Greenland.' In the Official Plan, 'Greenland' refers to lands throughout the Township that are considered important from a natural heritage perspective (Township of Severn, 2022).

2. Environmental Policy

This section identifies federal, provincial and other regulatory legislation, policies, official plans (OP) and OP amendments that are applicable and relevant to the Subject Area and the immediate vicinity. This includes policies that triggered the study. These documents may identify natural features, Species at Risk, wildlife habitat and other features relevant to this study.

2.1 Federal Legislation

2.1.1 Species at Risk Act (2023)

The Species at Risk Act (SARA 2023) incorporates several prohibitions to protect individuals of listed Threatened (THR), Endangered (END), or Extirpated (EXT) species at risk (SAR) – as designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Per Section 34, Section 58 and Section 61, these prohibitions apply to aquatic species and migratory birds protected by the MBCA, on all lands, and any other listed wildlife species when on federal lands, or any lands if recommended by the Minister of the ECCC to the Governor in Council.

2.1.2 Fisheries Act (1985)

The purpose of the Fisheries Act is to maintain healthy, sustainable and productive Canadian fisheries through the prevention of pollution, and the protection of fish and their habitat. The Fisheries Act provides protection provisions for fish and fish habitat in the form of standards, codes of practice, and guidelines for projects in and near water. These provide guidance on how to avoid and mitigate impacts to fish and fish habitat and comply with the Fisheries Act to avoid causing the death of a fish or harmful alteration, disruption or destruction (HADD) of fish habitat from your work, undertaking or activity.

Projects affecting waterbodies that support fish and fish habitat must comply with the provision of the Fisheries Act. The proponent is responsible for determining if the project is likely to cause impacts to fish and fish habitat and if these impacts can be avoided or mitigated. The proponent must gather information on the type and scale of impact on the fishery and determine if the impacts will result in the death of fish or a HADD of fish habitat. A Request for Review (RFR) should be submitted to Fisheries and Oceans Canada (DFO) if impacts cannot fully be avoided. Following DFO review, if it is determined that the impacts cannot be avoided or mitigated and will result in death of fish or a HADD of fish habitat, an authorization under Subsection 35 (2) of the *Fisheries Act* must be obtained from the DFO. Projects that have the potential to obstruct fish passage or affect flows needed by fish may require an authorization.

2.1.3 Migratory Birds Convention Act (1994 and 2022)

The Migratory Birds Convention Act (MBCA 1994) and Migratory Birds Regulations (MBR – Government of Canada 2022) protect most species of migratory birds and their active nests and eggs. Under the MBR 2022 it is now prohibited to damage, destroy, disturb or remove migratory bird nests when they contain a live bird or viable egg and prohibit the deposit of harmful substances in waters and areas frequented by them. For 18 species of migratory birds identified on Schedule 1, the MBR 2022 provides year-round nest protection until they can be deemed abandoned. The Schedule includes certain migratory birds who either re-use their own nests from one year to the next (colonial species), or whose nests are commonly re-used by other species of migratory bird species, like Pileated Woodpeckers. If the nest of a Schedule 1 species has not been occupied by a migratory bird for the entirety of the waiting time indicated in the MBR 2022, it is considered to be abandoned, and to no longer have high conservation value for migratory birds. Documentation to be provided to show that evidence.

Environment and Climate Change Canada (ECCC) implements policies and guidelines to protect migratory birds, providing guidance on the Environment Canada website to help to minimize the risk of detrimental effects to migratory birds and to achieve compliance with the law (Government of Canada 2022b). Compliance with the MBCA and MBR is best achieved through a due diligence approach based on a site-specific analysis in consideration of the avoidance guidelines on the ECCC website, such as the implementation of timing restrictions to ensure migratory birds and their young have left an area before it is disturbed due to construction or prior to vegetation removal.

The Site has been identified to be within Zone C2 (ECCC 2019) and as such this area of southern Ontario typically has migratory birds nesting between the time period of April 1st to August 31st of every year.

2.2 Provincial Legislation

2.2.1 Endangered Species Act (2007) and Regulations

The purposes of the Ontario Endangered Species Act (ESA 2007) are to:

1. To identify species at risk based on the best available scientific information, including information obtained from community knowledge and aboriginal traditional knowledge;
 2. To protect species that are at risk and their habitats, and to promote the recovery of species that are at risk;
 3. To promote stewardship activities to assist in the protection and recovery of species that are at risk.
- 2007, c. 6, s. 1. (Government of Ontario, 2018)

The ESA clearly defines the five classifications of species status as *extinct*, *extirpated*, *endangered*, *threatened*, or *special concern*, and provides guidelines on the process of species status determination.

Regulations made under this act include: Ontario Regulation 230/08 and 242/08.

Ontario Regulation 230/08 provides the list of Species at Risk (SAR) in Ontario. The list was most recently consolidated on January 29, 2024. Species status provided in the list is assessed by an independent body, the Committee on the Status of Species at Risk in Ontario (SARO), based on the best-available science and Aboriginal Traditional Knowledge.

General habitat protection is afforded to all species listed as *endangered* or *threatened*. General habitat descriptions are technical, science-based documents that have been developed for some of the species that are most likely to be affected by human activity. Further information including a *Recovery Strategy* or *Management Plan* is required for each listed species, on a timeline dictated by the species status.

Ontario Regulation 242/08 explains possible exemptions to the ESA and details on how the purpose of the ESA is to be carried out.

2.2.2 Provincial Planning Statement (2024)

The Provincial Planning Statement, 2024 (PPS) is the statement of the Ontario government's policies on land use planning. It applies province-wide (in the province of Ontario) and provides provincial planning direction on land use planning. Municipalities use the PPS to develop their official plans and to guide and inform decisions on other planning matters. The PPS is issued under Section 3 of the Planning Act and all decisions affecting land use planning matters 'shall be consistent with' the Provincial Planning Statement (MMAH 2024). A complete analysis of the PPS policies can be found in the 2025 Planning Justification Report, prepared by Esher Planning Inc. The Site is located within Ecoregion 6E. Policy Section 4.1 of the PPS 2024 outlines policies for Natural Heritage, and portions relevant to this project include:

- 4.1.4 *Development and site alteration shall not be permitted in:*
 - a. *significant wetlands in Ecoregions 5E, 6E and 7E1; and*
 - b. *significant coastal wetlands.*
- 4.1.5 *Development and site alteration shall not be permitted in:*
 - a. *significant wetlands in the Canadian Shield north of Ecoregions 5E, 6E and 7E;*
 - b. *significant woodlands in Ecoregions 6E and 7E (excluding islands in Lake Huron and the St. Marys River);*
 - c. *significant valleylands in Ecoregions 6E and 7E (excluding islands in Lake Huron and the St. Marys River);*
 - d. *significant wildlife habitat;*
 - e. *significant areas of natural and scientific interest; and*
 - f. *coastal wetlands in Ecoregions 5E, 6E and 7E1 that are not subject to policy 4.1.4.b), unless it has been demonstrated that there will be no negative impacts on the natural features or their ecological functions.*
- 4.1.6 *Development and site alteration shall not be permitted in fish habitat except in accordance with provincial and federal requirements.*
- 4.1.7 *Development and site alteration shall not be permitted in habitat of endangered species and threatened species, except in accordance with provincial and federal requirements.*
- 4.1.8. *Development and site alteration shall not be permitted on adjacent lands to the natural heritage features and areas identified in policies 4.1.4, 4.1.5 and 4.1.6 unless the ecological function of the adjacent lands has been evaluated, and it has been demonstrated that there will be no negative impacts on the natural features or on their ecological functions.*

2.3 Local and Other Regulatory Bodies

2.3.1 Official Plan of Simcoe County (2023)

The Official Plan of the County of Simcoe ("OP"), prepared under Ontario's Planning Act, provides policies for land use planning while addressing economic, social, and environmental impacts. It serves as a framework for approving local municipal plans, amendments, and land subdivision applications. Designed to manage growth in a rapidly developing county, the OP aligns with the Planning Statement (2024, as amended) and balances economic development, community building, and environmental

conservation. It also facilitates coordinated planning with neighbouring municipalities, agencies, and other government levels.

The OP schedule 5.1 (Land Use Designations) show the Site as “Rural”. Permitted land uses for lands denoted as “Rural” include:

- a. those land uses permitted in the Agricultural designation;*
- b. development related to the management or use of resources (subject to section 4.4 and other policies of this Plan as applicable);*
- c. resource-based recreational activities (including recreational dwellings);*
- d. limited residential development, subject to Section 3.7.11;*
- e. home occupations and home industries;*
- f. cemeteries; and,*
- g. other rural land uses.*

As the Site is to be a licenced quarry, the permitted use is subject to the policies of Section 4.4 (Aggregate Developments) and is shown OP schedule 5.2.1 (High Potential Mineral Aggregate Resources).

Mineral Aggregate operations are subject to the following criteria outlined in Section 4.4.1 of the OP:

Mineral aggregate operations are not subject to Sections 3.3.15, 3.3.19, 4.5.6 and 4.5.18 and shall be located according to the following criteria:

- i. Shall not be located in significant wetlands or significant coastal wetlands;*
- ii. Shall not be permitted in significant woodlands, significant valleylands, significant wildlife habitat, significant areas of natural and scientific interest, and coastal wetlands (not subject to 4.4.1(i)) unless it has been demonstrated that there will be no negative impacts on the natural features or their ecological functions; iii.)*
- iii. Shall not be permitted in fish habitat except in accordance with provincial and federal requirements;*
- iv. Shall not be permitted in habitat of endangered species and threatened species, except in accordance with provincial and federal requirements;*
- v. Shall not be permitted on adjacent lands to the natural heritage features and areas identified above unless the ecological function of the adjacent lands has been evaluated, and it has been demonstrated that there will be no negative impacts on the natural features or on their ecological functions;*

2.3.2 Severn Township Official Plan (2010)

The purpose of the Severn Township Official Plan (OP) is to build upon and further detail the general policy direction outlined in the Simcoe County Official Plan. It is tailored to reflect the character, role, and location of the Township within the County. This process has led to the creation of a Land Use Vision for the Township's future.

Schedule A (South Land Use) and Schedule C (Aggregate Resource Potential Area) of the OP shows the Site as a Licensed Pit or Quarry.

3. Background Review

3.1 Literature Review

A review of available background documents included examining existing reports and literature regarding known natural heritage features relevant to the subject lands and vicinity. Mapping by the Ministry of Natural Resources, along with a geographic query of the NHIC database, was conducted to identify occurrences of any designated natural features in the Study Area. These features include wetlands, provincially significant wetlands (PSWs), Areas of Natural and Scientific Interest (ANSIs), rare vegetation communities, and the presence of Species at Risk (SAR) and provincially rare species. A search of the following information sources was also conducted to identify species that may be present on the Site and in the Study Area. These sources included:

- MNR Land Information Ontario (LIO) database mapping and Natural Heritage Information Centre (NHIC) Make a Map tool (2024)
- Ontario Breeding Bird Atlas data (Bird Studies Canada, 2007)
- Ontario Reptile and Amphibian Atlas (Ontario Nature, 2024)
- Aquatic Resource Area - fish species list (OMNR, 2010)
- DFO Aquatic Species at Risk Mapping (Department of Fisheries and Oceans) (DFO, 2025)
- eBird and iNaturalist online databases

Additional sources and literature reviewed for this NER included:

- Natural Heritage Reference Manual (MNRF, 2010)
- Significant Wildlife Habitat Criteria Schedules for Ecoregion 6E. Peterborough, 38pp. (MNRF, 2015)
- Significant Wildlife Habitat Mitigation Support Tool (MNRF 2014)
- Aerial imagery
- Previous reports and data collected for the proposed quarry (NEA 2017)

3.2 Designated Natural Areas

The online MNR Make-a-Map: Natural Heritage Areas Application (MNR, 2025) was accessed to identify designated natural areas located on or within 5km of the Site. This included provincially significant wetlands (PSW's), Areas of Natural and Scientific Interest (ANSI's), and Environmentally Significant Areas (ESA's). The Project is located directly adjacent to the Grass Lake Significant Wetland. MNR mapping also shows several small topographic wetlands (non-evaluated) located within the Study Area and within 120 km. There are no ANSI's within 5km of the Site or within the Study Area.

4. Methodology

4.1 General Approach

This study was completed in four distinct phases. The first phase included a pre-consultation meeting with the Ministry of Natural Resources (MNR) on July 4, 2013. The meeting included a presentation on the Site and proposed operation, as well as potential Species At Risk and fisheries.

In the second phase of the Natural Environment Report, all available information in the Study Area and on Site was collected and reviewed. This included reviewing Official Plan Schedules, key natural feature mapping, air photographs, historical fisheries data and GIS mapping. Two additional meetings with MNR were conducted on March 14, 2013, and March 31, 2014.

The third phase included multi-season and multiple year Site visits by GHD terrestrial and aquatic biologists to confirm the data collected in the literature review and to collect information on species present including vegetation, herpetozoa, birds, fisheries, wetlands and mammals.

In the final phase, the literature review information and field data collected in Phases 2 and 3 were compiled and analyzed to complete a level 1 and level 2 NETR report. The contents of the 2017 report were based on the requirements of the Aggregate Resources Act. GHD worked with the study team including hydrogeologists, noise engineers and the applicant on the phasing, rehabilitation and mitigation measures.

GHD has completed this revised NER report as an update to the original report from 2017. The report adheres to the requirements outlined in the Official Plans and updated policy requirements for an NER report as per the ARA NER Technical Reports and Information Standards (2023). GHD has mapped all key natural heritage features and key hydrologic features, as well as recommended setbacks (**Figure 1, Figure 2, Figure 3**). The impact assessment section, mitigation measures, and recommendations address issues related to trees, wetlands, wildlife, and natural linkages and corridors in the area. The discussion regarding setbacks from the wetland is based on the staked location of the wetland boundary and a detailed assessment of the ecological and hydrological functions of this wetland. Compliance statements are included at the end of our report to demonstrate adherence to the Endangered Species Act and the Township of Severn Official Plan regulations. This report focuses solely on the suitability of the Study Area from a biological perspective and the constraints posed by the presence of natural features, such as wetlands.

4.2 Field Methodology

4.2.1 Vegetation and Plant Communities

4.2.1.1 Ecological Land Classification (ELC and vegetation Survey)

All vegetation communities encountered on the Study Area were inventoried during Site visits. Delineation and classification of the vegetation community types were based on the Ecological Land Classification for Southern Ontario (Lee et al., 1998). Delineation was done to the finest scale possible (e.g., Ecosite or Vegetation Type).

Rare, significant, or unusual species were searched for. Species significance or rarity on a national, provincial, regional and local level was based on published literature and standard status lists. These included SARA (2023), COSEWIC (2023), SARO (2024), Ontario Endangered Species Act (2007) and Varga et al. (2000).

4.2.1.2 Targeted Species at Risk Survey: Butternut Surveys

Visual surveys for butternut were conducted by an experienced biologist and certified Butternut Health Assessor across the entire Site. Any butternut trees found were assessed according to the protocol produced by the Ontario Ministry of Natural Resources and Forestry (2012 and 2021 edition). Information that was recorded as part of butternut health assessments included: tree diameter, crown health, presence of canker (yes/no), canker type (sooty or open) and extent of canker, if present. If hybrid butternuts were suspected, characteristics of the tree were collected and compared against the hybrid criteria as laid out in the Butternut Health Assessment Guidelines. The data was entered into the MNR BHA excel spreadsheet which determines if the tree is Category 1 (non-retainable), Category 2 (retainable) or Category 3 (archivable).

4.2.2 Birds

4.2.2.1 Breeding Birds

Breeding bird surveys were conducted during the peak breeding season. Two sets of surveys were conducted during the peak breeding period (May 24-July 10) approximately 10-15 days apart in three different years (2010, 2012 and 2013) for a total of six sets of surveys on Site. All birds seen or heard within each five-minute point count station period were documented and breeding evidence codes recorded. Surveys were conducted in the early mornings between dawn and 9 am. Sixteen (16) survey point count stations were established across the Subject Property. Location of survey stations are shown in **Figure 2**. The placement of the stations was planned to provide coverage in all habitat types on the Site and spaced based on the listening range of the observer, in forests, edge habitats, open areas, wetlands and fields.

In addition to breeding bird point counts, incidental observations of birds and bird nests detected while biologists were on Site conducting other surveys were recorded along with a breeding evidence code if known. Species significance or rarity on a national, provincial, regional and local level was based on published literature and standard status lists. These included SARA (2023), COSEWIC (2023), and SARO (2024).

Targeted Species at Risk Survey: Eastern Whip-poor-will and Common nighthawk

Eastern whip-poor-will and Common nighthawk (*Chordeiles minor*) surveys were conducted on July 8, 2013 and June 9, 2014 using the draft Whip-poor-will survey protocol released by the MNRF (2013). This protocol was used for both species due to the similar active periods for the two species. Surveys were conducted between the MNR recommended dates (May 18 -June 30) (MNRF, 2013) except for the first date within early July in 2013. Point counts were established prior to going out in the field and all calling males, if any, were identified within a 300-metre radius. Information was recorded including the direction and distance of each individual using a digital compass bearing. Surveys were completed thirty minutes after sunset. Only two surveys instead of three were conducted in total as surveys in June of 2014 were successful in recording large numbers of Whip-poor-will showing presence. Surveys on June 9th, 2014, were conducted at an air temperature of 24 °C with Beaufort wind scale of 0-1 NE, Cloud cover was 10% and the moon was 80% full.

4.2.2.2 Bat Acoustic Surveys

Acoustic bat surveys were conducted during June 2017 to satisfy the MNR's Significant Wildlife Habitat guidelines for maternity colonies and ESA guidelines to document presence of the Species at Risk (SAR) bats that may utilize this habitat, specifically: little brown (*Myotis Myotis lucifugus*), northern myotis (*M. septentrionalis*), eastern small-footed myotis (*M. leibii*) and tricoloured bat (*Perimyotis subflavus*). Newly

listed Endangered bat species, eastern red bat, hoary bat and silver-haired bat were also identified by these devices.

Bat detector units were placed to identify commuter zones that would give access to and from feeding areas. Sites were predominantly chosen based on their potential for bat use and their potential for high sequence quality (**Figure 2**). Sequence quality can be affected by the frequency and intensity of bat calls, temperature and humidity, and barometric pressure (Brigham et al., 1997; Lausen, 2017; Schnitzler and Kalko, 2001).

Surveys were conducted utilizing two Wildlife Acoustics SM4BAT-FS detectors. Detectors were set to start triggering in the time between ½ hour before sunset and ½ hour after sunrise. Deployed microphones were placed on 12-foot-high metal poles approximately 4 metres above the ground and anchored into the rock. Detectors were placed and left for a period of 10 nights minimum as per the MNR Bat Maternity protocol.

The bat detector units were deployed on August 1, 2017 and retrieved on August 11, 2017. One unit was deployed in an open area at the north end of the Site and the second was deployed at the south end near the entrance and the disturbed area. Both were near open areas and wetlands and would act as commuter corridors.

4.2.3 Other Mammals

Observations of mammals were made during all Site visits. Observations included direct sightings and indirect evidence such as calls, tracks, scat, burrows, dens and browse. Deer tracks/trails and presence of deer yards were investigated. There was limited dense hemlock or conifer stands in the Study Area, therefore winter browse surveys and presence of overwintering sites was not conducted. Moose overwintering sites and feeding area criteria were also assessed and potential habitat visited to determine the status. Black bear dens and other criteria that fall under the Significant Wildlife Habitat definitions were also investigated while on Site.

Species significance on a national, provincial, regional, and local level was based on COSEWIC (2023), SARO (2023), SARA (2024) and ESA (2007).

4.2.4 Herpetofauna

4.2.4.1 Amphibian Surveys- Marsh Monitoring Protocol

Targeted spring surveys were completed in the evening to detect any calling amphibians (i.e., frogs or toads). Surveys were conducted following a modified Marsh Monitoring Program protocol. Surveys were conducted when evening temperatures were a minimum of 5°C and 10°C and for 3 minutes per survey time period, starting no earlier than 30 minutes after stations are placed so that calling amphibians were detected from all wetland and adjacent upland habitats. Six survey stations were strategically placed across the Site (**Figure 2**) adjacent to wetlands and vernal pools. The MMP protocol generally has 250 m spacing between stations. For these surveys, stations are placed in close proximity to wetland pockets regardless of the distance between stations. The timing for the surveys was such that surveyors recorded observations no earlier than 30 minutes after sunset and no later than midnight. Field conditions were recorded upon arrival (cloud cover, temperature, wind, precipitation). Surveyors noted whether any species detected were within (or outside of) 100 meters of the survey station.

Protocol from Environment Canada's Marsh Monitoring Program was utilized that includes call level codes. Code 1: Calls not simultaneous, number of individuals can be accurately counted. Code 2: Some calls simultaneous, number of individuals can be reliably estimated. Code 3: Full chorus calls continuous and overlapping, number of individuals cannot be reliably estimated.

4.2.4.2 Herpetofauna Surveys

Herpetofauna surveys were conducted in multiple ways on Site which included area searches, basking surveys and snake boards. A specific effort was made to time visits to coincide with peak activity times (early morning, afternoon basking periods and peak season for nesting) to maximize the chances of detecting the snakes, skinks and turtles.

Basking Surveys

Targeted spring surveys for basking turtles were completed prior to June 15 and July 5, 2016 to determine whether turtles are utilizing in a pond adjacent to the Site (Community 1 - **Figure 2**), north of the proposed licenced area, to search for Blandings, spotted, map, painted and snapping turtles. These surveys followed the *Survey Protocol for Blanding's Turtle in Ontario* (MNR, 2015). Surveys were conducted by using binoculars with a minimum magnification of 10x to scan the entire perimeter of the shoreline and other potential basking sites. Surveys were conducted between 8am and 5pm on sunny days when air temperatures are warmer than water temperatures and water temperature is greater than 5°C. Other environmental factors which increase detectability were considered, such as: low winds, minimal cloud cover, and good conditions following several days of inclement weather.

Visual Encounter and Cover Objects (Snakes and Lizards)

Three 4 x 4-foot plywood snake cover boards were placed within Communities 9 and 11 in 2016 and left on site. These were checked regularly when biologists were on-site. Cover boards were placed in target areas, along field edges and open sunny locations, where grassland snakes may rest on colder mornings and early spring days. Coverboards were checked by wildlife biologists regularly on cooler days and early mornings to maximize possible detection of snakes.

Area Searches

Sand and gravel roadsides and areas of disturbed soils were checked for turtle nests during June Site visits, coinciding with peak nesting time and over the summer and fall periods to search for predated nests, eggshells or young emerging from successful nest sites.

4.3 Natural Features

4.3.1 Wetlands

4.3.1.1 Wetland Evaluation Methods

The wetland boundary was determined through use of the protocols of the Ontario Wetland Evaluation System (OWES) southern Ontario manual, 3rd edition, version 3.2 (MNR, 2013 and updates). This manual is used by wetland evaluators to identify wetlands and score them using the criteria outlined in the manual. A certified wetland evaluator delineated the wetland boundaries using OWES methodologies. Wetland boundaries were determined through the 50% rule, the wetland boundary falls where 50% or greater of the plants depict wetland conditions. Other OWES practices were used to determine if a vegetation community was wetland using the OWES definitions based on soils, wetland indicator species, wetland species and vegetation cover (%). Boundaries shown on the figures are a combination of air photo interpretation, ground truthing and GPS readings. Boundaries of the Provincially Significant Wetland within the Study Area were flagged in the field and surveyed by a Professional Ontario Land Surveyor (OLS). Wetland boundaries of unevaluated wetlands were also delineated using this method. The PSW boundary was checked with MNR OWES biologists during a Site visit in 2016.

4.3.2 Linkages and Corridors

The occurrence of linkages and corridors was assessed based on field work and existing literature. Observations of bird, mammal and herpetozoa movements were made during Site visits and information from air photos and GIS natural features mapping was reviewed to determine the presence of linkages across the landscape and between core natural areas. Tracks, trails, deer pellets, scat and wildlife sightings were noted and GPS readings made of any areas that may act as wildlife corridors and animal movement corridors.

4.3.3 Significant Wildlife Habitat

The identification of Significant Wildlife Habitat is completed in several stages. As part of the background review, natural areas on the Site and Study Area are examined along with aerial photography. A candidate list of SWH criteria/feature is determined. During the Site visits searches for evidence of those identified candidate features are conducted and the features assessed.

After the field inventories, GHD biologists analyzed the information collected and determined which SWH features were confirmed based on the habitats on Site and on the Ecological Land Classification communities present on the Site, using the criteria for Significant Wildlife Habitat in Ecoregion 6E (2015).

4.3.4 Fish and Aquatic Habitat

Biophysical habitat characteristics of the watercourses and waterbodies features within the Site and Study Area were assessed using aerial photography, literature and confirmed through ground-truthing by GHD fisheries biologists. The fish and aquatic habitat assessment was made using qualitative and quantitative studies.

4.3.4.1 Aquatic Habitat

An aquatic habitat assessment was completed for all watercourse features identified on Site and waterbodies within the Study Area. The features were assessed following standardized provincial aquatic methods from the Ontario Stream Assessment Protocol, Section 4, Module 11 (Stanfield 2017) and Ontario Ministry of Transportation (MTO) Environmental Guide for Fish and Fish Habitat Protocol Section 4.0 (MTO 2020). Aquatic habitat was quantified and characterized based on local substrate composition, vegetation, flow influence and condition, sediment transport, cover, channel morphology, groundwater indicators, riparian habitat, barrier presence and form, land use and landscape influences, human modifications and unique features. Appropriate assessment types were determined on Site based on feature type using professional judgment.

4.3.4.2 Fish Community

Fish community sampling was conducted by GHD within the Site and Study Area. Several standard gear types were used to conduct the fish community sampling including seine net, hoop net, mini hoop net and minnow traps.

The seine net dimensions are as follows; 15' x 4'), with a 3' (wide) x 4' (deep) x 4' (height) bag. (1/8" mesh size). Seining is a widely used technique to collect fish community and populations level data. It is a non-lethal, time efficient, and a supplemental methodology to electrofishing to ensure all habitat types in the Site are effectively sampled. Seining is best applied in slower moving waters such as pools and slow runs and can be an effective technique to sample turbid waters where electrofishing surveys are less effective. Seining methods followed the Ontario Stream Assessment Module S3.M2 (Stanfield, 2017).

The fyke net dimensions were 12.2 m x 1.5 m. The mini fyke nets has the following dimensions: 1/16" mesh size with treated coating. Total length of 3.2m, each wing length is 1.6m, the cord length is 1.5m, 2

hoops, with a 0.25m diameter each and the height is 0.3m. The nets were set so that the caud end was out of water minimizing risk of reptile and amphibian mortalities. The minnow traps are torpedo shaped wire traps measuring 0.4 m in length with a 2.66 cm opening. All nets were set overnight and retrieved the next day. At each site, the total length (mm) and weight (g) were recorded for the first ten individuals of each species at each site. The remaining individuals for each species were counted and weighed in bulk.

To ensure the projects meets provincial and federal species at risk legislation, a full review of the current Ontario Endangered Species Act (ESA) and Canadian Species at Risk Act (SARA) was completed. The background literature review included Department of Fisheries and Oceans (DFO) Species at Risk maps to identify the presence of any endangered and/or threatened species and critical habitat on a federal level. The MNR-NHIC database was reviewed to identify the potential presence of endangered and/or threatened species which would receive individual protection (Section 9, ESA) or receive general habitat protection (Section 10, ESA) on a provincial level.

4.3.4.3 Benthos Community

Baseline benthos samples were collected at three sites in 2012. A control study design was chosen for monitoring the potential effects to aquatic habitats downstream of the proposed quarry development using set reference sites to sample before and after the stressor discharge (construction and completion of quarry). Samples were collected using a 500 µm (mesh size) travelling kick and sweep method as outlined in the Ontario Benthos Biomonitoring Network Protocol Manual (OBBN, 2004).

It should be noted that during a site visit conducted in 2013 a newly constructed ATV/snowmobile trail was observed directly over top of the benthos control site. Therefore, in the fall of 2014 the control site was re-established slightly upstream of the original location in similar habitat.

A minimum of 100 animals were collected per replicate or sub-sample (OBBN, 2004). Specimens were preserved in 70% ethanol and identified in the lab to the taxonomic level of family. Subsequent data was analyzed using the Hilsenhoff Biotic Index, Simpsons Diversity Index and quantitative descriptions.

Hilsenhoff Biotic Index is based on a biotic index value. The higher the biotic index value reflects an assumed greater amount of organic pollution. The lower the biotic index reflects an assumed less organic pollution (Hilsenhoff, 1998). Simpsons Diversity Index measures the diversity within the sample where values ranged from 0 for low diversity samples to 1 for high diversity samples. Quantitative descriptions are also quantified and included the total number of organisms, richness (number of taxa, percent of dominant taxa, percent of Oligochaeta, percent of Chironomidae, percent of EPT, ratio of EPT to Chironomidae, and percent of ETO.

4.3.4.4 Surface Water Quality

Surface water quality was collected on Site. Measured parameters included dissolved oxygen (mg/L), conductivity (us/cm), total dissolved solids (mg/L) and water temperature (°C) using a handheld YSI Pro2030 System. The Canadian Water Quality Guidelines for the Protection of Aquatic Life (Canadian Council of Ministers of the Environment, 2002) and the Provincial Water Quality Objectives (PWQO) were used to interpret water quality data (Energy, 1994).

5. Existing Conditions

5.1 Physical Site Characteristics

The Study Area is located just south of the contact line between the St. Lawrence Platform made of sedimentary rock and Grenville made of metamorphic rock. Most of the property was relatively flat excluding the limestone ledge on the western portion. The Study Area is located just north-west of Highway 11 fronting on Nichols line. The vegetation communities contained a mix of forested, cleared and wetland area. Most of the property and adjacent lands was forested with treed swamps associated with the watercourse and depressions in the rock establishing as treed swamps. A portion of the property was cleared to allow an access road to the northern limits of the property. Agricultural lands were found on a northern portion of the property. The vegetation communities included a variety of deciduous, coniferous and mixed forest types, cultural meadows, rock barren, marshes, swamps and thickets. The Grass Lake PSW is in the southeast corner of the property and extends to the south and east.

The property has been historical used as a farmstead, with portions of the property having abandoned and active agricultural fields, selective and clear-cut logging operations for firewood and lumber and other disturbances. The variety in ages of the forested communities and meadows reflects these long-term uses on the property. The Grass Lake PSW is in the southeast corner of the property and extends to the south and east.

Adjacent land uses include an active licensed limestone quarry to the west, County-owned forest to the north, private land (licensed quarry) to the east and partially forested and abandoned farmland and pasture and forest to the south within the 120 m Study Area (**Figure 1**).

5.2 Biological Inventories

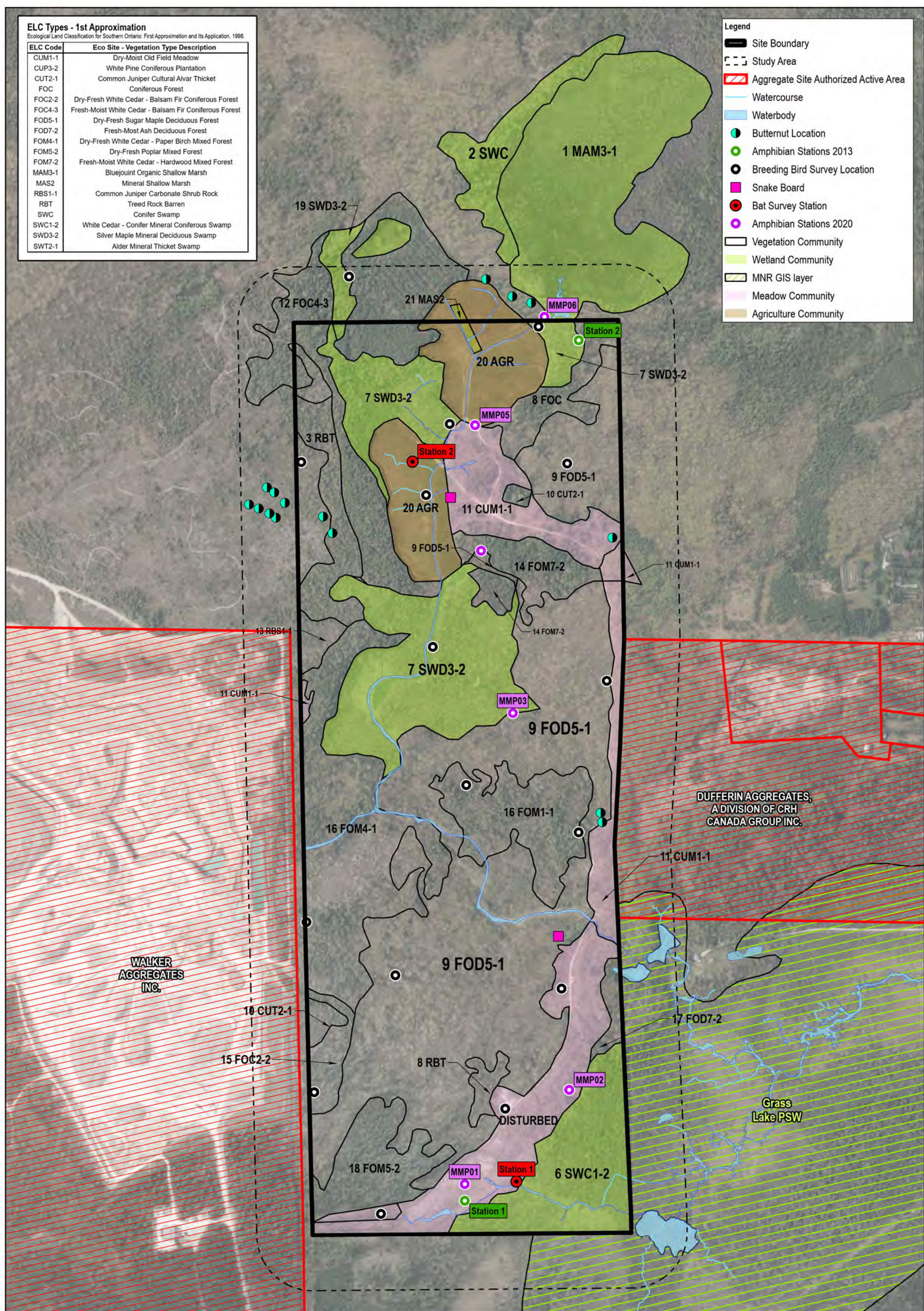
5.2.1 Level of Effort

A record of all of the field work conducted was compiled and includes details such as the date and time of day, the type of survey administered and the type of survey and/or target species. The following table (**Table 1**) summarizes the level of effort. During each Site visit photographs were taken, which have been compiled and are presented in **Appendix B**.

ELC Types - 1st Approximation

Ecological Land Classification for Southern Ontario: First Approximation and Its Application. 1998.

ELC Code	Eco Site - Vegetation Type Description
CUM1-1	Dry-Moist Old Field Meadow
CUP3-2	White Pine Coniferous Plantation
CUT2-1	Common Juniper Cultural Alvar Thicket
FOC	Coniferous Forest
FOC2-2	Dry-Fresh White Cedar - Balsam Fir Coniferous Forest
FOC4-3	Fresh-Moist White Cedar - Balsam Fir Coniferous Forest
FOD5-1	Dry-Fresh Sugar Maple Deciduous Forest
FOD7-2	Fresh-Moist Ash Deciduous Forest
FOM4-1	Dry-Fresh White Cedar - Paper Birch Mixed Forest
FOM5-2	Dry-Fresh Poplar Mixed Forest
FOM7-2	Fresh-Moist White Cedar - Hardwood Mixed Forest
MAM3-1	Bluejoint Organic Shallow Marsh
MAS2	Mineral Shallow Marsh
RBS1-1	Common Juniper Carbonate Shrub Rock
RBT	Treed Rock Barren
SWC	Conifer Swamp
SWC1-2	White Cedar - Conifer Mineral Coniferous Swamp
SWD3-2	Silver Maple Mineral Deciduous Swamp
SWT2-1	Alder Mineral Thicket Swamp



Paper Size ANSI B

0 75 150 225

Meters

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 17N



SEVERN AGGREGATES LTD. PARTNERSHIP
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Township of Severn, County of Simcoe
Natural Environment Report

TERRESTRIAL SURVEY LOCATIONS VEGETATION AND SPECIES-AT-RISK

Project No. 12659220
Revision No. -
Date Mar 25, 2025

FIGURE 2

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Print date: 25 Mar 2025 - 14:05

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Table 1 *Level of Effort for Aquatic and Terrestrial Field Work in the Study Area (2009-2020)*

Year	Date	Time of Day	Weather Conditions (when applicable)	Survey Type	Target Species
2009	Nov. 25	Daytime, evening	8.5°C	ELC, wetland delineation,	Plants
2010	April 12	Daytime	11°C	Aquatic Scoping	Aquatic habitat
	April 13	Daytime, Evening	14°C with a Beaufort wind scale of 0-1. No cloud cover	Marsh Monitoring, amphibian surveys, butternut assessments, aquatic scoping, plants, ELC	Amphibians, butternut, plants, turtles, snakes
	April 14	Daytime/Evening	16°C	Plants, ELC, snakes, birds, basking, snakes, wetland delineation	Plants, snakes, birds, herps
	May 19	Morning and daytime	13°C, partly cloudy, wind 1	ELC, SARs, herps, wetland delineation, Breeding Bird surveys (BBS), butternut assessment, basking survey	Butternut, plants, turtle basking, snakes, SARs, birds
	June 30	Daytime	18°C, wind 0, clear	ELC, wetland boundary, Breeding Bird surveys (BBS)	Vegetation, birds, incidental wildlife
2012	May 16	Morning	16°C, cloudy, wind 1	Bird surveys (BBS)	Birds, incidental wildlife
	July 6	Morning	20°C, clear, wind 1	Bird surveys (BBS)	Birds
	July 16	Daytime	29°C	ELC, wetland boundary,	Vegetation
	Sept. 20	Daytime	10°C	Plants, ELC, amphibians, mammals	Plants, amphibians, vegetation, turtles, mammals
	Oct. 24	Daytime	6°C	OBBN benthos community sampling, fish habitat and water quality assessments	Benthos Community
2013	May 7	Morning	24°C, clear, wind 0	Breeding Bird Surveys (BBS), Butternuts, SARs	Birds, butternuts, snakes
	June 3	Daytime	12°C	Fish community and habitat assessments, basking survey	Fish Community
	June 4	Daytime/ Evening	16°C	Fish community and habitat assessments; water quality assessment, basking survey, common nighthawk surveys	Fish Community
	July 4	Morning	20°C, clear, no wind	Bird surveys (BBS), basking survey	Birds, SAR

Year	Date	Time of Day	Weather Conditions (when applicable)	Survey Type	Target Species
	July 8	Evening	19°C	Common nighthawk surveys	Whip-poor-will/common nighthawk
	Aug. 29	Daytime	27°C	Butternut assessments	Butternut
2014	June 9	Evening	24 °C with Beaufort wind scale of 0-1 NE, Cloud cover was 10% and the moon was 80% full	Common nighthawk surveys	Whip-poor-will, common nighthawk
	Oct. 15	Daytime	15°C	OBBN benthos community at Control Site	Re-establishing control site for benthos community
2017	Aug 1-11	10-day period	N/A	Bat acoustic monitoring-2 boxes at commuter zones	4 SAR bat species
2018	Sept. 19	Daytime	17-21°C with Beaufort wind scale of 0, Cloud cover 10-60%, no precipitation	Vegetation and wetland surveys	Vegetation
2020	May 21	Evening	14°C with Beaufort wind scale of 0, Cloud cover 10%, no precipitation	Marsh monitoring amphibian surveys	Amphibians

5.2.2 Vegetation and Plant Communities

All vegetation communities on and adjacent to the study lands were visited on November 25, 2009 and throughout the growing season (spring, summer and fall): April 13, April 14, May 19, June 30, of 2010, July 16, September 20, 2012, and September 19, 2018. Additional notes were collected during Species at Risk surveys to document plant species pertinent to their habitat preferences. All portions of the Site and Study Area were visited including wetland, field, forest, aquatic and cultural communities.

National, provincial and regional significance was determined from accepted status lists and published reference lists such as SARA (2023), COSEWIC (2023), SARO (2024), Ontario Endangered Species Act (2007) and NHIC (2025). Regional and local lists were also reviewed and included Riley, (1989) and Varga et al. (2000). A full plant list by community is in **Appendix C** with representative photos of the communities in **Appendix B**. Significant plants are listed in **Appendix D**.

The Site was comprised of a diversity of vegetation community types (**Figure 2**). The forested areas dominated in white cedar/balsam fir, white cedar hardwood mix, white cedar/white birch, ash lowland, poplar mixed, white cedar conifer, white pine/red pine, sugar maple/oak and sugar maple forests. The wetland areas included communities such as a bluejoint marsh, alder thickets, black ash swamp, cedar swamp and a silver maple swamp.

A total of 21 vegetation communities were delineated within the Study Area (**Figure 2**) with a total of 326 plant species identified. The vegetation communities have been organized into wetlands (green shading), forest (no shading), rock barren (no shading), cultural (brown shading) and other/disturbed (pink shading) on **Figure 2**. The ELC type and dominant species are described in **Table 2**.

Table 2 Vegetation Community Codes and Descriptions.

Community Number and Code	Community Description
Wetland Communities	
Community 1: Bluejoint Organic Meadow Marsh Type (ELC Code: MAM3-1)	This community was located on the far northern limits of the property and the County lands to the north. This wetland generated by beaver activity was primarily dominated by Canada bluejoint (<i>Calamagrostis canadensis</i>), however contained other species interspersed throughout the wetland. American basswood (<i>Tilia americana</i>), balsam fir (<i>Abies balsamea</i>), black ash (<i>Fraxinus nigra</i>), eastern white cedar (<i>Thuja occidentalis</i>), green ash (<i>Fraxinus pennsylvanica</i> var <i>subintegra</i>) and silver maple (<i>Acer saccharinum</i>) were found throughout the wetland. Other species found on the ground included sensitive fern (<i>Onoclea sensibilis</i>), awl-fruited sedge (<i>Carex stipata</i>), bitter nightshade (<i>Solanum dolcamara</i>), boneset (<i>Eupatorium perfoliatum</i>), broad-leaved plantain (<i>Plantago major</i>) and common cattail (<i>Typha latifolia</i>).
Community 2: Coniferous Swamp (ELC Code: SWC)	This community was located on the northern limits of the study area. This small linear pocket of wetland was dominated by coniferous species including balsam fir (<i>Abies balsamea</i>), eastern hemlock (<i>Tsuga canadensis</i>) and eastern white pine (<i>Pinus strobus</i>). The ground contained species such as western poison-ivy (<i>Rhus rydbergii</i>), common strawberry (<i>Fragaria virginiana</i>), dwarf raspberry (<i>Rubus pubescens</i>), false Solomon's seal (<i>Smilacina racemosa</i>), jack-in-the-pulpit (<i>Arisaema triphyllum</i>), helleborine (<i>Epipactis helleborine</i>), marsh marigold (<i>Caltha palustris</i>) and mayapple (<i>Podophyllum peltatum</i>).
Community 5: Alder Mineral Thicket Swamp (ELC Code: SWT2-1)	This community was found just beyond the northern boundary of the study property and surrounded by a pine plantation. It was primarily dominated by speckled alder (<i>Alnus rugosa</i>). Other species also found within this thicket included Alleghany blackberry (<i>Rubus allegheniensis</i>), boneset (<i>Eupatorium perfoliatum</i>), burning bush (<i>Euonymus atropurpurea</i>), common gromwell (<i>Lithospermum officinale</i>), greenish sedge (<i>Carex viridula</i>), marsh bedstraw (<i>Galium palustre</i>) and marsh bellflower (<i>Campanula aparinoides</i>).
Community 6: White Cedar Conifer Mineral Coniferous Swamp (ELC Code: SWC1-2)	This community was located in the southeast corner and included part of the provincially significant wetland on the eastern borders of the property. Eastern white cedar was the dominant species in the cedar swamp. The swamp was hummocky in nature and contained other species characteristic of wet communities and moist areas. These species included American water-

Community Number and Code	Community Description
	horehound (<i>Lycopus americanus</i>), black ash, dwarf raspberry (<i>Rubus pubescens</i>), early meadow rue, field horsetail (<i>Equisetum arvense</i>) and foam flower (<i>Tiarella cordifolia</i>).
Community 7: Silver Maple Mineral Deciduous Swamp (ELC Code: SWD3-2)	Community 7 was identified in the central and north-western portions of the property. Mature silver maple (<i>Acer saccharinum</i>) was the dominant species of this community with minor associates of American basswood, American elm, balsam fir and balsam poplar. Other species found on the ground include bitter nightshade, broad-leaved plantain, bull thistle (<i>Cirsium vulgare</i>), Canada enchanter's nightshade (<i>Circaea lutetiana</i> L. ssp. <i>canadensis</i>), Canada mayflower, Christmas fern (<i>Polystichum acrostichoides</i>), cinnamon fern (<i>Osmunda cinnamomea</i>), common evening primrose (<i>Oenothera biennis</i>), dwarf raspberry and marsh beggar-ticks (<i>Bidens frondosa</i>).
Community 19: Silver Maple Mineral Deciduous Swamp (ELC Code: SWD3-2)	This community was identified within the coniferous forest found in the northeastern corner of the site and to the north. This wetland was connected to the watercourse running through the northern portion of the property. Dominated by silver maple (<i>Acer saccharinum</i>) other tree species identified here included white spruce (<i>Picea glauca</i>), eastern white cedar (<i>Thuja occidentalis</i>) and red maple (<i>Acer rubrum</i>). Wild red-raspberry (<i>Rubus idaeus</i>) and slender willow (<i>Salix petiolaris</i>) were identified within the understory, with Canada goldenrod (<i>Solidago canadensis</i>), coltsfoot (<i>Tussilago farfara</i>), New England aster (<i>Symphyotrichum novae-angliae</i>), Canada bluejoint (<i>Calamagrostis canadensis</i>), woolgrass (<i>Scirpus cyperinus</i>) and soft-stemmed bulrush (<i>Schoenoplectus tabernaemontani</i>) making up some of the vegetation on the ground layer.
Community Number and Code	Community Description
Forest Communities	
Community 8: Coniferous Forest (ELC Code: FOC)	This community was located on the north-eastern corner of the property bordering the agricultural area and Community 9. Dominated by coniferous species, trees within this community included eastern white pine and eastern white cedar.
Community 9: Dry-Fresh Sugar Maple Deciduous Forest (ELC Code: FOD5-1)	This community is in several areas around the property, a portion of land in the north-east corner and central area of the property, as well as a portion of land in the southern half of the property. A large portion of the property is comprised of this deciduous forest. Sugar maple makes up the dominant species for this community, however several other tree species are such as American basswood, American beech (<i>Fagus grandifolia</i>), American elm, balsam fir, balsam poplar, black ash and black cherry (<i>Prunus serotina</i>). Ground species included black medick (<i>Medicago lupulina</i>), black snakeroot (<i>Sanicula marilandica</i>), bloodroot (<i>Sanguinaria canadensis</i>), bottle gentian (<i>Gentiana andrewsii</i>) and bottle-brush grass (<i>Elymus hystrix</i>).
Community 12: Fresh-Moist White Cedar-Balsam Fir Coniferous Forest (ELC Code: FOC4-3)	This community was located along the western edge of the field set aside for agricultural purposes. This coniferous forest was primarily dominated by eastern white cedar and balsam fir. This forest was situated on a steep slope abutting the rock barren Community 13 to the west of it. Other tree species found in this community as minor associates included balsam poplar, red oak (<i>Quercus rubra</i>), trembling aspen, white birch and white spruce (<i>Picea glauca</i>). The ground cover was not dense as little sunlight reached the forest floor. Those ground species found to tolerate these conditions included American gromwell (<i>Lithospermum latifolium</i>), American yew (<i>Taxus canadensis</i>), black snakeroot, bluebead lily (<i>Clintonia borealis</i>), bristly black currant (<i>Ribes lacustre</i>), bulbet bladder fern (<i>Cystopteris bulbifera</i>), Canada mayflower, coltsfoot (<i>Tussilago farfara</i>) and common bearberry (<i>Arctosaphylos uva-ursi</i>).
Community 14: Fresh-Moist White Cedar-Hardwood Mixed Forest (ELC Code: FOM7-2)	This community was found in small pockets, patchy in nature, along the northern limits of the access road. This mixed forest contained eastern white cedar with other species including American basswood, American elm, balsam fir, black ash, bur oak and eastern red cedar. Other species found within these forest pockets included asparagus (<i>Asparagus officinalis</i>), barren strawberry, bitter nightshade, buffalo berry, common yarrow (<i>Achillea millefolium</i>), dwarf raspberry, fringed loosestrife (<i>Lysimachia ciliata</i>), grass-leaved goldenrod (<i>Euthamia graminifolia</i>), rugosa rose (<i>Rosa rugosa</i>) and snowberry (<i>Symphoricarpos albus</i>).
Community 15: Dry-Fresh White Cedar Coniferous Forest	This small community was found surrounding Community 10 on the western boundary of the property. Dominated by eastern white cedar, other tree species included balsam fir, balsam poplar, eastern white pine, ironwood (<i>Ostrya virginiana</i>) and red oak in lower densities. The

Community Number and Code	Community Description
(ELC Code: FOC2-2)	ground was covered in herbaceous species including Canada mayflower, helleborine, northern lady fern (<i>Athyrium filix-femina</i>), maidenhair spleenwort and western poison-ivy (<i>Rhus rydbergii</i>) with some patches of rock.
Community 16: Dry-Fresh White Cedar-White Birch Mixed Forest (ELC Code: FOM4-1)	This large community in the central portion of the property contained a good mixture of species. Several steep inclines existed within this community and lots of blowdown was found throughout. The dominant species were eastern white cedar, sugar maple and eastern hemlock and white birch present. Several other tree species were found including balsam fir, balsam poplar and American basswood. Other species within this community included bitter nightshade, black snakeroot, blue cohosh (<i>Caulophyllum giganteum</i>), bull thistle, Canada enchanter's nightshade, Christmas fern, coltsfoot (<i>Tussilago farfara</i>) and common gromwell (<i>Lithospermum officinale</i>).
Community 18: Dry-Fresh Poplar Mixed Forest (ELC Code: FOM5-2)	This community was found adjacent to the entrance to the quarry site and followed the access road. This community was primarily dominated by poplar species including trembling aspen and large-toothed aspen (<i>Populus grandidentata</i>). Other tree species found included eastern white cedar, eastern white pine, sugar maple, white ash and white birch. Shrub species present within the community included beaked hazel (<i>Corylus cornuta</i>), hawthorn species (<i>Crataegus</i> ssp), leatherwood (<i>Dirca palustris</i>) and prickly gooseberry.
Cultural Communities	
Community 4: White Pine Coniferous Plantation (ELC Code: CUP3-2)	This community was located on the northern limits of the property with most of the community located beyond the northern licensed boundary. This community almost entirely dominated by eastern white pine contained other tree species interspersed including American basswood, American elm, balsam fir, balsam poplar (<i>Populus balsamifera</i>) and black ash. The ground cover species included black snakeroot, Canada mayflower, eastern bracken fern (<i>Pteridium aquilinum</i>), black nightshade (<i>Solanum nigrum</i>), ground-pine (<i>Lycopodium obscurum</i>), helleborine and long spurred violet (<i>Viola rostrata</i>). Shrub species includes fly honeysuckle (<i>Lonicera canadensis</i>), European buckthorn (<i>Rhamus cathartica</i>), prickly gooseberry (<i>Ribes cynosbati</i>) and wild red raspberry (<i>Rubus idaeus</i>).
Community 10: Common Juniper Cultural Alvar Thicket Type (ELC Code: CUT2-1)	Several small pockets of juniper thickets were observed throughout the property. Two areas along the western property edge of the property, as well as a small pocket in the northern portion of the property. This community was dominated by common juniper with few scattered trees throughout, including American basswood, American elm, bur oak (<i>Quercus macrocarpa</i>), eastern red cedar and eastern white pine. The ground cover consisted of eastern bracken fern (<i>Pteridium aquilinum</i>), arrow-leaved aster (<i>Symphyotrichum urophyllum</i>), black-eyed Susan (<i>Rudbeckia hirta</i>), bladder campion (<i>Silene vulgaris</i>), broad-leaved plantain, bull thistle, calico aster (<i>Aster lateriflorus</i>), chicory (<i>Cichorium intybus</i>) and Canada goldenrod (<i>Solidago canadensis</i>).
Community 11: Dry-Moist Old Field Meadow (ELC Code: CUM1-1)	This community followed the access road to the northern portions of the property. Several areas of exposed rock were found within this community, especially on the southern portions of the property. This community contained mostly species typical of disturbed areas. Some of these species included agrimony (<i>Agrimonia gryposepela</i>), awnless brome grass (<i>Bromus inermis</i> ssp <i>inermis</i>), bird's-foot trefoil (<i>Lotus corniculatus</i>), bitter dock (<i>Rumex obtusifolius</i>), black-eyed Susan, burning bush (<i>Euonymus atropurpurea</i>) and Canada anemone (<i>Anemone canadensis</i>).
Community Number and Code	Community Description
Rock Barren Communities	
Community 3: Treed Rock Barren (ELC Code: RBT)	This community was located within the northwest sector of the property. In the areas bordering the access road, rock fissures were observed beneath the canopy. The rock base distinguished the two communities apart. The dominant tree species were young American elm (<i>Ulmus americana</i>) and sugar maple (<i>Acer saccharum</i> ssp. <i>saccharum</i>) with trembling aspen (<i>Populus tremuloides</i>) and white birch (<i>Betula papyrifera</i>) as minor associates. The community was generally flat with rock fixtures containing many deep crevices. The ground species contained only a few species including black snakeroot (<i>Sanicula marilandica</i>), Canada mayflower (<i>Maianthemum canadense</i>), common juniper (<i>Juniperus communis</i> var. <i>depressa</i>), western poison-ivy, maidenhair spleenwort (<i>Asplenium trichomanes</i> ssp. <i>quadrivalens</i>) and early meadow rue (<i>Thalictrum dioicum</i>).

Community Number and Code	Community Description
Community 13: Common Juniper Carbonate Shrub Rock Barren (ELC Code: RBS1-1)	This community was found directly adjacent to the existing quarry to the west. The tree cover varied from dense juniper patches and rock barren, to more closed in nature with a tree cover of <25% and shrub cover of >25%. Common juniper was the dominant shrub that persisted through the entire community. Some of the few tree species observed on site included American basswood, American elm, black cherry, bur oak, eastern white cedar and eastern white pine. Several ground species were found patchy in nature including balsam ragwort (<i>Senecio pauperculus</i>), barren strawberry (<i>Waldsteinia fragarioides</i>), Bicknell's crane's-bill (<i>Geranium bicknellii</i>), buffalo berry (<i>Shepherdia canadensis</i>), Canada goldenrod, climbing bittersweet (<i>Celastrus scandens</i>), maidenhair spleenwort and early saxifrage (<i>Saxifraga virginensis</i>).
Other Communities	
Community 20: Agricultural-Hay Fields No applicable ELC Code	Two large agricultural fields were identified on the northern portions of the property. These areas were planted in hay and were comprised of 70% grasses with red clover covering 10% and Queen-Anne's Lace covering 10% of the ground cover.
Community 21: Ditches Running through Agricultural Field (Community 20) No applicable ELC Code	Several ditches with open soil or pioneer vegetation were identified running through the agricultural fields on the northern portions of the property. These ditches contained an abundance of closed gentian (<i>Gentiana andrewsii</i>), slender gerardia (<i>Agalinis tenuifolia</i>), boneset (<i>Eupatorium perfoliatum</i>), common cattail (<i>Typha latifolia</i>), grass-leaved goldenrod (<i>Euthamia graminifolia</i>) and variegated scouring rush (<i>Equisetum variegatum</i>).

5.2.2.1 Butternut Surveys

A total of 14 butternut trees (**Figure 2**) were originally assessed on the Site or within the 120 m Study Area in May of 2010 but were reassessed a second time on August 29, 2013. Six retainable butternut trees were identified (Category 2). Of the six retainable trees, five contained 100% canopy cover. Little canker was identified on these trees. The remaining seven trees were heavily cankered, and all were found to be not retainable (Category 1).

Four retainable (Category 2) butternut trees were identified within the proposed licensed boundary and extraction area. Three of the four retainable trees found in the licensed boundary were suckers off of stumps that had been cut during past logging operations. These saplings were growing from the original stump and were all around 1cm diameter at breast height (dbh). A permit is required from MNR to remove the Category 2 retainable trees. The remaining 9 trees were found outside of the extraction limits but within the 120 m Study Area. They will not be negatively impacted by this quarry. No archivable trees (Category 3) were documented within the Site or Study Area.

Butternut plantings may be recommended as part of the MNR permitting process and will be incorporated into the rehabilitation plan. Suitable habitat will be chosen for the required plantings. It is recommended that these trees be reassessed prior to reaching the phase to which they are located and if necessary, apply for a permit/ Notice of Butternut Impact Assessment forms required at that time.

5.2.3 Wildlife

5.2.3.1 Breeding Bird Surveys

Breeding bird surveys (BBS) were conducted during the breeding season on May 19 and June 30, 2010; May 16 and July 6, 2012; May 7 and July 4, 2013, for peak breeding season birds. The surveys were a combination of point counts and area searches and covered all portions of the property. The surveys were conducted within all vegetation communities in the Study Area. Weather conditions during the surveys can be found in the Level of Effort table (**Table 1**).

A total of 72 bird species were recorded, representing forest, field and wetland species (**Appendix E**). Bird species included Canada goose (*Branta canadensis*), wood duck (*Aix sponsa*), mallard (*Anas platyrhynchos*), ruffed grouse (*Bonasa umbellus*), American bittern (*Botaurus lentiginosus*), killdeer (*Charadrius vociferous*), red-shouldered hawk

(*Buteo lineatus*), barred owl (*Strix varia*), belted kingfisher (*Megaceryle alcyon*) and blue-headed vireo (*Vireo solitarius*).

Five federally and/or provincially significant (SARO 2024; SARA 2023) species were identified during site surveys: eastern wood-pewee (*Contopus virens*: Special Concern), wood thrush (*Hylocichla mustelina*: Special Concern), common nighthawk (*Chordeiles minor*: special concern), eastern whip-poor-will (*Antrostomus vociferous*: Special Concern) and evening grosbeak (*Coccothraustes vespertine*: Special Concern).

A total of 9 bird species are considered area sensitive; which are species that require a minimum hectareage of contiguous suitable woodland habitat to successfully breed. These species are: yellow-bellied sapsucker (*Sphyrapicus varius*), blue-headed vireo (*Vireo solitarius*), red-breasted nuthatch (*Sitta canadensis*), winter wren (*Troglodytes troglodytes*), veery (*Catharus fuscescens*) black-throated blue warbler (*Dendroica caerulescens*), black-throated green warbler (*Dendroica virens*), ovenbird (*Seiurus aurocapillus*) and scarlet tanager (*Piranga olivacea*).

5.2.3.2 Targeted Species at Risk Survey: Eastern whip-poor-will and Common nighthawk

The survey results identified 5 common nighthawks foraging over the Site. A search was conducted for nesting or roosting sites and while there was no evidence of this habitat type, only foraging habitat was identified as the entirety of the Site.

5.2.3.3 Bat Acoustic Surveys

Bat surveys on the Site identified big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), tri-coloured bat (*Perimyotis subflavus*), and *Myotis* species. Each of these species, apart from big brown bat, are considered endangered federally and provincially. A full analysis and report of bat data was submitted by GHD (previously NEA) in 2019 (**Appendix F**)

All target species were active at Station 1 in the south of the Site however the number of sequences were low and there were no distinct days of activity that were much more active than others. From a commuting perspective, most sequences at both stations indicated commuting bats. Station 2 in the north of the Site, had the largest sequence activity among all target species and were clearly using the area for feeding purposes more than Station 1. It is also evident that the *Myotis* species recorded at Station 2 were mostly traveling in a western direction towards the microphone due to the properties of the sequences (i.e. amplitude and wave compression).

5.2.4 Herpetofauna

5.2.4.1 Amphibian Surveys- Marsh Monitoring Protocol

Marsh Monitoring Protocol Surveys for Amphibians identified breeding amphibians. The results per surveying year are summarized below in **Table 3 and 4**.

Table 3 2013 Amphibian Marsh Monitoring Results

Weather	Station 1	Station 2
14°C, 0% cloud cover, Beaufort wind scale 0-1, no Precipitation	Spring peeper, call code 3, within 100m of station	Spring peeper, call code 3, within 100m of Survey station Northern leopard frog, call code 1, within 100m of station

Table 4 2020 Amphibian Marsh Monitoring Results

Weather	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6
14°C Beaufort wind scale 0 Cloud cover 10% No precipitation	American toad Call level code 3 Within 100 m of station Calling from Community 6	American toad Call level code 3 Outside 100m radius Calling from Community 6	Gray treefrog Call level code 1 Within 100 m of station Calling from Community 7	American toad Call level code 2 Outside 100m radius Unknown origin	Gray treefrog Call level code 1 Outside 100m radius Unknown origin	Gray treefrog Call level code 3 Within 100 m of station Calling from Community 1
	Spring Peeper Call level code 3 Within 100 m of station Calling from Community 6	Spring Peeper Call level code 3 Outside 100m radius Calling from Community 6	Spring Peeper Call level code 3 Outside 100m radius Unknown origin.	Spring Peeper Call level code 2 Outside 100m radius Unknown origin.	Spring Peeper Call level code 1 Outside 100m radius Unknown origin.	Spring Peeper Call level code 3 Within 100 m of station Calling from Community 1
	Northern leopard frog Call level code 1 Within 100 m of station Calling from Community 6	Northern leopard frog Call level code 1 Outside 100m radius. Calling from Community 6	NA	NA	NA	American toad Call level code 1 Within 100 m of station Calling from Community 1

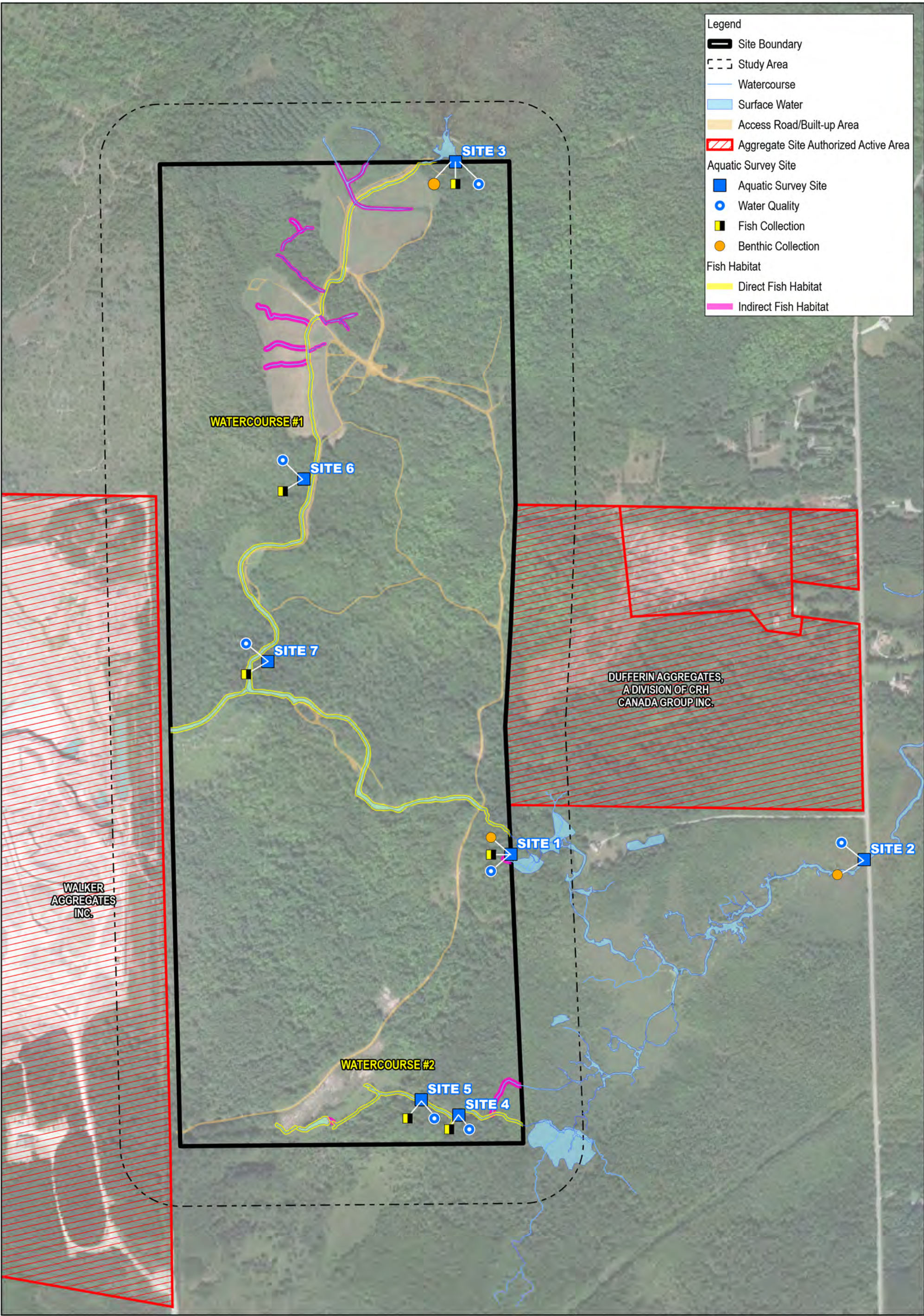
5.2.4.2 Herpetofauna Surveys

Amphibian species recorded in the spring and summer surveys included northern leopard frog, gray treefrog (*Hyla versicolor*), green frog (*Lithobates clamitans melanot*), American toad (*Bufo americanus americanus*), wood frog (*Rana sylvatica*), American bullfrog (*Lithobates catesbeiana*), spring peeper, red-spotted newt (*Notophthalmus viridescens viride*), and eastern red-backed salamander (*Plethodon cinereus*) (**Appendix G**). Dozens of adult, red-spotted newts were found in the watercourse throughout the Site.

Four snake species were observed within the Study Area including smooth green snake (*Opheodrys vernalis*), red-bellied snake (*Storeria occipitomaculata occipitamacu*), eastern ribbonsnake (*Thamnophis sirtalis*) and common gartersnake (*Thamnophis sirtalis*) (**Appendix G**). No massasauga or eastern hog-nosed snakes were observed. No hibernacula or oviposition sites were found during our surveys. An adult eastern painted turtle (*Chrysemys picta*) was caught in a fyke net in the pond north of the property limits on June 3rd, 2013. No northern map turtles (*Graptemys geographica*) spotted turtles (*Clemmys guttata*) or snapping turtles (*Chelydra serpentina*) were observed. One Blanding's turtle (*Emydoidea blandingii*) was identified on June 1, 2018, approximately 200 metres north of the Site on a snowmobile trail on property owned by the County of Simcoe (**Figure 1**). Blanding's turtles are a threatened species both federally and provincially.

5.2.5 Incidental Wildlife

Wildlife recorded on Site included white-tailed deer (*Odocoileus virginianus*), red squirrel (*Tamiasciurus hudsonicus*), black bear (*Ursus americanus*) and eastern chipmunk (*Tamias striatus*) (**Appendix H**). Other species recorded indirectly by sign included: American beaver (*Castor canadensis*), common porcupine (*Erethizon dorsatum*), common raccoon (*Procyon lotor*), coyote (*Canis latrans*), long-tailed weasel (*Mustela frenata*), eastern grey squirrel, red fox (*Vulpes vulpes*) and moose (*Alces alces*).



5.3 Natural Features

5.3.1 Wetlands

One provincially significant wetland was identified on or within 120 metres of the Site (Grass Lake Provincially Significant Wetland).

According to the Wetland Evaluation (R. Toth & M Townes, 1989), the Grass Lake Wetland Complex contains the following features:

- Composed of three wetland types (0.5% bog, 62.5% swamp and 37% marsh)
- Nesting of colonial water birds (active feeding area)
- Winter cover for wildlife (fox, coyote, rabbits, black bear)
- Significance for fish spawning and rearing
- Resource products (bullfrogs, snapping turtles, furbearers-muskrat, raccoon, beaver, mink, coyote, fox skunk)

There were several wetland areas located on the property (Communities 1, 2, 5, 6 & 7). All communities except for Community 6 (part of the PSW) have not been evaluated by MNR under the Ontario Wetland Evaluation System. Recent changes to OWES (2024) limit complexing of new unevaluated wetlands into existing PSW's. Based on our review of the OWES policies, the smaller wetland pockets on site are not considered provincially significant.

5.3.2 Linkages and Corridors

The Site is bordered by a large contiguous natural area to the North, with smaller corridors to natural areas along the southwestern and southeastern end of the Site. The Site contains some trails from the southwest to the northern extent of the subject property to access agricultural fields. The subject property is predominantly bordered by natural areas, with various corridors such as roadways and watercourses and linkages between various ecological communities.

5.3.3 Significant Woodland

The identification and evaluation of these features is a planning authority responsibility. A significant woodland natural heritage study has not been completed by Township or Simcoe County. A Natural Heritage System and Restoration Plan for the Lake Simcoe Watershed by LSRCA (2018). Assessment by GHD following the Natural Heritage Reference Manual indicates that the woodlands on Site may indicate significance due to the proximity to other woodlands and habitats, linkages between different habitats (wetlands, fields, rock barrens). The Lake Simcoe watershed currently has 35% forest cover (LRSCA 2025) which, according to the Natural Heritage Reference Manual, would indicate the woodlands on Site are significant, due to being greater than 50 ha on Site.

5.3.4 Significant Wildlife Habitat

In Ecoregion 6E, MNR has developed criteria that can be used to confirm five broad categories of Significant Wildlife Habitat (SWH): seasonal concentration areas of animals, rare vegetation communities, specialized habitat for wildlife, habitat for species of conservation concern (not including endangered or threatened species) and animal movement corridors. Within each category, there can be more than one specific type of Significant Wildlife Habitat (for example, seeps and springs are considered one type of specialized habitat for wildlife which is a category of SWH).

GHD biologists identified the following 13 candidate SWH types as having the potential to occur in the Study Area: waterfowl stopover and staging areas (aquatic), turtle wintering area, reptile hibernaculum, colonially-nesting bird breeding habitat (tree/shrub), deer yarding area, deer winter congregation area, woodland raptor nesting habitat, turtle and lizard nesting areas, amphibian breeding habitat (woodland), marsh bird breeding habitat, special concern and rare wildlife species, amphibian movement corridor and deer movement corridor.

See **Appendix I** for a list of all SWH in Ecoregion 6E and rationale for whether candidate SWH occurred within the subject property.

5.3.5 Fish and Aquatic Habitat

5.3.5.1 Aquatic Habitat Assessment

GHD biologist assessed the aquatic habitat form and function of the watercourses located within the Site on October 24, 2012, June 3 and June 4, 2013. Two first order watercourses run through the Site and belong to Regional Black-Severn River watershed (Drinking Water Source Protection, 2019). The watercourses outlet into the Grass Lake Wetland which is classified as a Provincially Significant Wetland (PSW). Several unnamed tributaries to these watercourses were identified during assessments and identified as indirect fish habitat (**Figure 3**). Detailed aquatic habitat assessments were not completed on these tributaries.

The first order watercourses were not officially named. For the Cumberland Quarry project, they will be referred to as Watercourse 1 and Watercourse 2, both watercourses are classified as having intermittent flows. Surface water flows are provided from the upstream wetland headwater features located off-site, four on-site catchment areas and Watercourse 1 and 2 local catchment, local springs and the neighbouring Severn Pines Quarry groundwater discharge and precipitation, diverted directly into Watercourse 1 (MTE, 2014). The Severn Pines Quarry (operating licensed Walker quarry to west) contributes 76% of the Watercourse 1 baseflow and is a predominant feature influencing the watercourse aquatic habitat.

The number and distribution of survey sites were selected and stratified based on the study objective (before and after comparison), stream order, current land use and unique features. Aquatic habitat sites were established to provide baseline conditions of the watercourse substrate composition, riparian habitat, percent in-stream cover and unique features. Each site was representative of the watercourse and reflective of unique habitat types. A total of seven aquatic habitat sites were established and assessed in 2012 and 2013, five sites were located within the Site and two were located within the Study Area boundaries for long-term monitoring (**Figure 3**). Detailed site descriptions have been provided below and a summary of aquatic habitat characteristics along with surveys completed at each site has been provided in **Appendix J**.

Watercourse 1

The Watercourse 1 channel form appeared to have been heavily modified from historic ditching and grading. The ditching had straightened and hardened the watercourse banks, exposing the shallow limestone and homogenizing the aquatic substrate. The surrounding land use north of the Severn Pines Quarry outlet was cleared for agricultural purposes, minimizing the riparian buffer, destabilizing banks and enhancing sedimentation of upland soils into the watercourse. Downstream of the Severn Pines Quarry, the surrounding land use was primary forested lands that have been maintained, and channel manipulation was less prevalent. The watercourse leaves the Site along the west property line through a corrugated steel pipe (CSP) culvert, draining into a wetland where natural channel form returns. Biologists walked the entire length of the watercourse of approximately 2,269 m and established a total of three aquatic survey sites (Site 1, 6 and 7).

Watercourse 1 Site Descriptions

Site 1 was in the southeast portion of Watercourse 1, located north on Nichols Line and northeast of the quarry entrance. The site was downstream of the confluence and east of the ATV trail. The substrate was dominated by sand (0.06-2mm) with low overhead cover (0-24%) consisting of overhanging terrestrial grasses, trees and shrubs. The instream cover was also low consisting of small woody debris, the average wetted width was approximately 1.5 m and the average water depth was 0.43 m. The surrounding riparian vegetation was dominated by terrestrial shrubs. The watercourse was classified as direct fish habitat based on its permanency, habitat structure and the presence of fish. This site was located in Community 11 (**Figure 2**), detailed riparian habitat can be found in **Section 5.2.1**.

Site 6 was in the north portion of Watercourse 1, located approximately 600m northeast of the Severn Pines Quarry. The substrate at this site was dominated by sand (0.06-2mm) with low overhead cover (0-24%) consisting of trees and

overhanging terrestrial grasses. The instream cover was considered to be moderate with aquatic emergent vegetation. The average wetted width was 2.2 m with an average water depth of 0.13 m. The surrounding vegetation was dominated by terrestrial grasses and woody debris. The watercourse was classified as direct fish habitat based on its permanency, habitat structure and the presence of fish. This site was located in Community 7 (**Figure 2**), detailed riparian habitat can be found in **Section 5.2.1**.

Site 7 was located approximately 512 m south of Site 6 and 615m northwest of Site 1. The substrate was dominated by clay (hard pan) and with low overhead cover (0-24%) consisting of trees and non woody vegetation. There was little to no instream cover, the average wetted width was approximately 4.0 m with an average water depth of 0.3 m. The surrounding vegetation was dominated by a wooded lot. The watercourse was classified as direct fish habitat based on its permanency, habitat structure and the presence of fish. Site 7 was located between Vegetation Communities 9 and 16 (**Figure 2**), detailed riparian habitat can be found in **Section 5.2.1**.

Watercourse 2

The Watercourse 2 channel form has been modified from ditching and grading at its headwaters. The ditching has straightened and hardened the watercourse banks, exposing the shallow limestone and homogenizing the aquatic substrate. Watercourse manipulation has degraded the riparian buffer, destabilized banks and enhanced sedimentation of upland soils into the watercourse. The lower half of the watercourse has been maintained and channel form is naturalized, dissipating into a PSW wetland. Biologists walked the entire length of the watercourse of approximately 427 m and established a total of two aquatic survey sites (Site 4 and 5).

Watercourse 2 Site Descriptions

Site 4 was located in the southeast portion of the Site, approximately 500 m southeast of Site 1. The substrate was comprised equally of fine organics and detritus with moderate overhead cover (25-49%) consisting of trees, and large woody debris. The instream cover was dense and comprised of large amounts of algae mats. The average wetted width was approximately 3.5 m with an average water depth of 0.69m. The surrounding riparian vegetation consisted of a wooded lot and terrestrial vegetation common to those found in swamps. The watercourse was classified as direct fish habitat based on its permanency, habitat structure and the presence of fish. This site was located in Vegetation Community 6 (**Figure 2**), detailed riparian habitat can be found in **Section 5.2.1**.

Site 5 was located at the southeast portion of the Site boundaries, approximately 120 m west of Site 4. The substrate at this site was dominated by clay (hard pan) with low overhead cover (0-24%) consisting of shrubs and overhanging terrestrial grasses, similar to Site 4 the instream cover was dense with algae. The average wetted width was approximately 3.5m and average water depth was 0.46m. The surrounding vegetation consisted of terrestrial and aquatic shrubs and grasses. The watercourse was classified as direct fish habitat based on its permanency, habitat structure and the presence of fish. The site was located in Vegetation Community 6 (**Figure 2**), detailed riparian habitat can be found in **Section 5.2.1**

Off-Site Locations

Site 2 was located on the east side of South Sparrow Road, approximately 1000 m northwest of the Cambrian Road, South Sparrow Road intersection and 720m northeast of Site 1. The substrate was dominated by gravel (2-65mm) with little to no overhead cover (0-24%) consisting of overhanging terrestrial and wetland grasses. The instream cover was comprised of emergent and submergent aquatic vegetation. The average wetted width was approximately 7.8m with an average water depth was 0.50m. The surrounding vegetation consisted of wetland plant species. The watercourse was classified as direct fish habitat based on its permanency, habitat structure and the presence of fish.

Site 3 was established as the control site to compare temporal aquatic form and function data during operation and decommissioning. The site was located north on South Sparrow Road (approximately 1000m north of Site 2) in a wetland located directly north of the Site boundary, west of the ATV trail. The site was selected as a control site and will be used to assess long-term aquatic habitat health within the Study Area. The control site is upstream of the quarry development and will not be directly impacted by the proposed works. The site substrate was comprised equally of clay (hard pan), silt (<0.06mm) and detritus. Overhead cover was low (0-24%) consisting of dead trees and

aquatic vegetation. The instream cover was dense with emergent aquatic vegetation; the average wetted width was approximately 30m with an average water depth of 0.35m. The surrounding vegetation was dominated by common wetlands species. The watercourse/wetland was classified as direct fish habitat based on its permanency, habitat structure and the presence of fish.

5.3.5.2 Fish Community Assessment

GHD conducted fish community surveys in Watercourse 1 and Watercourse 2 during the 2013 assessments. Fish sampling locations have been illustrated in **Figure 3** and environmental conditions, level of effort and results have been found in **Appendix K**. The preferred habitat for the fish species collected during the fish community sampling has also been provided in **Appendix K**.

In Watercourse 1, a total of 20 fish were collected. A total of four fish species made up the fish community: brassy minnow (*Hybognathus hankinsoni*), creek chub (*Semotilus atromaculatus*), northern redbelly dace (*Chrosomus neogaeus*) and pumpkinseed (*Lepomis gibbosus*). The fish species represent two families *Cyprinidae* and *Centrarchidae*. The fish community was dominated by fish species that prefer cool water thermal regimes.

In Watercourse 2, a total of 31 fish were collected representing three fish species: brook stickleback (*Culaea inconstans*), central mudminnow (*Umbra limi*), and northern redbelly dace. The fish species were represented by three families, *Cyprinidae*, *Gasterosteidae* and *Umbridae*. Similar to Watercourse 1, the fish community was dominated by fish species that prefer cool water thermal regimes.

Grass Lake is located approximately 5 kilometres downstream of the Study Area. Fish species known to inhabit Grass Lake include a mix of both warm and cool-water species. A list of historical fish species documented in Grass Lake include; brassy minnow, brook stickleback, common carp (*Cyprinus carpio*), creek chub, central mudminnow, largemouth bass (*Micropterus salmoides*), northern redbelly dace, northern pike (*Esox Lucius*), pumpkinseed (*Lepomis gibbosus*), yellow perch (*Perca flavescens*) and walleye, (*Sander vitreus*) (OMNR, 1989; OMNR 2010). The literature review found no provincially and/or nationally rare species documented within the Site (COSEWIC 2023; SARO 2024).

5.3.5.3 Benthos Community Assessment

The benthos community baseline sample locations were established and collected on October 24, 2012. Three sites were established (Sites 1, 2 & 3), three subsamples (A, B and C) were collected within Sites 1 and 3 and two subsamples within Site 2 (**Figure 3** and **Appendix L**). Benthos community sampling metrics are displayed in **Table 5**. Raw benthos abundance and community data is in **Appendix M**.

The benthos community control site (Site 3) was re-established and sampled on October 15, 2014, directly upstream (northwest) of the constructed ATV/snowmobile trail. The 2012 and 2014 samples for Site 3 were compared and discussed in this section, analysis and comparisons for the entire benthos community will include Site 1, 2 (2012 collection) and Site 3 (2014 collection).

Site 3 Comparison

Comparisons of the benthos community between the 2012 and 2014 samples show that some families were not collected in 2014 that were in 2012. As well new families that appeared in the 2014 samples that were not observed in the 2012 samples. The aquatic habitat was slightly different in 2014 with sand being the second dominate substrate whereas it was clay in 2012 (**Appendix J**). This habitat difference could be the reasoning behind the difference in families between the 2012 and the 2014 benthic samples.

The Hilsenhoff values were similar between both sampling year. The environmental sensitivity metrics were also similar except for percent EPT. *Ephemeroptera* only appeared in the 2014 samples (**Appendix L**).

Grass Lake Tributary Benthos Community

The Grass Lake tributary benthos community was comprised of 14 orders and 37 families (**Appendix L**). The most abundant order was *Diptera* which made up 46.9% of all samples combined. The least abundant was *Odonata*

(Dragonfly) (0.35%), *Tricoptera* and *Odonata* (Damselflies). Each of these orders made up 0.47% of all samples combined. Of the 46.86% of *Diptera*, 33% was comprised of the family *Chironomidae*, 11% was *Ceratopogonidae*, 0.95% was *Tabanidae*, 0.35% was *Tipulidae*, 0.7% was *Tipulidae* and the remaining 0.1% was comprised of *Emphididae* and *Simuliidae*. Site 2, sample A/B (2) had the highest species diversity (13 families). Site 1, sample C had the lowest species diversity (8 families). The most abundant family appearing in all samples was *Chironomidae* which is part of the *Diptera* (Flies) taxonomic order. They are also known as non-biting midges or *chironomids*. *Chironomids* are tolerant to a wide range of water and air temperatures and are found in almost any aquatic ecosystem. *Chironomids* are considered to be gatherers/collectors' feeders. They tend to feed on fine to medium detritus particles on organic substrates. During their entire life cycle, they are heavily preyed upon by young-of-year predaceous fish (Meritt, Cummins, & Berg, 2008).

Several families were considered rare and only appeared once within all the samples. Within the *Diptera* (flies) order, the family *Simuliidae* was only seen in Site 1 subsample C and *Emphididae* was only seen in Site 1, subsample A. Within the *Tricoptera* (Caddisfly) order, the family *Glossosomatidae* was also only seen once in Site 1, subsample A. The order *Ephemeroptera* (Mayflies) was only observed in Site 3 (**Appendix L**).

The total percentage of each taxonomic family within the entire sampling area, including all three subsample sites has been illustrated in **Table 5**.

Table 5 Baseline Benthos Community Composition in Grass Lake Tributary

Taxa	Total Individuals	Percentage (%) of Organisms for All Samples (Site 1, 2 and 3)
<i>Chironomidae</i>	287	33.92
<i>Perlodidae</i>	118	13.95
<i>Ceratopogonidae</i>	97	11.47
<i>Physidae</i>	47	5.56
<i>Gammaridae</i>	46	5.44
<i>Hyalellidae</i>	46	5.44
<i>Hydrobiidae</i>	37	4.37
<i>Tubificidae</i>	35	4.14
<i>Asellidae</i>	28	3.31
<i>Sphaeriidae</i>	23	2.72
<i>Crangonyctidae</i>	22	2.60
<i>Corixidae</i>	9	1.06
<i>Tabanidae</i>	8	0.95
<i>Hirudinea</i>	6	0.71
<i>Ephemerellidae</i>	5	0.59
<i>Dysticidae</i>	4	0.47
<i>Halplidae</i>	4	0.47
<i>Siphonuridae</i>	4	0.47
<i>Lestidae</i>	4	0.47
<i>Tipulidae</i>	3	0.35
<i>Heptageniidae</i>	2	0.24
<i>Gomphidae</i>	2	0.24
<i>Phryganeidae</i>	2	0.24

Taxa	Total Individuals	Percentage (%) of Organisms for All Samples (Site 1, 2 and 3)
<i>Cyclopoida</i>	1	0.12
<i>Empididae</i>	1	0.12
<i>Simuliidae</i>	1	0.12
<i>Planoribidae</i>	1	0.12
<i>Libellulidae</i>	1	0.12
<i>Glossosomatidae</i>	1	0.12
<i>Limnephilidae</i>	1	0.12

Environmental Sensitive Metrics

The benthos community composition for the Grass Lake tributary was assessed using the five environmental sensitive metrics described below and summarized in **Appendix L**.

Families of *Ephemeroptera*, *Plecoptera* and *Trichoptera* (EPTs) are considered to be sensitive to pollution, preferring oxygen rich habitats. Higher proportions of these organisms are expected at less impacted sites area (Merrit, Cummins, & Berg, 2008). The percentage of EPTs was variable across the samples, averaging 14.62%, ranging from 0% to 58.62% within the samples

ETOs (*Ephemeroptera*, *Trichoptera* and *Oligochaeta*) are a grouping considered to be environmentally sensitive (Merrit, Cummins, & Berg, 2008). The average percentage of ETO through all eight samples was 5.94% and ranged from 0% to 16.00%.

The average proportion of EPT to one *Chironomidae* was high (0.96), ranging from 0.00 to 4.25%. The high observed values indicate a balance community and is reflective of little environmental stress.

Simpsons Diversity Index simply measures the diversity within the sample; zero (0) indicates a low diversity and one (1) indicates a high diversity. The sample that had the lowest diversity was sample A/B (2) in Site 2 with a rating of 0.14 and the sample with the highest diversity was sample A in Site 3 with a rating of 0.48.

Hilsenhoff Biotic Indices (HBI) results, water quality index value and degree of organic pollution for all sites are provided in **Table 5**. The higher the biotic index value is the greater amount of organic pollution assumed. The lower the biotic index the less organic pollution assumed. The majority of the samples had “fair” water quality indicating existing baseline aquatic environment was impacted by organic pollution. Site 1, subsample B had “good” water quality indicating there was very low organic pollution. All subsamples within Site 3 had “fairly poor” water quality, indicating existing baseline aquatic environment was impacted substantially by organic pollution.

Table 6 Evaluation of Water Quality using the Biotic Index (Hilsenhoff, 1988)

Sampling Year	Site	Sample	Sub Sample	Hilsenhoff Biotic Index	Water Quality Index	Degree of Organic Pollution
2012	1	1	A	6.53	Fair	Fairly Significant Organic Pollution
			B	4.77	Good	Some Organic Pollution
			C	3.99	Very Good	Possible Slight Organic Pollution
2012	2	1	A/B (1)	6.45	Fair	Fairly Significant Organic Pollution
			A/B (2)	5.88	Fair	Fairly Significant Organic Pollution
2012	3	1	A	6.40	Fair	Fairly Significant Organic Pollution

Sampling Year	Site	Sample	Sub Sample	Hilsenhoff Biotic Index	Water Quality Index	Degree of Organic Pollution
2014	3	2	B	5.98	Fair	Fairly Significant Organic Pollution
			C	6.54	Fairly Poor	Significant Organic Pollution
			A	6.49	Fairly Poor	Significant Organic Pollution
			B	5.93	Fairly Poor	Significant Organic Pollution
			C	6.42	Fairly Poor	Significant Organic Pollution

Benthos Habitat

The benthos habitat was recorded at each sample site within the Grass Lake tributary. A summary of the benthic habitat has been provided below and details can be found in **Appendix L**.

The substrate varied at each benthos sampling site. Site 1 substrates were dominated by cobble. Site 2 substrates were mixed with both gravel and detritus and Site 3 substrates were dominated by silt. Depths for all sampling locations ranged from 0.11 m to 0.56 m.

The two most abundant families found within the benthos samples were *Chironomidae* and *Perlodidae* (**Table 4**). *Chironomidae* can be found in almost any kind of aquatic ecosystem and are very resilient (Merrit, Cummins, & Berg, 2008), thus it is expected that this family would be the most abundant within all samples. The *Perlodidae* family is within the *Plecoptera* (Stonefly) order. They are typically found in cool waters that have gravel/cobble substrate (McCafferty, 1998). *Perlodidae* were only found in Site 2, subsample B and C (**Appendix M**). This likely due to the dominate substrate found at these two subsample locations namely cobble and gravel, which is considered optimal habitat for *Plecoptera*.

5.3.5.4 Surface Water Quality Assessment

Surface water quality was collected on October 24, 2012, and June 4, 2013, at all sample locations approximately 0.1 m to 0.2 m below the surface of the water to support interpretation of aquatic assessment findings. Detailed sample information has been provided in **Appendix N** and sample locations illustrated in **Figure 3**.

The surface water quality parameters collected in 2012 and 2013 were within the acceptable range for aquatic life. The baseline data obtained can be used to compare conditions to construction and post construction monitoring results to ensure all parameters are kept within the acceptable range. It should be noted that MTE has conducted surface water quality monitoring at eight stations (five on-site and three off-site) to compare the water chemistry entering the Grass Lake Wetland from on and off-site location (MTE, January 31, 2014).

6. Site Plan Development

Site plans have been developed for the proposed quarry and GHD provided input to formation of the plan in the form of mitigation measures and recommendations on the setbacks, buffers, rehabilitation plan drawing and notes, and the phasing of the rehabilitation. The extraction area encompasses approximately 118.5 hectares with the total licensed area of 138 hectares, including portions of Lots 12, 13 and 14.

The quarry will be extracted in 9 phases starting in the southern portion of the proposed licensed area with Phases 1 and 2 and progressing north (refer to the operational plan and sequencing of rehab). Phase 1A includes the Processing, Shipping and Recycling Area. The land in each phase will be progressively rehabilitated.

The main gates are in the southwest portion of Lot 12 off Nichols Line and will be used to access the Processing, Shipping and Recycling Area (Phase 1A).

There is an existing intermittent watercourse (Watercourse 1) that enters the Site at the north inlet which flows across the Site and exits at a point along the eastern boundary. This watercourse will be realigned in stages as part of the operational plan for the proposed quarry such that a new drainage channel will be constructed on the quarry floor that will mimic Watercourse 1 and provide fish habitat post-extraction (Refer to Stages of Operational Plan – Sheets 6, 7, and 8).

A 90m buffer is incorporated into the operational plan in the northern portion of the proposed licensed area. This area will be used to develop a tree nursery, and the construction of a habitat linkage that will connect the new drainage channel to the northern inlet. This habitat linkage will be carved into the limestone rock face inside the 90m buffer and allow for fish in this area to access the new drainage channel and the downstream outlet along the eastern boundary. Further details regarding this habitat link and the benefits to fish habitat are described in Section 7.1.3.

Included in the operational plan for the proposed quarry is a Wetland Compensation Plan that outlines how wetlands removed during extraction are successfully recreated in a timely manner so that impacts on wetland and wildlife habitat are avoided. Further details regarding the Wetland Compensation Plan are presented in Section 8.1.3.

A summary of the operational activities and rehabilitation of each phase along with the number of years to complete each phase has been summarized in **Table 7**. Part of the objectives of the rehabilitation plan was to recreate eastern whip-poor-will habitat, as it was a threatened species under the ESA at the time. Since its status has been changed to Special Concern, the rehabilitation plan may need to be revisited.

Table 7 *Phases and the Number of Years to Completion*

Phase	Area (ha)	Years to Completion	Operational Activities	Rehabilitation
1A/1B	13.5/ 10.5 (24ha)	11	Processing, shipping, recycling area created and scales for duration of project	8.0 ha to be used to create open field meadow while the remaining 5.5 ha will be used to service ongoing agricultural and forestry activities and remain as rock platform
2	16ha	9	Excavated, new drainage channel constructed to drain runoff from active area, forest removed. At least 2 territories of Whip-poor-will (WPWI) removed	Create partial wetland using organics from Community 17 found in Phase 3A. Create forest connection east to west across Site along new drainage channel. Create Whip-poor-will habitat in open field meadow area.
3A/ 3B	13.5/13 (26.5ha)	25	Excavated, Walker's Severn Pines Quarry discharge water diverted into new drainage channel, created on quarry floor and connected to north inlet using a habitat linkage (need to submit plans for habitat linkage to MNR before extraction in Phase 3B commences), forest and wetland removed. At least 1 territory of WPWI removed. Butternut trees to be removed (need Notice of Butternut Impact form completed prior to clearing).	Create forest connection east to west across Site along new drainage channel. Develop agricultural soils and farmland. Habitat Linkage created. Create forest along western and northern portions of phases. Butternut trees compensated/replaced.
4A	13.5	8	Excavated, forest removed. Butternut trees to be removed (need Notice of Butternut Impact form completed prior to clearing)	Create remainder of wetland using organics from community 17 in Phase 4B along new drainage channel and forest corridor. Finish forest connection east to west across Site along new drainage channel. Rehabilitate to Open field meadow, which can be used for whip-poor-will habitat.
4B	14.5	10	Excavated, forest and part of Community 7 wetland removed. At least 2 territories of WPWI removed.	Create forest along eastern edge and slope. Rehabilitate to agriculture. Create forest along eastern portions of phase.
4C	12	10	Excavated, forest and wetland removed. At least two territories of WPWI removed.	Create forest along eastern edge and slope and southwest portion. Rehabilitate to agriculture. Create forest along eastern portions of phase.
4D	12	9	Excavated, forest and wetland removed. At least two territories of WPWI removed.	Create forest along eastern edge and northern edges and slopes. Rehabilitate to agriculture. Create forest along eastern portions of phase.

7. Impact Assessment

The following section provides a description of the predicted impacts that may result from the proposed development. It also identifies mitigation measures to be implemented to avoid and/or minimize adverse effects to the natural environment features within or near the project.

7.1 General Impacts

7.1.1 Birds and wildlife

The logging of the forest and vegetation cover will occur prior to overburden stripping in each phase. The progressive rehabilitation plan shows a phasing from south to north with rehabilitation occurring after each of the nine phases. The forest clearing will remove nesting sites of breeding birds protected under the Migratory Birds Convention Act. It is recommended that clearing occur outside of the peak breeding bird season, acknowledged by Environment Canada to be from April 1 to August 31 of any given year.

Clearing should occur in phases and only as necessary for the active extraction operations. This will minimize the area of cleared forest and maintain habitat for species at risk birds, herpetofauna, deer and other wildlife and plants. It is also recommended that clearing of trees be conducted outside of the active season for SAR bat species, which is May 1 to August 31 of any given year.

Breeding habitat for amphibians was identified on Site. Impacts to amphibians are associated with direct loss of wetland habitat, and road mortality due to increased traffic into the area of the Site. The installation of ESC fencing around all access and construction envelopes can act as an exclusionary boundary to reduce herpetofauna from entering the Site. Fencing would be installed prior to or after the active herpetofauna season which is from April 1 to November 1 of any given year and would remain in place over the construction period. A wetland compensation plan has also been recommended to maintain amphibian habitat.

7.1.2 Regionally Rare Plants

Fifteen regionally rare species were found within the Study Area. These included meadow horsetail (*Equisetum pratense*), diploid maidenhair spleenwort (*Asplenium trichomanes ssp. trichomanes*), early buttercup (*Ranunculus fascicularis*), butternut (*Juglans cinerea*), black walnut (*Juglans nigra*), meadow chickweed (*Cerastium arvens ssp. arvens*), Canadian St. John's-wort (*Hypericum canadense*), purple-flowering raspberry (*Rubus odoratus*), common meadow-beauty (*Rhexia virginica*), racemed milkwort (*Polygala polygama*), European wood-sorrel (*Oxalis stricta*), wild geranium (*Geranium maculatum*), white heath aster (*Aster pilosus var. pilosus*), tall goldenrod (*Solidago altissima*) and foxtail sedge (*Carex alopecoidea*).

These species were located within the property licensed area. For the protection of these species re-location is required when possible. The need for a salvage plan to confirm the continued presence of these species and transplant the specimens will be discussed with MNR.

7.1.3 Linkages and Corridors

There will be a temporary loss of woodland habitat due to clearing within each phase. The plan includes several phases that cover relatively small areas. In this way the amount of habitat loss and vegetation clearing will be limited at any one time (generally less than 25 acres). As the progressive rehab continues in subsequent phases the age structure of the vegetation, in particular the forest blocks will be staggered, creating a mixture of early-late successional forest habitat.

Connectivity of forested areas will be maintained throughout the property over the different phases. A linear forested block will connect the proposed forest on the south end of the property to the forest on the eastern edge of the property. This will act as an important corridor for wildlife moving east-west, once established.

The recommended rehabilitation of the quarry after extraction involves forests, wetland, and establishing meadow habitats. As well, one large area of land will be managed for hay in the central and northern portions of the property. The open field/meadows will be seeded with native grasses but also be allowed to re-establish naturally. This will reinstate most of the natural pre-construction forest cover and connectivity/linkages in that area while maintaining the existing biodiversity provided by the other habitat types.

7.2 Species at Risk

All species at risk which may or may not have habitat within the Site Boundary or Study Boundary have been summarized in Table 3 below. The table is compiled to show all species identified during our background literature reviews from the NHIC Make-a-Map records, the Ontario Breeding Bird Atlas, and correspondence with MNR.

The site plan conditions include a series of mitigation measures to limit the potential impacts to Species at Risk found and their habitat on Site. The confirmed Threatened or Endangered species identified on Site or within the Study Area include: Butternut, black ash, and *Myotis* bat species, tri-coloured bat, hoary bat, eastern red bat and silver-haired bats. A Blanding's turtle was also identified by non-GHD staff approximately 200 m north of the Site Boundary in 2020. Since 2017 report, Whip-poor-will is no longer listed as a threatened species in Ontario.

Table 8 Species at Risk birds Habitat Impact Assessment.

Species	Status	Habitat Preference	Existing Habitat on Site	Observations	Restoration Plan Habitat/ Further Action
Birds					
*Canada warbler	Special Concern (federal and provincial)	Deciduous and coniferous forests and swamps with a well-developed, dense shrub layer.	Preferred habitat exists on Site within the forest and swamp communities. This habitat will be removed.	No Canada warblers were observed on Site.	Preferred habitat will be present, once vegetation is re-established, on and adjacent to the property during all phases of operation.
*Olive-sided flycatcher	Special Concern (federal and provincial)	Natural forest edges and openings. Commonly uses forests that are logged or burned, using the snags as perches. Breed in coniferous or mixed forests adjacent to water bodies or within beaver ponds and flooded wetlands.	Preferred habitat exists on Site within the logged areas, forests, and forest edges. This habitat will be removed.	No olive-sided flycatchers were observed on Site.	Preferred habitat will be present, once vegetation is re-established, on and adjacent to the property during all phases of operation.
*Bobolink	Special Concern (federal), threatened (provincial)	Grasslands or graminoid dominated hayfields with tall vegetation with a forb component and a moderate litter layer.	None. No open grassland present on Site.	None	NA
Eastern meadowlark	Threatened (federal and provincial)	Moderately tall grasslands with abundant litter cover, high grass proportion, and a forb component	None. No open grassland present on Site.	None	NA
Chimney swift	Threatened (federal and provincial)	Urban, suburban, rural and wooded sites. They are most associated with towns	None. No structures with chimneys or large, hollow DBH trees	None	NA

Species	Status	Habitat Preference	Existing Habitat on Site	Observations	Restoration Plan Habitat/ Further Action
		and cities with large concentrations of chimneys			
Eastern whip-poor-will	Special concern (federal and provincial)	A mix of open and forested areas within open woodlands or openings in more mature, deciduous, coniferous and mixed forests.	Preferred habitat exists on Site within the woodland clearings, rock outcrops and logged forests. This habitat will be removed.	Thirteen (13) eastern whip-poor-will were observed on Site during targeted surveys.	Preferred foraging habitat and/or nesting habitat will be present, on and adjacent to the property at different times over the course of extraction phases and rehabilitation activities.
Common nighthawk	Special concern (federal and provincial)	Open field habitats for foraging and natural open habitats for nesting, such as sand dunes, beaches, recently burned-over areas, pastures, exposed rocky outcrops, rock barrens, and rooftops for nesting.	Suitable habitat exists within the woodland clearings, rock outcrops and logged forests. This habitat will be removed.	Five (5) common nighthawks were observed on Site during targeted surveys.	Preferred foraging habitat and/or nesting habitat will be present, on and adjacent to the property at different times over the course of extraction phases and rehabilitation activities.
<u>Red-headed woodpecker</u>	Endangered (federal and provincial)	Habitats dominated by oak and beech or forests within a floodplain area. May occur in a variety of more open habitats (i.e. pastureland, golf courses, and cemeteries) however these areas must also contain many over- mature deciduous and dead trees for perching and nesting.	Suitable habitat exists within open areas as well as mixed and deciduous forests. Selective lumber harvesting has reduced current habitat quality. This habitat will be removed.	No red-headed woodpeckers were observed on Site.	The progressive rehabilitation plan will create and maintain forest habitat during all phases of the project. Potential habitat for this species may continue to exist on and adjacent to the property.
<u>Eastern wood-pewee</u>	Special concern (federal and provincial)	All woodland types. Winters in partially cleared shrubby habitats and secondary forests.	Suitable habitat exists in the forests and logged areas on Site. Dense stands of forest and the open subcanopy nature of some of the forest communities creates ideal habitat. This habitat will be removed.	Several eastern wood-pewees were observed in forested areas.	Preferred habitat will be present, once vegetation is re-established, on and adjacent to the property during all phases of operation.
<u>Bank swallow</u>	Threatened (federal and provincial)	Streamside banks, sand and gravel pits.	None.	NA	NA
Barn Swallow	Special concern (federal and provincial)	Human made structures including barns, buildings, sheds, bridges, and culverts. Preferred	None	NA	NA

Species	Status	Habitat Preference	Existing Habitat on Site	Observations	Restoration Plan Habitat/ Further Action
		foraging habitat includes grassy fields, pastures, agricultural cropland, lake and river shorelines,			
<u>*Cerulean warbler</u>	Threatened (provincial), Endangered (federal)	Second-growth or mature deciduous forest with a tall canopy of uneven vertical structure and a sparse understory in wet bottomland forests and upland areas, and often contains large hickory and oak trees.	None, no mature forest on Site	None observed	NA
<u>Golden-winged warbler</u>	Special concern (provincial), threatened (federal)	Regenerating scrub habitat with dense ground cover and a patchwork of shrubs, usually surrounded by forest that is characteristic of a successional landscape associated with natural or anthropogenic disturbance.	No suitable shrub habitat present on Site	None observed	NA
<u>Wood thrush</u>	Special concern (provincial), threatened (federal)	Deciduous and mixed forests in areas with large trees, moderate understory abundant in leaf litter and shade present.	Suitable habitat exists within the forests on Site. This habitat will be removed.	Several wood thrush were observed on Site.	Preferred habitat will be present, once vegetation is re-established, on and adjacent to the property during all phases of operation.
Least bittern	Threatened (federal and provincial)	Marshes, usually greater than 5 ha, with emergent vegetation, relatively stable water levels and areas of open water. Preferred habitat has water less than 1 m deep	Potential for this species to inhabit the beaver pond and stream on the northern limits of the licensed area and in the 120 m Study Area.	None observed	There is no anticipated negative impact to the least bittern from the quarry operation.
Herpetofauna					
Snapping turtle	Special concern (federal and provincial)	Shallow, slow-moving water, soft substrates and dense aquatic vegetation. Hibernation takes place in soft substrates under water. Nesting sites consist of sand or gravel banks along	Standing water existed beaver pond (Community 1 MAM3-1) north of Site year-round with a sand-based road and disturbed soils in close proximity that could provide nesting opportunities.	None observed.	There is no anticipated negative impact to the snapping turtle from the quarry operation. Extraction area does not extend into beaver pond. A 90m buffer is also incorporated into operational plan.

Species	Status	Habitat Preference	Existing Habitat on Site	Observations	Restoration Plan Habitat/ Further Action
		waterways or roadways			
Blanding's turtle	Endangered (federally) and Threatened (provincially)	Shallow, standing or slow-moving water, rich nutrient levels, organic substrates and abundant aquatic vegetation.	Community 1 – MAM3-1 may contain appropriate habitat	None observed by GHD, reported sighting of Blanding's turtle 200 m north of the Site on a snowmobile trail	There is no anticipated negative impact Blanding's turtle habitat from the quarry operation. Extraction area does not extend into Community 1. A 90m buffer is also incorporated into operational plan.
Eastern musk turtle	Special concern (federal and provincial)	Prefers permanent bodies of water that are shallow and clear, with little or no current and soft substrates with abundant organic materials. Abundant floating and submerged vegetation is preferred.	Community 1 – MAM3-1 is considered suitable musk turtle habitat due to its isolated nature, lack of flowing water or permanent watercourse and lack of logs or emergent vegetation.	None observed	N/A
Spotted turtle	Special concern (federal)	Small, shallow bodies of water including bogs, marshes, fens, and small ponds	There is limited potential for this species to exist within the wetland on the northern limits of the Study Area (Community 1).	None observed	Approximately 90 metres exists between the proposed licensed boundary and the pond and this wetland area is off the property and outside of the proposed extraction area and licensed boundary.
Eastern hog-nose snake	Threatened (federal and provincial)	Snake prefers sandy, well-drained habitats including beaches and dry woods with access to wet areas such as swamps.	The property contained a portion of the snake habitat requirements in that it contained various swamps and marshes across the property, however the soils were not sandy as preferred by this species for laying their eggs in burrows and hibernation.	None observed	It is possible that hog-nosed snake would find habitats on this property, post-rehabilitation.
Eastern ribbonsnake	Special concern (federal and provincial)	Prefer close to water, especially marshes.	The property supports habitat in proximity to wetlands as they exist on and adjacent to the property. There is suitable habitat for	None observed	Post-rehabilitation, this species may find habitat in the new shallow wetlands to be constructed as part of the rehabilitation plan.

Species	Status	Habitat Preference	Existing Habitat on Site	Observations	Restoration Plan Habitat/ Further Action
			this species on the property.		
Eastern massasauga rattlesnake	Threatened (federal and provincial)	This snake is found near water and in pine forests, meadows, shoreline habitats, wetlands, sand barrens and dunes, rock barrens, grasslands and old fields.	Potential habitat exists for this species on the property in Community 8, 13, and 21.	None observed	The rehabilitation plan includes the re-creation of forest, wetland, rock outcrops and open field meadow habitats. Habitat will continue to exist once vegetation is established, on and adjacent to the Site during all phases of operation. The final elevation of the quarry floor will have exposed rock and other habitat features that may provide habitat for this species. Natural fissures in the rock post-construction may provide potential hibernacula for this species. The licensee and staff will be provided identification sheets for this species and measures are in place to document occurrences
Mammals					
Eastern red bat	Endangered (federal and provincial)	A solitary species that roosts in the terminal foliage of mature deciduous and coniferous trees typically at the edge of a clearing, often in dead leaf clusters or pinecone clusters. This species migrates to the south to the US each winter prior to hibernation.	Habitat exists in treed habitats on Site.	Identified in bat acoustic analysis	No specific plans for compensation. But forest in phases will be at various stages with snag trees generally continually present.
Eastern small-footed myotis	Endangered (provincially)	Roosts on the ground under rocks, in rock crevices, talus slopes, or rock piles, and occasionally inhabits buildings. Areas near the entrances of caves or abandoned mines.	Habitat may exist in Communities 3, 8 and 13.	<i>Myotis</i> species identified in bat acoustic study.	No specific plans for compensation. But forest in phases will be at various stages with snag trees generally continually present.
Hoary bat	Endangered (federal and provincial)	Solitary species that roosts in the terminal foliage of mature deciduous and coniferous trees	Habitat exists in treed habitats on Site.	Identified in bat acoustic analysis	No specific plans for compensation. But forest in phases will be at various stages with snag trees generally continually present.

Species	Status	Habitat Preference	Existing Habitat on Site	Observations	Restoration Plan Habitat/ Further Action
		typically at the edge of a clearing.			
Little brown myotis	Endangered (federal and provincial)	Roosts in both natural and man-made structures and require a number of large dead trees, in specific stages of decay and that project above the canopy in relatively open area	Habitat may exist in treed habitats on Site,	<i>Myotis</i> species identified in bat acoustic study.	No specific plans for compensation. But forest in phases will be at various stages with snag trees generally continually present.
Northern myotis	Endangered (federal and provincial)	Usually roost in hollows, crevices, and under loose bark of mature trees. Roosts may be established in the main trunk or a large branch of either living or dead trees.	Habitat may exist in treed habitats on Site,	<i>Myotis</i> species identified in bat acoustic study.	No specific plans for compensation. But forest in phases will be at various stages with snag trees generally continually present.
Silver-haired bat	Endangered (federal and provincial)	Often form small maternity colonies in hollow trees and bark crevices, and do not make use of buildings or caves and migrates south to the US each winter prior to hibernation.	Habitat exists in treed habitats on Site,	Identified in bat acoustic analysis	No specific plans for compensation. But forest in phases will be at various stages with snag trees generally continually present.
Tri-coloured bat	Endangered (federal and provincial)	Roost in foliage, in clumps of old leaves, hanging moss or squirrel nests. They typically feed over aquatic areas with an affinity to large-bodied water and will likely roost in close proximity to these. Hibernation sites and may choose the exact same spot in a cave or mine from year to year.	Habitat exists in treed habitats on Site.	Identified in bat acoustic analysis	No specific plans for compensation. But forest in phases will be at various stages with snag trees generally continually present.
Plants					
<u>*Butternut</u>	Endangered (federal and provincial)	Stream banks, on wooded valley slopes, and in deciduous and mixed forests. It is commonly associated with beech, maple, oak and hickory	Habitat is	13 trees were found (Figure 1) in 2010 and reassessed in 2013.	Recommended that butternut be reassessed and next steps will determine at that time and whether compensation plantings might be incorporated into the restoration plan. Butternut health assessment report. Section 8 outlines the rehabilitation and

Species	Status	Habitat Preference	Existing Habitat on Site	Observations	Restoration Plan Habitat/ Further Action
					compensation required. A re-assessment of butternut is recommended given the time that has passed since initial assessments. Once retainable trees may now be non-retainable and not require permitting under the ESA.
Black Ash	Endangered (provincial), Threatened (federal)	Swamps, floodplains and fens. It has an intermediate light requirement and a tendency toward greater abundance in more alkaline sites. Most sites in which it is dominant are flood prone and high tolerance of seasonal flooding	Habitat is present in Communities 1, 2, 4, 5, 6, 7, 9, and 14.	Individuals noted in Communities 1, 2, 4, 5, 6, 7, 9, and 14.	Since this species was not a listed species when surveys were initially conducted, it is recommended that a health assessment of black ash be conducted to determine if ESA permitting would be required.
Broad-beech fern	Special concern (provincial and federal)	Rich, undisturbed mature deciduous forest dominated by beech and maple. Typically grows in moist to wet, sandy soils of lower valley slopes and occasional swamps	Habitat may be present in Community 10	None found	NA
Asterisk (*) = Species identified from NHIC mapping lists within 10km radius Bold lettering = Species identified by OBBA records in 10km x 10km radius <u>Underlining</u> = Potential habitat identified by MNR correspondence					

Refer to GHD rehabilitation plan (**Section 8**) for detail rehabilitation measures for the project. The rehabilitation plan has been specifically designed to mimic the existing conditions of the site. After progressive rehabilitation, the new habitat will provide the ideal conditions for the species listed above in **Table 8**.

7.3 Natural Features

7.3.1 Wetlands

There are unevaluated and non-provincial wetlands located on the northern and southern portions of the Study Area Site (Communities 1, 2, 5, 6 & 7). The Grass Lake PSW is partially located on Site (community 6) .

The existing Watercourse 1 flows through all wetlands on the Site connecting them hydrologically by surface water. The water runs south through the Site emptying into the PSW (Community 6). As indicated in the Hydrogeological Investigation (MTE 2014) the PSW has several sources of surface water inputs including the watercourse that runs through the Site. The watercourse receives 76% of its base flow from the active Walkers Severn Pines Quarry (pumped discharge water) to the west and 17% from the unevaluated wetland to the north (GHD's Community 1) (MTE, 2014). It is important to maintain inputs and outputs from wetland Communities 1 and 6 to maintain the

hydrological and ecological conditions that currently exist. It is recommended that the surface water contributions continue to the PSW throughout the life of the quarry. As identified in the Water Budget, MTE predicts the total discharge from the site will increase by 3% with a 1% increase in total average discharge at full operation and will not adversely affect the PSW (MTE, 2014). GHD supports the conclusion that so long as a continued connection of surface water is maintained from Community 1 to Community 6 there will be no negative impacts to the PSW.

Maintenance of the hydrological function of the PSW is the prime objective. It is recommended that a 30 m buffer be established from the boundary of the PSW to protect its functions. The minor change in flow from Watercourse 1 will not result in increased water levels in the PSW. The vegetation communities, plant species and nature of the wetland will not be impacted by the slight increase in volumes. The large size of this riverine wetland will absorb the slight increase and with a permanent inflow and outflow from the wetland, level changes would not occur.

A wetland area (Community 7) exists in the central and northern portions of the Site and extends beyond the Site boundary onto lands owned by the County of Simcoe. This wetland area exists in the proposed extraction area and therefore will be removed. This wetland is a permanent feature, however as it is in the central portions of the extraction area and if preserved, would become an isolated and raised feature, surrounding by a lower quarry. Retaining this wetland with extraction on all sides would likely not protect the wetland as it would dry up with no water source and be a raised "island". Upon extraction the containment of water within an area to form a wetland was not an option as the water table is located too far beneath the ground and water would percolate through the cracks in the rock. The limestone quarry is below-water-table as per the regulations and the license application. The rehabilitation plan incorporates the creation of wetland within the west-central portions of the Site. This wetland will replace the habitat that was lost within Community 7 because of the quarry operations. It should be noted that the registered landowners of the Site are in the process of restoring farmlands, which will eventually include these areas on the Site, to reinstate historical farming use. The remaining wetlands (Community, 1, 2 & 5) identified north of the Site on lands owned by the County of Simcoe will not be negatively impacted by the quarry. Site Community 1 and 2 were found adjacent to one another. No impacts will occur so long as source water outputs continue to occur from this wetland, southwards. GHD recommends the source water movement north to south be maintained to maintain wetland conditions. Community 5 was an isolated wetland pocket with no obvious connection by surface water to any of the other wetland features. This wetland will continue to exist after the quarry begins operation.

7.3.2 Significant Woodland

Impacts to the Significant Woodland on Site are discussed in Section 7.4.

7.3.3 Significant Wildlife Habitat

7.3.3.1 Woodland Area-sensitive Bird Breeding Habitat

The Significant Wildlife Habitat Criteria Schedules for Region 6E (MNR 2015) identifies habitat for woodland area sensitive species as a priority for preservation. It specifically discusses forest fragmentation, edge effects and grassland habitat.

The bird surveys for this project recorded 8 woodland area sensitive species. Areas sensitive (AS) species are those that require a minimum hectareage of contiguous suitable habitat to successfully breed (OMNR, 2015). The species included: blue-headed vireo (*Vireo solitaries*), red-breasted nuthatch (*Sitta canadensis*), winter wren (Troglodytes troglodytes), veery (*Catharus fuxcescens*), black-throated blue warbler (*Dendroica caerulescens*), black-throated green warbler (*Dendroica virens*), ovenbird (*Seiurus aurocapillus*) and scarlet tanager (*Piranga olivacea*). The territory of these species included the Study Area and adjoining lands due to the overlap of the vegetation communities into both areas.

The presence of area sensitive species is due to the large contiguous forest and wetland areas in this part of the Township where few roads are present. The proposed extraction area would remove forest cover and rock barren areas on the property during the phasing and operational life of the quarry. The progressive rehabilitation plan and phasing of the cuts would limit the amount of mature forest cut at any one time. The impact on the area sensitive

species would be a direct loss of habitat. The habitat is presently disturbed through long term selective logging and other works.

A nine-phase sequence of extraction and progressive rehabilitation operations will be followed. In all phases, progressive rehabilitation leading to final rehabilitation will follow the extraction operations from south to north and will occur in both extraction and processing areas. As such the amount of disturbed land within the operation will be restricted to parts of each phase.

The rehabilitation plan includes reforestation of portions of the Site, while other portions will allow for the regeneration of fields and meadows. Agriculture fields (hayfields) will also be incorporated into the rehabilitation plan in the central portions of the property. The property is currently a mix of wetland, forest and field habitats, the functions of the field and grassland communities cannot be overlooked, as they are as necessary to some species as forest is to others. While reforestation is a long-term restoration goal (20-50 years to mature) it will allow these wildlife species to reoccupy this property in the future, especially the species at risk that inhabit the Site currently (whip-poor-will, common nighthawk). The design of this progressive rehabilitation plan allows for the species to inhabit other areas of the property while overburden clearing is being conducted in one extraction area. The species will continue to find habitat in areas where the extraction is not actively taking place. Large tracts of forest are suitable habitat for forest dwelling species, particularly area sensitive species such as warblers, vireos and tanagers.

7.3.3.2 Amphibian Breeding Habitat (Woodlands and Wetlands)

The Significant Wildlife Habitat technical guide notes that the greatest significance would be assigned to woodland ponds that support a high diversity of species, species of conservation concern and high numbers of amphibians (2000).

There were five wetland communities on the property (Communities 1, 2, 5, 6 & 7) as seen in **Figure 2**. As stated in the Significant Wildlife Habitat Manual (2000), Woodland amphibian ponds are:

...unpolluted, and contain a variety of vegetation structure, both in and around the edge of the pond, for egg-laying and calling by frogs. The best adjacent habitats are closed-canopy woodlands with rather dense undergrowth that maintains a damp environment. Moist fallen logs are another important habitat component required by salamanders. Site with several ponds and/or ponds close to creeks are especially valuable.

Communities 1, 5 and 6 all meet the above definition of "Woodland amphibian ponds". Community 1 located on the northern limits of the property is a large marsh with a beaver pond on the south edge of the wetland. This pond contained standing water and was optimal for amphibian breeding conditions. Both coniferous and deciduous woodlands surrounded the edges of this wetland. Those habitats are used for foraging and overwintering by some of the amphibian species.

Community 5 was also located on the northern edges of the study limits and was a swamp area that contained woodland surrounding it. Some standing water existed, and fallen logs were present in this community. A large diversity of plant species were recorded in this area providing a large diversity of habitats.

Community 6 is the provincially significant wetland and is designated as a swamp. Some standing water existed within this wetland with mature trees growing through out. This community would provide suitable habitat for amphibian breeding.

Amphibian species observed throughout surveys included northern leopard frog, spring peeper, green frog, gray treefrog, American toad, wood frog, American bullfrog, red-spotted newt and eastern red-backed salamander.

The Category 2 quarry is to be located below the water table. Communities 1, 5 and 6 will not be affected by the quarry so long as surface water flow is maintained throughout the property. All wetlands suitable for amphibian breeding are found outside of the licensed boundary.

7.3.3.3 Special Concern and Rare Wildlife Species

Species of Special Concern under the ESA included: wood thrush, eastern wood-pewee, common nighthawk and eastern whip-poor-will. These species will be temporarily impacted by woodland removal. Mitigation measures and the rehabilitation plan phasing will maintain habitat and reinstate habitat in a progressive phasing. As these species are all birds, the impacts and recommendations are covered under Section 7.1.1, 7.3.3.1, and Section 7.4.

7.3.4 Fish and Aquatic Habitat

The fish habitat present within the Site and Study Area function as direct and indirect fish habitat. Specifically, Watercourses 1 and 2 were confirmed to be fish bearing and provide direct fish habitat. In Ontario, fish habitat is managed and protected under the Federal Fisheries Act, as administered by the Department of Fisheries and Oceans. All watercourses on Site provide direct and/or indirect fish habitat and therefore the Fisheries Act legislation and applies apply to proposed quarry development. Unless authorized by the Minister, no person shall carry on any work, undertaking or activity that results in the harmful, alteration, disruption and destruction (HADD) to fish habitat as defined by the Fisheries Act. This applies to work being conducted in or near waterbodies that support fish and fish habitat, including Watercourse 1 and 2 within the Study Area and flow alterations.

The proposed quarry extraction requires habitat removal and relocation of Watercourse 1, which functions as direct fish habitat and will likely result in result in the harmful, alteration, disruption and destruction (HADD) of fish habitat. Watercourse 1 will be removed and reconstructed approximately 40 m parallel to the original watercourse location. For this to be achieved, Phases 2, 3a and 3b will be extracted within 20 metres from the existing Watercourse 1 channel, leaving the Watercourse 1 and a corridor intact. As each phase is extracted, the new drainage channel will be progressively rehabilitated. The surface water management (SWM) pond will be constructed in conjunction with Phase 2 extraction. The pond will be installed at the discharge point along the east boundary line, capturing all flows from the new drainage channel.

As Phase 2 extraction progresses in a westerly direction, the new drainage channel will be constructed at the inlet of the SWM Pond and move westerly at approximately 20 metres from the excavated rock face. In total, the new drainage channel will be located approximately 40 metres from Watercourse 1. As discussed in the Hydrogeological Investigation (MTE, 2014), the upper 5 metres of the Gull River Formation drains within hours of spring runoff or large precipitation events, causing the watercourse to have intermittent surface water, therefore hydrologically, it is predicted the removal of surrounding lands due to extraction will not dehydrate Watercourse 1.

It is estimated that Phase 2, 3a, 3b will take 34 years or more to complete extraction. Therefore, the new drainage channel and its riparian habitat will have 34 years to reestablish through active and passive rehabilitation before the upstream flows are redirected into the new drainage channel. However, the southern half of the new drainage channel (Phase 2) will be receiving discharge waters from the adjacent western quarry, Severn Pines once Phase 3A is completed. The discharge water from the Walker's Severn Pines quarry contributes up to 76% of the existing base flow for the downstream PSW (Community 6) (MTE, 2014).

The hydrological function and connection of Watercourse 1 from the north inlet will be maintained through Phase 2, and 3a until the extraction of Phase 3b is completed and the new drainage channel is fully constructed, including construction of the new habitat linkage, which will be carved into the limestone rock face inside the 90-metre buffer zone. At this point, the flow will be redirected from the existing watercourse to the new drainage channel, connecting and maintaining surface flow and upstream inputs across the Site to the existing SWM Pond and outlet along the eastern Site boundary. Phase 4a extraction will begin once the new drainage channel has been connected to the north inlet and is functioning as designed.

The quarry floor will follow the Shadow Lake Formation at an average elevation of 216 masl. The design of the new watercourse will maintain a bottom elevation ranging from 214 masl to 214.5 masl to accommodate fish habitat compensation features such as pool-run sequences and fish overwintering habitat.

Culverts will be installed across the new watercourse to provide access for quarry machinery. The number of culvert crossings will be minimized. The progressive rehabilitation methods used to create the new drainage channel will greatly reduce the short-term impacts of relocating the watercourse. The new drainage channel will provide a barrier

free habitat for non-jumping fish species, connecting the PSW to the upstream fish habitat north of the Site which is currently not available due to existing culverts at the north inlet and natural cascades at the eastern outlet.

The channel morphology features will include riffles/runs, pools, shallow wetlands and typical stream features. In addition to inverted root wads and sweepers which will provide in-stream woody debris. Aquatic substrate will also be designed to provide to support the fish community and will include the following particles; silt, sand, gravel, cobble and boulders. Therefore, the new drainage channel will offset the removal of the existing Watercourse 1 by providing equal or greater area of productive fish habitat by providing a diversity of breeding, nursery, feeding and overwintering fish habitat.

To avoid the mortality of individual fish from the extraction process, mitigation measures must be implemented, including a Fish Salvage Plan. Specifically, the proposed quarry extraction requires removal and relocation of Watercourse 1, which directly supports fish. It is recommended that a Fish Salvage Plan be submitted to the MNR for approval prior to extraction in Phase 3B. See Mitigation Measures, Section 10 for the Fish Salvage Plan details.

The HADD of fish habitat is anticipated from the proposed quarry development resulting in the direct and indirect (flow alteration) alteration and destruction of fish habitat. The Project progressive rehabilitation plan offers on-site fish habitat offsetting opportunities. Early engagement with the Department of Fisheries and Oceans is recommended to ensure the Project Fisheries Act requirements are considered in the quarry development plans.

7.4 Other Impacts to Natural Features from Quarry Activity

The key activities on the property that have the potential to impact on the natural features noted above include: clearing of forest cover, road construction, noise attenuation berms, excavation; noise, dust and heavy equipment, sediment and construction runoff, loss of catchment area for wetlands, alteration to watercourse and fish habitat, change of grading and landform, blasting, dewatering, road or accidental mortality and, habitat of Species at Risk.

7.4.1 Clearing of Vegetation

The logging of the forest will occur prior to overburden stripping in each phase. The progressive rehabilitation plan shows a phasing from south to north with rehabilitation occurring after each of the nine phases. The forest clearing will remove nesting sites of breeding birds protected under the Migratory Birds Convention Act. It is recommended that clearing occur outside of the peak breeding bird season, acknowledged by Environment Canada to be from April 1 to August 31st.

Clearing should occur in phases and only as necessary for the active extraction operations. This will minimize the area of cleared forest and maintain habitat for bats, eastern wood-pewee, wood thrush, whip-poor-will, common nighthawk, deer and other wildlife and plants.

The recommended rehabilitation of the quarry after extraction involves forests, wetland, and establishing meadow habitats. As well, one large area of land will be managed for hay in the central and northern portions of the property. The open field/meadows will be seeded with native grasses but also be allowed to re-establish naturally. This will reinstate most of the natural pre-construction forest cover and connectivity/linkages in that area while maintaining the existing biodiversity provided by the other habitat types.

There will be a loss of woodland habitat due to clearing within each phase. The plan includes a number of phases that cover relatively small areas. In this way the amount of habitat loss and vegetation clearing will be limited at any one time (generally less than 25 acres). As the progressive rehab continues in subsequent phases the age structure of the vegetation, in particular the forest blocks will be staggered, creating a mixture of early-late successional forest habitat.

Connectivity of forested areas will be maintained throughout the property over the different phases. A linear forested block will connect the proposed forest on the south end of the property to the forest on the eastern edge of the property. This will act as an important corridor for wildlife moving east-west, once established.

7.4.2 Road Construction

The current access from Nichols Line will be utilized as the main entrance/exit to the quarry over its lifetime. This road and the existing all-weather road used as an internal haulage road through the licensed quarry will be utilized. The entrance is located on the southern edge of the property.

7.4.3 Noise Attenuation Berms

Berms are used to store topsoil and overburden material for rehabilitation as the phasing progresses and to attenuate noise to adjacent sensitive receptors. Berms are constructed within the portion where a 15-30 m excavation setback from the licensed area boundary is required.

Berming is required within the 15m setback from the existing road. The berms will be created along the eastern license boundary separating the excavation limit from the road allowance. Berm development will also follow the extraction phases. Berms will be graded and seeded with native grasses after construction and reseeded as needed to control erosion. The construction of perimeter berms within the licensed area will not have any additional impacts on the vegetation or wildlife present in those areas. These berms will be temporary and the stored topsoil reused for the rehabilitation of the site.

7.4.4 Excavation; Noise, Dust and Heavy Equipment

No sensitive bird species or colonies (great blue heron) or wildlife areas are present in this area that would be directly or indirectly impacted by extraction activities and the noise generated.

The noise from quarries and generation of dust can also impact on wildlife populations. However, there were no significant or sensitive wildlife found within 120m of the property. As private lands are located on all sides of the property, biologist were unable to access these areas for inventory. No records of sensitive species including great-blue heron colonies or nesting hawks were identified within 1km of the licensed area that may be impacted by noise or dust. Currently quarries are found on either side of the property (east and west).

7.4.5 Sediment / Construction Runoff

The Class A Quarry below Water licensed quarry is below the water table and dewatering activities will be required. Sediment and erosion control measures are being designed and will be in place for all phases and pumping activities. The inclusion of stormwater ponds and other best management practices will be completed as part of the operation. The hydrology report and operation plan provides details on sediment control measures.

7.4.6 Loss of Catchment Area for Wetlands

The wetlands are located on the northern and southern portions of the property (Communities 1, 2, 5, 6 & 7), the largest wetland being community 6 (the PSW).

The existing watercourse runs through all wetlands on the property connecting them hydrologically by surface water. The water runs south through the property emptying into the PSW (community 6). As indicated in the Hydrogeological Investigation (MTE, 2014) the PSW has several sources of water inputs including the watercourse that runs through the property. The watercourse receives 76% of its baseflow from the active Severn Pines Quarry to the west and 17% from the unevaluated wetland to the north (Community 1) (MTE, 2014). It is important to maintain inputs and outputs from wetland communities 1 and 6 in order to maintain the conditions that currently exist. It is recommended the surface water contributions continue to the PSW throughout the life of the quarry. As identified in the Water Budget, MTE predicts the total discharge from the Site will increase by 3% with a 1% increase in total average discharge at full operation and will not adversely affect the PSW (MTE, 2014) GHD supports the conclusion that so long as a continued connection of surface water is maintained from Community 1 to Community 6 there will be no negative impacts to the PSW. Maintenance of the hydrological function of the PSW is the prime objective. The minor change in the flow will not result in increased water levels in the PSW as the frequency and duration of the flow is dependent on the size

of the operation and pumping rates. The vegetation communities, plant species and nature of the wetland will not be impacted by the slight increase in volumes. The large size of this riverine wetland will absorb the slight increase and with a permanent inflow and outflow from the wetland, level changes would not occur.

A wetland area (Community 7) exists in the central and northern portions of the property and also extends beyond the property boundary. This wetland area exists in the excavation area and therefore will be removed. This deciduous wetland was a permanent feature however as it was located in the central portions of the extraction area and if preserved, would become an isolated feature. Retaining this wetland with extraction on all sides would likely not protect the wetland as it would dry up with no water source. Upon extraction the containment of water within an area to form a wetland was not an option as the water table is located too far beneath the ground and water would percolate through the cracks in the rock. The limestone quarry is below-water-table as per the regulations and the license application. The rehabilitation plan incorporates the creation of wetland within the west-central portions of the property. This wetland will replace the habitat that was lost within Community 7 as a result of the quarry operations at a greater than 1:1 ratio.

The surface water connection moving north to south in the watercourse will be maintained and reconstructed. There will be some affect to the groundwater as the quarry is classified as being below-water-table. However, no impact is expected provided recommendations are utilized.

The remaining wetlands (Community, 1, 2 & 5) identified on the property will not be negatively impacted by the quarry. These wetlands were identified on the northern limits of the property and the adjacent County lands. Community 1 & 2 were found adjacent to one another. No impacts will occur so long as source water outputs continue to occur from this wetland, south. GHD recommends the source water movement north to south be maintained in order to maintain wetland conditions. Community 5 was an isolated wetland pocket with no obvious connection by surface water to any of the other wetland features. This wetland will continue to exist after the quarry begins operation.

7.4.7 Change of Grading and Landforms

The change of grading and landforms to the property may temporarily lead to a loss of wildlife habitat and vegetation cover within that particular phase area. The rehabilitation plan has been designed to replace the habitat that previously existed and enhance what existed prior to the extraction (wetland, forest area, field habitat). The progressive phasing rehabilitation plan will allow for species to find suitable habitat on other sections of the property throughout the extraction processes while it is occurring on one.

As the horizontal limit of extraction is reached, the operator will create an average slope no steeper than 2:1. Topsoil/overburden and organic material will be spread at variable depths on the 2:1 slope. Habitat will be enhanced and will create variable topography which will promote and contribute to micro habitat development, topsoil development and moisture retention.

7.4.8 Blasting

Blasting will occur on the site as the quarry stone is extracted. Impacts on wildlife, sensitive receptors and fish can occur from blasting activities. As there are several species at risk on the property, disturbance to nesting and behaviour patterns can occur. Generally blasting should be limited to a minimum during the bird nesting season (April 15th –July 15th). Blasts do tend to be very short events with disturbance from the noise predominantly. Although birds such as herons are more sensitive to these sudden sharp noises, most birds are adaptable/acclimatize and are more prone to abandon only from repeatedly being disturbed by sharp and random noises. There are no specific sensitive receptors, such as great-blue heron colonies within 500 m of the Study Area.

7.4.9 Road or Accident Mortality

The quarry staff will be trained in the identification and proper handling for the relocation of turtles (snapping turtle, eastern musk turtle and spotted turtle) or snakes (eastern hog-nosed snake, eastern ribbonsnake and eastern massasauga rattlesnake), out of harm's way if they are found within the quarry operating area or roads. Silt fencing

(restrictive fencing) will be installed to limit access to active excavation areas to limit these species at risk from accessing the Site, including stockpiles, road edges or cover.

Signs will be posted and information provided to individuals entering the quarry site to identify the presence of the Species At Risk.

8. Rehabilitation Plan

8.1 Overview of Rehabilitation Plan

The progressive rehabilitation plan prepared for this quarry operation includes reforestation, creating field meadows, wetland and agricultural lands. This will reinstate the existing vegetation cover and roughly equal percentage of each habitat. The diversity of mixed forest, meadow and wetland habitat will reinstate the variety of plants and wildlife habitat currently present.

The rehabilitation plan will include use of stockpiled topsoil, overburden and unmarketable limestone to create stable slopes on the vertical face. Due to the thin layer of overburden in this area sufficient material to cover the entire excavation area may not be possible.

This plan will reconnect the forest to the east and proposed forest pocket to the west providing a wildlife corridor across the Site. The area should be levelled with unmarketable limestone and soils from the excavation process to fill in fissures and fractures for the creation of forested areas and open field meadows. This material will contain a seed bank that will regenerate in those areas. Seeding with a native seed mixture will also be conducted as part of the rehabilitation plan. The creation of forested areas, open field meadows and wetland in the central portion of the Site will create a wide variety of habitats post-rehabilitation. The agricultural lands can be planted in a variety of crops, which could include hayfields. Those areas will provide habitat for several grassland species, currently not found on this Site; namely bobolink and meadowlark and potentially other grassland birds. In order to prevent harm to nesting grassland birds including SAR (bobolink and meadowlark) cutting restrictions in the peak breeding bird season (April 15th -August 15th) will be implemented.

The overall details of the final rehabilitation plan are shown on the large scale submitted drawings.

Four forested areas will be created as part of the rehabilitation plan. The size and shape vary depending on each pocket. Approximately one third of the Site will be re-forested, with less than a third being open field meadow habitat and wetland covering approximately 8 hectares. The remainder of the Site will be comprised of agricultural fields.

The forested areas will be comprised of species such as sugar maple, eastern white pine, eastern hemlock, eastern white cedar, white birch, red oak and red maple. It is recommended that 70% of the species within each forest pocket be planted in coniferous and 30% be deciduous, to reestablish what existed prior to clearing. The pockets will be arranged in order to reestablish the corridors that existed prior to excavation. A forest corridor with a minimum of 100 m width will connect the east and west sides of the Site to act as a linkage across the Site. This has been located along the new drainage channel. Available topsoil, overburden and organic material soils will be utilized, and organic material will be spread at variable depths on the forest pockets and a thin layer of soil spread 15 m beyond the forest blocks in all directions to create successive habitats.

The open field meadow habitats will be planted with a native grass mix to diversify the wildlife habitat on the Site. Meadow habitats are currently limited to cleared areas, agricultural fields and open disturbed habitats in the licensed area.

The new drainage channel will continue to run through the Site from the north to south and contain wetland and forested sections. This will maintain the runoff to the provincially significant wetland.

Final quarry faces and limits of extraction will be progressively sloped (infilling and cut/fill). Overburden and topsoil applied, graded, seeded with grass seed conducive to tree planting and planted with clumps of trees, sloping of final

excavation faces will be at a minimum 2:1. Overburden and topsoil removed for extractive purposes will be spread over the final extractive floor, graded, seeded with grass seed conducive to pasturing and planting of trees and planted with stands of trees. Material may be imported that includes biodegradable materials such as soil and organic soil. This will be used for rehabilitation purposes and for enhancing the agricultural fields.

This rehabilitation plan will reinstate the natural wildlife corridors, wildlife habitat and native forest on the Site post-extraction. Habitat for Species at Risk will be enhanced including habitat for whip-poor-will and common nighthawk. The re-forested areas will be comprised of similar species to what existed prior to the quarry operation in order to attract whip-poor-will and common nighthawk back into that area. The mixture of open field meadow and forested habitats will provide suitable habitat for these species. Phasing will minimize the cleared and active quarry area to be around 25 ha at any given point, with the existing habitat in future phases left untouched until the phase is reached, and progressive rehabilitation re-creating habitats, all at the same time.

8.1.1 Species at Risk Management Plan

Several Species at Risk were found in the licensed area (butternut trees, whip-poor-will, common nighthawk, eastern wood-pewee and wood thrush) in addition to several others with suitable habitat found within the Study Area. Appropriate operational measures and mitigation measures are included here to provide the operator with protocols to prevent accidental mortality or injury to any animal that may wander through the quarry during the operational phase.

8.1.1.1 Herpetofauna (Snakes and Turtles with Exception of Eastern Hog-nosed Snake)

The presence of snapping turtle was not confirmed through our field surveys. However, the pond on the northern limits of the property and north (Community 1) would provide habitat for this species.

To protect any turtles (Snapping turtle, eastern musk, spotted turtle) or snakes (Eastern hog-nosed snake, eastern ribbonsnake and eastern massasauga rattlesnake) that may enter the extracting area, the following recommendations are made.

- A biologist to check the initial excavation phase area to be stripped and excavated prior to the overburden removal and provide Species At Risk training to quarry staff.
- Quarry staff to be briefed on the Species at Risk that may be found in the area and contingency/response protocols established and reviewed (during initial inspection).
- Daily checks of wetlands and adjacent lands be conducted during the turtle's nesting season (early to mid-summer) by trained site staff.
- Daily checks of the area should be conducted in search for SAR snakes.
- If a turtle/snake is found, the species is to be confirmed and avoided temporarily or the turtle/snake be relocated outside the active quarry area. MNR will be contacted regarding any Species At Risk sightings and issues.
- All persons who enter the site be provided Information on Species At Risk, this includes all employees or contractors on site.
- The licensee shall install signs on site at suitable locations to identify the possible presence of snapping turtle, eastern musk turtle, spotted turtle, eastern hog-nosed snake, eastern ribbonsnake and eastern massasauga rattlesnake).
- The licensee will keep records of the search dates, personnel and times and action taken in a logbook.

The contingency plan can include the need for additional visual searches of the quarry during nesting season. If there are multiple sightings of turtles/snakes, the need for restrictive fencing can be discussed with MNR.

It is easier for birds to avoid excavation areas as they are more mobile than reptiles, however additional information on bird species such as whip-poor-will, common nighthawk, Canada warbler, olive-sided flycatcher, red-headed woodpecker, eastern wood-pewee and wood thrush will also be provided to the operator. It is recommended that clearing and grubbing be done outside of the peak breeding bird window (April 1st –August 31st) and if clearing must

be conducted during this time a qualified bird biologist should conduct a nest search for any evidence of active nests within the area to be cleared.

8.1.1.2 Butternut

Six butternut trees were found on the property in 2013. Butternut trees were identified in Communities 2, 3, 4 and 7 (Figure 2). The butternut health assessment conducted found five (5) trees within the proposed extraction area that were determined to be Category 2 (retainable) under the MNR health matrix.

Based on the diameter of the trees, the ESA regulation requires different ratios of replacement. For the six Category 2 trees the total replacement/compensation number is 15.

The five small trees (less than 1 cm dbh) suckering from the cut stumps cannot be relocated, which is a typical compensation measure. The small trees will be replaced at a 2:1 ratio, as a result. The sixth tree at 6 cm dbh requires a 5:1 ratio.

Regulation 248 allows up to 10 trees to be removed with applicable compensation and the completion of the Notice of Activity form. MNR has 30 days to comment and/or audit the butternut assessment.

The recommended location for the compensation plantings is within the 90 m setback at the north end of the licensed area. This is the best location for the following reasons:

- This area is not within the extraction area of the operation,
- This area is immediately adjacent to the County forest where butternuts were found. This area contains ideal habitat with limestone based soils, sandy topsoil, moist soils, partially forested with gaps in the canopy and a regenerating community.
- This area is found in a good long-term location for the butternut trees as no work will occur in this part of the property.
- Access for long term monitoring is available

The trees will be planted using standard planting techniques and monitored annually for 5 years to ensure they establish and grow. An annual monitoring report will be sent MNR as per the Notice of Activity.

A search of the Site is recommended prior to extraction, such that current butternut can be assessed and compliance with ESA can be determined.

8.1.1.3 Eastern Hog-nosed Snake

The eastern hog-nosed snake is listed as threatened in Ontario (SARO, 2013) and threatened in Canada (COSEWIC, 2014; SARA, 2013). It is also protected in Ontario under the Endangered Species Act (May 14, 2013). The ESA affords protection to the animal and its habitat. The hog-nosed snake is found throughout central Ontario in a variety of habitats on and off the Shield. Peterborough, Simcoe, Muskoka, Kawartha Lakes, Haliburton and Parry Sound are within the range of this species.

This species habitat preference includes sandy areas with fields and forests. Sandy areas are required for hibernacula and nest sites. Individual snakes have a broad territory and can travel several kilometres over a period of weeks. The snakes are active foragers, hunting mostly at night for toads, which make up almost 90% of their diet. Toads are common in a variety of habitats from rural areas and forests to wetlands and open fields. They are most active at night when calling activity, mating and foraging occurs.

The key habitat features required by hog-nosed snake include:

- Sandy areas for nest sites
- Sandy and rocky sites for diurnal dens and overwintering hibernacula
- Population of toads
- Forest and field habitats for foraging

- Large contiguous habitat with few roads

The main impacts responsible for the decline of snakes in Ontario and throughout its range include persecution by public, road mortality and forest fragmentation.

The proposed quarry extraction area will encompass approximately 116.15 ha of limestone rock, field, coniferous forest, deciduous forest and former cattle pasture. Of these habitats, the fields and forested areas would be the preferred habitat for the snakes. Toads which are the main prey item are also found in these habitats.

The maintenance of hog-nosed snake habitat and long-term protection for the local population can be achieved through limiting the disturbed area, mitigative measures, operational procedures and habitat enhancement measures as part of the progressive rehabilitation.

The rehabilitation plan includes an end use of the Site as meadow and forest, as currently exists on the Site.

The creation of blocks of forest and open field as part of the rehabilitation plan will also recreate a diversity of habitats for this species. It is recommended that the forest blocks include two features specifically designed for snakes and also turtles. This includes a sand feature approximately 60 cm deep and 3 x 3 metres that will provide a possible nesting site. Many snakes and turtles utilize sandy areas for nest sites. The second feature is the construction of snake hibernacula and rock piles using available limestone blocks. Two sand piles and two hibernacula will be constructed as part of the rehabilitation plan. In addition, brush piles can be created to act as thermoregulation sites.

8.1.2 Rare Vegetation Salvage Plan

As mentioned in Section 7.1.2, there are 15 regionally rare species were found within the proposed licensed area. The presence of rare species on this Site is due to the diversity of community types providing opportunity for many species. In order to mitigate any potential impacts to these species, re-location is recommended when possible. The need for a salvage plan to provide for the continued presence of these species in the watershed and transplanting the specimens will be discussed with MNR.

8.1.3 Wetland Compensation Plan

The provincially significant wetland is protected and is entirely outside the extraction area with a minimum 30 m setback. The remaining wetlands are unevaluated. The wetland north of the Site on lands owned by the County of Simcoe will be protected using a 90 m buffer. The remaining unevaluated wetlands are within the extraction area for the proposed license. To ensure that the ecological functions of those wetlands is re-instated after extraction of those phases of the operation, an analysis of the existing wetlands was conducted for the purpose of designing the rehabilitation plan.

8.1.3.1 Wetland Creation

The current habitat includes swamps and meadow marshes, approximately 8 ha. The current wetlands on-Site are located along Watercourse 1 and provide wildlife habitat, flood attenuation, water quality improvements and habitat for a diversity of plants and trees. The rehabilitation plan includes the creation of wetlands with the same ecological functions but also other enhanced functions. This is proposed at the south end of the new drainage channel in Phases 2, 3A, and 4A. The benefit to the downstream watershed will be the attenuation of runoff/flooding, filtering of fine sediments and wildlife functions.

It is our plan to create a more diverse wetland plant community in the compensatory wetland that will include:

- All organic soils, topsoil and vegetation within the existing wetlands being removed
- Amphibian breeding habitat in vernal pools within compensatory wetland
- Wildlife habitat for amphibians, reptiles, birds and mammals
- Mixture of meadow marsh, cattail marsh, willow thicket swamp and treed swamp in compensation area
- Habitat for breeding and overwintering for turtles, frogs and salamanders

- Woody debris as basking, cover and nesting sites
- Contiguous wetland with access of wildlife to water source, habitat, nesting sites
- and other natural habitats (forested valley, fields)

The criteria to be applied to the design of the wetlands will be:

1. Create a shallow area with year-round to seasonal water levels.
2. Use shallow slope of final grade of quarry floor to assist in trapping water and allowing ponding. Allow water table to maintain deeper areas
3. Create deeper pools or cut channels (up to 1.3 m) to facilitate flooding that would permit wood frog breeding and green frog habitat.
4. Transplant organics from the wetlands to be removed in each phase into the new compensation area after completion of that phase and spread in variable depths to 0.3 to 0.5 m on average.
5. Maintain input of surface water from snowmelt/runoff from catchment area upstream and intercept groundwater table.
6. Maintain open meadow around ponds for amphibian habitat
7. Place logs in water to act as sunning sites for frogs and possible turtles.
8. Design with low berming along edges and greater than 5:1 slope.
9. Size wetland to compensate for a ratio of greater than 1:1.
10. Design hydrological regime for seasonal flooding, and permanent ponds
11. Maintain water in parts of wetland, particularly the vernal pools for up to 15 weeks.
12. Seed area with native meadow mix to create marsh habitats
13. Create pit and mound topography in portions and plant mounds with native swamp tree and shrub species, to create a hummocky swamp condition.

The new wetland will be constructed in phases as the progressive rehabilitation occurs in that area. Wetlands will be constructed during the rehabilitation of phases 2, 3A and 4A. The wetland will overlap the new drainage channel to take advantage of spring flooding. As the new drainage channel is progressively constructed, water will flow through each phase to the new wetland areas. This water will be in the form of groundwater from the active quarry face and surface water collected on the quarry floor from spring runoff and rain events. The wetland soils and grading in the wetland rehabilitation areas will hold the moisture and create conditions suitable for wetland growth and establishment.

This design will also allow time for the new wetlands to stabilize and vegetation to establish. Plantings will be completed and all grading surrounding the wetland completed in the fall season. This will limit the impacts of grading and sedimentation on the wetland and allow the water to stabilize and sediments to settle out. This will allow frogs time to find the ponds and use it as a new breeding site in the next spring season. From past experience, the wetland will attract frogs naturally and there is no need to transfer adults or tadpoles from other sites. The watercourse already acts as a corridor for movement of aquatic species such as newts and frogs.

Natural regeneration, seeding, planting and transplanting are the preferred method of vegetation establishment in the new wetland. The seed bank, transplanted vegetation and natural seed dispersal will allow this area to regenerate quickly (by first summer) in a high diversity of wetland vegetation.

The clearing and grading for each phase and the Site preparation activities must occur outside the breeding period of the frogs in the existing wetlands on Site. This will minimize the loss of adult and overwintering tadpoles and be conducted when those areas are virtually empty of spring frog species. Clearing and grading should occur outside the March 30th-July 30th period. The wetland should also not be cleared and trees cut within the peak breeding bird nesting season of April 15th to August 15th. If clearing must be conducting during this time a qualified bird biologist should conduct a nest search for any evidence of active nests within the area to be cleared.

The new wetlands will be constructed on the Shadow Lake Formation which is composed of Shale bedrock. This bedrock has a low permeability, which will allow wetlands to hold water. In the event that unexpected fissures or crevasses are encountered, they will be filled with waste rock and soil and can be compacted using heavy equipment. There is a seasonal high-water table that will allow the area to flood seasonally from groundwater, in addition to the surface water sources. Final grades of the rock elevation and maintaining a grade that allows water to pond and not drain out are key to the success of the wetland.

8.1.4 Watercourse and Fish Habitat Rehabilitation Plan

Watercourse 1 provides direct fish habitat for baitfish species that support a downstream recreational fishery. The rehabilitation plan includes the creation of a new drainage channel with the same ecological and fish habitat functions as Watercourse 1 but also other enhanced functions, such as upstream connection for non-jumping fish species to the north inlet via a habitat linkage, overwintering habitat, enhanced cover and in-stream habitat structure complexity.

The rehabilitation plan will have the new drainage channel designed as a sinuous channel with both high and low flow channels to accommodate seasonal water level fluctuations. The average channel wetted width will vary between be 0.8 -2.5 m and provide an average water depth of 0.1-1.5m.

The channel morphology will vary based on habitat type. Five channel cross-sections (**Appendix O**) have been selected to ensure a diversity of habitat types and they include; typical stream, pool, riffle, shallow wetland #1 (pit and mounds) and shallow wetland #2 (10:1 slope).

The northern portion of the new drainage channel upstream of the proposed wetlands (Phase 3a, 3b, 4d, 4c, 4b) will be designed with riffle/run, pool and typical stream cross sections. Moving south into the created wetlands the channel will be designed with shallow wetland #1 -pit and mounds and shallow wetland #2-10:1 slope to provide flooding shallow waters for the wetland vegetation. In this area, one or more channel restrictions will be installed to back up water and increase the water retention time to create suitable wetland hydraulic conditions. In addition, smaller tributaries or veins may be created off the mainstream to deliver surface flows throughout the entire wetland area. A professional geomorphologist will be consulted on the new drainage channel design to ensure the recommended channel morphology design and available flows will provide the desired habitat described within the rehabilitation plan.

Multiple large pools (1-3m deep) will be created along the new drainage channel as overwintering habitat for fish, invertebrates and general aquatic life, both upstream and downstream of the wetland. The channel substrate and morphology will reflect that of habitat found downstream: silt, sand, organic material with sorted sections of gravel, cobble and sparse boulders.

Sweepers and inverted root wads (i.e. woody debris) will be placed in the wetland and riparian edge habitat of the new drainage channel to increase aquatic habitat complexity and micro-habitat diversity. The large on-line wetland complex will incorporate the adjacent quarry outlet waters and provide high quality nursery, foraging and breeding and feeding habitat for fish.

Fascines

The rope-like bundle of live native willow cuttings will be used as a stream bank erosion control measure and a habitat improvement measure. Fascines will be installed along the entire length of both banks of the new drainage channel, as a part of the phased progressive rehabilitation. An information sheet has been provided as **Appendix P**.

Sweepers

Sweeper trees mimic natural fallen trees and provide habitat for aquatic and terrestrial insects. The tree crown provided in-stream cover and food in the form of aquatic insects. Entire cedar trees (crown, trunk and roots) should be salvaged and stockpiled to be used as sweeper trees. Sweeper trees should be installed along the entire new drainage channel. An information sheet has been provided as **Appendix Q**.

Standing Root Wads/Stumps

Root wads will be installed within the wetland habitat between the high and low flow channel elevations to create in-water habitat complexity and diversity, as well as provide terrestrial habitat for insects and birds. Root wads mimic dead trees, “snags”, and storm damage that would be present in a natural wetland. An information sheet has been provided as **Appendix R**.

The bottom elevation of the new drainage channel will match the existing inlet and outlet of Watercourse 1 to allow fish movement over multiple seasons. The riparian edge will be a minimum of 15m wide and contiguous along the entire new drainage channel, including agricultural lands. The riparian edge to be planted with local native plant species common within the watershed (as per wetland and vegetation recommendations provided within this report). To minimize stream bank erosion and build the riparian edge fascines and riparian buffer plantings will be installed during the spring and or fall of each progressive rehabilitation phase.

Buffer Plantings

Each phase will be progressively rehabilitated as per the Stages of Operation Plans (Refer to sheets 6, 7, and 8 of the Operational Plans). The riparian zone will be planted using native shrub and trees species for a minimum of 30m from the high-water mark unless specified otherwise within the rehabilitation plan (i.e. wetland and forest compensation plans).

9. Policies and Legislative Compliance

The following section describes how the proposed development will be in conformance with the relevant federal, provincial, and other regulatory legislation, policies, OPs, and OP amendments that are applicable and relevant to the Site and the immediate vicinity.

9.1 Federal Legislation

9.1.1 Species at Risk Act

The lands are not federally owned and are not lands recommended by the Minister of the ECCC to the Governor in Council. However, federally listed threatened and/or endangered species will be impacted as a result of the proposed quarry operation. GHD has provided recommendations to mitigate these impacts.

9.1.2 Fisheries Act

The Fisheries Act requires projects avoid causing the harmful alteration, disruption or destruction (HADD) of fish habitat unless authorized by the Minister of Fisheries and Oceans Canada. This applies to work being conducted in or near waterbodies that support fish and fish habitat and includes Watercourse 1 and 2. The proposed removal and relocation of Watercourse 1 will cause the harmful alteration, disruption or destruction (HADD) of fish habitat.

The proposed in-water works cannot integrate the *DFO Measures to Protect Fish and Fish Habitat* and have the potential to cause a HADD through destruction of fish habitat by infilling. A DFO Request for Review document must be submitted to DFO for formal project assessment to determine the next steps in project compliance. In addition, if a stormwater management pond is proposed in the future, evaluation of the location and design will be necessary to understand potential impacts and Fisheries Act compliance.

Mortality to fish can be avoided through proper implementation of a Fish Salvage Plan (**Section 7.3.4.1**) and essential measures to avoid death to fish given our knowledge of the proposed work plan and construction techniques (**Section 6.0**). Additional measures to avoid harm and general fish protection information can be found on DFO's website

<https://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures-eng.html> to support continued compliance with the Fisheries Act.

Discussions with MNR and DFO were conducted as part of the ARA application review process and for the phased realignment. Ultimately to determine if a Fisheries Act Authorization will be required, the next step in the process is to provide DFO staff with a completed “Request for Review” (RFR) document. The Request for Review Document details the existing conditions, impacts and project description and information needed for DFO to assess the Project under the Fisheries Act. A DFO biologist will be assigned to project and will confirm whether an authorization is required to carry on the project works, undertaking or activity. If a HADD cannot be avoided and an authorization is required, they will work with the applicant to develop an offsetting plan and submission of an “Application for Paragraph 35(2)(b) Fisheries Act Authorization” Prior to the issuance of an authorization, a Letter of Credit must be provided to cover the cost for implementing all elements of an offsetting plan, including monitoring.

9.1.3 Migratory Birds Convention Act

The core breeding period in Ontario for migratory birds under the MBCA for Bird Conservation Region 13 (i.e., the one the subject property lies within) extends from April 1 to August 31 (Environment and Climate Change Canada, 2014). As such clearing of the trees and other vegetation for the development cannot occur during this timing window.

9.2 Provincial Legislation

9.2.1 Endangered Species Act

Species identified on Site that are protected under the ESA include: butternut, black ash, SAR bats, and potential habitat for Blanding's turtle. Given the elapsed time since initial survey efforts, health assessments of butternut and black ash are recommended prior to extraction. Additional effort may be required to determine if other SAR species are now using the Site. Permitting and authorizations will be required under the ESA in order for the proposed extraction to occur and to comply with the latest status lists at the time.

9.2.2 Provincial Planning Statement (2024)

The Site contains significant wetlands in the Canadian Shield north of Ecoregions 5E, 6E and 7E and significant woodlands, significant wildlife habitat, and fish habitat. No significant valleylands or significant ANSIs were identified on or adjacent to the Site or Study Area. As a result, Sections 4.1.4a), 4.1.5 a), b), d) and e) of the Provincial Planning Statement (PPS 2024) apply to this project. Sections 7, 8 and 10 of this report include mitigation measures, progressive rehabilitation and recommendations that restore habitats such that compliance with PPS is achieved. That is, long term, no negative impacts on the natural heritage features or ecological functions. Discussions with MECP regarding compliance/permitting re threatened and endangered species will occur to comply with section 4.1.7.

9.3 Local and Other Regulations

9.3.1 Official Plan of Simcoe County, 2023

This report has been prepared to satisfy Section 4.4 of the Official Plan of Simcoe County. Section 4.4.1 states that no mineral aggregate operations are to occur within Significant Wetlands. This NER and the operational plan for the quarry demonstrates that no works or negative impacts on the Grass Lake PSW provided the mitigation measures, restoration plans and recommendations are implemented. The PSW is outside of the extraction area and a 30 m buffer is shown.

The OP also states that no development is to occur in Significant natural heritage features such as significant wetlands. For other features, wording is taken from the PPS, where mineral aggregate operations are not permitted I significant woodlands, significant wildlife habitat or ANSI's *unless it has been demonstrated that there will be no negative impacts on the natural features or their ecological functions*. For fish habitat and habitat of threatened or

endangered species, the OP states that mineral aggregate operations shall not be permitted, except in accordance with provincial and federal requirements. This report provides recommendations, including progressive rehabilitation that will recreate/restore and maintain or enhance those habitats and natural features for the long term. For the fish habitat, a DFO request for review will be prepared and submitted for approval for the channel realignment. For the habitat of threatened and endangered species, the required documentation will be submitted to MECP to obtain approvals/overall benefit permit to comply with the Endangered Species Act.

With the implementation of all our recommendations, and compliance with the applicable legislation as above, the proposed mineral aggregate operation will not have a negative impact on the natural heritage features or their ecological functions. The progressive rehabilitation plan is the key to achieving no negative impacts in the long term.

9.3.2 Lake Simcoe Protection Plan, 2009

This report satisfies the policies 4.17-SA, 4.18-SA and 4.19-SA of the LSPP which apply to mineral aggregate resources activities and measures to protect water quality.

Section 6 of the LSPP, which contains policies related to key natural heritage features, key hydrological features and the Lake Simcoe Shoreline, have also been satisfied in this report.

10. Mitigation Measures and Recommendations

10.1 General

The Project Manager and Contractor are obligated to ensure that all mitigation measures are strictly observed.

All measures must be carried out to the satisfaction of Ontario Ministry of Natural Resources and any agencies they deem necessary.

Take proactive measures to prevent any construction debris and deleterious substances, such as soil and other debris from entering any off-Site natural features.

10.2 Work Timing Restrictions

1. No in-water works between March 15th and July 15th to protect spring spawning fish species and their life history processes.
2. All tree clearing required for construction access prior to extraction should be completed outside the Peak Breeding Bird season of April 15th to August 15th as per Environment Canada guidelines. If clearing must be conducting during this time, a qualified bird biologist should conduct a nest search for any evidence of active nests within the area to be cleared.
3. Cutting restrictions during Peak Breeding Bird season (April 15th-August 15th) may be placed on agricultural activities if hay crops are grown on-Site.
4. The clearing and grading of existing wetlands on-Site for each phase must occur outside the breeding period of frogs (March 30th -July 30th).
5. Excavation and blasting on the rock ledge in Phase 3A and Phase 3B must occur outside the snake hibernacula period (October 1-March 31). If snakes are encountered on this rock ledge, work should cease in that area until MNR is contacted. Site personnel must be aware of any concentrations of snakes during extraction of this ledge and the rock barren.

10.3 Site Access

6. Check heavy equipment, machinery and tools prior to entering the work site to ensure they are clean, and free of leaks.
7. All heavy equipment, machinery, and tools required for the work shall be regularly inspected and maintained to avoid leakage of fuels and liquids and shall be stored in a manner that prevents any deleterious substance from entering the soil, or nearby watercourses.
8. All heavy equipment, machinery and tools used or maintained for the purpose of this project shall be operated in a manner that prevents any deleterious substance from entering soil or nearby waterbodies.
9. Any stockpiled materials will be stored and stabilized away from the water above the high-water mark at a minimum of 30m where possible.
10. Adhere to noise requirements as per the Noise Mitigation Measures identified in the Noise Report by Valcoustics (2017).
11. The Project Manager/Contractor shall restrict any deleterious substances as defined in the Canadian Fisheries Act (such as silt), caused by the work from entering off- Site waterbodies.
12. Site access to be limited to the designated access roads.

10.4 Refueling and Spill Response

13. Vehicle and equipment refuelling shall be conducted on impermeable pads/pans within the defined staging area.
14. An emergency spill kit shall be kept on site, and employed immediately should a spill occur. In the case of a spill, the Ontario Spill Action Center shall be notified immediately at 1-800-268-6060. All provincial and federal regulations shall be adhered to.
15. Maintain an adequate supply of clean-up materials on-Site. Construction crews will be fully trained in their use to ensure timely and effective responses to spill incidents.
16. Refuelling and maintenance of equipment shall be conducted off slopes and away from water bodies on impermeable pads to allow full containment of spills at a recommended distance of a minimum of 30 meters from a waterbody or wetland.

10.5 Sediment and Erosion Control Plan

A Sediment and Erosion Control Plan will be required prior to Site preparation. The following items should be included in the plan:

17. Sediment control measures shall be installed prior to site preparation and shall be maintained throughout the project and each Phase to prevent the entry/outward flow of sediment into off-Site waterbodies.
18. At a minimum all sediment and erosion control measures shall be installed, maintained and removed in accordance with the Ontario Provincial Standard Specification (OPSS) standards for Temporary Erosion and Sediment Control Measures (OPSS 577).
19. All sediment and erosion control measures shall be inspected daily during the extraction by the site inspector and periodically thereafter to ensure they are functioning properly, maintained and upgraded as required.
20. In the event that sediment and erosion control measures are not functioning, the construction supervisor shall address the sediment/erosion problem, which could include alternative control measures.
21. Remove accumulated sediment prior to removing sediment control measures and in a way that prevents the escape or suspension of sediments.
22. In the event the temporary erosion and sediment control measures fail, a contingency plan will be in place, kept on-Site and followed. Contingency measure(s) will include a list of key personal to be contacted. Additional erosion and sediment control materials (i.e. sandbags, stop logs, straw bales, erosion control blankets, heavily duty silt fence shall be stockpiled and easily accessible from the Site in the event of an emergency.
23. Fascines can be used as a stream bank erosion control measure and a habitat improvement measure. Fascines will be installed along the entire length of both banks of the new drainage channel, as a part of the phased progressive rehabilitation. An information sheet has been provided as Appendix I.

10.6 Fish Salvage

To avoid the mortality of individual fish from the extraction process, the following mitigation measures will be implemented prior to extraction.

24. A professional biologist will design and implement a Fish Salvage Plan prior to extraction in Phase 3B.
25. The plan will incorporate the removal and relocation of fish occupying the fish habitat within the extraction area.
26. Fish will be relocated to similar habitat of equal or greater value within the same watershed.
27. Fish salvage efforts should not be conducted during the winter or ice conditions to enhance individual survivorship.

28. Salvaged fish habitat will be isolated to prevent the movement of fish back into the habitat using fish screens, berms or site-specific appropriate measures that maintain flow and prevent fish movement.
29. Fish collection permits may be required by the Ministry of Natural Resources.
30. Consultation with the DFO will be required to determine if a Fisheries Act Authorization/offsetting will be required.

10.7 Blasting

31. Blasting shall be done in accordance with the Blast Impact Analysis completed by Explotech (2017).
32. Whenever feasible, schedule different noisy activities (e.g. blasting and excavating) to occur at the same time.
33. Provide mitigation measures for noise and dust suppression to minimize airborne dust during excavating activities, prior to clearing, backfilling, compacting, or grading, and during blasting.
34. Maintain noise-reduction devices (e.g. mufflers) in good working order on vehicles and equipment.
35. Conduct blasting to minimize the occurrence and velocity of flyrock (e.g. blast mats) and ground vibration to safe levels.
36. If possible, subdivide large charges into a series of smaller discrete detonations, using time-delay detonation to reduce to a series of smaller discrete events.
37. Blasting mats to be used to ensure the 100kPa overpressure criteria is achieved.
38. A silt curtain will be deployed to disrupt shock waves.
39. Blasting will be avoided on windy days to minimize the suspension of fine sediment into the water column and ensure sediment control measures are not disturbed.
40. The removed blasting material (bedrock) will be removed from the site and stored a minimum of 30m from any watercourse high water mark.
41. Where possible, blasting should occur outside the breeding bird season to avoid negative impact to local breeding birds.
42. When blasting close to active spawning beds, blasting should occur outside the spawning period for fish (March-15 - July 15).

10.8 Blasting Guidelines, per DFO Guidelines (Wright & Hopky, 1998)

43. Blasting guidelines are intended to prevent or avoid the destruction of fish, or any potentially harmful effects to fish habitat that could result from the use of explosives. The use of confined or, in particular, unconfined explosives in or near Canadian fisheries waters is discouraged, and proponents are encouraged to utilize other potentially less destructive methods wherever possible.
44. No use of ammonium nitrate-fuel oil mixtures occurs in or near water due to the production of toxic by-products (ammonia). Note: The deposit of deleterious substances into waters frequented by fish is prohibited under Section 34(1) of the Fisheries Act, unless otherwise permitted by regulation. There is no regulation pursuant to the Fisheries Act that permits the deposit of by-products resulting from the use of ammonium nitrate-fuel oil mixtures.
45. After loading a charge in a hole, the hole is to be backfilled (stemmed) with angular gravel to the level of the substrate/water interface or the hole collapsed to confine the force of the explosion to the formation being fractured. The angular gravel is to have a particle size of approximately 1/12th the diameter of the borehole.
46. All "shock-tubes" and detonation wires are to be recovered and removed after each blast.
47. No explosive is to be detonated in or near fish habitat that produces or is likely to produce an instantaneous pressure change (i.e. overpressure) greater than 100 kPa (14.5 psi) in the swim bladder of a fish. Notes: For

confined explosives, setback distances from the land-water interface (e.g. the shoreline), or burial depths from fish habitat (e.g. from under the riverbed) that will ensure that explosive charges meet the 100 kPa overpressure guidelines.

48. If a confined explosive is to be detonated close to the substrate-water interface (such as in trenching or demolition), the set-back distance closely approximates the theoretical lethal range within which 50% of the fish may be killed or injured.
49. Consequently, the 100 kPa guideline is not likely to be met in those situations where, because of the design constraints of the project, it is also likely not possible or practical to 'adjust' the setback distance as a means to meet the 100 kPa guideline. For example, preparation of a trench for a pipeline crossing typically requires no more than a below grade burial depth of about 2m. Therefore, the weight of explosive charge per delay will have to be adjusted in an effort to meet the 100 kPa guideline. Clearing of vegetation in each phase (trees, shrubs and ground vegetation) occur outside the peak breeding bird season (April 1-August 31) as per Environment Canada guidelines.

10.9 General Recommendations

1. Clearing of vegetation in wetlands occur outside the peak herpetofauna season (April 15 – October 15).
2. Any tree clearing required shall be completed outside of the active season for bats that use treed habitats (April 1 -September 30).
3. Reassess the health of butternut trees on Site as per MNR butternut health assessment guidelines.
4. Health assessment of newly listed black ash trees on Site following MECP health assessment guidelines.
5. Clearing occurs in phases with minimal clearing done on the next phase prior to the need for additional aggregate.
6. Maintain and establish as 30 m setback from the PSW. Setback boundary should be fenced with heavy-duty silt-fencing and left in place for the duration of quarry operations.
7. Applicant to apply and obtain all relevant permitting related to natural heritage policies.
8. The progressive rehabilitation plan end use be partial reforestation and reinstatement of the natural tree cover, east to west connectivity/linkages through the centre of the extraction area, as well as establishing agricultural field and meadow habitats.
 - a. The reforestation plan should include only native tree and shrub species indigenous to the Orillia area and be derived from stock from local nurseries.
 - b. Forested areas as shown in the rehabilitation plan will be created on the quarry floor and slopes created, utilizing available topsoil/overburden and organic material.
 - c. Topsoil/overburden and organic material will be spread at variable depths in the forest blocks and a thin layer of soil spread 15 metres beyond the forest in all directions to create successional habitats.
 - d. - Forests should be planted with a mixture of coniferous and deciduous trees that include appropriate native species currently found on site that include, sugar maple, eastern white cedar, eastern white pine, eastern hemlock, white birch, red oak and red maple. Within forested areas 70% of trees should be coniferous and 30% deciduous.
9. Quarry operational phasing and progressive rehabilitation schedules be coordinated to limit the area of disturbed tree cover at any one time.
10. Monitoring: mortality surveys conducted for snakes and turtles from traffic for quarry operation.
11. Habitat to enhance habitat for Species at Risk (snakes and turtles) will be created.
 - a. Three clean sand piles will be placed on the northern end of the extraction area (Phases 5 and 8) to a depth of 60 cm in a 3 by 3 metre area.

- b. Three rock piles/ snake hibernacula will be constructed in Phases 1, 3 and 5. They will consist of excavations and piles of flat limestone slabs and woody debris randomly piled to maximize spaces and cover.
- 12. The area outside the forested areas on the pit floor be graded with fine aggregate to fill in the fissures and crevasses and uneven surfaces and those areas seeded with a native grass species suitable to the dry conditions.
- 13. Recommendations for de-watering activities:
 - a. Recharge the water back into the aquifer between the quarry and the wetlands,
 - b. Limit the depth and extent of draw down,
 - c. Place low permeability barriers to restrict the flow of groundwater into the depression created by the dewatering,
 - d. Work in phases to limit the extent of open excavation at one time,
 - e. Monitor the PSW (community 6) and record any change in vegetation community that may be occurring as a result of the de-watering. Monitoring plots will be set up within the wetland and will be monitored on a yearly basis.
- 14. Species at Risk Management:
 - a. A biologist to check the initial excavation area to be stripped and excavated prior to the overburden removal and provide Species At Risk training to quarry staff.
 - b. Quarry staff to be briefed on the Species at Risk that may be found in the area and contingency/response protocols established and reviewed (during initial inspection).
 - c. Daily checks of wetlands and adjacent lands be conducted during the turtle's nesting season (early to mid-summer) by trained site staff.
 - d. Daily checks of the area should be conducted by license staff in search for SAR snakes.
 - e. If a turtle/snake is found, the turtle is to be confirmed and avoided temporarily or the turtle/snake be relocated outside the active quarry area. MNR will be contacted regarding snapping turtle sightings and issues.
 - f. All persons who enter the site be provided information on Species At Risk, this includes all employees or contractors on site
 - g. The licensee shall install signs on site at suitable locations to identify the possible presence of snapping turtle, eastern musk turtle, spotted turtle, eastern hog-nosed snake, eastern ribbonsnake and eastern massasauga rattlesnake).
 - h. The licensee keeps records of the search dates, personnel and times and action taken
 - i. The contingency plan can include the need for additional visual searches of the quarry during nesting season. If there are multiple sightings of turtles/snakes, the need for restrictive fencing can be discussed with MNR
 - j. The quarry staff will be trained in the identification and proper handling for the relocation of turtles (snapping turtle, eastern musk turtle and spotted turtle) or snakes (eastern hog-nosed snake, eastern ribbonsnake and eastern massasauga rattlesnake), out of harm's way if they are found within the quarry operating area or roads.
 - k. Silt fencing (restrictive fencing) will be installed to limit access to active excavation areas to limit these species at risk from accessing the site.
 - l. Signs will be posted and information provided to individuals entering the quarry site to identify the presence of the snapping turtle or the eastern musk turtle.
- 15. A diverse wetland be constructed in the central portion of the site along the watercourse, that includes meadow marsh, marsh and swamp habitats. The detailed design to be determined through consultation with MNR.

10.10 Operational Plan-Notes Section

The following is a list of notes to be included on the Site Plan for the proposed quarry:

1. Prior to any site preparation, retain a qualified biologist to develop a Species At Risk Management Plan and obtain an Endangered Species Act Permit (overall benefit permit) from MNR.
2. Prior to extraction in Phase 2, retain a qualified biologist to develop a Wetland Compensation Plan.
3. Retain a qualified biologist to develop a Rare Vegetation Salvage Plan in consultation with MNR for salvaging and transplanting regionally rare plants.
4. Prior to the relocation of Watercourse 1, retain a qualified biologist to develop and implement a Fish Salvage Plan. This plan will be submitted to the MNR and the DFO to determine if a fisheries act authorization will be required.
5. Prior to Site preparation of each stage shown on sheets 6 through 8 of the Site Plans, design and implement a Sediment and Erosion Control Plan.
6. Maintain surface water flows to the PSW during extraction.
7. Ensure clearing and grubbing of each phase occurs outside the peak breeding bird period (April 15th - August 15th). If clearing must be conducting during this time, a qualified bird biologist should conduct a nest search for any evidence of active nests within the area to be cleared.
8. As extraction proceeds, progressively rehabilitate the new drainage channel as per the rehabilitation plan.
9. Prior to clearing areas with butternut trees, assess the health of the butternut trees. Submit a notice of butternut impact form under the endangered species act to the MNR for those butternut trees identified as Category 2 (retainable). Replace butternut trees as required by the MNR permit at a ratio of 15:1 in the 90m buffer.
10. Cutting restrictions during peak breeding bird season (April 15th - August 15th) may be placed on agricultural activities if hay crops are grown on-Site.

11. Conclusion

The development of a quarry on the Site will have no negative impact on the identified Species at Risk and other natural features identified, if the compensation/rehabilitation measures, mitigation measures and recommendations are followed and necessary permits obtained.

The quarry will have no negative impacts on the provincially significant Grass Lake wetland, provided the 30 m setback and mitigation measures are implemented. Hydrological functions will be maintained and flows and water quality outletting to the PSW from the on-site watercourse have been controlled through rehabilitation efforts. A water balance calculation confirmed the runoff, and flows will be similar pre- to post-construction. GHD has recommended a 30 m setback from the Provincially Significant Wetland, and a 90 m buffer from the pond/swamp located on lands owned by the County of Simcoe north of the Site. The project has the potential to cause the Harmful, Alteration, Disruption and Destruction of fish habitat and a review under the Fisheries Act is required.

The phasing of the extraction coupled with the detailed progressive rehabilitation plan, will restore, recreate and enhance the existing habitats post-extraction. It is anticipated that there will be no negative impacts on the natural heritage features and ecological functions of these features within the study area, if all of the mitigation measures, restoration plan and the recommendations in this NER report are implemented.

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Appendices

Appendix A

Site Plan

EXISTING FEATURES NOTES

GENERAL

1. THE LANDOWNER REGISTERED ON TITLE FOR THE SITE IS 1662947 ONTARIO INC. AND IS CURRENTLY USING THE SITE FOR AGRICULTURAL AND FORESTRY PRACTICES. 1662947 ONTARIO INC. HAS ENTERED INTO AN AGREEMENT WITH SEVERN AGGREGATE LIMITED TO PURSUE A CLASS A CATEGORY 2, AGGREGATE LICENSE UNDER THE AGGREGATE RESOURCES ACT.

SITE DESCRIPTION

2. THE CURRENT USES ON THE SITE INCLUDE FARMING, FORESTRY, AND WOODLANDS.

3. THE CURRENT LAND USES HAVE CREATED STOCKPILES OF BRUSH AND STUMPS THROUGHOUT THE SITE THAT WILL EVENTUALLY BE UTILIZED FOR PROGRESSIVE REHABILITATION. ALL DRAINAGE SWALES IN THE NORTH PORTION OF THE SITE, WHICH HAVE BEEN CREATED FOR FARMING PURPOSES, WILL BE MAINTAINED UNTIL THAT PORTION OF THE SITE IS READY TO BE EXTRACTED. EXISTING AND FUTURE AGRICULTURE AND FORESTRY PRACTICES WILL CONTINUE IN UNDISTURBED AREAS OF THE SITE WHILE EXTRACTION PROCEEDS.

4. THERE ARE NO BUILDINGS LOCATED ON THE SITE OR WITHIN 120 METERS OF THE SITE. THE CLOSEST BUILDING IS A RESIDENTIAL DWELLING (LABELED AS R1) APPROXIMATELY 180 METERS FROM THE EAST BOUNDARY OF THE SITE.

5. STRUCTURES ON THE SITE INCLUDE A STORAGE CONTAINER LOCATED IN THE SOUTH PORTION OF THE SITE, WHICH IS USED TO SECURE EQUIPMENT FOR FORESTRY AND AGRICULTURE. STRUCTURES WITHIN 120 M. OF THE SITE INCLUDE THOSE RELATED TO THE SEVERN PINES QUARRY OPERATED BY WALKER AGGREGATES TO THE WEST, AND THE SYLER PIT OPERATED BY K.J. BEAMISH CONSTRUCTION CO. TO THE EAST. THERE IS ALSO A CULVERT THAT CROSSES NICHOLS LINE NEAR THE SOUTHWEST CORNER OF THE SITE.

6. PRIVATE WELL LOCATIONS WITHIN 500 METERS OF THE SITE ARE NOTED ON THE SITE PLAN. A SUMMARY OF PRIVATE WELL DETAILS IS PROVIDED ON TABLE 2.

7. NOISE RECEPTORS AS PER THE NOISE IMPACT ANALYSIS COMPLETED BY VALCOUSTICS (DATED _____) ARE NOTED ON THE SITE PLAN (SEE R1-R5).

8. THERE IS ONE STOCKPILE OF TOPSOIL AND OVERBURDEN LOCATED ON THE SITE NEAR SURFACE WATER MONITORING STATION SW7 ALONG THE SOUTHERN BOUNDARY.

9. THERE ARE NO STOCK PILES OF AGGREGATE OR AGGREGATE RECYCLABLE MATERIALS LOCATED ON THE SITE.

10. PORTABLE FUEL TANKS ARE USED ON-SITE FROM TIME TO TIME TO SERVE EXISTING AGRICULTURAL AND FORESTRY PRACTICES. SEE ALSO NOTE 41 (SHEET 2 OF 8) FOR DETAILS ON FUEL STORAGE.

11. SCRAP STORED ON THE SITE INCLUDES STOCKPILES OF BRUSH AND STUMPS, AND METAL FROM MACHINERY USED ON-SITE, WHICH MAY BE RELOCATED FROM TIME TO TIME AS AGRICULTURAL AND FORESTRY USES ARE EXPANDED. THE IRON METAL STORAGE AREA WILL BE LOCATED IN THE PROCESSING/RECYCLING AREA IN THE SOUTHEAST CORNER OF THE SITE AS SHOWN ON SHEET 2 OF 8.

12. THERE ARE NO EXISTING FACES OR REHABILITATED AREAS ON THE SITE.

13. THERE ARE NO EXISTING BERMS ON THE SITE.

14. THE AREA TO BE LICENSED IS 138 HECTARES (341 ACRES).

15. THE AREA TO BE EXTRACTED IS 118.5 HECTARES (293 ACRES).

16. CROSS-SECTIONS SHOWING EXISTING TOPOGRAPHY, FINAL QUARRY FLOOR ELEVATION AND THE ANTICIPATED FINAL ELEVATION OF THE GROUNDWATER TABLE, WITHIN THE LICENSED BOUNDARY ARE FOUND ON SHEET 3 OF 8.

17. NICHOLS LINE IS A DESIGNATED HAUL ROUTE.

18. THERE IS A PROVINCIALLY SIGNIFICANT (PSW) IN THE SOUTH EAST CORNER OF THE SITE.

19. ALL MEASUREMENTS SHOWN ON THESE SITE PLANS ARE IN METRIC.

GROUNDWATER TABLE

20. BASED ON THE LEVEL 1 AND 2 HYDROGEOLOGICAL INVESTIGATION BY MTE CONSULTANTS INC. THE ESTABLISHED GROUNDWATER TABLE WITHIN THE SHALLOW BEDROCK OF THE GULL RIVER FORMATION VARIES FROM AN ELEVATION OF 239 MASL AT MW6S-07 IN THE NORTHWEST CORNER OF THE SITE TO AN ELEVATION OF 215 MASL AT MW14-12 IN THE SOUTHEAST CORNER OF THE SITE.

21. 29 GROUNDWATER MONITORING WELLS WERE DRILLED ON THE SITE BETWEEN 2007 AND 2014 AS PART OF THE LEVEL 1 AND 2 HYDROGEOLOGICAL INVESTIGATION. A SUMMARY OF THE MONITORING WELLS IS PROVIDED ON THE SITE PLAN IN TABLE 1. GROUNDWATER MONITORING AT THESE WELLS IS ONGOING.

SURFACE WATER DRAINAGE

22. SURFACE WATER DRAINAGE ON THE SITE AND WITHIN 120 METERS OCCURS IN THE DIRECTION SHOWN BY THE ARROWS ON THE PLAN. WATER THAT INFILTRATES INTO THE UPPER FIVE METERS OF BEDROCK (EPHKARST) IS QUICKLY DRAINED TO SURFACE WATER FEATURES WITHIN DAYS OF PRECIPITATION/MELT EVENTS.

23. THERE ARE TWO EXISTING SURFACE WATER COURSES THAT SERVE TO DRAIN THE SITE. WATERCOURSE 1 RUNS THROUGH THE NORTHERN AND CENTRAL PORTIONS OF THE SITE, WHILE WATERCOURSE 2 DRAINS THE SOUTHERN PORTION OF THE SITE. BOTH WATERCOURSES FLOW INTERMITTENTLY WHEN THERE IS SUFFICIENT PRECIPITATION AND MELT WATER TO SUSTAIN FLOW.

24. 18 SURFACE WATER STATIONS WERE ESTABLISHED ON THE SITE IN 2014 TO MEASURE SURFACE WATER FLOW AND CHEMISTRY. A SUMMARY OF THE SURFACE WATER STATIONS IS PROVIDED ON THE SITE PLAN IN TABLE 2. SURFACE WATER MONITORING AT THESE STATIONS IS ONGOING.

SITE PLAN REFERENCES

1. THE SITE IS IDENTIFIED AS A HIGH POTENTIAL MINERAL AGGREGATE RESOURCE IN SCHEDULE 5.2.1 OF THE SIMCOE COUNTY OFFICIAL PLAN. AN OFFICIAL PLAN AMENDMENT IS NOT REQUIRED.

2. THE SITE IS DESIGNATED AS BEDROCK AGGREGATE RESOURCE ACCORDING TO SCHEDULE C OF THE TOWNSHIP OF SEVERN OFFICIAL PLAN.

3. CONTOUR INFORMATION COMPILED BY TOPOGRAPHICAL SURVEY AND AERIAL PHOTOGRAPHY BY J.D. BARNES LTD. 2012. ELEVATIONS SHOWN ARE RELATED NAD 83 TO A GEODETIC BENCHMARK DESCRIBED AS: SQUARE IRON BAR AT SOUTHWEST CORNER OF LICENCE BOUNDARY. ELEVATION: 227.62 MASL.

4. BOUNDARY INFORMATION BASED ON PLAN OF SURVEY BY J.D. BARNES LIMITED, DATED NOVEMBER 30, 2012. THE COORDINATES OF EACH CORNER BAR OF THE SITE ARE SHOWN ON THE SITE PLAN.

5. ZONING INFORMATION COMPILED FROM TOWNSHIP OF SEVERN ZONING BY-LAW 2010-65, DATED AUGUST 5, 2010.

6. SIGNIFICANT WETLAND BOUNDARY ESTABLISHED BY NIBLETT ENVIRONMENTAL ASSOCIATES INC. MAY 16, 2012.

7. STAGE 1, 2 AND 3 ARCHAEOLOGICAL ASSESSMENTS BY KINCKNICHER HERITAGE CONSULTANTS, MAY 2008.

8. NATURAL ENVIRONMENT LEVEL 1 AND 2 REPORTS BY NIBLETT ENVIRONMENTAL ASSOCIATES INC. DATED FEBRUARY 2015 AND SEPTEMBER 2015.

9. LEVEL 1 AND 2 HYDROGEOLOGICAL INVESTIGATION BY MTE CONSULTANTS INC., DATED NOVEMBER 28, 2014.

10. NOISE IMPACT ANALYSIS BY VALCOUSTICS CANADA LTD., DATED SEPT. 14, 2017.

11. BLAST IMPACT ANALYSIS BY EXPLOTECH ENGINEERING LTD. DATED _____, 2015.

12. TRAFFIC IMPACT STUDY BY SKELTON BRUMWELL & ASSOCIATES INC. DATED FEBRUARY, 2015.

Table 1: Monitoring Well Summary

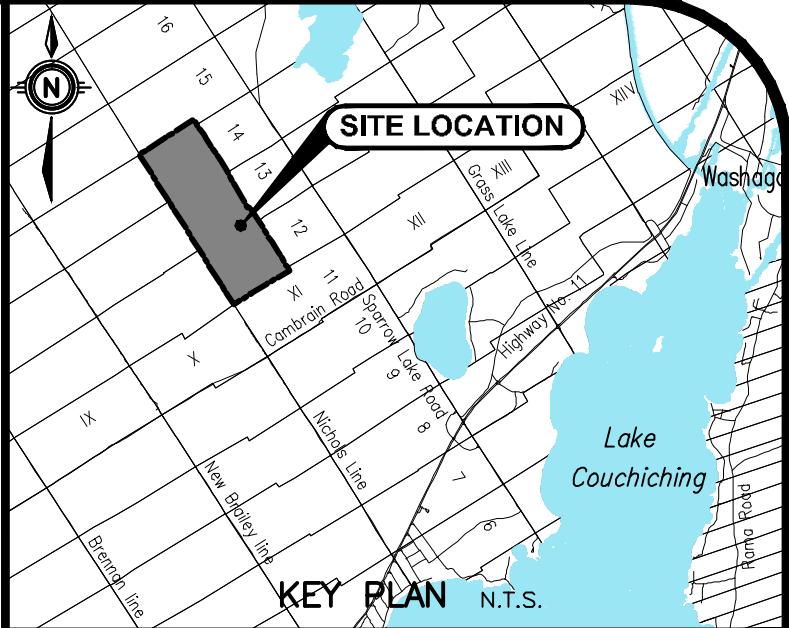
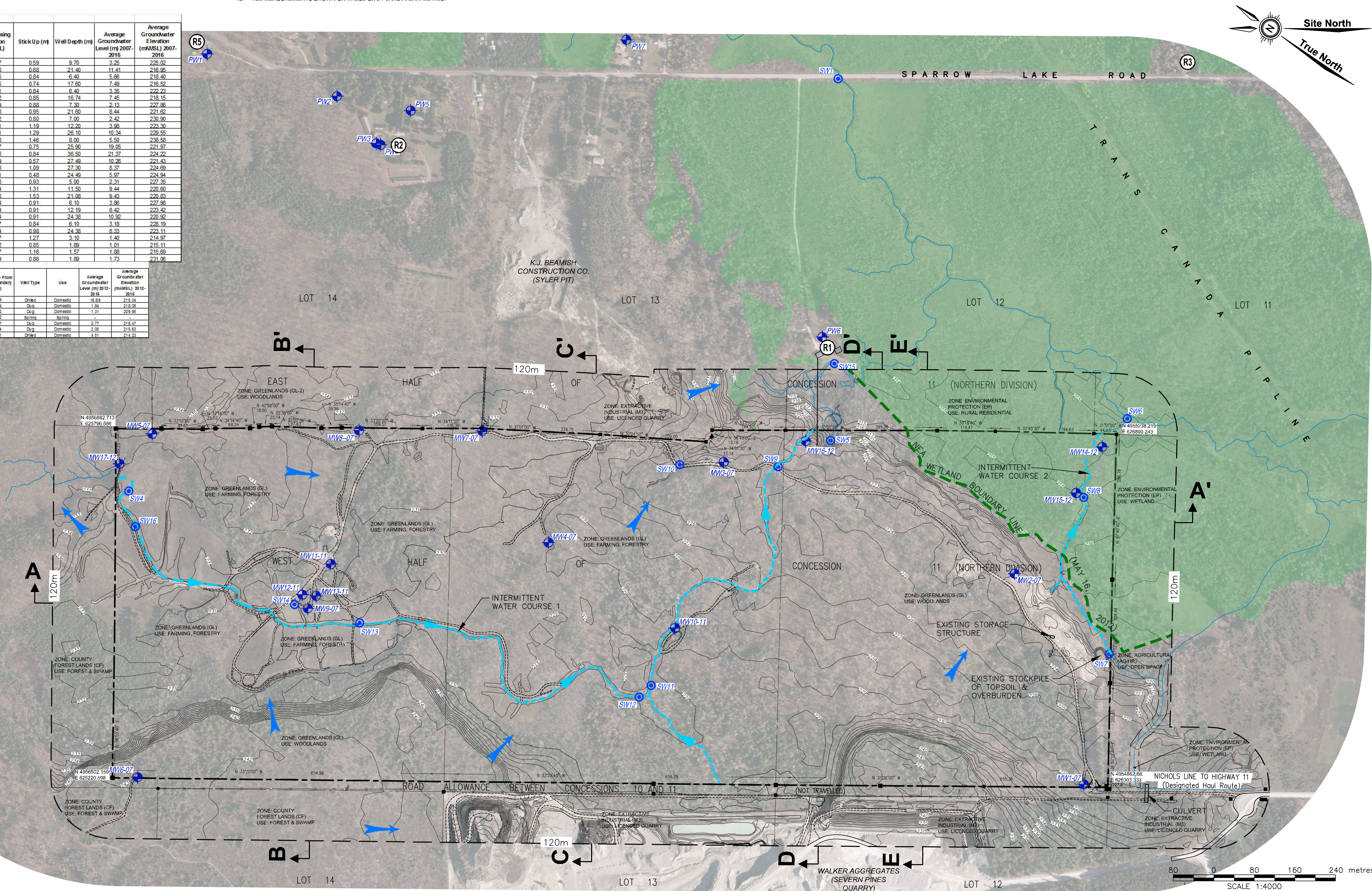
Well ID	Installation Date	Ground Elevation (mMASL)	Top of Casing Elevation (mMASL)	Stick Up (m)	Well Depth (m)	Average Groundwater Level (m) 2007-2016	Average Groundwater Elevation (mMASL) 2007-2016
MW1S-07	28-Apr-07	227.68	228.27	0.59	9.70	3.25	225.02
MW1D-07	28-Apr-07	227.68	228.36	0.68	21.40	11.41	216.95
MW2S-07	4-Apr-07	223.21	224.05	0.84	6.40	5.86	219.40
MW2D-07	4-Apr-07	223.21	223.95	0.74	17.60	7.49	216.52
MW3S-07	4-Apr-07	224.77	225.61	0.84	6.40	3.35	222.21
MW3D-07	4-Apr-07	224.77	225.06	0.29	16.74	7.45	216.15
MW4S-07	25-Apr-07	229.21	230.05	0.84	7.30	2.13	227.85
MW4D-07	25-Apr-07	229.21	230.16	0.95	21.60	8.44	221.62
MW5S-11	1-Sep-11	232.42	233.22	0.80	7.00	2.42	230.90
MW5D-07	25-Apr-07	232.42	233.61	1.19	12.20	3.98	223.30
MW5D-07	25-Apr-07	232.42	233.71	1.29	26.10	10.34	229.55
MW6S-11	1-Sep-11	242.62	244.06	1.46	8.00	5.50	238.58
MW6D-07	25-Apr-07	242.62	243.37	0.75	25.90	19.05	241.97
MW6D-07	25-Apr-07	242.62	243.46	0.84	36.90	21.37	244.22
MW7-07	1-Sep-07	231.12	231.69	0.57	27.40	10.26	221.43
MW8-07	1-Sep-07	231.97	233.06	1.09	27.30	8.37	224.69
MW9-07	1-Sep-07	230.43	230.91	0.48	24.49	5.97	224.94
MW10S-11	1-Sep-11	228.73	229.66	0.93	5.00	2.31	227.35
MW10L-11	1-Sep-11	228.73	230.04	1.31	11.50	9.44	220.60
MW10D-11	1-Sep-11	228.73	230.26	1.53	21.06	9.43	220.83
MW11S-12	1-Feb-12	230.93	231.84	0.91	6.10	3.88	227.98
MW11L-12	1-Feb-12	230.93	231.84	0.91	12.19	8.42	223.42
MW11D-12	1-Feb-12	230.93	231.84	0.91	24.35	10.92	220.92
MW12-12	1-Feb-12	230.53	231.37	0.84	6.10	3.19	228.19
MW13-12	1-Feb-12	230.46	231.44	0.98	24.35	8.33	223.11
MW14-12	1-Oct-12	215.10	216.37	1.27	3.10	1.40	214.97
MW15-12	1-Oct-12	215.27	216.12	0.85	1.89	1.01	215.11
MW16-12	1-Oct-12	216.41	217.57	1.16	1.57	1.88	215.89
MW17-12	1-Oct-12	231.93	232.79	0.86	1.89	1.73	231.05

Table 2: Private Well Summary

Well ID	Ground Elevation (mMASL)	Top of Well Elevation (mMASL)	Depth (m)	Distance From Site Boundary (m)	Well Type	Use	Average Groundwater Level (m) 2012-2015	Average Groundwater Elevation (mMASL) 2012-2015
PW1	231.69	232.02	109.728	739	Drilled	Domestic	8.63	213.34
PW2	219.17	219.89	4.87	854	Drilled	Domestic	1.84	218.05
PW3	230.79	230.8	1.52	862	Drilled	Domestic	1.51	229.85
PW4	230.79	230.84	363	862	Drilled	Domestic	1.51	229.85
PW5	219.3	219.34	1.62	637	Drilled	Domestic	2.77	216.47
PW6	217.89	217.89	4.3	94	Drilled	Domestic	3.28	215.63
PW7	219.37	219.74	-	781	Drilled	Domestic	4.61	214.93

Table 3: Surface Water Station Summary

Station ID	Installation Date	Reference Elevation	Average Flow (L/s) 2012-2016
SW1	21-Feb-12	212.54	227.23
SW2	21-Feb-12	217.45	7.11
SW3	21-Feb-12	217.97	38.84
SW4-SW16	Nov-28-12	Nov-29-12	12.93
SW5	21-Feb-12	215.79	20.12
SW6	21-Feb-12	220.00	41.72
SW7	21-Feb-12	218.06	40.07
SW8	21-Feb-12	214.47	9.38
SW9	21-Feb-12	222.89	67.19
SW10	21-Feb-12	224.39	0.94
SW11	21-Feb-12	228.51	31.53
SW12	21-Feb-12	227.88	28.19
SW13	21-Feb-12	228.91	19.24
SW14	21-Feb-12	228.51	3.82
SW15	1-Nov-12	215.94	70.81



LEGEND

- LICENCED BOUNDARY / PROPERTY BOUNDARY
- LOT LINE
- BARN
- POST & PAGE WIRE FENCE (UNLESS OTHERWISE NOTED)
- INTERNAL ROAD
- INTERMITTENT WATER COURSE
- OFFSITE WATER COURSE
- 250 CONTOURS ELEVATION (masl)
- GENERAL DIRECTION OF DRAINAGE
- GATE
- PROVINCIALLY SIGNIFICANT WETLAND
- NEA WETLAND BOUNDARY
- A A' CROSS - SECTION LOCATION (See Sheet 5)
- MW2-07 GROUNDWATER MONITORING WELL
- PW7 PRIVATE WELL
- SW7 SURFACE WATER MONITORING STATION
- R5 NOISE RECEPTOR
- 227.6 BENCHMARK WITH ELEVATION (masl)

SITE PLAN AMENDMENTS

NO.	REVISION	BY	DATE



MTE
Engineers | Scientists | Surveyors

www.mte85.com

DECLARATION OF PURPOSE
THIS SITE PLAN IS PREPARED UNDER THE AGGREGATE RESOURCES ACT FOR A CLASS 'A' LICENCE, CATEGORY 2.

PROJECT
CUMBERLAND QUARRY
LICENSEE: SEVERN AGGREGATES LIMITED
161 WHITENALL DRIVE,
MARKHAM, ONTARIO
L3R 9T1

DRAWING
EXISTING FEATURES
WEST HALF LOTS 12, 13 AND 14, CONCESSION 11
GEOGRAPHIC TOWNSHIP OF ORILLIA, NORTH DIVISION
TOWNSHIP OF SEVERN, COUNTY OF SIMCOE

Project Manager J. Flanagan	Project No. 33876-300
Design By	Checked By
Drawn By K.X.M	Checked By
Surveyed By	Drawing No.
Date Oct. 18, 2017	
Scale 1:4000	Sheet 1 of 8

OPERATIONAL NOTES:

PROPOSED REHABILITATION

1. EXTRACTION AND REHABILITATION OF THE QUARRY WILL RETURN THE SITE TO PRODUCTIVE AGRICULTURE WITH ECOLOGICAL ENHANCEMENTS COMPATIBLE WITH THE SURROUNDING LANDS SUCH AS OPEN FIELD MEADOWS WETLAND AND FOREST CORRIDORS.

MAXIMUM AREA TO BE EXTRACTED

2. THE MAXIMUM AREA TO BE EXTRACTED WILL BE +/-118.5 HA. THE AREA TO BE LICENSED WILL BE +/-138 HA.

MAXIMUM TONNAGE LIMIT

3. THE AMOUNT OF AGGREGATE TO BE REMOVED FROM THE SITE WILL NOT EXCEED 500,000 TONNES IN ANY CALENDAR YEAR.

HOURS OF OPERATION

4. LOADING AND SHIPPING - 6:00 AM TO 6:00 PM MONDAY TO FRIDAY, 6:00 AM TO 12:00 PM ON SATURDAYS, AFTER HOURS LOADING AND SHIPPING MAY OCCUR AT THE REQUEST OF THE PROVINCE OF ONTARIO.

5. PROCESSING - CRUSHING, SCREENING AND WASHING - 7:00 AM TO 6:00 PM MONDAY TO FRIDAY, 7:00 AM TO 12:00 PM ON SATURDAYS.

6. BLASTING - 8:00 AM TO 6:00 PM MONDAY TO FRIDAY.

7. CONSTRUCTION ACTIVITIES INCLUDING STRIPPING AND REHABILITATION - 7:00 AM TO 7:00 PM MONDAY TO FRIDAY.

8. NO OPERATIONS ARE PERMITTED ON PUBLIC HOLIDAYS AS DEFINED BY THE EMPLOYMENT STANDARDS ACT.

EXTRACTION SEQUENCE

9. EXTRACTION OF THE SITE WILL BE DONE IN NINE PHASES AND WILL OCCUR SEQUENTIALLY TO MINIMIZE THE DISTURBED AREA. SEE STAGES OF OPERATIONS (SHEETS 6, 7 AND 8) FOR A DESCRIPTION OF THE ACTIVITIES PROPOSED FOR EACH PHASE AND FINAL REHABILITATION.

PROCESSING/SHIPPING/RECYCLING AREA

10. PHASE 1A (THE PROCESSING/SHIPPING/RECYCLING AREA) WILL BE DESIGNATED AS THE MAIN AREA FOR CRUSHING, SCREENING AND WASHING OF AGGREGATE. PRIMARY CRUSHING OPERATIONS MAY ALSO OCCUR IN AREAS UNDERGOING EXTRACTION PENDING APPROVAL OF APPROPRIATE NOISE MITIGATION MEASURES (SEE NOISE RECOMMENDATIONS ON SHEET 3 OF 8).

11. THIS AREA WILL ALSO BE THE MAIN AREA FOR THE STORAGE OF FUEL, SCRAP, AND AGGREGATE RECYCLING. THE SHOP AND SCALE HOUSE WILL ALSO BE LOCATED IN THIS AREA.

DEPTH OF EXTRACTION AND EXTRACTION LIFTS

12. PHASE 1A WILL BE EXTRACTED DOWN TO 224 MASL MAKING THE DEPTH OF EXTRACTION RANGE FROM 3 METERS TO 18 METERS.

13. THE ELEVATION OF THE QUARRY FLOOR IN PHASES 2 THROUGH 4D WILL RANGE FROM 216.0 M TO 217.0 MASL, 216.4 MASL ON AVERAGE. THE HIGHEST GROUND ELEVATION ON THE SITE IS 242.5 MASL, WHICH OCCURS IN THE NORTHWEST CORNER OF THE SITE. THE MAXIMUM DEPTH OF EXTRACTION WILL BE 25.5 METERS, WHICH WILL BE EXTRACTED IN TWO LIFTS OF APPROXIMATELY 13 METERS EACH (SEE DETAIL A ON SHEET 4 OF 8). TWO LIFTS WILL BE USED ALONG THE WEST BOUNDARY AND THE NORTH BOUNDARY. ONCE THE UPPER LIFT HAS BEEN REMOVED ALONG THESE TWO BOUNDARIES, THE LOWER LIFT WILL BE EXTRACTED DOWN TO FULL DEPTH (SEE DETAIL B). FOR THE REMAINDER OF THE SITE, ONE LIFT WILL BE USED AND THE DEPTH OF EXTRACTION WILL VARY FROM 7 METERS TO 16 METERS. THE MAXIMUM HEIGHT OF EACH LIFT WILL NOT EXCEED MINISTRY OF LABOUR REQUIREMENTS.

14. THE AVERAGE ELEVATION OF THE SHALLOW GROUNDWATER IN THE NORTHEAST PORTION OF THE SITE IS 239 MASL (AT MW25-07) AND 218 MASL IN THE SOUTH PORTION (AT MW25-07) (SEE TABLE 1 ON SHEET 1 OF 8). BETWEEN THESE LOCATIONS, THE QUARRY FLOOR WILL VARY FROM 23 METERS BELOW WATER TABLE TO 2 METERS BELOW WATER TABLE. THE AVERAGE ELEVATION OF THE SHALLOW GROUNDWATER IN THE PROVINCIALLY SIGNIFICANT WETLAND AT MW14 IS 215 MASL. THE ELEVATION OF THE QUARRY FLOOR WILL REMAIN ABOVE THIS ELEVATION SO AS NOT TO UNDERCUT THE WETLAND.

15. THE ELEVATION OF THE QUARRY FLOOR MAY VARY AS IT FOLLOWS THE ELEVATION OF THE SHADOW LAKE FORMATION, WHERE THE QUALITY OF MATERIAL DOES NOT MEET THE OPERATOR'S MARKET REQUIREMENTS, THE DEPTH OF EXTRACTION MAY BE REDUCED.

16. AS THE LIMIT OF EXTRACTION IS REACHED, THE OPERATOR WILL UTILIZE ONE OF THE LIFT EXTRACTION OPTIONS AS OUTLINED IN DETAIL A ON SHEET 4 OF 8. ALL EXTRACTION FACES WILL BE STABILIZED TO PREVENT EROSION INTO THE SETBACK AREA.

17. CROSS-SECTIONS SHOWING THE EXISTING GROUND ELEVATION, THE SHALLOW GROUNDWATER ELEVATION AND THE FINAL FLOOR ELEVATION ARE SHOWN ON SHEET 3 OF 8.

AGGREGATE STOCKPILING

18. STOCKPILES OF AGGREGATE WILL BE LOCATED IN THE PROCESSING/SHIPPING/RECYCLING AREA OR IN THE OPERATING PHASE. THE MAXIMUM HEIGHT OF AGGREGATE STOCKPILES WILL BE 20 METERS. AGGREGATE STOCKPILES IN THE OPERATING PHASE WILL REMAIN NO CLOSER THAN 30 METERS FROM THE LICENSED BOUNDARY. A VARIANCE IS REQUIRED SO THAT STOCKPILES STORED IN THE PROCESSING/SHIPPING/RECYCLING AREA CAN BE LOCATED CLOSER THAN 30 METERS FROM THE LICENSED BOUNDARY (TABLE 4).

FENCING

19. 1.2 METER HIGH POST AND WIRE FENCING OF THE LICENSED BOUNDARY WILL BE COMPLETED WITHIN 1 YEAR OF THE DATE OF THE LICENSE AND WILL BE MAINTAINED FOR THE LIFE OF THE QUARRY. EXCEPTIONS TO THE FENCING REQUIREMENTS ARE NOTED ON TABLE 4. UNFENCED LICENSED BOUNDARIES WILL BE STAKED WITH 1.2 M MARKER POSTS EVERY 60 METERS (+/-) FOR IDENTIFICATION PURPOSES. MARKER POSTS WILL BE INSTALLED WITHIN 1 YEAR OF LICENSING.

SETBACKS AND BUFFERS

20. APPROPRIATE SETBACKS SHALL BE MAINTAINED AS DRAWN ON THE SITE PLANS. A 15 METER SETBACK ALONG THE EAST BOUNDARY (ON LOT 14); A 30 METER SETBACK ALONG THE SOUTHEAST BOUNDARY ADJACENT TO THE PSW; AND A 15 METER SETBACK ALONG THE SOUTH BOUNDARY.

21. A VARIANCE (0 METER SETBACK) IS REQUIRED ALONG THE NORTH BOUNDARY, EAST BOUNDARY (ON LOT 13), AND ALONG THE WEST BOUNDARY AS DETAILED IN TABLE 4.

22. A 90 METER BUFFER WILL BE MAINTAINED ALONG THE NORTH BOUNDARY TO ALLOW FOR THE CONSTRUCTION OF A TREE NURSERY AND A FISH HABITAT LINKAGE CONNECTING THE NORTH OUTLET TO THE NEW WATER CHANNEL (SEE DETAIL D, SHEET 4 OF 8).

SITE PREPARATION, TOPSOIL AND OVERBURDEN STRIPPING

23. CLEARING OF VEGETATION IS TO OCCUR OUTSIDE THE PEAK BREEDING BIRD SEASON (APRIL 15TH - AUGUST 15TH). IF CLEARING MUST BE CONDUCTED DURING THIS TIME, A QUALIFIED BIRD BIOLOGIST MUST CONDUCT A NEST SEARCH FOR ANY EVIDENCE OF ACTIVE NESTS WITHIN THE AREA TO BE CLEARED.

24. TREE STUMPS AND BRUSH COLLECTED WHILE CLEARING TREES DURING SITE PREPARATION WILL BE STORED IN THE EXTRACTION AREA OF THE SITE UNTIL THEY ARE BURNED OR CHIPPED FOR REHABILITATION PURPOSES.

25. NO TOPSOIL WILL BE REMOVED FROM THE SITE. TOPSOIL AND OVERBURDEN FROM PHASE 1A WILL BE STRIPPED AND USED FOR CONSTRUCTING NOISE ATTENUATION BARRIERS (I.E. BERMS) AROUND THE PROCESSING/SHIPPING/RECYCLING AREA OR STOCKPILED FOR USE DURING THE REHABILITATION OF PHASE 1B. TOPSOIL AND OVERBURDEN FROM SUBSEQUENT PHASES WILL BE USED FOR PROGRESSIVE REHABILITATION OR TEMPORARILY STOCKPILED WITHIN THE DISTURBED AREA BUT NOT WITHIN 30 METERS OF THE LICENSE BOUNDARY. A VARIANCE IS REQUIRED TO ALLOW TOPSOIL AND OVERBURDEN TO BE STORED CLOSER THAN 30 METER TO THE LICENSED BOUNDARY IN THE PROCESSING/SHIPPING/RECYCLING AREA (SEE TABLE 4).

NOISE ATTENUATION BARRIERS

26. NOISE ATTENUATION BARRIERS WILL BE CONSTRUCTED AROUND THE PROCESSING/SHIPPING/RECYCLING AREA USING TOPSOIL AND OVERBURDEN FROM PHASE 1A AS PER NOISE CONTROL RECOMMENDATIONS BY VALCUSTICS CANADA LTD (SEE NOISE RECOMMENDATIONS ON SHEET 3 OF 8). WHEN THIS TOPSOIL/OVERBURDEN IS REQUIRED FOR REHABILITATION IN PHASE 1B, IT WILL BE REPLACED WITH AN APPROPRIATE ALTERNATIVE NOISE BARRIER (SEE DETAIL C ON SHEET 4 OF 8). THE OTHER REQUIRED NOISE ATTENUATION BARRIERS WILL BE CONSTRUCTED IN STAGES AS PER DETAIL E ON SHEET 4 OF 8.

SLOPES AND GRADING

27. NOISE ATTENUATION BARRIERS THAT ARE MADE USING TOPSOIL/OVERBURDEN AND/OR UNMARKETABLE LIMESTONE AND/OR IMPORTED CLEAN INERT FILL WILL BE GRADED TO A MINIMUM 2:1 SLOPE.

28. PERIMETERS WILL BE REHABILITATED AS THE LIMITS OF EXTRACTION ARE REACHED. ANY SLOPES CONSTRUCTED WILL BE ESTABLISHED AS OUTLINED IN DETAIL B ON SHEET 4 OF 8 BY BACKFILLING WITH OVERBURDEN, IMPORTED CLEAN INERT FILL, AND/OR UNMARKETABLE LIMESTONE. PERIMETER SLOPES WILL BE GRADED PRIOR TO THE PLACEMENT OF TOPSOIL. PORTIONS OF THE PERIMETER MAY BE REHABILITATED AS VERTICAL FACES.

29. ALL AVAILABLE OVERBURDEN, TOPSOIL AND ORGANIC MATTER WILL BE APPLIED TO THE SLOPES AND QUARRY FLOOR, WHERE THERE IS A DEFICIT OF OVERBURDEN FOR REHABILITATION PURPOSES. CLEAN INERT FILL WILL BE IMPORTED AS PER NOTE #1. TOPSOIL, OVERBURDEN AND ORGANIC MATERIAL, AND IMPORTED CLEAN INERT FILL WILL BE SPREAD AT VARIABLE DEPTHS IN AREAS TO BE FORESTED TO CREATE THE NECESSARY SOIL DEPTH FOR TREE GROWTH AND WHERE WETLANDS ARE PROPOSED.

30. THE QUARRY FLOOR WILL FOLLOW THE SHADOW LAKE FORMATION AND BE GRADED AS REQUIRED BY THE REHABILITATION PLAN FOR EACH PHASE. PHASES 1 AND A PORTION OF PHASE 2 WILL BE GRADED SUCH THAT DRAINAGE IS TOWARDS THE SOUTH, WHILE THE BALANCE OF PHASE 2 PLUS PHASES 3 AND 4 ARE TO BE GRADED TOWARDS THE NEW DRAINAGE CHANNEL BUILT IN EACH PHASE, WHERE SAID GRADING IS NOT POSSIBLE DUE TO UNDULATIONS IN THE SHADOW LAKE FORMATION, THEN GRADING WILL BE DONE IN CONSULTATION WITH THE MNRF AND A QUALIFIED ENVIRONMENTAL BIOLOGIST AND/OR ENGINEER SO THAT HABITATS ARE RECREATED IN A WAY THAT IS SUITABLE TO EACH PHASE.

SEEDING AND PLANTING

31. EXISTING TREES AND SHRUBS WITHIN THE SETBACK ALONG THE EAST LICENSED BOUNDARY IN LOT 14 WILL BE MAINTAINED AS SCREENS.

32. ANY NOISE ATTENUATION BARRIERS THAT ARE MADE USING TOPSOIL AND OVERBURDEN, AS WELL AS ANY STOCKPILES OF TOPSOIL AND OVERBURDEN WILL BE SEEDED WITH A NATIVE GRASS SEED MIX. VEGETATION SHALL BE MAINTAINED TO CONTROL EROSION.

33. ANY PERIMETER SLOPES MADE USING TOPSOIL AND OVERBURDEN WILL BE SEEDED WITH A NATIVE GRASS SEED MIX TO CONTROL EROSION.

34. NATIVE TREE AND SHRUB SPECIES INDIGENOUS TO THE ORILLIA/WASHAGO AREA WILL BE PLANTED IN AREAS SLATED FOR REHABILITATION TO FOREST. PLANT MATERIALS WILL BE OBTAINED FROM LOCAL NURSERIES, THE ON-SITE NURSERY, OR TRANSPLANTED FROM AREAS THAT ARE TO BE PREPARED FOR EXTRACTION.

35. FORESTED AREAS WILL BE COMPRISED OF SUGAR MAPLE, EASTERN WHITE PINE, EASTERN HEMLOCK, EASTERN WHITE CEDAR, WHITE BIRCH, RED OAK AND RED MAPLE. IT IS RECOMMENDED THAT 70% OF THE SPECIES WITHIN EACH FOREST POCKET BE CONIFEROUS AND 30% DECIDUOUS TO RE-ESTABLISH WHAT EXISTED PRIOR TO CLEARING.

36. AREAS OF THE SITE TO BE REHABILITATED TO AGRICULTURE WILL BE SEEDED WITH A SUITABLE CROP TYPE.

37. AREAS OF THE SITE TO BE REHABILITATED TO OPEN FIELD MEADOW WILL BE SEEDED WITH A NATIVE GRASS SEED MIX.

38. THERE ARE FOUR CATEGORY 3 BUTTERNUT TREES FOUND ON THE SITE. A NOTICE OF ACTIVITY UNDER THE ENDANGERED SPECIES ACT WILL BE REQUIRED FROM THE MNRF TO ENSURE PROPER REPLACEMENT/COMPENSATION FOR THE REMOVAL OF THESE TREES.

39. THERE ARE TWELVE REGIONALLY RARE SPECIES IN THE PROPOSED LICENSED AREA. A PROFESSIONAL BIOLOGIST WILL DEVELOP A VEGETATION SALVAGE PLAN TO TRANSPLANT AND RELOCATE ANY RARE VEGETATION SPECIES. THE VEGETATION SALVAGE PLAN WILL BE APPROVED BY MNRF BEFORE EXTRACTION PROCEEDS.

IMPORTATION OF MATERIAL FOR REHABILITATION

40. TOPSOIL AND CLEAN INERT FILL MAY BE BROUGHT ON SITE FOR REHABILITATION. TOPSOIL AND CLEAN INERT FILL WILL BE STOCKPILED SEPARATELY FROM NATIVE MATERIAL. IF NOT USED IMMEDIATELY FOR REHABILITATION, THE LICENSEE MUST ENSURE THAT THE MATERIAL IS TESTED AT SOURCE BEFORE IT IS DEPOSITED ON SITE TO ENSURE THAT THE MATERIAL MEETS THE MOECC'S CRITERIA UNDER TABLE 1 OF THE MOECC'S SOILS, GROUNDWATER AND SEDIMENT STANDARDS FOR USE UNDER PART XV.1 OF THE ENVIRONMENTAL PROTECTION ACT. SAMPLING RESULTS WILL BE PROVIDED TO THE MNRF UPON REQUEST.

EQUIPMENT

41. EQUIPMENT USED ON SITE WILL VARY DEPENDANT ON OPERATIONS. EQUIPMENT SHALL OPERATE IN ACCORDANCE WITH THE NOISE IMPACT ANALYSIS RECOMMENDATIONS FOUND ON SHEET 3 OF 8. IF REQUIRED, AN MOECC ENVIRONMENTAL COMPLIANCE APPROVAL WILL BE OBTAINED FOR PROCESSING EQUIPMENT TO BE USED ON-SITE.

42. EQUIPMENT USED FOR STRIPPING AND REHABILITATION WILL INCLUDE BUT NOT LIMITED TO SCRAPERS, EXCAVATORS, LOADERS, BULLDOZERS AND TRUCKS. PROCESSING OPERATIONS WILL USE PORTABLE CRUSHING AND SCREENING PLANTS, WASH PLANTS, CONVEYORS, STACKERS, FEED BINS, TOOL TRAILERS, ROCK SAWS, AND WOOD GRINDERS.

43. ELECTRIC POWER WILL BE PROVIDED USING PORTABLE POWER PLANTS OR AN EXISTING HYDROELECTRIC LINE.

44. FARM EQUIPMENT MAY BE USED IN UNDISTURBED AREAS WHILE EXTRACTION PROCEEDS AND FOR PROGRESSIVE AND FINAL REHABILITATION PURPOSES.

45. PORTABLE EQUIPMENT WILL MOVE THROUGHOUT THE SITE IN PROXIMITY TO THE EXTRACTION FACE OR IN THE PROCESSING/SHIPPING/RECYCLING AREA. IF REQUIRED, AN ENVIRONMENTAL COMPLIANCE APPROVAL WILL BE OBTAINED FOR PROCESSING EQUIPMENT TO BE USED ON SITE.

FUEL STORAGE AND EQUIPMENT MAINTENANCE

46. FUEL STORAGE WILL BE IN ABOVE GROUND TANKS CERTIFIED IN ACCORDANCE WITH APPROVED STANDARDS. REFUELING BY A FUEL TRUCK IS ALSO PERMITTED. FUEL STORAGE WILL BE LOCATED IN THE PROCESSING/SHIPPING/RECYCLING AREA. THE OPERATOR SHALL MAINTAIN A RECORD OF FUEL DELIVERIES NOTING THE QUANTITY AND DATE OF EACH TRANSFER.

47. MINOR SERVICING OF MOBILE EQUIPMENT WILL OCCUR ON SITE. MAJOR SERVICING OF MOBILE EQUIPMENT MAY OCCUR IN THE SHOP WHEN CONSTRUCTED. STATIONARY EQUIPMENT WILL BE SERVICED ON SITE.

48. ALL PETROLEUM WASTE PRODUCTS WILL BE COLLECTED AND DISPOSED OF BY AN MOECC APPROVED AGENT.

49. A SPILLS CONTINGENCY PLAN WILL BE IN PLACE PRIOR TO SITE PREPARATION.

BUILDINGS AND STRUCTURES

50. A SCALE AND SCALE HOUSE, SHOP AND FUEL STORAGE FACILITIES MAY BE INSTALLED ON THE SITE SUBJECT TO APPLICABLE PERMITS AND APPROVALS.

HAUL ROUTE

51. THE HAUL ROUTE FOR ALL SHIPPING, EXCEPT LOCAL DELIVERIES, WILL BE SOUTH FROM THE SITE ENTRANCES/EXITS ON THE DESIGNATED HAUL ROUTE KNOWN AS NICHOL'S LINE, WHICH PROVIDES ACCESS TO HIGHWAY 11 SOUTH.

52. THE UNOPENED PORTION OF NICHOL'S LINE LEADING TO THE SITE ENTRANCE WILL BE DESIGNED, APPROVED, AND THEN CONSTRUCTED TO SERVICE THE SITE. THIS HAUL ROAD SHALL BE CONSTRUCTED TO MUNICIPAL STANDARDS FOR YEAR ROUND USE BY THE REGISTERED LANDOWNER AND LICENSEE AT NO COST TO THE MUNICIPALITY.

ENTRANCE AND EXIT AND GATES:

53. TRUCK TRAFFIC WILL ENTER AND LEAVE THE SITE ONTO NICHOL'S LINE THROUGH THE PROCESSING/SHIPPING/RECYCLING AREA. THE ENTRANCE AND EXIST WILL BE GATED AND LOCKED WHEN THE QUARRY IS NOT IN USE.

INTERNAL HAUL ROADS

54. AGGREGATE WILL BE TRANSPORTED BY TRUCKS FROM THE ACTIVE QUARRY FACE OR PROCESSED STOCKPILES USING AN INTERNAL HAUL ROAD TO BE ESTABLISHED ON THE QUARRY FLOOR. THE INTERNAL HAUL ROAD IS TEMPORARY AND THE ACTUAL LOCATION WILL VARY AS THE OPERATION PROGRESSES.

AGGREGATE WASHING

55. A WASH PLANT WILL BE ESTABLISHED IN THE PROCESSING/SHIPPING/RECYCLING AREA. A PERMIT TO TAKE WATER WILL BE OBTAINED FROM MOECC FOR UTILIZING GROUND AND/OR SURFACE WATER.

56. WATER WILL BE PUMPED FROM THE CLEAN WATER POND TO BE LOCATED IN PHASE 1B. WASH WATER WILL BE DISCHARGED INTO SETTLING POND 1 WHERE FINE MATERIAL WILL SETTLE OUT SO THAT CLEAN WATER CAN BE REUSED IN THE WASHING PROCESS. THE WASH PLANT SYSTEM WILL FUNCTION AS A CLOSED LOOP SYSTEM WHICH RECYCLES ALMOST ALL WATER.

AGGREGATE RECYCLING

57. RECYCLING OF ASPHALT, CONCRETE, AND MASONRY MATERIALS WILL BE STOCKPILED IN THE PROCESSING/SHIPPING/RECYCLING AREA FOR THE PURPOSE OF RESALE AND/OR BLENDING WITH ON SITE PRODUCTS. RECYCLED AGGREGATE WILL BE REMOVED ON AN ON-GOING BASIS. RECYCLED ASPHALT WILL NOT BE STOCKPILED WITHIN 30 METERS OF ANY WATER BODY OR MANMADE POND; OR TWO METERS OF THE SURFACE OF THE WATER TABLE. A VARIANCE IS REQUIRED TO PERMIT STOCKPILES OF RECYCLED AGGREGATE CLOSER THAN 30 METERS TO THE LICENSED BOUNDARY (SEE TABLE 4).

58. ANY REBAR AND OTHER METAL WILL BE REMOVED FROM THE RECYCLED AGGREGATE AND PLACED IN A DESIGNATED SCRAP BIN ON SITE WHICH WILL BE REMOVED ON AN ON-GOING BASIS. ALL RECYCLED AGGREGATE WILL BE REMOVED FROM THE PROPERTY PRIOR TO FINAL REHABILITATION OF THE SITE.

59. ONCE THE AGGREGATE ON SITE HAS BEEN DEPLETED, NO FURTHER IMPORTS WILL BE PERMITTED. ONCE FINAL REHABILITATION HAS BEEN COMPLETED AND APPROVED IN ACCORDANCE WITH THE SITE PLAN, ALL RECYCLING OPERATIONS SHALL CEASE.

SCRAP

60. ANY SCRAP SUCH AS DISCARDED MACHINERY, EQUIPMENT, MOTOR VEHICLES, AND TIRES WILL BE COLLECTED AND TEMPORARILY STORED WITHIN THE CURRENT OPERATING PHASE IN ONE LOCATION, OR STORED IN THE PROCESSING/SHIPPING/RECYCLING AREA AND WILL BE REMOVED ON AN ONGOING BASIS. NO SCRAP WILL BE LOCATED WITHIN 30 METERS OF ANY BODY OF WATER. SCRAP STORED WITHIN THE CURRENT OPERATING PHASE WILL REMAIN 30 METERS FROM THE LICENSED BOUNDARY. A VARIANCE IS REQUIRED TO PERMIT SCRAP STORAGE CLOSER THAN 30 METERS OF THE LICENSED BOUNDARY IN THE PROCESSING/SHIPPING/RECYCLING AREA (SEE TABLE 4).

DRAINAGE CONTROLS

61. SETTLING POND 1 SHALL BE DESIGNED PRIOR TO EXTRACTION IN PHASE 1B AND LOCATED ALONG THE SOUTHERLY EXTRACTION BOUNDARY. AN MOECC ENVIRONMENTAL COMPLIANCE APPROVAL FOR PERIODIC DISCHARGE OF WATER WILL BE REQUIRED. CONCEPTUAL DETAILS FOR THIS POND ARE SHOWN ON DETAIL F (SHEET 4 OF 8).

62. SETTLING POND 2 SHALL BE DESIGNED PRIOR TO EXTRACTION IN PHASE 2 AND LOCATED AT THE OUTLET OF THE NEW WATER COURSE. AN MOECC ENVIRONMENTAL COMPLIANCE APPROVAL FOR PERIODIC DISCHARGE OF WATER WILL BE REQUIRED. CONCEPTUAL DETAILS FOR THIS POND ARE SHOWN ON DETAIL G (SHEET 4 OF 8). THE CONSTRUCTION OF SETTLING POND 2 WILL REQUIRE EXCAVATION IN THE 30 METER RESIDENTIAL SETBACK. A VARIANCE IS REQUIRED TO PERMIT EXCAVATION IN THIS AREA (SEE TABLE 4).

63. EXTRACTION IN PHASES 2 AND 3 WILL REQUIRE THE CREATION OF A NEW DRAINAGE CHANNEL THAT WILL BE ALIGNED PARALLEL TO THE EXISTING CHANNEL (WATERCOURSE 1). THE PATH OF THE NEW DRAINAGE CHANNEL IS SHOWN ON THE OPERATIONS PLAN (SHEET 2 OF 8). THE STAGING OF THE NEW DRAINAGE CHANNEL IS SHOWN ON THE STAGES OF OPERATIONS PLAN (SHEET 6, 7, AND 8).

64. THE NEW DRAINAGE CHANNEL WILL CONNECT TO THE NORTH INLET OF THE SITE USING A HABITAT LINKAGE (SEE DETAIL D ON SHEET 4 OF 8). FINAL DESIGN DETAILS FOR THE HABITAT LINKAGE WILL BE PROVIDED TO MNRF BEFORE EXTRACTION COMMENCES IN PHASE 3B.

65. WHEN MAKING THE SWITCH FROM WATERCOURSE 1 TO THE NEW DRAINAGE CHANNEL, FISH WILL NEED TO BE SALVAGED AND TRANSFERRED TO THE NEW DRAINAGE CHANNEL. SEE FISH SALVAGE PLAN ON PAGE 5 OF 8.

66. TEMPORARY MINOR DRAINAGE DITCHES WILL BE CREATED AS NECESSARY TO CATCH PRECIPITATION AND GROUNDWATER AND DIRECTED TOWARDS SETTLING POND 1 OR SETTLING POND 2.

67. TO ASSIST WITH DRAINAGE CONTROL, WETLANDS ARE PROPOSED FOR CONSTRUCTION ON THE QUARRY FLOOR IN PHASES 2, 3A, AND 4A ADJACENT TO THE NEW DRAINAGE CHANNEL (SEE SHEET 5 OF 8). FINAL DESIGN DETAILS FOR THE CONSTRUCTED WETLAND WILL BE PROVIDED TO MNRF BEFORE EXTRACTION PROCEEDS IN PHASE 3A.

EROSION AND SEDIMENTATION CONTROLS

68. A SEDIMENT AND EROSION CONTROL PLAN WILL BE DESIGNED AND IMPLEMENTED PRIOR TO SITE PREPARATION OF EACH STAGE SHOWN ON SHEETS 6, 7, AND 8.

DUST CONTROLS

69. DUST WILL BE MITIGATED ON SITE. WATER OR OTHER PROVINCIALLY APPROVED DUST SUPPRESSANT WILL BE APPLIED TO INTERNAL HAUL ROADS AND PROCESSING AREAS AS OFTEN AS REQUIRED TO MITIGATE DUST. PROCESSING EQUIPMENT WILL BE EQUIPPED WITH DUST SUPPRESSING OR COLLECTING DEVICES WHERE THE EQUIPMENT CREATES DUST AND IS BEING OPERATED WITHIN 300 METRES OF A SENSITIVE RECEPTOR.

BLASTING CONTROLS

70. ALL BLASTS WILL BE MONITORED FOR GROUND VIBRATION AND BLAST OVERPRESSURE TO ENSURE COMPLIANCE WITH CURRENT PROVINCIAL GUIDELINES.

71. BLASTING WILL NOT OCCUR ON HOLIDAY OR BETWEEN THE HOURS OF 6PM. ON ANY DAY AND 8AM ON THE FOLLOWING DAY.

72. ALL BLAST MONITORING REPORTS WILL BE AVAILABLE UPON REQUEST BY THE MNRF FOR AUDIT PURPOSES.

VARIATION OF OPERATIONAL STANDARDS

73. THE CONDITIONS ILLUSTRATED ON TABLE 4 OF THIS PLAN VARY FROM THE REQUIREMENTS OF THE PROVINCIAL STANDARDS THAT APPLY TO LICENSED PITS AND QUARRIES IN ONTARIO.

NO.	VARIANCE	STANDARD
1.0	STOCKPILES OF AGGREGATE AND/OR TOPSOIL AND/OR OVERBURDEN WILL BE LOCATED CLOSER THAN 30 METERS FROM THE LICENSED BOUNDARY IN THE PROCESSING/SHIPPING/RECYCLING AREA.	AGGREGATE STOCKPILES (5.13)
2.0	THE WESTERLY 300 METRES OF THE SOUTH BOUNDARY WILL BE FENCED. THE LIMIT OF EXTRACTION ADJACENT TO THE SIGNIFICANT WETLAND IN THE SOUTH EAST CORNER OF THE SITE WILL BE DELINEATED WITH MARKER POSTS AND BOUNDARIES WILL NOT BE FENCED BUT WILL BE DEMARCATED WITH MARKER POSTS. THE ADJACENT LANDS ARE VACANT, HEAVILY WOODED, OR AN EXISTING QUARRY.	FENCING (5.1)
3.0	THE SETBACK ALONG THE EAST SITE BOUNDARY IN LOT 13 ADJACENT TO THE EXISTING LICENSED QUARRY (E6AM15-1) WILL BE REDUCED TO 0 METERS. THE SETBACK ALONG THE WEST SITE BOUNDARY ADJACENT TO AN UNOPENED AND UNTRAVELED ROAD ALLOWANCE AND WILL BE REDUCED TO 0 METERS. THE SETBACK ALONG THE NORTH BOUNDARY WILL BE REDUCED TO 0 METERS TO ALLOW FOR THE CONSTRUCTION OF A TREE NURSERY AND A FISH LADDER CONNECTING THE NORTH OUTLET TO THE NEW WATER CHANNEL.	SETBACKS (5.10)
4.0	SCRAP WILL BE STORED CLOSER THAN 30 METERS TO THE LICENSED BOUNDARY IN THE PROCESSING/SHIPPING/RECYCLING AREA.	SCRAP (5.8)
5.0	EXCAVATION IN THE 30 METER RESIDENTIAL SETBACK ALONG THE EAST BOUNDARY WILL BE REQUIRED TO PROPERLY CONSTRUCT SETTLING POND 2 SO THAT ITS OUTLET IS AN ELEVATION BELOW 216.0 MASL.	EXCAVATION WITHIN SETBACK (5.11)



LEGEND

---	LICENCED BOUNDARY / PROPERTY BOUNDARY
---	LIMIT OF EXTRACTION
---	PHASE BOUNDARY
---	SILT FENCE
---	BUILDINGS AND STRUCTURES
---	POST & PAGE WIRE FENCE (UNLESS OTHERWISE NOTED)
---	INTERNAL ROAD
---	NEW WATER CHANNEL
---	INTERMITTENT WATER COURSE
---	OFFSITE WATER COURSE
---	CONTOURS ELEVATION (masl)
---	QUARRY ENTRANCE/EXIT
---	DIRECTION/SEQUENCE OF EXTRACTION
---	GATE
---	PROVINCIALLY SIGNIFICANT WETLAND
---	NEA WETLAND BOUNDARY
---	CROSS - SECTION ARROWS
---	BENCHMARK WITH ELEVATION (masl)
---	TREE NURSERY PLANTING AREA
---	HABITATE LINKAGE

SITE PLAN AMENDMENTS

NO.	REVISION	BY	DATE



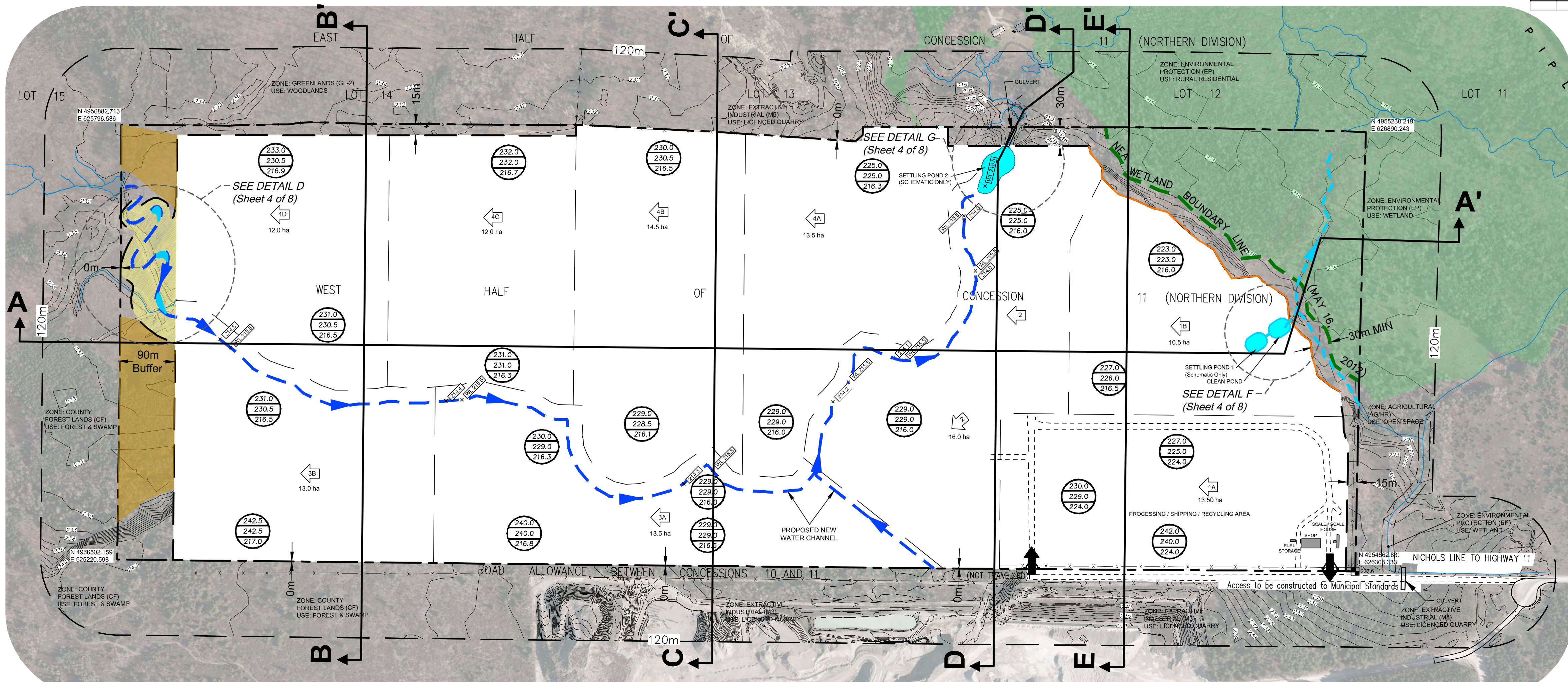
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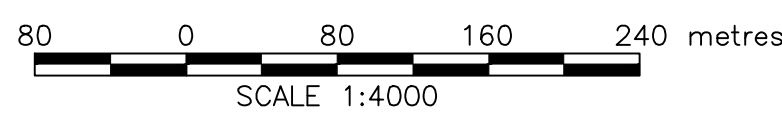
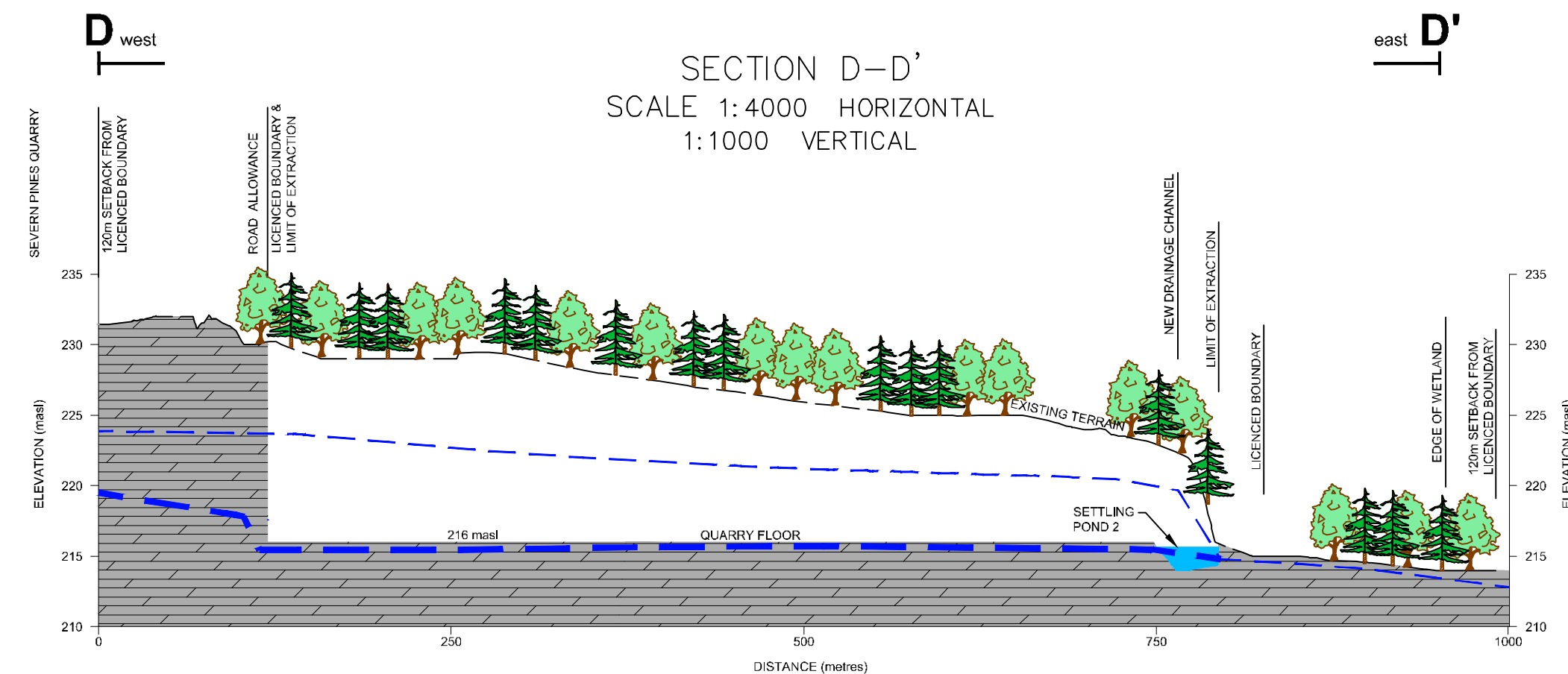
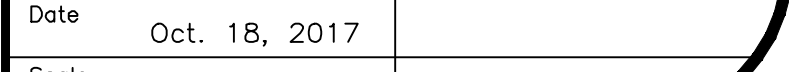
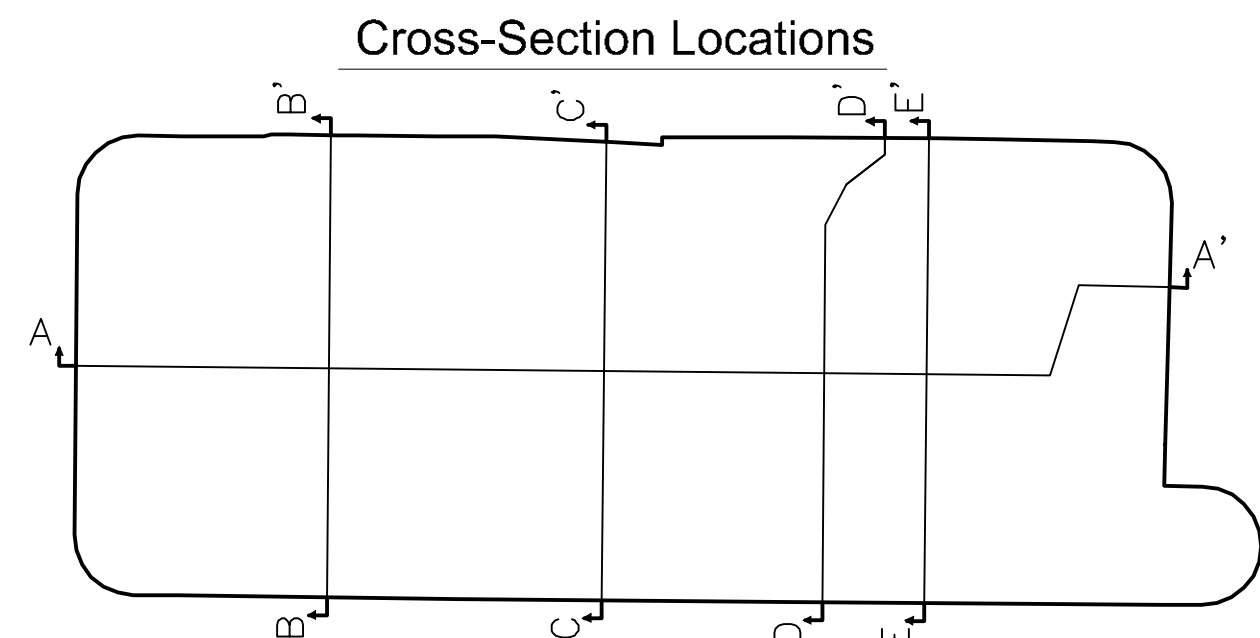
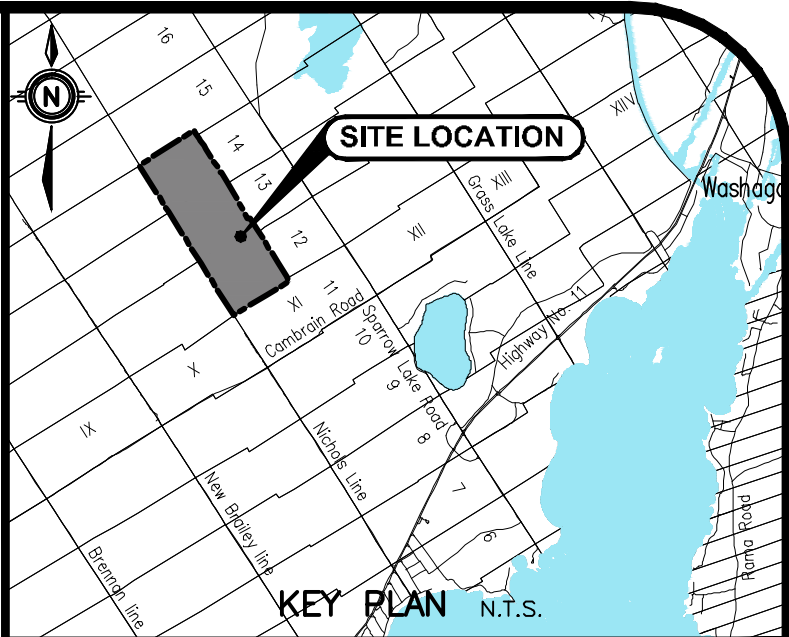
DECLARATION OF PURPOSE
THIS SITE PLAN IS PREPARED UNDER THE AGGREGATE RESOURCES ACT FOR A CLASS 'A' LICENCE, CATEGORY 2.

PROJECT
CUMBERLAND QUARRY
LICENSEE: SEVERN AGGREGATES LIMITED
151 WHITEHALL DRIVE,
MARKHAM, ONTARIO
L3R 9T1

DRAWING
OPERATIONAL PLAN
WEST HALF LOTS 12, 13 AND 14, CONCESSION 11
GEOGRAPHIC TOWNSHIP OF ORILLIA, NORTH DIVISION
TOWNSHIP OF SEVERN, COUNTY OF SIMCOE

Project Manager J. Flanagan	Project No. 33876-300
Design By	Checked By
Drawn By K.X.M.	Checked By
Surveyed By	Drawing No.
Date Oct. 18, 2017	
Scale 1:4000	Sheet 2 of 8





REHABILITATION NOTES:

GENERAL

1. THE MAXIMUM HECTAREAGE TO BE REHABILITATED IS 118.5 HECTARES (293 ACRES).
2. REHABILITATION WILL BE PROGRESSIVE, GENERALLY IN ACCORDANCE WITH THE STAGES OF OPERATION PLAN (SEE SHEETS 6, 7, AND 8). AS EXTRACTION MOVES FROM SOUTH TO NORTH, THE QUARRY FLOOR WILL BE PROGRESSIVELY REHABILITATED IN 25 HECTARE BLOCKS (APPROXIMATELY).
3. THE PROGRESSIVE AND FINAL REHABILITATION INCLUDES A SERIES OF FOREST BLOCKS, OPEN FIELD MEADOWS, SWAMPS, MARSH AND AGRICULTURAL LANDS. THESE USES WILL REINSTATE THE VARIETY OF PLANT AND WILDLIFE HABITAT CURRENTLY PRESENT. THE LAYOUT WILL CONNECT THE FOREST TO THE EAST AND FOREST POCKETS TO THE WEST, PROVIDING A WILDLIFE CORRIDOR ACROSS THE PROPERTY.
4. THE PROCESSING/SHIPPING/RECYCLING AREA WILL BE THE FINAL AREA TO BE REHABILITATED. EIGHT HECTARES OF THIS AREA WILL REMAIN POST-REHABILITATION TO BE USED FOR FUTURE LAND USES INCLUDING ACCESS TO AGRICULTURAL AREAS.
5. ALL EXTRACTION EQUIPMENT AND AGGREGATE STOCKPILES WILL BE REMOVED FROM THE SITE. BUILDINGS AND INTERNAL ROADS MAY REMAIN FOR ACCESS AND AGRICULTURAL USE.
6. ALL OVERBURDEN AND TOPSOIL STOCKPILES WILL BE UTILIZED IN PROGRESSIVE AND FINAL REHABILITATION.
7. THE FINAL REHABILITATED SITE WILL MAINTAIN DRAINAGE, INLETS/OUTLETS AND GENERAL FLOW DIRECTION.

STAGING

8. STAGING OF PROGRESSIVE REHABILITATION AND FINAL REHABILITATION WILL FOLLOW THE DIRECTION AND SEQUENCE OF EXTRACTION AS SHOWN ON THE STAGES OF OPERATIONS PLAN (SHEETS 6 THROUGH 8). PROGRESSIVE REHABILITATION WILL OCCUR IN NINE PHASES COMPRISING OF 14 STAGES (SOUTH TO NORTH).
9. AS THE HORIZONTAL LIMIT AND/OR MAXIMUM DEPTH OF EXTRACTION IS REACHED IN EACH PHASE, PROGRESSIVE REHABILITATION WILL COMMENCE WITH BACKFILLING TO THE PRESCRIBED SLOPES AND ELEVATIONS (SEE DETAIL B). UTILIZING TOPSOIL/OVERBURDEN, UNMARKETABLE LIMESTONE, AND IMPORTED MATERIAL FROM STOCKPILES OR AREAS BEING PREPARED FOR EXTRACTION.
10. WHERE THE QUALITY OF AGGREGATE MATERIAL DOES NOT MEET THE OPERATOR'S MARKET REQUIREMENTS, THE HORIZONTAL EXTENT OR DEPTH OF EXTRACTION MAY BE REDUCED AND PROGRESSIVE REHABILITATION COMMENCED AS REQUIRED.
11. CLEARING OF VEGETATION IS TO OCCUR OUTSIDE THE PEAK BREEDING BIRD SEASON (APRIL 15TH - AUGUST 15TH).
12. ONLY NATIVE TREE AND SHRUB SPECIES INDIGENOUS TO THE ORILLIA/ASHADOO AREA AND DERIVED FROM STOCK FROM LOCAL NURSERIES OR THE NURSERY ON-SITE ARE TO BE USED IN THE PROGRESSIVE REHABILITATION PROCESS.

TOPSOIL/OVERBURDEN

13. TOPSOIL/OVERBURDEN STRIPPED PRIOR TO AGGREGATE EXTRACTION WILL BE UTILIZED ON FINAL GRADED SLOPES. TOPSOIL/OVERBURDEN WILL BE STORED IN BERMS ALONG THE EXTRACTION LIMITS OR ON THE QUARRY FLOOR, AND EVENTUALLY SPREAD OVER THE FINAL FLOOR. IT WILL BE GRADED AND SEEDED WITH GRASS SEED CONDUIVE TO PASTURING AND PLANTING OF TREES AND SHRUBS.
14. DUE TO THE THIN LAYER OF OVERBURDEN IN SOME AREAS OF THE SITE, SUFFICIENT MATERIAL TO COVER THE ENTIRE QUARRY FLOOR MAY NOT BE POSSIBLE; THUS, CLEAN INERT FILL MAY BE IMPORTED.

15. DEEPER/HEAVIER BANDS OR NODES OF TOPSOIL/OVERBURDEN WILL BE CREATED AND PLANTED WITH NATIVE TREE AND SHRUB SPECIES. THIS MATERIAL WILL BE SPREAD AT VARIABLE DEPTHS WITHIN THE TREE NODES AND A THIN LAYER OF SOIL SPREAD THROUGHOUT THE AREA IN ALL DIRECTIONS TO CREATE SUCCESSIONAL HABITATS AND AGRICULTURAL LANDS.
16. ORGANIC SOILS WILL BE STRIPPED AND STORED SEPARATELY FOR USE IN REHABILITATION OF WETLAND HABITAT IN PHASES 2, 3A AND 4A AS PER THE STAGES OF OPERATIONS PLAN (SHEETS 6, 7, AND 8).

IMPORTATION OF MATERIAL

17. CLEAN INERT FILL MAY BE IMPORTED TO FACILITATE THE ESTABLISHMENT OF 2:1 SLOPES ON THE QUARRY FACES. THE LICENSEE MUST ENSURE THAT THE MATERIAL IS TESTED AT THE SOURCE, BEFORE IT IS DEPOSITED ON-SITE. TO ENSURE THE MATERIAL MEETS THE MOECC'S CRITERIA UNDER TABLE 1 OF MOE'S SOILS, GROUND WATER AND SEDIMENT STANDARDS FOR USE UNDER PART XXV OF THE ENVIRONMENTAL PROTECTION ACT, SAMPLING RESULTS WILL BE PROVIDED TO THE MNRF UPON REQUEST.

QUARRY SLOPING

18. QUARRY FACES WILL BE BACKFILLED AND GRADED TO A MINIMUM 2:1 SLOPE FROM CREST TO TOE DOWN TO AN ELEVATION NO LOWER THAN 216.0 MASL.
19. QUARRY FACES WILL BE SLOPED USING A COMBINATION OF EXTRACTING METHODS AND BACKFILLING (SEE DETAIL A AND B ON SHEET 4 OF 8). TOPSOIL/OVERBURDEN, UNMARKETABLE LIMESTONE, OR CLEAN INERT FILL WILL BE USED TO BACKFILL TO ESTABLISH THE SLOPES. THIS MATERIAL WILL BE PLACED ON THE SLOPES AND GRADED TO THE DESIGN CONTOUR.
20. QUARRY FACES ALONG THE EAST SIDE OF PHASES 3A AND 3B WILL BE PARTIALLY BACKFILLED USING ROCK DEBRIS/TALUS AND SOBBE ALONG THEIR TOE. THE EXPOSED PORTION WILL REMAIN A VERTICAL FACE. THE SLOPES IN THESE AREAS WILL BE UTILIZED TO CREATE HABITAT ENHANCEMENTS USING FLAT LIMESTONE SLABS RANDOMLY PILED TO MAXIMIZE SPACES AND COVER FOR SNAKES.
21. OTHER HABITAT ENHANCEMENTS WILL INCLUDE PILES OF CLEAN SAND NEAR THE WATERCOURSE TO A DEPTH OF 60 CENTIMETERS IN A 3 X 3 METRE AREA TO CREATE HABITAT FOR SPECIES AT RISK (I.E. SNAKES AND TURTLES). TWO SAND PILES AND TWO HIBERNACULA WILL BE CONSTRUCTED AS PART OF THE REHABILITATION PLAN.

VEGETATION

22. REHABILITATED SLOPES AND THE QUARRY FLOOR WILL BE VEGETATED PROGRESSIVELY AS THE RESOURCE IN EACH PHASE IS EXHAUSTED.
23. REHABILITATED SLOPES WILL BE VEGETATED WITH A NATIVE GRASS SEED MIX.
24. A COVER CROP OF AGRICULTURAL GRASSES SUCH RYE GRASSES, FESCUES AND LEGUMES SUCH AS BIRD'S FOOT TREFOIL, ALFALFA AND RED CLOVER WILL BE PLANTED TO STABILIZE SOILS AND PROVIDE ORGANIC AMENDMENT THAT WILL EVENTUALLY BE INCORPORATED INTO THE SOIL. PROGRESSIVE REHABILITATION WILL PROVIDE TIME FOR NATURAL REGENERATION/SUCCESSION OF NATIVE VEGETATION.
25. FORESTED AREAS WILL BE COMPRISED OF SPECIES INDIGENOUS TO THE SEVERN AREA. 70% PERCENT OF THE TREES WILL BE CONIFEROUS AND 30% WILL BE DECIDUOUS (CONSISTENT WITH THE SURROUNDING NATURAL AREA). FORESTED AREAS WILL BE COMPRISED OF TREES SUCH AS:
 - a. SUGAR MAPLE (ACER SACHARINUM),
 - b. EASTERN WHITE PINE (PINUS STROBUS),
 - c. EASTERN HEMLOCK (TSUGA CANADENSIS),
 - d. EASTERN WHITE CEDAR (TAXUS OCCIDENTALIS),
 - e. WHITE BIRCH (BETULA Papyrifera),
 - f. RED OAK (QUERCUS RUBRA), AND
 - g. RED MAPLE (ACER RUBRUM).

26. A FOREST CORRIDOR WITH A MINIMUM OF 100M WIDTH WILL BE CREATED TO CONNECT THE EAST AND WEST SIDES OF THE PROPERTY TO ACT AS A LINKAGE ACROSS THE PROPERTY. THIS CORRIDOR WILL BE LOCATED ALONG THE REALIGNED WATERCOURSE. AVAILABLE TOPSOIL/OVERBURDEN, ORGANIC SOILS, UNMARKETABLE LIMESTONE OR CLEAN INERT FILL WILL BE USED AND SPREAD 15 METERS BEYOND THE FOREST BLOCKS IN ALL DIRECTIONS TO CREATE SUCCESSIVE HABITATS.

27. WETLANDS WILL BE ESTABLISHED ALONG SECTIONS OF THE NEW DRAINAGE CHANNEL. STOCKPILED ORGANIC SOIL WILL BE RE-ESTABLISHED IN THOSE AREAS AND THE WETLAND PLANTED WITH A MIXTURE OF NATIVE TREE AND SHRUB SPECIES. THESE MAY INCLUDE (BUT NOT LIMITED TO):
 - a. BALSAM FIR (ABIES BALSAMEA),
 - b. EASTERN WHITE CEDAR (TAXUS OCCIDENTALIS),
 - c. SILVER MAPLE (ACER SACHARINUM),
 - d. RED MAPLE (ACER RUBRUM),
 - e. TAMARACK (LARIX LARICINA),
 - f. RED-OSSER DOGWOOD (CORNUS STOLONIFERA),
 - g. SPECKLED ALDER (ALNUS INCANA),
 - h. NARROW-LEAVED MEADOWSWEET (SPIRAEA ALBA), AND
 - i. TUSSOCK SEDGE (CAREX STRICTA).

28. THERE ARE SIX CATEGORY 2 BUTTERNUT TREES FOUND ON THE SITE. A NOTICE OF BUTTERNUT IMPACT FORM UNDER THE ENDANGERED SPECIES ACT WILL BE REQUIRED FROM THE MNRF TO ENSURE PROPER REPLACEMENT/COMPENSATION FOR THE REMOVAL OF THESE TREES.

29. THERE ARE TWELVE REGIONALLY RARE SPECIES IN THE PROPOSED LICENSED AREA. A PROFESSIONAL BIOLOGIST WILL DEVELOP A VEGETATION SALVAGE PLAN TO TRANSPLANT AND RELOCATE ANY RARE VEGETATION SPECIES. THE VEGETATION SALVAGE PLAN WILL BE APPROVED BY MNRF BEFORE EXTRACTION PROCEEDS.

BUILDINGS AND STRUCTURES

30. THE SCALE AND SCALE HOUSE WILL BE REMOVED WITHIN ONE YEAR OF FINAL REHABILITATION.

INTERNAL HAUL ROADS

32. INTERNAL HAUL ROADS WILL REMAIN TO ALLOW ACCESS TO AGRICULTURAL AREAS.

FINAL WATER TABLE ELEVATION

33. THE FINAL ELEVATION OF THE WATER TABLE WILL BE APPROXIMATELY 215.5 MASL.

SURFACE WATER DRAINAGE

34. THE QUARRY FLOOR WILL BE DESIGNED WITH A NEW DRAINAGE CHANNEL TO CONVEY WATER FROM THE NORTH PORTION OF THE SITE TO SETTLING POND 2 LOCATED ALONG THE EASTERN BOUNDARY OF THE SITE. FINAL DESIGN DETAILS WILL BE PROVIDED TO MNRF BEFORE EXTRACTION COMMENCES IN PHASE 2.
35. WATER FROM THE SITE WILL BE PASSIVELY DISCHARGED THROUGH AN OUTLET AT AN ELEVATION OF 215.5 MASL LOCATED ON THE DOWNSTREAM END OF SETTLING POND 2. THIS NEW DRAINAGE CHANNEL WILL ALSO RECEIVE AND CONVEY WATER FROM THE SEVERN PINES QUARRY. THE STAGING OF THE NEW DRAINAGE CHANNEL IS SHOWN ON THE STAGING PLAN (SHEETS 6, 7 AND 8).
36. THE NEW DRAINAGE CHANNEL WILL CONNECT TO THE NORTH INLET OF THE SITE USING A HABITAT LINKAGE. SEE OPERATIONAL PLAN (SHEET 3 OF 8) AND DETAIL D ON SHEET 4 OF 8. FINAL DESIGN DETAILS FOR THE HABITAT LINKAGE WILL BE PROVIDED TO MNRF BEFORE EXTRACTION COMMENCES IN PHASE 3B.

37. WHEN MAKING THE SWITCH FROM WATERCOURSE 1 TO THE NEW DRAINAGE CHANNEL, FISH WILL NEED TO BE SALVAGED AND TRANSFERRED TO THE NEW DRAINAGE CHANNEL. SEE FISH SALVAGE PLAN ON THIS PAGE.

38. ON THE QUARRY FLOOR A WETLAND WILL BE CONSTRUCTED ADJACENT TO THE NEW DRAINAGE CHANNEL. FINAL DESIGN DETAILS FOR THE CONSTRUCTED WETLAND WILL BE PROVIDED TO MNRF BEFORE EXTRACTION PROCEEDS IN PHASE 3A.

PROVINCIALY SIGNIFICANT WETLAND

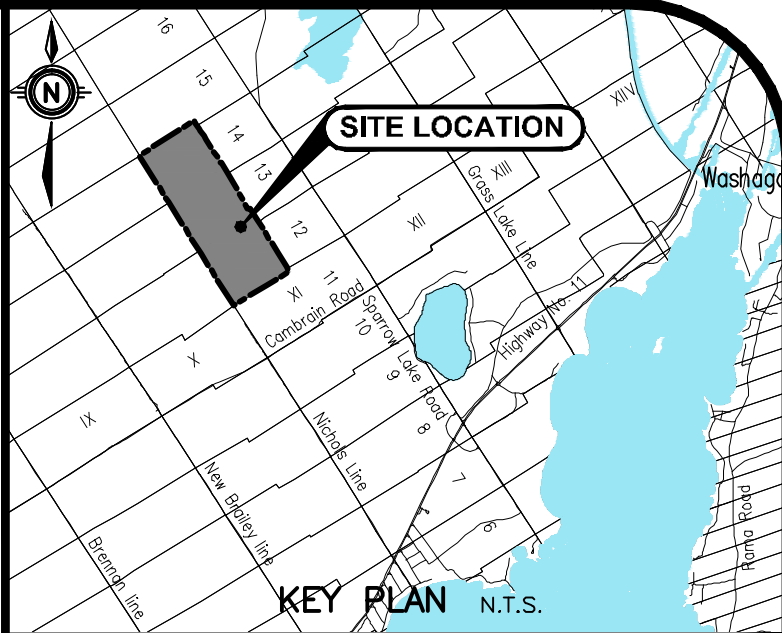
39. NO TREES OR VEGETATION WILL BE REMOVED AND NO DISTURBANCE UNDERTAKEN WITHIN THE SETBACK AREA FROM THE PROVINCIALY SIGNIFICANT WETLAND. NO STUMPS OR BERMS ARE TO BE LOCATED WITHIN THE 30 METER SETBACK.

FISH SALVAGE PLAN

40. THE PROPOSED QUARRY EXTRACTION REQUIRES RELOCATION OF WATERCOURSE 1 WHICH SUPPORTS FISH. TO AVOID THE MORTALITY OF INDIVIDUAL FISH FROM THE EXTRACTION PROCESS, A PROFESSIONAL BIOLOGIST WILL DESIGN AND IMPLEMENT A FISH SALVAGE PLAN BEFORE EXTRACTION PROCEEDS IN PHASE 3B. THE FISH SALVAGE PLAN WILL BE SUBMITTED TO MNRF FOR REVIEW AND APPROVAL.

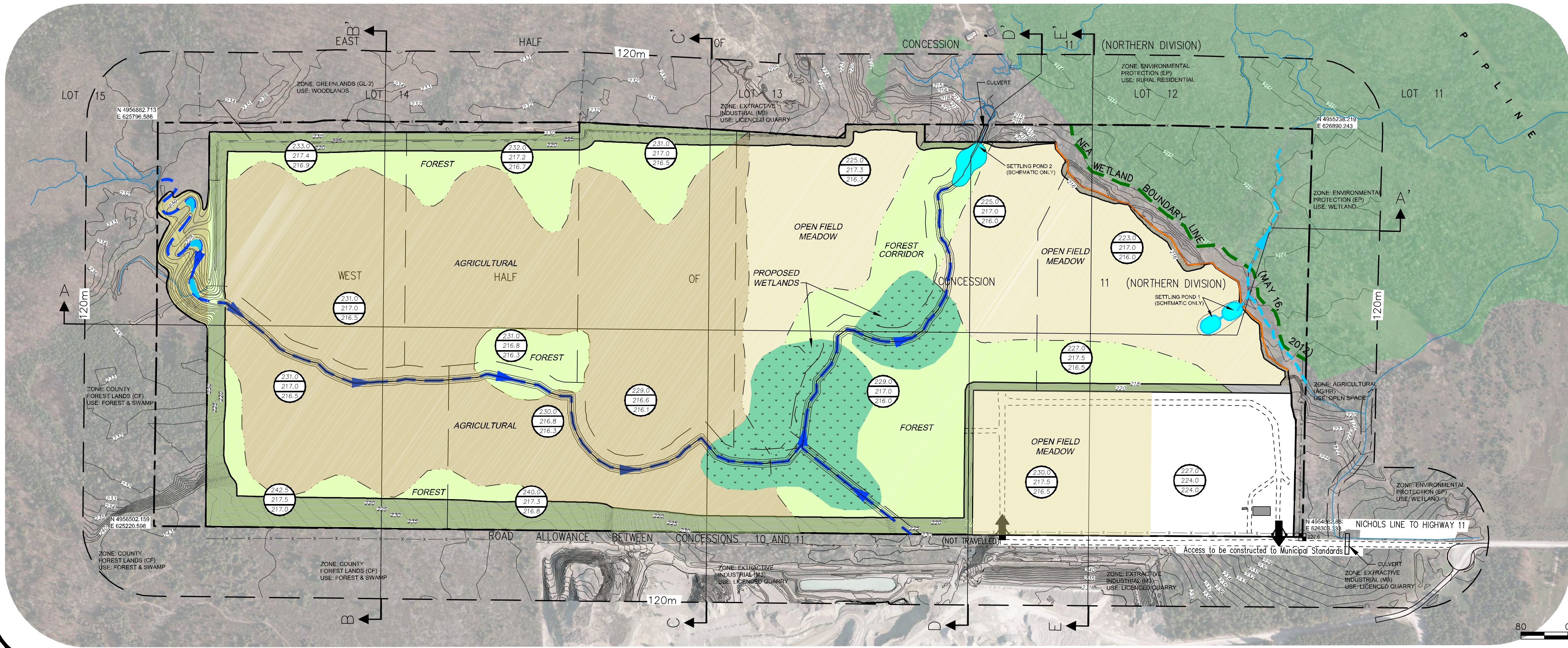
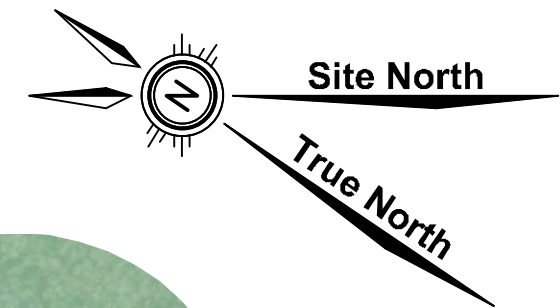
SPECIES AT RISK

41. TO PROTECT ANY SPECIES AT RISK IDENTIFIED ON THE SITE, A SPECIES AT RISK PLAN WILL BE DEVELOPED AND SUBMITTED IN SUPPORT OF AN APPLICATION FOR AN OVERALL BENEFIT PERMIT FROM THE MNRF BEFORE EXTRACTION PROCEEDS.



LEGEND

- LICENCED BOUNDARY / PROPERTY BOUNDARY
- - - - - LIMIT OF EXTRACTION
- PHASE BOUNDARY
- SILT FENCE
- BARN
- POST & PAGE WIRE FENCE (UNLESS OTHERWISE NOTED)
- INTERNAL ROAD
- NEW WATER CHANNEL
- 250 --- CONTOURS ELEVATION
- QUARRY ENTRANCE/EXIT
- GATE
- PROVINCIALY SIGNIFICANT WETLAND
- NEA WETLAND BOUNDARY
- A A' CROSS - SECTION ARROWS
- 227.6 BENCHMARK WITH ELEVATION (masl)
- 227.0 --- EXISTING GROUND ELEVATION
- 226.0 --- REHABILITATION ELEVATION
- 216.5 --- LOWEST QUARRY FLOOR ELEVATION



80 0 80 160 240 metres
SCALE 1:4000

SITE PLAN AMENDMENTS

NO.	REVISION	BY	DATE



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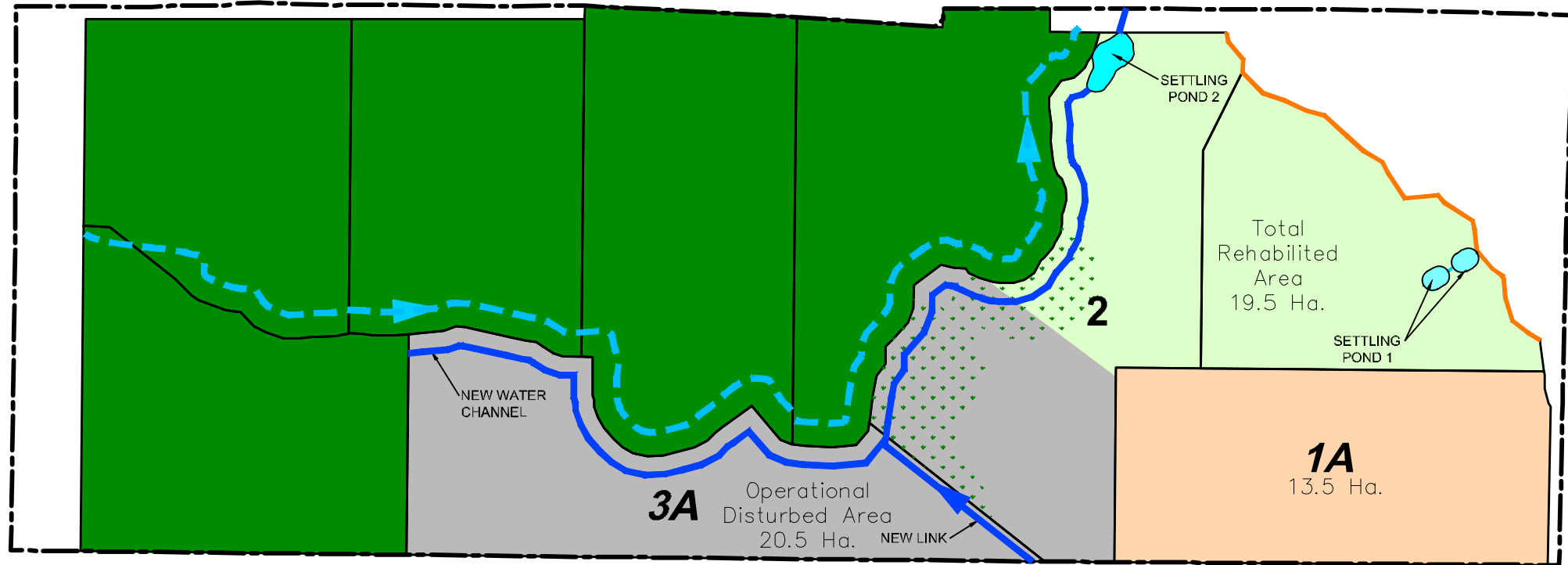
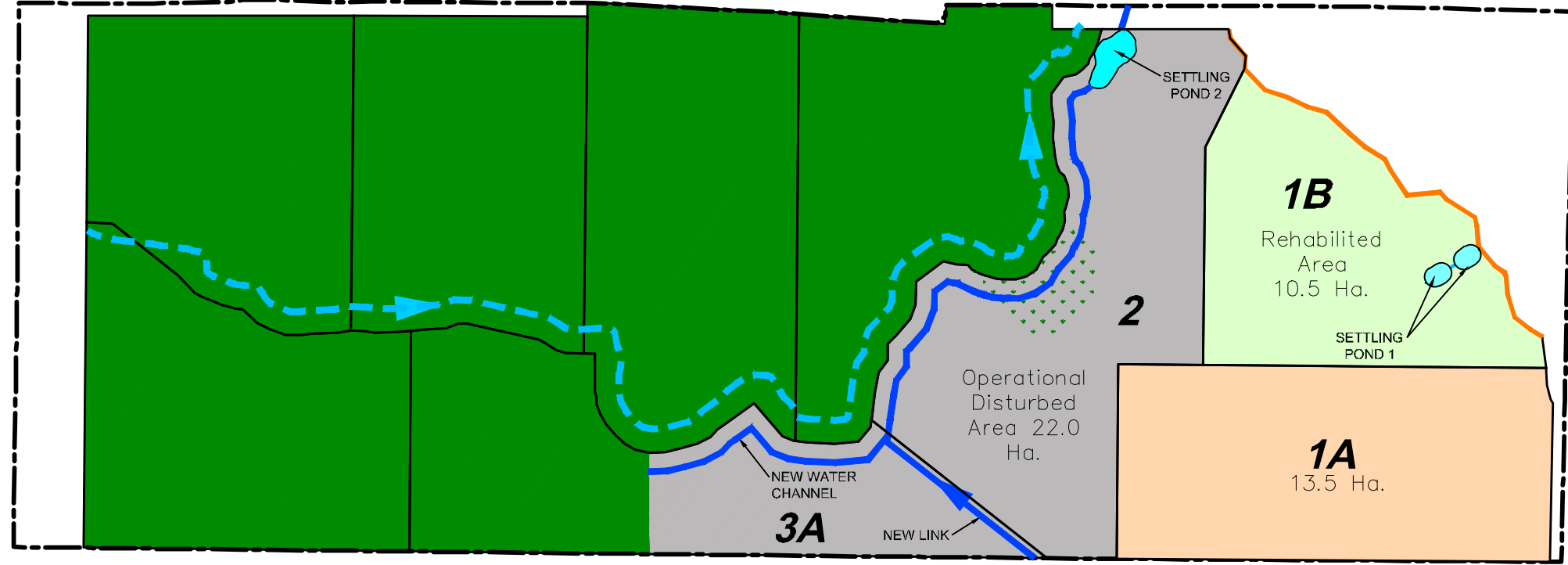
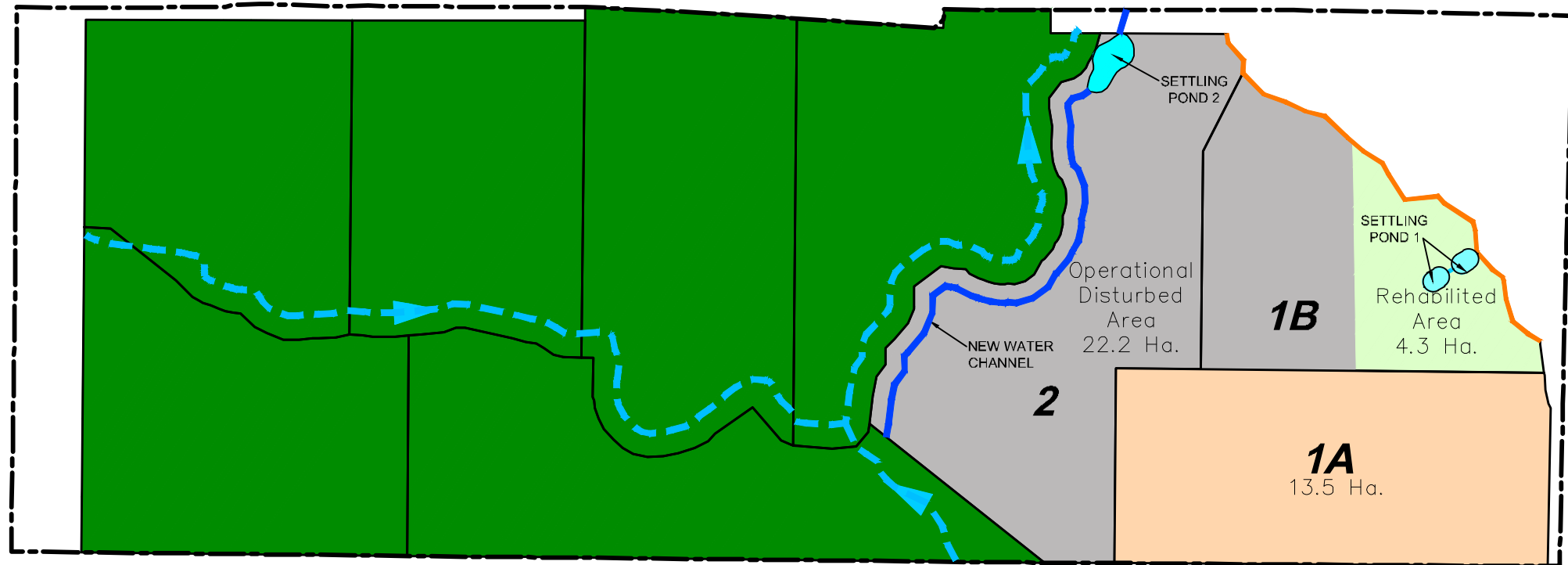
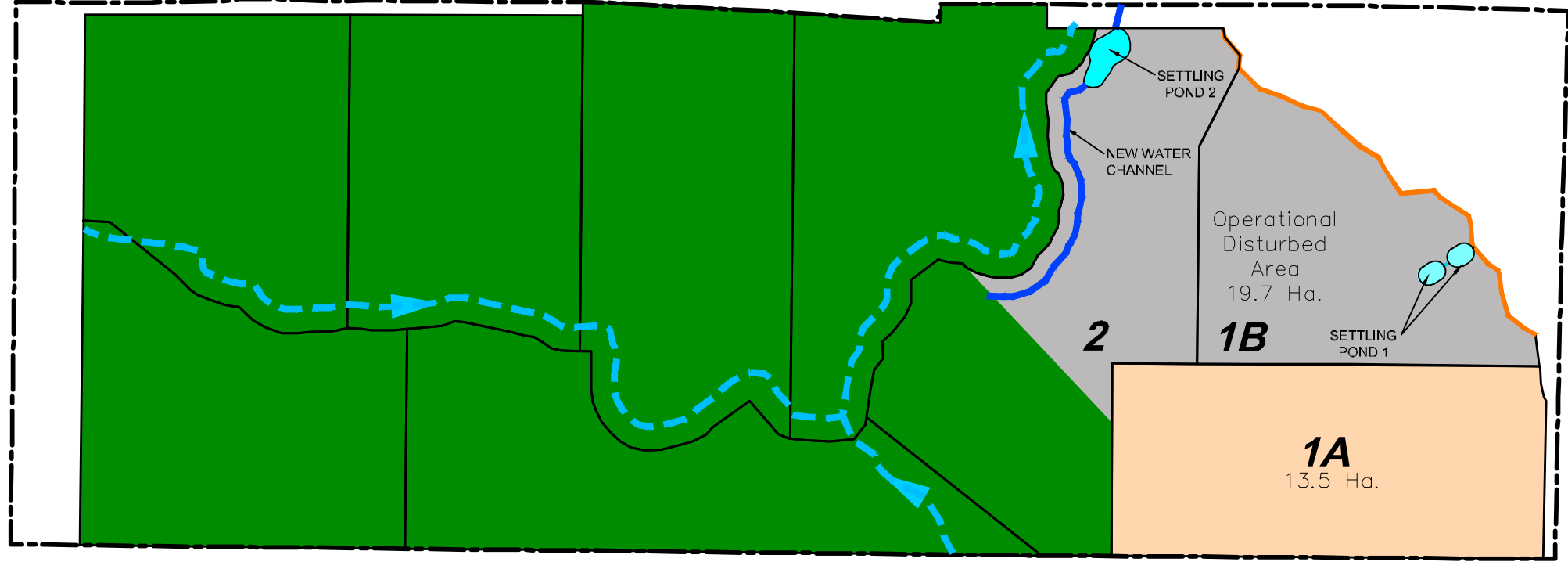
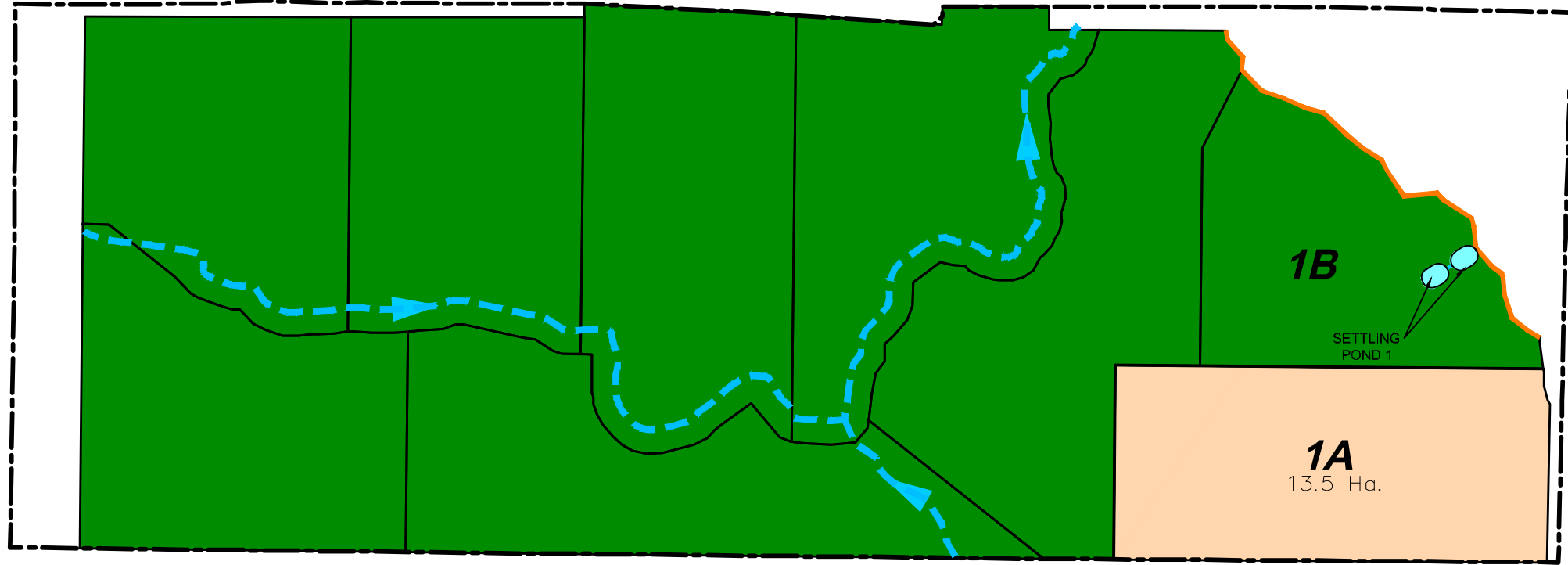
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DECLARATION OF PURPOSE
THIS SITE PLAN IS PREPARED UNDER THE AGGREGATE RESOURCES ACT FOR A CLASS 'A' LICENCE, CATEGORY 2.

PROJECT
CUMBERLAND QUARRY
LICENSEE: SEVERN AGGREGATES LIMITED
161 WHITEHALL DRIVE,
MARKHAM, ONTARIO
L3R 9T1

DRAWING
FINAL REHABILITATION PLAN
WEST HALF LOTS 12, 13 AND 14, CONCESSION 11
GEOGRAPHIC TOWNSHIP OF ORILLIA, NORTH DIVISION
TOWNSHIP OF SEVERN, COUNTY OF SIMCOE

Project Manager J. Flanagan	Project No. 33876-300
Design By	Checked By
Drawn By K.X.M.	Checked By
Surveyed By	Drawing No.
Date Oct. 18, 2017	
Scale 1:4000	Sheet 5 of 8



STAGE 1

PHASE 1A

1. FENCE THE WESTERLY 300 METRES OF THE SOUTH BOUNDARY. MAINTAIN THE FENCE FOR THE LIFE OF THE QUARRY.
2. DELINEATE THE SOUTH EAST CORNER OF THE SITE ADJACENT TO THE PSW WITH MARKER POSTS AND SILTATION CONTROLS ARE TO BE MAINTAINED FOR THE LIFE OF THE QUARRY.
3. DEMARCATE THE WEST, NORTH AND NORTH EAST LICENSED BOUNDARIES WITH MARKER POSTS. MARKER POSTS ARE TO BE MAINTAINED FOR THE LIFE OF THE QUARRY.
4. THE UNOPENED PORTION OF NICHOL'S LINE SHALL BE DESIGNED, APPROVED AND THEN CONSTRUCTED TO SERVICE THE SITE. CONSTRUCTION OF THIS PORTION OF THE DESIGNATED HAUL ROUTE, WILL BE DONE IN CONJUNCTION WITH THE CLEARING, STRIPPING AND PREPARATION OF THE PROCESSING/SHIPPING/RECYCLING AREA.
5. CONSTRUCT AND INSTALL NOISE BARRIERS OR ALTERNATIVE NOISE MITIGATION OPTIONS AS PER THE NOISE STUDY ALONG THE NORTH AND EAST PORTIONS OF PHASE 1A.
6. EXTRACT AND REMOVE AGGREGATE IN PHASE 1A DOWN TO 224.0MASL.

PHASE 1B

1. CONSTRUCT SETTLING POND 1 ALONG THE SOUTH EAST BOUNDARY OF PHASE 1B ADJACENT TO THE PSW TO CONTROL RUNOFF AND PROTECT THE SETBACK FROM SILTATION.

STAGE 2

PHASE 1A

1. PROCESSING EQUIPMENT SHALL BE LOCATED WITHIN THE PROCESSING/SHIPPING/RECYCLING AREA IN PHASE 1A.

PHASE 1B

1. AS REQUIRED, COMMENCE CONSTRUCTION OF NOISE BARRIERS OR ALTERNATIVE NOISE MITIGATION OPTIONS.
2. COMMENCE CLEARING, TREE REMOVAL, STRIPPING OF SOILS, THEN STOCKPILE WITHIN THE PHASE.
3. EXTRACT AND REMOVE AGGREGATE ALONG THE SOUTHERN EXTRACTION LIMIT AND PROCEED IN A NORTHERLY DIRECTION
4. COMMENCE PROGRESSIVE REHABILITATION ONCE SUFFICIENT AGGREGATE HAS BEEN EXTRACTED.
5. CREATE TEMPORARY MINOR DRAINAGE DITCHES WHERE NECESSARY TO CATCH PRECIPITATION AND GROUNDWATER AND DIRECT THE WATER TO SETTLING POND 1.

PHASE 2/1B

1. COMMENCE CLEARING, TREE REMOVAL AND STRIPPING OF SOILS IN THE EAST PORTION OF PHASE 2.
2. USE SOILS REMOVED FROM THE EAST PORTION OF PHASE 2 TO REHABILITATE THE SOUTH PORTION OF PHASE 1B TO OPEN FIELD MEADOWS. ADDITIONAL MATERIALS SUCH AS UNMARKETABLE LIMESTONE, WOOD CHIPS AND IMPORTED CLEAN INERT FILL MAY BE REQUIRED FOR REHABILITATION.
3. FINISH REMOVAL OF AGGREGATE IN THE NORTH PORTION OF PHASE 1B AND COMMENCE REMOVAL OF AGGREGATE IN THE EAST PORTION OF PHASE 2.
4. CONSTRUCT SETTLING POND 2 AND AFFILIATED SILT FENCING ALONG THE EAST BOUNDARY OF PHASE 2 TO PROTECT THE 30 M SETBACK FROM SILTATION.
5. CONSTRUCT THE EAST PORTION OF THE NEW WATER CHANNEL IN PHASE 2.
6. CREATE TEMPORARY MINOR DRAINAGE DITCHES AS NECESSARY TO CATCH PRECIPITATION AND GROUNDWATER TO DIRECT THE WATER TO SETTLING POND 1 IN PHASE 1B AND/OR SETTLING POND 2 IN PHASE 2.
7. MAINTAIN NOISE BARRIERS AS CONSTRUCTED DURING STAGE 1.
8. WHEN STAGE 2 IS COMPLETE, THE OPERATIONAL DISTURBED AREA WILL BE APPROXIMATELY 25.9 HA.

STAGE 3

PHASE 1B

1. REHABILITATION COMPLETE IN THE SOUTH PORTION OF PHASE 1B. THE TOTAL REHABILITATED AREA WILL BE APPROXIMATELY 4.3 HA. REHABILITATION INCLUDES OPEN FIELD MEADOWS AND FOREST.

PHASE 2/1B

1. COMMENCE CLEARING, TREE REMOVAL AND STRIPPING OF SOILS IN THE WEST PORTION OF PHASE 2.
2. USE SOILS REMOVED FROM THE WEST PORTION OF PHASE 2 TO PROGRESSIVELY REHABILITATE THE NORTH SECTION OF PHASE 1B TO OPEN FIELD MEADOWS. ADDITIONAL MATERIALS SUCH AS UNMARKETABLE LIMESTONE, WOOD CHIPS AND IMPORTED CLEAN INERT FILL MAY BE REQUIRED FOR REHABILITATION.
3. PLANT TREES IN THE WEST PORTION OF PHASE 1B NORTH TO BE PART OF THE NEW FOREST CONNECTIONS.
4. FINISH REMOVAL OF AGGREGATE IN THE EAST PORTION OF PHASE 2 AND COMMENCE THE REMOVAL OF AGGREGATE IN THE WEST PORTION OF PHASE 2.
5. CONSTRUCT THE WEST PORTION OF THE NEW WATER CHANNEL IN PHASE 2.
6. MAINTAIN NOISE BARRIERS AS CONSTRUCTED DURING STAGE 1.
7. WHEN STAGE 3 IS COMPLETE, THE OPERATIONAL DISTURBED AREA WILL BE APPROXIMATELY 22.2 HA.

STAGE 4

PHASE 1B

1. REHABILITATION COMPLETE IN THE NORTH PORTION OF PHASE 1B INCREASING THE TOTAL REHABILITATED AREA TO APPROXIMATELY 10.5 HA. REHABILITATION INCLUDES OPEN FIELD MEADOWS AND FOREST.

PHASE 2/3A

1. COMMENCE CLEARING, TREE REMOVAL, AND STRIPPING OF SOILS IN THE SOUTH PORTION OF PHASE 3A.
2. USE SOILS REMOVED FROM THE SOUTH PORTION OF 3A TO PROGRESSIVELY REHABILITATE THE EAST PORTION OF PHASE 2 TO OPEN FIELD MEADOWS. ADDITIONAL MATERIALS SUCH AS UNMARKETABLE LIMESTONE, WOOD CHIPS AND IMPORTED CLEAN INERT FILL MAY BE REQUIRED FOR REHABILITATION.
3. CREATE NEW WETLANDS ALONG THE SOUTH SIDE OF THE NEW WATER CHANNEL IN PHASE 2.
4. FINISH REMOVAL OF AGGREGATE IN THE WEST PORTION OF PHASE 2 AND COMMENCE REMOVAL OF AGGREGATES IN THE SOUTH PORTION OF PHASE 3A.
5. CONSTRUCT THE NEW WATER CHANNEL LINK BETWEEN PHASE 2 WEST AND PHASE 3A SOUTH TO RECEIVE DISCHARGE WATER FROM THE SEVERN PINES QUARRY.
6. CONNECT THE DISCHARGE WATER FROM THE SEVERN PINES QUARRY TO THE NEW LINK AND NEW WATER CHANNEL.
7. CONSTRUCT THE NEW WATER CHANNEL THROUGH THE SOUTH PORTION OF PHASE 3A.
8. MAINTAIN NOISE BARRIERS AS CONSTRUCTED DURING STAGE 1.
9. WHEN STAGE 4 IS COMPLETE, THE OPERATIONAL DISTURBED AREA WILL BE APPROXIMATELY 22.0 HA.

STAGE 5

PHASE 2

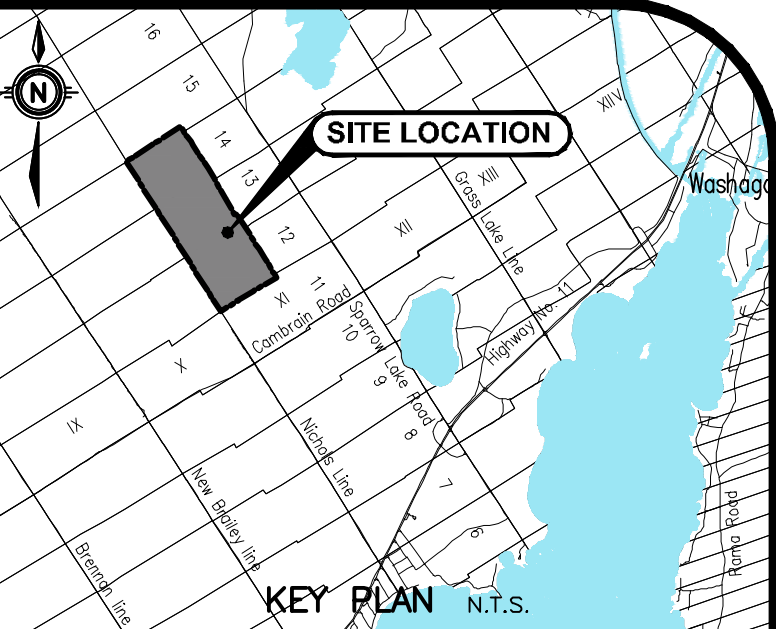
1. REHABILITATION COMPLETE IN THE EAST PORTION OF PHASE 2 INCREASING THE TOTAL REHABILITATED AREA TO APPROXIMATELY 19.5 HA. REHABILITATION INCLUDES OPEN FIELD MEADOWS AND WETLANDS.

PHASE 2/3A

1. COMMENCE CLEARING, TREE REMOVAL, AND STRIPPING OF SOILS IN THE NORTH PORTION OF PHASE 3A.
2. USE SOILS REMOVED FROM THE NORTH PORTION OF PHASE 3A TO PROGRESSIVELY REHABILITATE THE WEST PORTION OF PHASE 2 TO OPEN FIELD MEADOW AND FOREST BLOCKS. CREATE NEW WETLANDS ALONG THE SOUTH SIDE OF THE NEW WATER CHANNEL IN PHASE 2. ADDITIONAL MATERIALS SUCH AS UNMARKETABLE LIMESTONE, WOOD CHIPS AND IMPORTED CLEAN INERT FILL MAY BE REQUIRED FOR REHABILITATION.
3. FINISH EXTRACTING AGGREGATE IN THE SOUTH PORTION OF PHASE 3A AND BEGIN EXTRACTING AGGREGATE IN THE NORTH PORTION OF 3A.
4. CONSTRUCT THE NEW WATER CHANNEL IN THE NORTH PORTION OF 3A.
5. MAINTAIN NOISE BARRIERS AS CONSTRUCTED DURING STAGE 1.
6. WHEN STAGE 5 IS COMPLETE, THE OPERATIONAL DISTURBED AREA WILL BE APPROXIMATELY 20.5 HA.

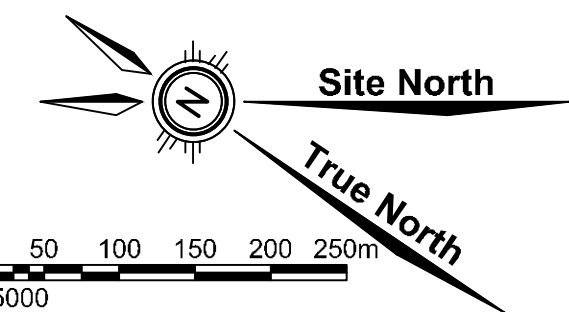
STAGES OF OPERATION NOTES

1. EXTRACTION WILL COMMENCE IN THE SOUTH PART OF THE SITE IN PHASE 1A AND PROCEED NORTHERLY THROUGH SUBSEQUENT PHASES. THE DISTURBED AREA FOR THE SITE WILL BE MINIMIZED USING PROGRESSIVE REHABILITATION.
2. PHASE 1A WILL BE THE DESIGNATED AREA FOR PROCESSING, SHIPPING AND RECYCLING OF AGGREGATE. THIS DISTURBED AREA WILL BE APPROXIMATELY 13.5 HECTARES AND WILL REMAIN THROUGHOUT THE LIFE OF THE QUARRY. SUCCESSIVE DISTURBED AREAS, HEREBY REFERRED TO AS 'OPERATIONAL DISTURBED AREAS', WILL BE 25 HECTARES ON AVERAGE AND WILL INCLUDE CLEARING, TREE REMOVAL, STRIPPING OF SOILS, EXTRACTION OF AGGREGATE AND AREAS UNDERGOING REHABILITATION.
3. THE MAXIMUM DEPTH OF EXTRACTION WILL FOLLOW THE TOP OF THE SHADOW LAKE FORMATION RANGING IN ELEVATION FROM 216 MASL TO 217 MASL.
4. THE REHABILITATION PLAN FOR THE SOUTH PORTION OF THE SITE WILL INCLUDE WETLANDS, FOREST BLOCKS, AND OPEN FIELD MEADOWS. THE REHABILITATION PLAN FOR THE NORTH PORTION OF THE SITE WILL INCLUDE AGRICULTURE AND FOREST BLOCKS.
5. DRAINAGE AND SILTATION CONTROLS WILL BE UTILIZED IN BOTH PORTIONS OF THE SITE TO ALLOW FOR SUCCESSFUL REHABILITATION.
6. ADDITIONAL MATERIALS SUCH AS OVERBURDEN, TOPSOIL, UNMARKETABLE LIMESTONE, AND IMPORTED CLEAN INERT FILL WILL BE REQUIRED TO SUPPLEMENT THE LACK OF SOILS PRESENT ON SITE TO ACHIEVE REHABILITATION ELEVATIONS RANGING FROM 217 MASL TO 218 MASL.
7. A 90 METER BUFFER AT THE NORTH END OF THE SITE WILL FORM PART OF THE REHABILITATION PLAN TO REDUCE THE POTENTIAL INFLUENCE TO AN OFF-SITE POND TO THE NORTH, TO PROVIDE SPACE FOR A NEW TREE NURSERY, AND CREATE A LINK (USING A FISH LADDER) BETWEEN THE SURFACE WATER INLET AND THE NEW WATER CHANNEL.
8. NOISE MITIGATION IS DETAILED ON EACH STAGE OF OPERATIONS.
9. A BLASTING ATTENUATION STUDY WILL BE CARRIED OUT DURING THE FIRST 12 MONTHS OF OPERATION TO DESIGN FUTURE BLASTS. ALL BLASTS WILL BE MONITORED AS PER THE BLASTING RECOMMENDATIONS (SEE SHEET 3 OF 8).



LEGEND

- UNDISTURBED AREA
- DISTURBED AREA
- REHABILITATED COMPLETELY
- PROCESSING / SHIPPING / RECYCLING AREA
- SILTATION CONTROL POND
- NEW WETLAND
- NEW WATER CHANNEL
- EXISTING WATER COURSE
- SILT FENCE



0 50 100 150 200 250m

1:5000

SITE PLAN AMENDMENTS

NO.	REVISION	BY	DATE



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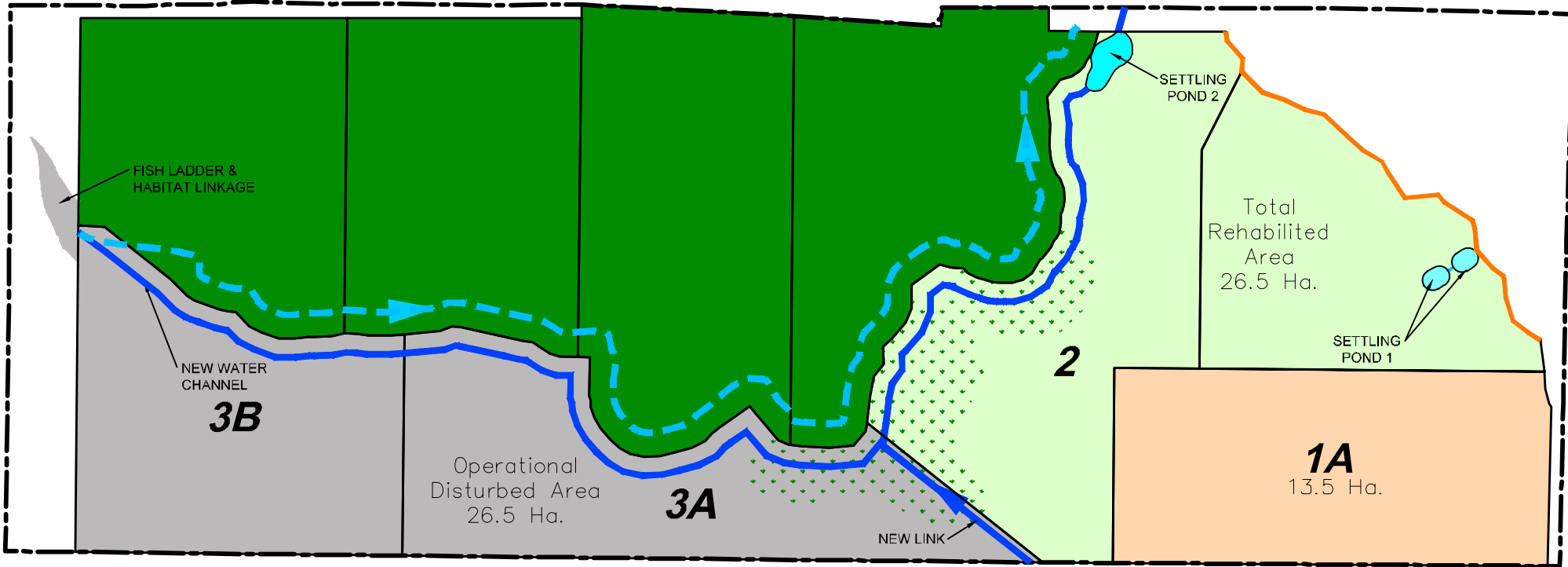
DECLARATION OF PURPOSE
THIS SITE PLAN IS PREPARED UNDER THE AGGREGATE RESOURCES ACT FOR A CLASS 'A' LICENCE, CATEGORY 2.

PROJECT
CUMBERLAND QUARRY
LICENSEE: SEVERN AGGREGATES LIMITED
151 WHITEHALL DRIVE,
MARKHAM, ONTARIO
L3R 9T1

DRAWING
STAGES OF OPERATIONS
WEST HALF LOTS 12, 13 AND 14, CONCESSION 11
GEOGRAPHIC TOWNSHIP OF ORILLIA, NORTH DIVISION
TOWNSHIP OF SEVERN, COUNTY OF SIMCOE

Project Manager J. Flanagan	Project No. 33876-300
Design By	Checked By
Drawn By K.M. / S.X.P.	Checked By
Surveyed By	Drawing No.
Date Oct. 18, 2017	
Scale 1:7500	Sheet 6 of 8

150 0 150 300 450 metres
SCALE 1:7500



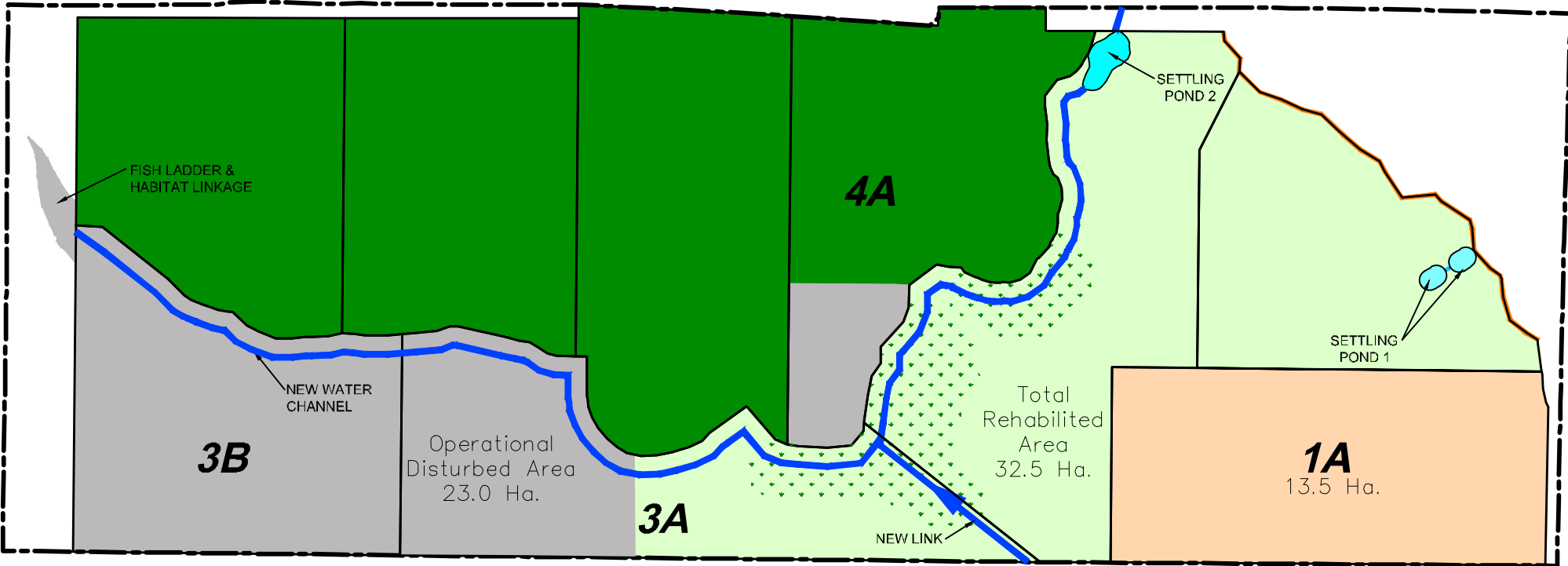
STAGE 6

PHASE 2

1. REHABILITATION COMPLETE IN THE WEST PORTION OF PHASE 2 INCREASING THE TOTAL REHABILITATED AREA TO APPROXIMATELY 26.5 HA. REHABILITATION INCLUDES OPEN FIELD MEADOW, FOREST AND WETLANDS.

PHASE 3A/3B

1. COMMENCE CLEARING, TREE REMOVAL AND STRIPPING OF SOILS IN PHASE 3B.
2. USE SOILS REMOVED FROM PHASE 3B TO PROGRESSIVELY REHABILITATE THE SOUTH SECTION OF PHASE 3A TO AGRICULTURE AND FOREST BLOCKS. ADDITIONAL MATERIALS SUCH AS UNMARKETABLE LIMESTONE, WOOD CHIPS AND IMPORTED CLEAN INERT FILL MAY BE REQUIRED FOR REHABILITATION.
3. PLANT TREES ON THE NORTH SIDE OF THE NEW WATER LINK ADJACENT THE NEW WETLAND TO FORM PART OF THE FOREST BLOCK.
4. FINISH EXTRACTION OF AGGREGATE IN THE NORTH PORTION OF 3A AND COMMENCE EXTRACTION IN PHASE 3B.
5. CONSTRUCT THE NEW WATER CHANNEL IN PHASE 3B.
6. CONSTRUCT A FISH LADDER AND HABITAT LINK IN THE 90-METER BUFFER AREA IN PHASE 3B.
7. LINK THE NORTH INLET OF THE SITE, TO THE NEW FISH LADDER AND WATER CHANNEL.
8. MAINTAIN NOISE BARRIERS AS CONSTRUCTED DURING STAGE 1.
9. WHEN STAGE 6 IS COMPLETE, THE OPERATIONAL DISTURBED AREA WILL BE APPROXIMATELY 26.5 HA.



STAGE 7

PHASE 3A

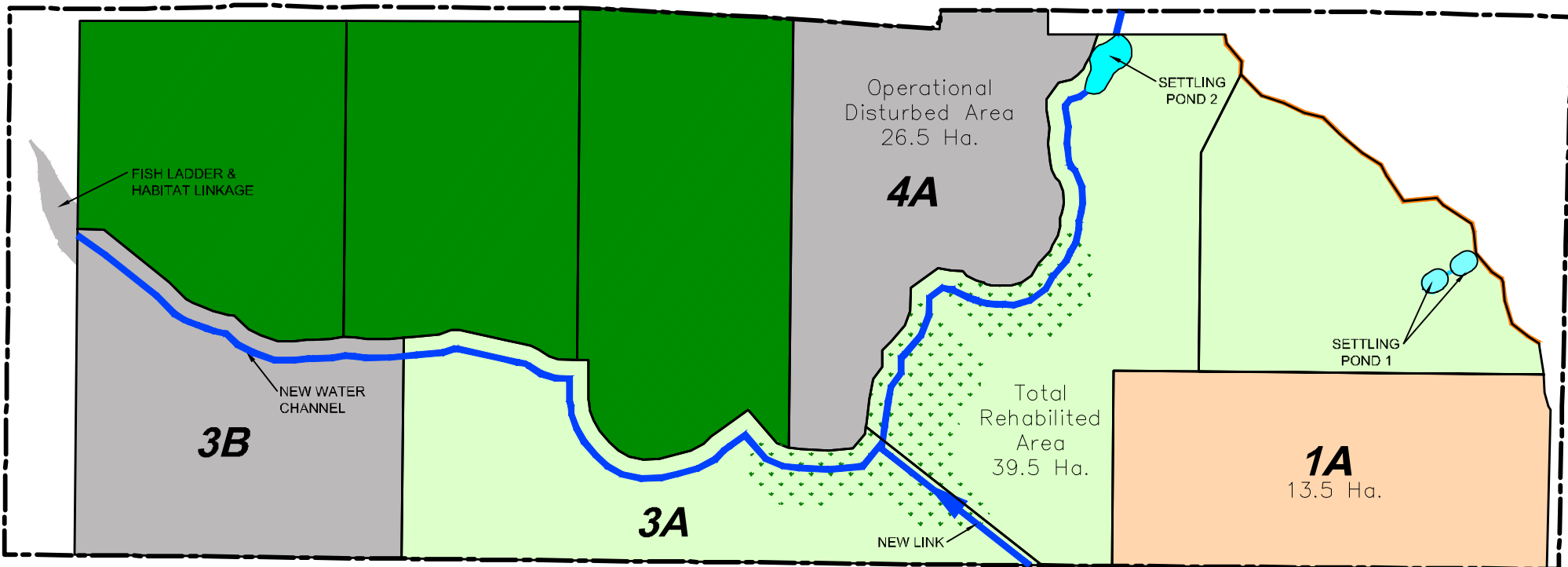
1. REHABILITATION COMPLETE IN THE SOUTH PORTION OF 3A INCREASING THE TOTAL REHABILITATED AREA TO APPROXIMATELY 32.5 HA. REHABILITATION INCLUDES AGRICULTURAL, FOREST AND WETLANDS.

PHASE 3A/3B

1. COMMENCE AGGREGATE EXTRACTION.
2. USE SOILS REMOVED FROM THE SOUTH PORTION OF 4A TO PROGRESSIVELY REHABILITATE THE NORTH PORTION PHASE 3A TO AGRICULTURE AND FOREST. ADDITIONAL MATERIALS SUCH AS UNMARKETABLE LIMESTONE, WOOD CHIPS AND IMPORTED CLEAN INERT FILL MAY BE REQUIRED FOR REHABILITATION.
3. PLANT TREES ALONG THE WEST BOUNDARY OF PHASE 3A PHASE 3B TO CREATE FOREST.

PHASE 4A

1. MAINTAIN NOISE BARRIERS AS CONSTRUCTED DURING STAGE 1.
2. CONSTRUCT NOISE BARRIERS OR ALTERNATIVE NOISE MITIGATION OPTIONS AS PER THE NOISE STUDY ALONG THE EAST PORTION OF PHASE 4B.
3. CONSTRUCT EQUIPMENT CROSSINGS OVER THE NEW WATER CHANNEL TO ACCESS PHASE 4A.
4. COMMENCE CLEARING, TREE REMOVAL, AND STRIPPING OF SOILS IN THE WEST PORTION OF PHASE 4A.
5. FINISH EXTRACTION OF AGGREGATE IN 3B AND COMMENCE EXTRACTION IN THE WEST PORTION OF PHASE 4A.
6. WHEN STAGE 7 IS COMPLETE, THE OPERATIONAL DISTURBED AREA WILL BE APPROXIMATELY 23.0 HA.



STAGE 8

PHASE 3A

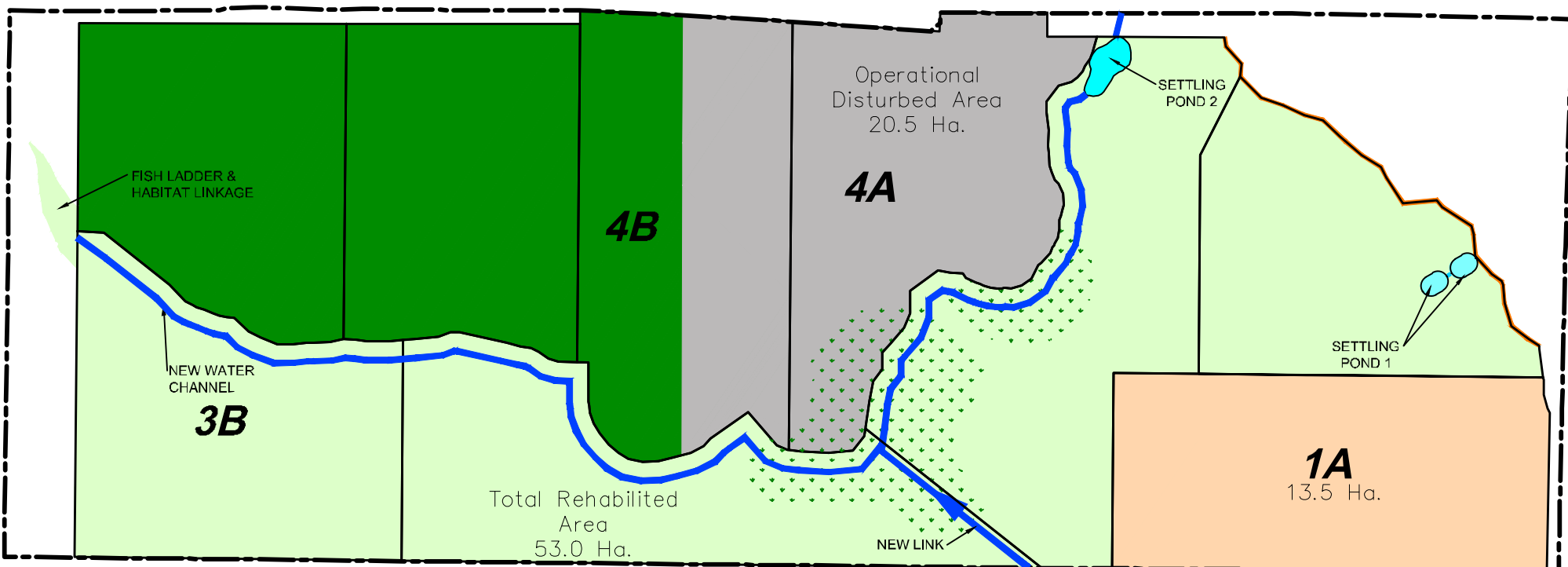
1. REHABILITATION COMPLETE IN PHASE 3A INCREASING THE TOTAL REHABILITATED AREA TO APPROXIMATELY 39.5 HA. REHABILITATION INCLUDES AGRICULTURAL AND FOREST.

PHASE 3B

1. FINISH REMOVAL OF AGGREGATE.
2. CONTINUE WITH PROGRESSIVE REHABILITATION.

PHASE 4A

1. MAINTAIN NOISE BARRIERS AS CONSTRUCTED DURING STAGES 1 AND STAGE 7.
2. COMMENCE CLEARING, TREE REMOVAL, STRIPPING OF SOILS IN THE EAST PORTION OF PHASE 4A.
3. FINISH EXTRACTION OF AGGREGATE IN THE WEST PORTION OF PHASE 4A, AND COMMENCE EXTRACTION IN THE EAST PORTION OF PHASE 4A.
4. USE SOILS REMOVED FROM THE EAST PORTION OF 4A TO PROGRESSIVELY REHABILITATE THE WEST PORTION PHASE 4A TO OPEN FIELD MEADOW, FOREST BLOCKS AND NEW WETLANDS ALONG THE NORTH SIDE OF THE NEW WATER CHANNEL. ADDITIONAL MATERIALS SUCH AS UNMARKETABLE LIMESTONE, WOOD CHIPS AND IMPORTED CLEAN INERT FILL MAY BE REQUIRED FOR REHABILITATION.
5. WHEN STAGE 8 IS COMPLETE, THE OPERATIONAL DISTURBED AREA WILL BE APPROXIMATELY 26.5 HA.



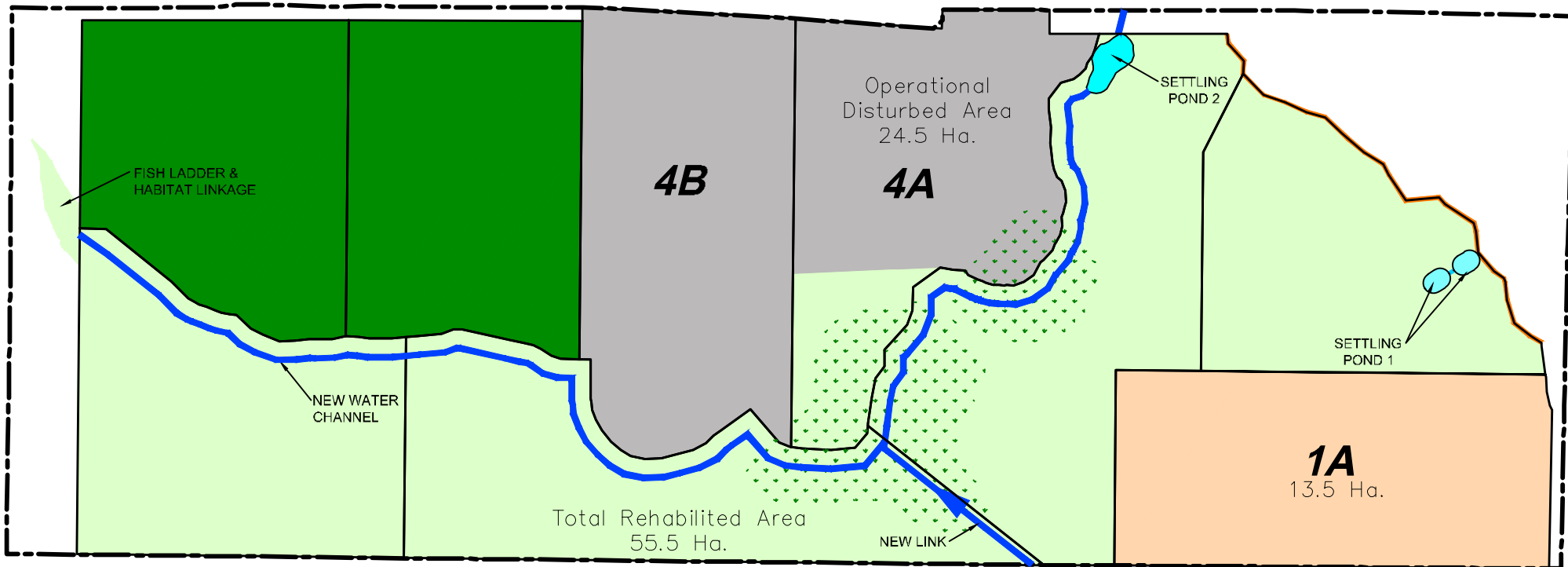
STAGE 9

PHASE 3B

1. REHABILITATION COMPLETE IN PHASE 3B INCREASING THE TOTAL REHABILITATED AREA TO APPROXIMATELY 53.0 HA. REHABILITATION INCLUDES AGRICULTURAL AND FOREST BLOCKS.

PHASE 4A/4B

1. MAINTAIN NOISE BARRIERS AS CONSTRUCTED DURING STAGES 1 AND STAGE 7.
2. CONSTRUCT AND INSTALL NOISE BARRIERS OR ALTERNATIVE NOISE MITIGATION OPTIONS AS PER THE NOISE STUDY ALONG THE EAST PORTION OF PHASE 4C.
3. COMMENCE CLEARING, TREE REMOVAL, STRIPPING OF SOILS IN THE SOUTH PORTION OF PHASE 4B.
4. FINISH AGGREGATE EXTRACTION IN THE EAST PORTION OF PHASE 4A AND COMMENCE AGGREGATE EXTRACTION IN THE SOUTH PORTION OF 4B.
5. USE SOILS REMOVED FROM THE SOUTH PORTION OF PHASE 4B TO PROGRESSIVELY REHABILITATE THE WEST PORTION OF 4A TO OPEN FIELD MEADOW AND FOREST ALONG THE NEW WATER CHANNEL. ADDITIONAL MATERIALS SUCH AS UNMARKETABLE LIMESTONE, WOOD CHIPS AND IMPORTED CLEAN INERT FILL MAY BE REQUIRED FOR REHABILITATION.
6. WHEN STAGE 9 IS COMPLETE, THE OPERATIONAL DISTURBED AREA WILL BE APPROXIMATELY 20.5 HA.



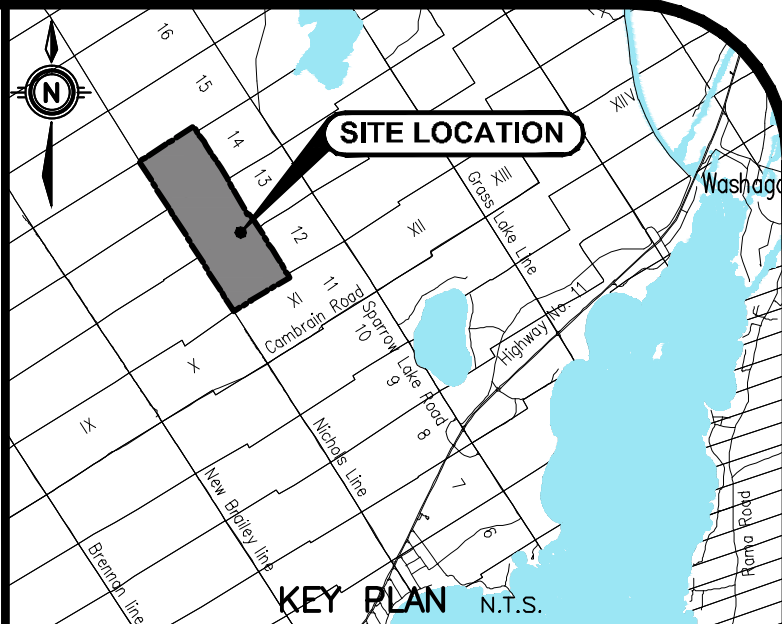
STAGE 10

PHASE 4A

1. REHABILITATION COMPLETE IN THE WEST PORTION OF PHASE 4A, INCREASING THE TOTAL REHABILITATED AREA TO APPROXIMATELY 55.5 HA. REHABILITATION INCLUDES WETLAND AND OPEN FIELD MEADOWS.

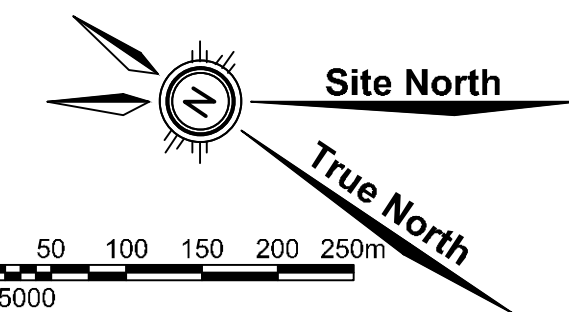
PHASE 4A/4B

1. COMMENCE CLEARING, TREE REMOVAL, STRIPPING OF SOILS IN THE NORTH PORTION OF PHASE 4B.
2. USE SOILS REMOVED FROM THE NORTH PORTION OF PHASE 4B TO PROGRESSIVELY REHABILITATE THE EAST PORTION OF PHASE 4A TO OPEN FIELD MEADOWS AND FOREST. ADDITIONAL MATERIALS SUCH AS UNMARKETABLE LIMESTONE, WOOD CHIPS AND IMPORTED CLEAN INERT FILL MAY BE REQUIRED FOR REHABILITATION.
3. FINISH AGGREGATE EXTRACTION IN THE SOUTH PORTION OF PHASE 4B AND COMMENCE REMOVAL OF AGGREGATE IN THE NORTH PORTION OF PHASE 4B.
4. MAINTAIN NOISE BARRIERS AS CONSTRUCTED DURING STAGES 1, 7 AND 9.
5. WHEN STAGE 10 IS COMPLETE, THE OPERATIONAL DISTURBED AREA WILL BE APPROXIMATELY 24.5 HA.



LEGEND

- UNDISTURBED AREA
- DISTURBED AREA
- REHABILITATED COMPLETELY
- PROCESSING / SHIPPING / RECYCLING AREA
- SILTATION CONTROL POND
- NEW WETLAND
- NEW WATER CHANNEL
- EXISTING WATER COURSE
- SILT FENCE



SITE PLAN AMENDMENTS

NO.	REVISION	BY	DATE



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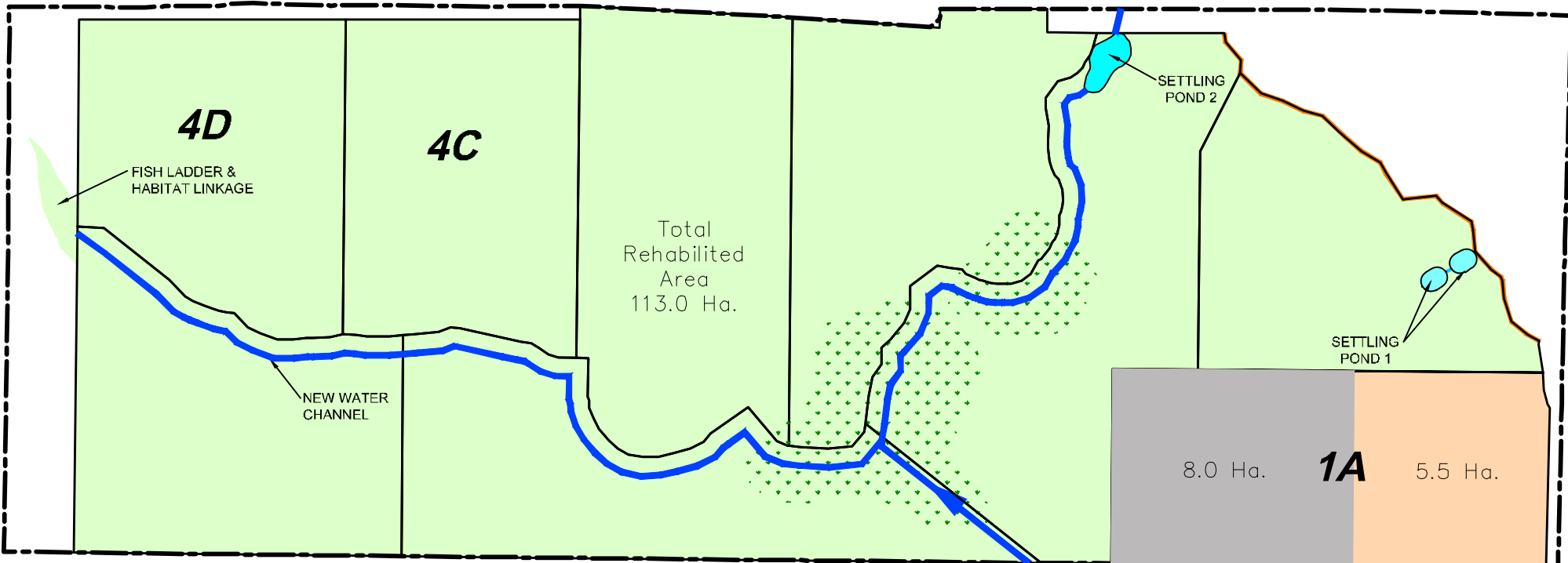
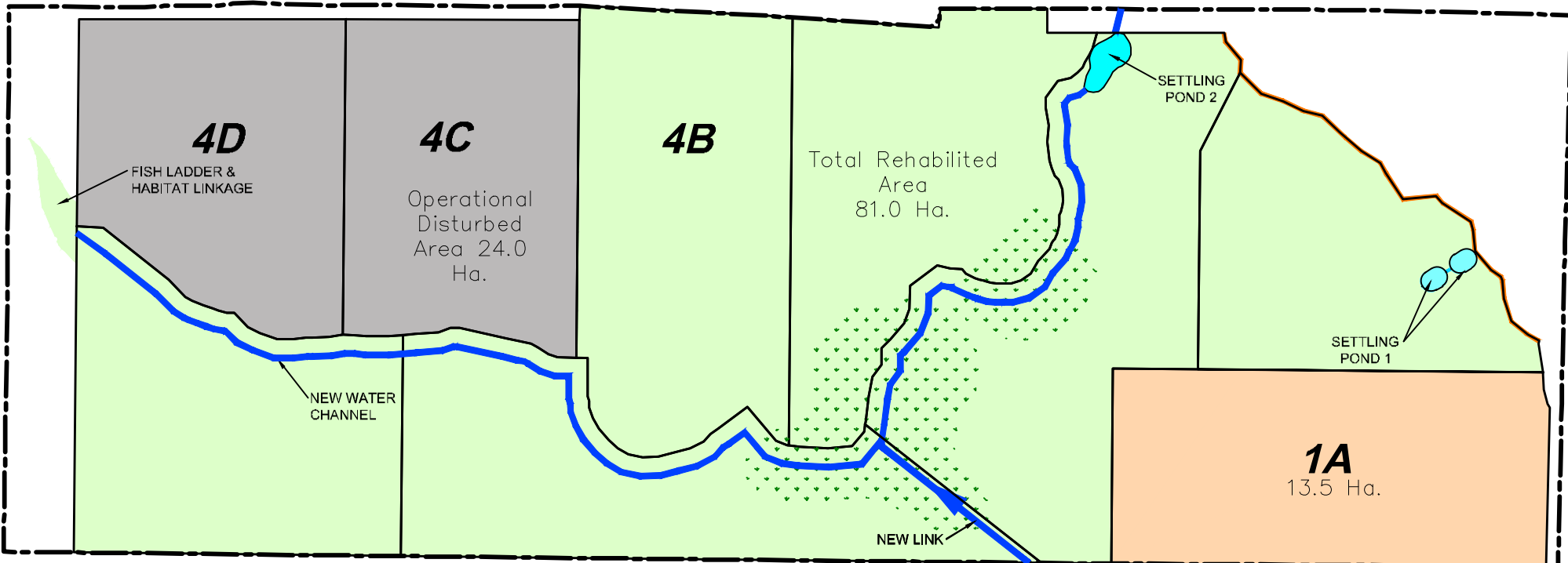
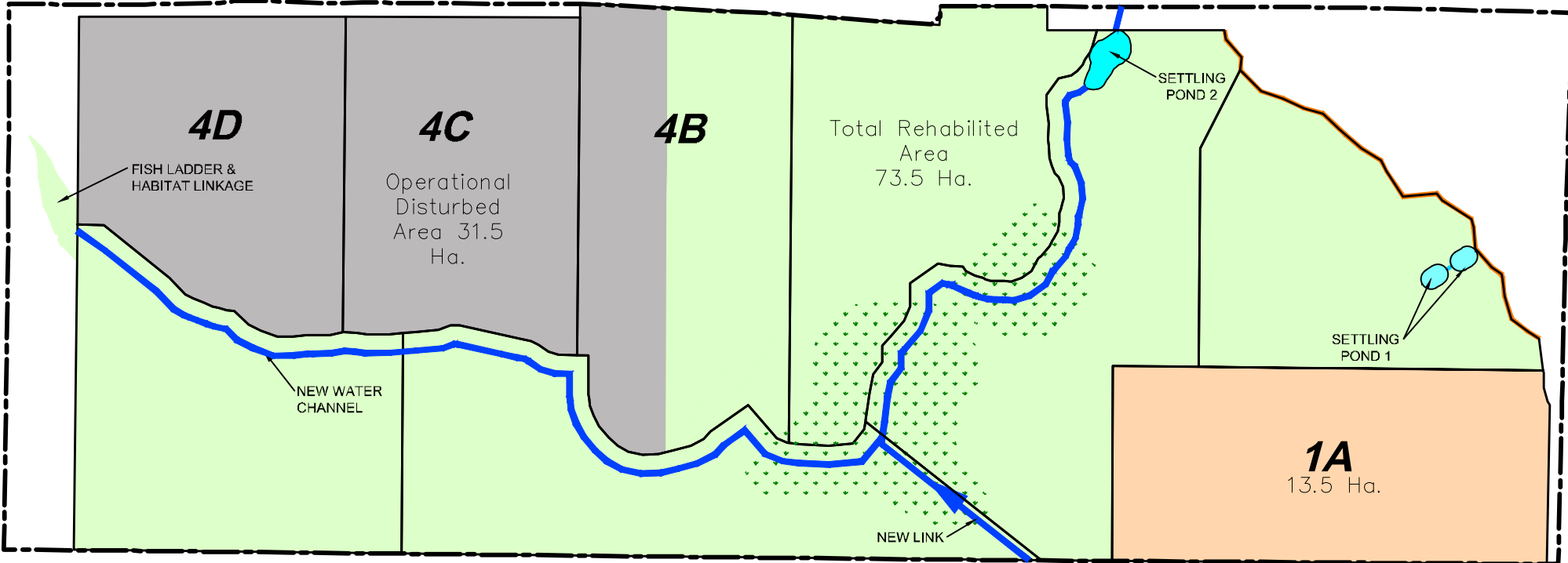
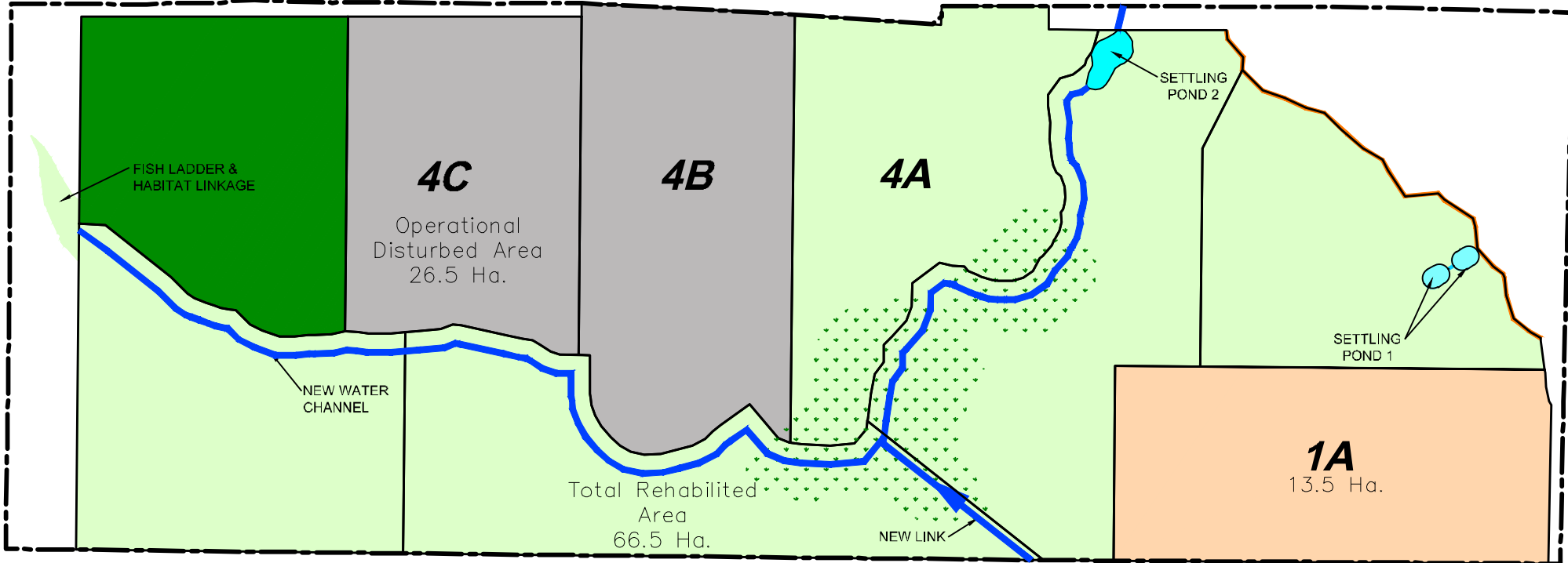
DECLARATION OF PURPOSE
THIS SITE PLAN IS PREPARED UNDER THE AGGREGATE RESOURCES ACT FOR A CLASS 'A' LICENCE, CATEGORY 2.

PROJECT
CUMBERLAND QUARRY
LICENSEE: SEVERN AGGREGATES LIMITED
151 WHITEHALL DRIVE,
MARKHAM, ONTARIO
L3R 9T1

DRAWING
STAGES OF OPERATIONS
WEST HALF LOTS 12, 13 AND 14, CONCESSION 11
GEOGRAPHIC TOWNSHIP OF ORILLIA, NORTH DIVISION
TOWNSHIP OF SEVERN, COUNTY OF SIMCOE

Project Manager J. Flanagan	Project No. 33876-300
Design By	Checked By
Drawn By K.M. / S.X.P.	Checked By
Surveyed By	Drawing No.
Date Oct. 18, 2017	
Scale 1:7500	Sheet 7 of 8

150 0 150 300 450 metres
SCALE 1:7500



STAGE 11

PHASE 4A

1. REHABILITATION COMPLETE IN PHASE 4A INCREASING THE TOTAL REHABILITATED AREA TO APPROXIMATELY 66.5 HA. REHABILITATION INCLUDES WETLANDS, FOREST AND OPEN FIELD MEADOWS.

PHASE 4B/4C

1. MAINTAIN NOISE BARRIERS AS CONSTRUCTED DURING STAGES 1, 7 AND 9.
2. CONSTRUCT NOISE BARRIERS OR ALTERNATIVE NOISE MITIGATION OPTIONS AS PER THE NOISE STUDY ALONG THE EAST PORTION OF PHASE 4D.
3. FINISH AGGREGATE EXTRACTION IN THE NORTH PORTION OF PHASE 4B AND COMMENCE AGGREGATE EXTRACTION IN PHASE 4C.
4. USE SOILS REMOVED FROM PHASE 4C TO PROGRESSIVELY REHABILITATE THE SOUTH PORTION OF PHASE 4B TO AGRICULTURE AND FOREST. ADDITIONAL MATERIALS SUCH AS UNMARKETABLE LIMESTONE, WOOD CHIPS AND IMPORTED CLEAN INERT FILL MAY BE REQUIRED FOR REHABILITATION.
5. WHEN STAGE 11 IS COMPLETE, THE OPERATIONAL DISTURBED AREA WILL BE APPROXIMATELY 26.5 HA.

STAGE 12

PHASE 4B

1. REHABILITATION COMPLETE IN THE SOUTH PORTION OF PHASE 4B, INCREASING THE TOTAL REHABILITATED AREA TO APPROXIMATELY 73.5 HA. REHABILITATION INCLUDES AGRICULTURAL, FOREST AND OPEN FIELD MEADOWS.

PHASE 4B/4C/4D

1. MAINTAIN NOISE BARRIERS AS CONSTRUCTED DURING STAGES 1, 7, 9, and 11.
2. COMMENCE CLEARING, TREE REMOVAL, AND STRIPPING OF SOILS IN PHASE 4D.
3. FINISH AGGREGATE EXTRACTION IN PHASE 4C AND COMMENCE REMOVAL OF AGGREGATES IN PHASE 4D.
1. USE SOILS REMOVED FROM PHASE 4D TO PROGRESSIVELY REHABILITATE THE NORTH PORTION OF PHASE 4B TO OPEN FIELD MEADOWS AND FOREST. ADDITIONAL MATERIALS SUCH AS UNMARKETABLE LIMESTONE, WOOD CHIPS AND IMPORTED CLEAN INERT FILL MAY BE REQUIRED FOR REHABILITATION.
2. WHEN STAGE 12 IS COMPLETE, THE OPERATIONAL DISTURBED AREA WILL BE APPROXIMATELY 31.5 HA.

STAGE 13

PHASE 4B

1. REHABILITATION COMPLETE IN THE NORTH PORTION OF PHASE 4B INCREASING THE TOTAL REHABILITATED AREA TO APPROXIMATELY 81.0 HA. REHABILITATION INCLUDES AGRICULTURAL AND FOREST.

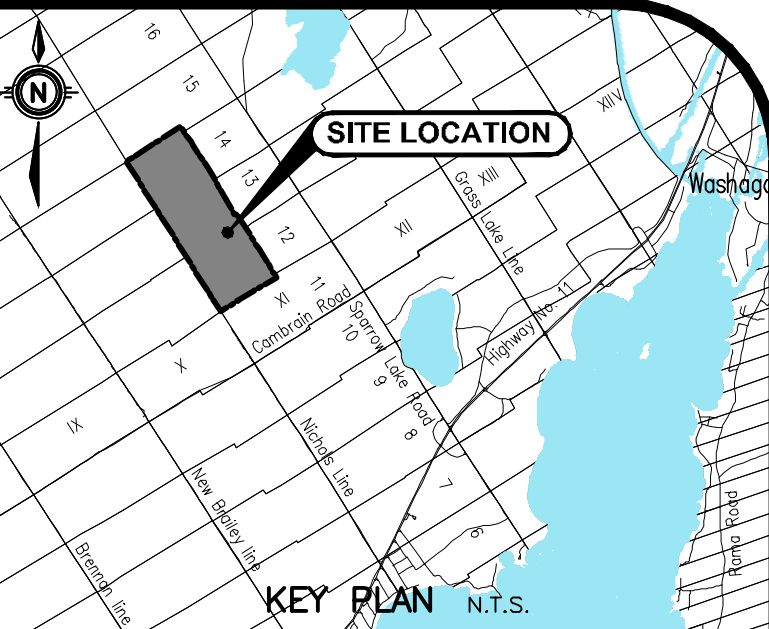
PHASE 4C/4D

1. FINISH AGGREGATE EXTRACTION IN PHASE 4D.
2. CONTINUE PROGRESSIVE REHABILITATION OF PHASE 4C TO AGRICULTURE AND FOREST. ADDITIONAL MATERIALS SUCH AS UNMARKETABLE LIMESTONE, WOOD CHIPS AND IMPORTED CLEAN INERT FILL MAY BE REQUIRED FOR REHABILITATION.
3. WHEN STAGE 13 IS COMPLETE, THE OPERATIONAL DISTURBED AREA WILL BE APPROXIMATELY 24.0 HA.

STAGE 14

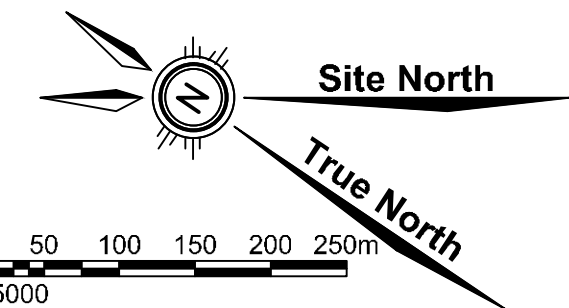
PHASE 1A/4C/4D

1. REHABILITATION COMPLETE IN THE PHASE 1A, Phase 4C and Phase 4D INCREASING THE TOTAL REHABILITATED AREA TO APPROXIMATELY 113.0 HA. REHABILITATION INCLUDES AGRICULTURAL AND FOREST BLOCKS.
2. THE SOUTHERN PORTION OF PHASE 1A WILL REMAIN TO SERVICE FUTURE LAND USES.
3. ALL PROCESSING EQUIPMENT AND STOCKPILES WILL BE REMOVED.
4. ANY STRUCTURES USED FOR AGRICULTURAL PURPOSES WILL REMAIN.



LEGEND

- UNDISTURBED AREA
- DISTURBED AREA
- REHABILITATED COMPLETELY
- PROCESSING / SHIPPING / RECYCLING AREA
- SILTATION CONTROL POND
- NEW WETLAND
- NEW WATER CHANNEL
- EXISTING WATER COURSE
- SILT FENCE



SITE PLAN AMENDMENTS

NO.	REVISION	BY	DATE



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DECLARATION OF PURPOSE
THIS SITE PLAN IS PREPARED UNDER THE AGGREGATE
RESOURCES ACT FOR A CLASS 'A' LICENCE, CATEGORY 2.

PROJECT
CUMBERLAND QUARRY
LICENSEE: SEVERN AGGREGATES LIMITED
151 WHITEHALL DRIVE,
MARKHAM, ONTARIO
L3R 9T1

DRAWING
STAGES OF OPERATIONS
WEST HALF LOTS 12, 13 AND 14, CONCESSION 11
GEOGRAPHIC TOWNSHIP OF ORILLIA, NORTH DIVISION
TOWNSHIP OF SEVERN, COUNTY OF SIMCOE

Project Manager J. Flanagan	Project No. 33876-300
Design By	Checked By
Drawn By K.M. / S.X.P.	Checked By
Surveyed By	Drawing No.
Date Oct. 18, 2017	
Scale 1:7500	Sheet 8 of 8

150 0 150 300 450 metres
SCALE 1:7500

Appendix B

Photo Log



Photo 1: Community 1 Bluejoint organic meadow marsh (ELC Code: MAM3-1)
(Photo Date: June 30, 2010)



Photo 2: Community 3 Treed rock barren (talus) (ELC Code: RBT)
(Photo Date: July 16, 2012)



Site Photographs

Severn Quarry – NER Update

Date of Photos: May 19, 2010 – October 15, 2014

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Photo 3: Community 4 White pine plantation (ELC Code: CUP3-2)
(Photo Date: July 16, 2012)



Photo 4: Community 6 White cedar swamp (ELC Code: SWC1-2)
(Photo Date: May 19, 2010)



Site Photographs

Severn Quarry – NER Update

Date of Photos: May 19, 2010 – October 15, 2014

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**Photo 5: Community 7 Silver maple swamp (ELC Code: SWD3-2)
(Photo Date: July 12, 2012)**



Photo 6: Community 9 Sugar maple forest (ELC Code: FOD5-1) (Photo Date: August 29, 2013)



Site Photographs

Severn Quarry – NER Update

Date of Photos: May 19, 2010 – October 15, 2014

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Photo 7: Community 10 Juniper thicket (ELC Code: CUT2-1) (Photo Date: August 29, 2013)



**Photo 8: Community 11 Field meadow with some exposed rock (ELC Code: CUM1-1)
(Photo Date: August 29, 2013)**



Site Photographs

Severn Quarry – NER Update

Date of Photos: May 19, 2010 – October 15, 2014

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**Photo 9: Community 11 Field meadow with some exposed rock (ELC Code: CUM1-1)
(Photo Date: August 29, 2013)**



Photo 10: Community 12 Conifer forest (ELC Code: FOC4-3) (Photo Date: August 29, 2013)



Site Photographs

Severn Quarry – NER Update

Date of Photos: May 19, 2010 – October 15, 2014

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Photo 11: Community 13 Juniper shrub rock barren (ELC Code:RBS1-1)
(Photo Date: August 29, 2013)



Photo 12: Community 13 Juniper shrub rock barren (ELC Code:RBS1-1)
(Photo Date: August 29, 2013)



Site Photographs

Severn Quarry – NER Update

Date of Photos: May 19, 2010 – October 15, 2014

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**Photo 13: Community 16 Steep slope of white cedar-white birch mixed forest
(ELC Code: FOM4-1) (Photo Date: August 29, 2013)**



Photo 14: Community 20 Agricultural-Hay field (No ELC Code) (No date)



Site Photographs

Severn Quarry – NER Update

Date of Photos: May 19, 2010 – October 15, 2014

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Photo 15: Painted turtle caught June 3, 2013



Photo 16: Adult eastern red-spotted newt



Site Photographs

Severn Quarry – NER Update

Date of Photos: May 19, 2010 – October 15, 2014

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**Photo 17: Site 6, fish community and water quality location, facing north
(Photo Date: June 3, 2013)**



**Photo 18: Site 7, fish community and water quality location, facing north
(Photo Date: June 4, 2013)**



Site Photographs

Severn Quarry – NER Update

Date of Photos: May 19, 2010 – October 15, 2014

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Photo 19: Site 1, fish community and water quality location, facing east (downstream of benthos collection) (Photo Date: June 3, 2013)



Photo 20: Site 1, benthos and water quality location, facing east (upstream of fish community sampling location) (Photo Date: October 24, 2012)



Site Photographs

Severn Quarry – NER Update

Date of Photos: May 19, 2010 – October 15, 2014

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**Photo 21: Site 4, fish community and water quality location, facing west
(Photo Date: June 3, 2013)**



**Photo 22: Site 5, fish community and water quality location, facing east
(Photo Date: June 4, 2013)**



Site Photographs

Severn Quarry – NER Update

Date of Photos: May 19, 2010 – October 15, 2014

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Photo 23: Site 2, benthos and water quality location, facing east (Photo Date: October 24, 2012)



Photo 24: Site 3, fish community, benthos and water quality location, facing northeast (Photo Date: June 4, 2013)



Site Photographs

Severn Quarry – NER Update

Date of Photos: May 19, 2010 – October 15, 2014

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**Photo 25: ATV road constructed in 2013 through the off-site wetland, facing northeast
(Photo Date: August 29, 2013)**



**Photo 26: Site 3, newly established benthos community control site upstream of ATV road,
facing northwest (Photo Date: October 15, 2014)**



Site Photographs

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Photo 27: Site 3, newly established benthos community control site upstream of ATV road, facing northeast (Photo Date: October 15, 2014)



Site Photographs

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Appendix C

Vegetation Community Plant List

APPENDIX C Plant Species by Community

Families and genera for the plant species found in this appendix are listed in taxonomic order. The species are listed alphabetically by scientific name within each genus.

Three standard reference works were used for the botanical nomenclature and taxonomy (Newmaster et. al., 1998; Gleason and Cronquist 1991; Voss 1980; 1985). Other published works for botanical names included; ferns (Cody and Britton 1989); grasses (Dore and McNeill 1980); orchids (Whiting and Catling 1986); shrubs (Soper and Heimburger 1982) and trees (Farrar 1995).

Total: Number of communities where plant species was recorded

X : Plant species recorded

Common Name	Scientific Name	Total	COMMUNITY NUMBER														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
STONEWORT FAMILY	CHARACEAE																
stonewort	<i>Chara spp.</i>	1															
PEAT MOSS FAMILY	SPHAGNACEAE																
sphagnum moss species	<i>Sphagnum spp.</i>	1									X						
CLUBMOSS FAMILY	LYCOPODIACEAE																
common clubmoss	<i>Lycopodium clavatum</i>	1												X			
ground-pine	<i>Lycopodium obscurum</i>	1				X											
HORSETAIL FAMILY	EQUISETACEAE																
field horsetail	<i>Equisetum arvense</i>	4						X	X		X		X				
water horsetail	<i>Equisetum fluviatile</i>	1	X														
meadow horsetail	<i>Equisetum pratense</i>	2						X	X								
wood horsetail	<i>Equisetum sylvaticum</i>	1							X								
variegated horsetail	<i>Equisetum variegatum</i>	1															

Common Name	Scientific Name	Total	COMMUNITY NUMBER														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ADDER'S-TONGUE FAMILY	OPHIOGLOSSACEAE																
rattlesnake fern	<i>Botrychium virginianum</i>	2												X			
ROYAL FERN FAMILY	OSMUNDACEAE																
cinnamon fern	<i>Osmunda cinnamomea</i>	3						X	X		X						
interrupted fern	<i>Osmunda claytoniana</i>	2						X									
royal fern	<i>Osmunda regalis var. spectabilis</i>	2		X					X								
MAIDENHAIR FERN FAMILY	PTERIDACEAE																
northern maidenhair fern	<i>Adiantum pedatum</i>	2						X			X						
BRACKEN FERN FAMILY	DENNSTAEDTIACEAE																
hay-scented fern	<i>Dennstaedtia punctilobula</i>	2		X							X						
eastern bracken fern	<i>Pteridium aquilinum</i>	10			X	X			X		X	X	X	X		X	
BEECH FERN FAMILY	THELYPTERIDAE																
northern beech fern	<i>Phegopteris connectilis</i>	2		X					X								
marsh fern	<i>Thelypteris palustris</i>	1	X														
SPLEENWORT FAMILY	ASPLENIACEAE																
walking fern	<i>Asplenium rhizophyllum</i>	2			X									X			
maidenhair spleenwort	<i>Asplenium trichomanes ssp. quadrival</i>	6			X						X			X	X		X
WOOD FERN FAMILY	DRYOPTERIDACEAE																
northern lady fern	<i>Athyrium filix-femina</i>	2									X						X
bulbet bladder fern	<i>Cystopteris bulbifera</i>	3		X				X						X			
spinulose wood-fern	<i>Dryopteris carthusiana</i>	9				X	X	X			X			X		X	
evergreen wood-fern	<i>Dryopteris intermedia</i>	3						X	X								
marginal wood-fern	<i>Dryopteris marginalis</i>	6			X	X		X	X		X			X			
oak fern	<i>Gymnocarpium dryopteris</i>	6		X	X			X			X			X			
ostrich fern	<i>Matteuccia struthiopteris</i>	4	X	X					X		X						
sensitive fern	<i>Onoclea sensibilis</i>	8	X	X			X	X	X				X			X	
Christmas fern	<i>Polystichum acrostichoides</i>	5		X					X		X						
POLYPODY FAMILY	POLYPODIACEAE																
rock polypody fern	<i>Polypodium virginianum</i>	2									X						

Common Name	Scientific Name	Total	COMMUNITY NUMBER														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PINE FAMILY	PINACEAE																
balsam fir	<i>Abies balsamea</i>	13	X	X	X	X		X	X		X			X		X	X
tamarack	<i>Larix laricina</i>	3	X			X		X									
white spruce	<i>Picea glauca</i>	13	X			X		X	X		X	X	X	X	X	X	X
red pine	<i>Pinus resinosa</i>	1															
eastern white pine	<i>Pinus strobus</i>	13		X	X	X			X	X	X	X	X		X	X	X
Scot's pine	<i>Pinus sylvestris</i>	1											X				
eastern hemlock	<i>Tsuga canadensis</i>	3		X							X						
CYPRESS FAMILY	CUPRESSACEAE																
common juniper	<i>Juniperus communis var. depressa</i>	9	X		X				X		X	X	X		X	X	
eastern red cedar	<i>Juniperus virginiana</i>	3						X				X				X	
eastern white cedar	<i>Thuja occidentalis</i>	15	X		X	X	X	X	X	X	X			X	X	X	X
YEW FAMILY	TAXACEAE																
American yew	<i>Taxus canadensis</i>	1												X			

Common Name	Scientific Name	Total	COMMUNITY NUMBER														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
BUTTERCUP FAMILY	RANUNCULACEAE																
white baneberry	<i>Actaea pachypoda</i>	2									X			X			
red baneberry	<i>Actaea rubra</i>	3						X	X								
Canada anemone	<i>Anemone canadensis</i>	3									X	X	X				
thimbleweed	<i>Anemone virginiana</i>	6	X						X		X	X	X		X		
wild columbine	<i>Aquilegia canadensis</i>	4			X						X	X			X		
marsh marigold	<i>Caltha palustris</i>	5	X	X					X		X			X			
virgin's bower	<i>Clematis virginiana</i>	5					X	X	X					X		X	
goldthread	<i>Coptis trifolia</i>	1						X									
sharp-lobed hepatica	<i>Hepatica acutiloba</i>	3			X						X						
round-lobed hepatica	<i>Hepatica americana</i>	3									X	X					
small-flowered buttercup	<i>Ranunculus abortivus</i>	3									X		X	X			
tall buttercup	<i>Ranunculus acris</i>	3	X									X	X				
cursed crowfoot	<i>Ranunculus sceleratus</i>	1						X									
early meadow rue	<i>Thalictrum dioicum</i>	7			X			X	X		X	X					
tall meadow rue	<i>Thalictrum pubescens</i>	6						X	X		X			X	X	X	
BARBERRY FAMILY	BERBERIDACEAE																
blue cohosh	<i>Caulophyllum giganteum</i>	3		X													
mayapple	<i>Podophyllum peltatum</i>	1		X													
POPPY FAMILY	PAPAVERACEAE																
bloodroot	<i>Sanguinaria canadensis</i>	1									X						
ELM FAMILY	ULMACEAE																
American elm	<i>Ulmus americana</i>	10		X	X	X	X		X		X	X		X	X	X	
NETTLE FAMILY	URTICACEAE																
false nettle	<i>Boehmeria cylindrica</i>	4	X					X			X						
wood nettle	<i>Laportea canadensis</i>	2						X	X								
WALNUT FAMILY	JUGLANDACEAE																
butternut	<i>Juglans cinerea</i>	4			X						X		X		X		
black walnut	<i>Juglans nigra</i>	2									X						

Common Name	Scientific Name	Total	COMMUNITY NUMBER														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
BEECH FAMILY	FAGACEAE																
American beech	<i>Fagus grandifolia</i>	1									X						
white oak	<i>Quercus alba</i>	7				X	X		X		X				X	X	
bur oak	<i>Quercus macrocarpa</i>	6			X						X	X	X		X	X	
red oak	<i>Quercus rubra</i>	11			X	X	X		X		X	X	X	X	X	X	X
oak	<i>Quercus sp</i>	1												X			
BIRCH FAMILY	BETULACEAE																
speckled alder	<i>Alnus rugosa</i>	6	X				X		X		X			X		X	
yellow birch	<i>Betula alleghaniensis Britt.</i>	4	X	X					X		X						
white birch	<i>Betula papyrifera</i>	13	X		X	X			X		X	X		X	X	X	X
blue beech	<i>Carpinus caroliniana</i>	1									X						
beaked hazel	<i>Corylus cornuta</i>	2									X						
ironwood	<i>Ostrya virginiana</i>	4			X						X						X
PINK FAMILY	CARYOPHYLLACEAE																
Deptford pink	<i>Dianthus armeria</i>	1									X						
bladder campion	<i>Silene vulgaris</i>	1										X					
common chickweed	<i>Stellaria media</i>	1													X		
BUCKWHEAT FAMILY	POLYGONACEAE																
marshpepper smartweed	<i>Polygonum hydropiper</i>	1	X														
curled dock	<i>Rumex crispus</i>	3	X								X	X					
bitter dock	<i>Rumex obtusifolius</i>	1											X				
great water dock	<i>Rumex orbiculatus</i>	1	X														
ST. JOHN'S-WORT FAMILY	GUTTIFERAE																
common St. John's-wort	<i>Hypericum perforatum</i>	2							X		X						
marsh St. John's-wort	<i>Triadenum fraseri</i>	2	X						X								
LINDEN FAMILY	TILIACEAE																
American basswood	<i>Tilia americana</i>	10	X	X	X	X			X		X	X			X	X	

Common Name	Scientific Name	Total	COMMUNITY NUMBER														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
VIOLET FAMILY	VIOLACEAE																
dog violet	<i>Viola conspersa</i>	4						X	X		X						
lance-leaved violet	<i>Viola lanceolata</i>	1									X						
northern white violet	<i>Viola macloskeyi</i>	1															
downy yellow violet	<i>Viola pubescens</i>	1										X					
long-spurred violet	<i>Viola rostrata</i>	2				X					X						
GOURD FAMILY	CUCURBITACEAE																
wild cucumber	<i>Echinocystis lobata</i>	1							X								
WILLOW FAMILY	SALICACEAE																
balsam poplar	<i>Populus balsamifera</i>	10		X	X	X	X		X		X		X	X			X
large-toothed aspen	<i>Populus grandidentata</i>	6									X	X	X		X	X	
trembling aspen	<i>Populus tremuloides</i>	12	X	X	X		X		X		X	X		X	X	X	
Bebb's willow	<i>Salix bebbiana</i>	1	X														
pussy willow	<i>Salix discolor</i>	3	X									X				X	
slender willow	<i>Salix petiolaris</i>	4	X				X						X				
willow species	<i>Salix spp.</i>	1															
MUSTARD FAMILY	BRASSICACEAE																
garlic mustard	<i>Alliaria petiolata</i>	1							X								
tower mustard	<i>Arabis glabra</i>	2			X						X						
black mustard	<i>Brassica nigra</i>	1															
Pennsylvania bittercress	<i>Cardamine pensylvanica</i>	1															
wild mustard	<i>Sinapsis arvensis</i>	3	X				X						X				
HEATH FAMILY	ERICACEAE																
common bearberry	<i>Arctostaphylos uva-ursi</i>	2												X	X		
trailing arbutus	<i>Epigaea repens</i>	1									X						
lowbush blueberry	<i>Vaccinium angustifolium</i>	2			X										X		
small cranberry	<i>Vaccinium oxycoccos</i>	1	X														
INDIAN PIPE FAMILY	MONOTROPACEAE																
indian pipe	<i>Monotropa uniflora</i>	1															

Common Name	Scientific Name	Total	COMMUNITY NUMBER														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PRIMROSE FAMILY	PRIMULACEAE																
fringed loosestrife	<i>Lysimachia ciliata</i>	1														X	
moneywort	<i>Lysimachia nummularia</i>	2															
starflower	<i>Trientalis borealis</i>	4			X			X						X			
GOOSEBERRY FAMILY	GROSSULARIACEAE																
prickly gooseberry	<i>Ribes cynosbati</i>	5			X	X					X				X		
smooth gooseberry	<i>Ribes hirtellum</i>	1									X						
bristly black currant	<i>Ribes lacustre</i>	2									X			X			
swamp red currant	<i>Ribes triste</i> Pallas	1												X			
ORPINE FAMILY	CRASSULACEAE																
mossy stonecrop	<i>Sedum acre</i>	4			X						X		X		X		
SAXIFRAGE FAMILY	SAXIFRAGACEAE																
naked miterwort	<i>Mitella nuda</i>	2						X									
early saxifrage	<i>Saxifraga virginensis</i>	2											X		X		
foam flower	<i>Tiarella cordifolia</i>	4						X	X		X			X			

Common Name	Scientific Name	Total	COMMUNITY NUMBER														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ROSE FAMILY	ROSACEAE																
agrimony	<i>Agrimonia gryposepela</i>	5						X	X		X	X	X				
downy serviceberry	<i>Amelanchier arborea</i>	2											X		X		
hawthorn species	<i>Crataegus spp.</i>	6				X					X	X	X			X	
woodland strawberry	<i>Fragaria vesca</i>	3			X						X			X			
common strawberry	<i>Fragaria virginiana</i>	12	X	X	X	X	X				X	X	X		X	X	
yellow avens	<i>Geum aleppicum</i>	6			X		X		X		X					X	
white avens	<i>Geum canadense</i>	2									X						
silvery cinquefoil	<i>Potentilla argentea</i>	1													X		
rough cinquefoil	<i>Potentilla norvegica</i>	2			X										X		
marsh cinquefoil	<i>Potentilla palustris</i>	1	X														
sulfur cinquefoil	<i>Potentilla recta</i>	6					X		X			X	X		X		
Canada plum	<i>Prunus nigra</i>	1									X						
pin cherry	<i>Prunus pensylvanica</i>	4										X			X	X	
black cherry	<i>Prunus serotina</i>	5		X							X				X		
choke cherry	<i>Prunus virginiana</i>	7			X				X		X	X	X		X	X	
smooth rose	<i>Rosa blanda</i>	3					X					X			X		
rugosa rose	<i>Rosa rugosa</i>	1														X	
Alleghany blackberry	<i>Rubus allegheniensis</i>	5			X		X		X		X						
wild red raspberry	<i>Rubus idaeus</i>	14	X		X	X	X	X	X		X	X	X		X	X	
purple-flowering raspberry	<i>Rubus odoratus</i>	1									X						
dwarf raspberry	<i>Rubus pubescens</i>	5		X				X	X					X		X	
narrow-leaved meadowsweet	<i>Spiraea alba</i>	4	X			X	X		X								
barren strawberry	<i>Waldsteinia fragarioides</i>	3									X				X	X	

Common Name	Scientific Name	Total	COMMUNITY NUMBER														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PEA FAMILY	FABACEAE																
crown-vetch	<i>Coronilla varia</i>	2	X									X					
bird's-foot trefoil	<i>Lotus corniculatus</i>	1											X				
black medick	<i>Medicago lupulina</i>	1									X						
white sweet-clover	<i>Melilotus alba</i>	3			X				X			X					
low hop clover	<i>Trifolium agrarium</i>	3			X						X						
red clover	<i>Trifolium pratense</i>	7	X						X			X	X			X	
white clover	<i>Trifolium repens</i>	3							X		X	X					
cow vetch	<i>Vicia cracca</i>	2											X				
OLEASTER FAMILY	ELAEAGNACEAE																
buffalo berry	<i>Shepherdia canadensis</i>	3									X				X	X	
MEZEREUM FAMILY	THYMELAEACEAE																
leatherwood	<i>Dirca palustris</i>	4			X						X						
EVENING PRIMROSE FAMILY	ONAGRACEAE																
dwarf enchanter's nightshade	<i>Circaea alpina</i>	1															
Canada enchanter's nightshade	<i>Circaea lutetiana</i> L. ssp. <i>canadensis</i>	4						X	X		X						
northern willow-herb	<i>Epilobium ciliatum</i> ssp. <i>glandulosum</i>	1	X														
common evening primrose	<i>Oenothera biennis</i>	1							X								
DOGWOOD FAMILY	CORNACEAE																
alternate-leaf dogwood	<i>Cornus alternifolia</i>	3			X				X		X						
bunchberry	<i>Cornus canadensis</i>	1														X	
round-leaved dogwood	<i>Cornus rugosa</i>	3		X											X		
red-osier dogwood	<i>Cornus stolonifera</i>	9	X			X	X		X		X	X		X	X	X	
STAFF-TREE FAMILY	CELASTRACEAE																
climbing bittersweet	<i>Celastrus scandens</i>	1													X		
burning bush	<i>Euonymus atropurpurea</i>	2					X						X				
SPURGE FAMILY	EUPHORBIACEAE																
cypress spurge	<i>Euphorbia cyparissias</i>	1	X														

Common Name	Scientific Name	Total	COMMUNITY NUMBER														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
BUCKTHORN FAMILY	RHAMNACEAE																
European buckthorn	<i>Rhamnus cathartica</i>	3				X					X					X	
GRAPE FAMILY	VITACEAE																
Virginia creeper	<i>Parthenocissus inserta</i>	6		X	X			X	X		X						
wild grape	<i>Vitis riparia</i>	1									X						
MILKWORT FAMILY	POLYGALACEAE																
fringed polygala	<i>Polygala paucifolia</i>	4			X						X				X		
racemed milkwort	<i>Polygala polygama</i>	1													X		
MAPLE FAMILY	ACERACEAE																
Manitoba maple	<i>Acer negundo</i>	1				X											
striped maple	<i>Acer pensylvanicum</i>	1												X			
Norway maple	<i>Acer platanoides</i>	1									X						
red maple	<i>Acer rubrum</i>	10	X	X	X		X	X	X		X			X			
silver maple	<i>Acer saccharinum</i>	6	X				X	X	X							X	
sugar maple	<i>Acer saccharum ssp.saccharum</i>	12	X		X	X					X	X	X	X	X	X	
Freeman's maple	<i>Acer x freemanii</i>	2							X							X	
CASHEW FAMILY	ANACARDIACEAE																
western poison-ivy	<i>Rhus rydbergii</i>	12		X	X	X		X	X		X	X		X		X	X
staghorn sumac	<i>Rhus typhina</i>	6			X		X				X	X			X	X	
WOOD-SORREL FAMILY	OXALIDACEAE																
European wood-sorrel	<i>Oxalis stricta</i>	1											X				
GERANIUM FAMILY	GERANIACEAE																
Bicknell's crane's-bill	<i>Geranium bicknellii</i>	1													X		
wild geranium	<i>Geranium maculatum</i>	2			X						X						
herb Robert	<i>Geranium robertianum</i>	1									X						
TOUCH-ME-NOT FAMILY	BALSAMINACEAE																
spotted jewelweed	<i>Impatiens capensis</i>	7	X	X			X		X		X					X	

Common Name	Scientific Name	Total	COMMUNITY NUMBER														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
GINSENG FAMILY	ARALIACEAE																
wild sarsaparilla	<i>Aralia nudicaulis</i>	10		X	X	X		X	X		X			X		X	
spikenard	<i>Aralia racemosa</i>	1							X								
CARROT FAMILY	APIACEAE																
Queen-Anne's lace	<i>Daucus carota</i>	9			X				X		X	X	X			X	
woolly sweet cicely	<i>Osmorhiza claytonii</i>	2			X						X						
black snakeroot	<i>Sanicula marilandica</i>	5			X	X					X			X			
GENTIAN FAMILY	GENTIANACEAE																
bottle gentian	<i>Gentiana andrewsii</i>	2									X						
DOGBANE FAMILY	APOCYNACEAE																
spreading dogbane	<i>Apocynum androsaemifolium</i>	5				X			X		X		X			X	
MILKWEED FAMILY	ASCLEPIADACEAE																
swamp milkweed	<i>Asclepias incarnata</i>	1	X														
common milkweed	<i>Asclepias syriaca</i>	2									X		X				
swallow-wort	<i>Cynanchum rossicum</i>	1									X						
NIGHTSHADE FAMILY	SOLANACEAE																
bitter nightshade	<i>Solanum dulcamara</i>	7	X	X				X	X		X					X	
black nightshade	<i>Solanum nigrum</i>	1				X											
WATERLEAF FAMILY	HYDROPHYLLACEAE																
Virginia waterleaf	<i>Hydrophyllum virginianum</i>	2									X		X				
BORAGE FAMILY	BORAGINACEAE																
American gromwell	<i>Lithospermum latifolium</i>	2									X			X			
common gromwell	<i>Lithospermum officinale</i>	4					X					X			X		
LOPSEED FAMILY	PHRYMACEAE																
lopseed	<i>Phryma leptostachya</i>	1															

Common Name	Scientific Name	Total	COMMUNITY NUMBER														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
MINT FAMILY	LAMIACEAE																
wild basil	<i>Clinopodium vulgare</i>	6				X					X	X	X				
ground ivy	<i>Glechoma hederacea</i>	2										X		X			
American water-horehound	<i>Lycopus americanus</i>	3						X									
wild mint	<i>Mentha arvensis</i>	5	X				X		X		X			X			
spear mint	<i>Mentha spicata</i>	2									X						
wild bergamot	<i>Monarda fistulosa</i>	2									X	X					
wild marjoram	<i>Origanum vulgare</i>	4									X		X		X		
heal-all	<i>Prunella vulgaris</i> ssp. <i>Lanceolata</i>	6	X						X		X				X		
PLANTAIN FAMILY	PLANTAGINACEAE																
narrow-leaved plantain	<i>Plantago lanceolata</i>	7	X						X		X	X	X				
broad-leaved plantain	<i>Plantago major</i>	7	X						X		X	X	X			X	
Rugel's plantain	<i>Plantago rugelii</i>	2										X	X				
OLIVE FAMILY	OLEACEAE																
white ash	<i>Fraxinus americana</i>	10				X			X		X	X	X		X	X	X
black ash	<i>Fraxinus nigra</i>	8	X	X		X	X	X	X		X					X	
green ash	<i>Fraxinus pennsylvanica</i> var. <i>subinteg</i>	7	X						X		X					X	
lilac	<i>Syringa vulgaris</i>	1										X					
FIGWORT FAMILY	SCROPHULARIACEAE																
slender-leaved agalinis	<i>Agalinis tenuifolia</i>	1															
square-stemmed monkeyflower	<i>Mimulus ringens</i>	1	X														
wood betony	<i>Pedicularis canadensis</i>	1									X						
hairy beardtongue	<i>Penstemon hirsutus</i>	1									X						
common mullein	<i>Verbascum thapsus</i>	9	X		X				X		X	X	X		X		
HAREBELL FAMILY	CAMPANULACEAE																
marsh bellflower	<i>Campanula aparinoides</i>	1					X										
Indian tobacco	<i>Lobelia inflata</i>	1							X								

Common Name	Scientific Name	Total	COMMUNITY NUMBER														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
MADDER FAMILY	RUBIACEAE																
rough bedstraw	<i>Galium asprellum</i>	3	X						X								
white bedstraw	<i>Galium mollugo</i>	4									X		X	X			
marsh bedstraw	<i>Galium palustre</i>	2					X		X								
sweet scented bedstraw	<i>Galium triflorum</i>	1							X								
creeping partridge-berry	<i>Mitchella repens</i>	3						X			X			X			
HONEYSUCKLE FAMILY	CAPRIFOLIACEAE																
bush-honeysuckle	<i>Diervilla lonicera</i>	1															
fly honeysuckle	<i>Lonicera canadensis</i>	3				X							X		X		
limber honeysuckle	<i>Lonicera dioica</i>	2											X		X		
honeysuckle	<i>Lonicera spp. E</i>	1									X						
tartarian honeysuckle	<i>Lonicera tatarica</i>	4			X			X			X			X			
common elderberry	<i>Sambucus canadensis</i>	3						X	X		X						
red-berried elderberry	<i>Sambucus racemosa</i>	1									X						
snowberry	<i>Symphoricarpos albus</i>	3									X				X	X	
narrow-leaved horse-gentian	<i>Triosteum angustifolium</i>	1															
scarlet-fruited horse-gentian	<i>Triosteum aurantiacum</i>	3						X			X						
maple-leaved viburnum	<i>Viburnum acerifolium</i>	1						X									
nannyberry	<i>Viburnum lentago</i>	2	X						X								
downy arrow-wood	<i>Viburnum rafinesquianum</i>	7			X						X	X	X		X	X	
high bush cranberry	<i>Viburnum trilobium</i>	1										X					

Common Name	Scientific Name	Total	COMMUNITY NUMBER														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ASTER FAMILY	ASTERACEAE																
common yarrow	<i>Achillea millefolium</i>	9	X		X				X		X	X	X			X	
common ragweed	<i>Ambrosia artemisiifolia</i>	5							X			X	X	X		X	
pearly everlasting	<i>Anaphalis margaritacea</i>	1											X				
common burdock	<i>Arctium minus</i>	1									X						
ox-eye daisy	<i>Chrysanthemum leucanthemum</i>	9	X		X		X		X		X	X	X		X		
chicory	<i>Cichorium intybus</i>	1										X					
bull thistle	<i>Cirsium vulgare</i>	4							X		X	X					
flat top white aster	<i>Doellingeria umbellata</i> var. <i>umbellata</i>	1	X														
daisy fleabane	<i>Erigeron annuus</i>	1											X				
Philadelphia fleabane	<i>Erigeron philadelphicus</i> ssp. <i>philadelphicus</i>	6			X				X		X	X				X	
spotted joe-pyeweed	<i>Eupatorium maculatum</i>	5	X				X		X							X	
boneset	<i>Eupatorium perfoliatum</i>	3	X				X										
white snakeroot	<i>Eupatorium rugosum</i>	1									X						
large-leaved aster	<i>Eurybia macrophylla</i>	6			X				X		X			X	X	X	
grass-leaved goldenrod	<i>Euthamia graminifolia</i>	4					X				X					X	
wild lettuce	<i>Lactuca canadensis</i>	7		X	X				X		X			X			
balsam ragwort	<i>Packera paupercula</i>	1													X		
orange hawkweed	<i>Pilosella aurantiaca</i>	1										X					
field hawkweed	<i>Pilosella caespitosa</i>	1											X				
king devil hawkweed	<i>Pilosella floribunda</i>	1													X		
black-eyed Susan	<i>Rudbeckia hirta</i>	2										X	X				
tall goldenrod	<i>Solidago altissima</i>	4									X	X					
Canada goldenrod	<i>Solidago canadensis</i>	9					X				X	X	X		X	X	
early goldenrod	<i>Solidago juncea</i>	4					X				X		X			X	
rough-leaved goldenrod	<i>Solidago patula</i>	1							X								
rough goldenrod	<i>Solidago radula</i>	1									X						
field sow thistle	<i>Sonchus arvensis</i>	1															
heart-leaved aster	<i>Symphotrichum cordifolium</i>	8		X					X		X		X	X	X	X	

Common Name	Scientific Name	Total	COMMUNITY NUMBER														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
white heath aster	<i>Symphyotrichum ericoides</i> var. <i>ericoides</i>	1															
panicked aster	<i>Symphyotrichum lanceolatum</i>	4	X				X		X							X	
calico aster	<i>Symphyotrichum lateriflorum</i> var. <i>lateriflorum</i>	7						X	X		X	X				X	
New England aster	<i>Symphyotrichum novae-angliae</i>	5	X				X		X								
purple-stemmed aster	<i>Symphyotrichum puniceum</i>	2	X										X				
arrow-leaved aster	<i>Symphyotrichum urophyllum</i>	1										X					
common dandelion	<i>Taraxacum officinale</i>	4									X	X	X				
goat's-beard	<i>Tragopogon dubius</i>	2										X	X				
coltsfoot	<i>Tussilago farfara</i>	6	X					X						X			
WATER-PLANTAIN FAMILY	ALISMACEAE																
broad-leaved arrowhead	<i>Sagittaria latifolia</i>	1	X														
ARUM FAMILY	ARACEAE																
Jack-in-the-pulpit	<i>Arisaema triphyllum</i>	4		X					X		X						
DUCKWEED FAMILY	LEMNACEAE																
common duckweed	<i>Lemna minor</i>	1	X														
SEDGE FAMILY	CYPERACEAE																
yellow sedge	<i>Carex flava</i>	2	X										X				
few-seeded sedge	<i>Carex oligosperma</i>	1													X		
Pennsylvania sedge	<i>Carex pensylvanica</i>	5	X						X		X					X	
plantain-leaved sedge	<i>Carex plantaginea</i>	1															
retorse sedge	<i>Carex retrorsa</i>	1	X														
awl-fruited sedge	<i>Carex stipata</i>	1	X														
tussock sedge	<i>Carex stricta</i>	2	X	X													
greenish sedge	<i>Carex viridula</i>	1					X										
wool-grass	<i>Scirpus cyperinus</i>	5	X				X		X				X				
softstem bulrush	<i>Scirpus validus</i>	2	X						X								

Common Name	Scientific Name	Total	COMMUNITY NUMBER														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
GRASS FAMILY	POACEAE																
redtop	<i>Agrostis gigantea</i>	1	X														
rough hair grass	<i>Agrostis scabra</i>	1							X								
fringed brome grass	<i>Bromus ciliatus</i>	1											X				
awnless brome grass	<i>Bromus inermis ssp.inermis</i>	1											X				
Canada bluejoint grass	<i>Calamagrostis canadensis</i>	2	X														
orchard grass	<i>Dactylis glomerata</i>	2	X														
poverty oatgrass	<i>Danthonia spicata</i>	2									X		X				
bottle-brush grass	<i>Elymus hystrix</i>	3			X			X			X						
fowl manna grass	<i>Glyceria striata</i>	1	X														
rice cut grass	<i>Leersia oryzoides</i>	1	X														
reed canary grass	<i>Phalaris arundinacea</i>	4	X			X							X			X	
timothy	<i>Phleum pratense</i>	5							X		X	X				X	
BUR-REED FAMILY	SPARGANIACEAE																
broad-fruited bur-reed	<i>Sparganium eurycarpum</i>	1	X														
CATTAIL FAMILY	TYPHACEAE																
narrow-leaved cattail	<i>Typha angustifolia</i>	1	X														
common cattail	<i>Typha latifolia</i>	3	X														

Common Name	Scientific Name	Total	COMMUNITY NUMBER														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LILY FAMILY	LILIACEAE																
asparagus	<i>Asparagus officinalis</i>	1														X	
bluebead lily	<i>Clintonia borealis</i>	3						X						X			
trout lily	<i>Erythronium americanum ssp. ameri</i>	2				X					X						
tiger lily	<i>Lilium lancifolium</i>	1									X						
Canada mayflower	<i>Maianthemum canadense</i>	11			X	X		X	X		X			X		X	X
Indian cucumber-root	<i>Medeola virginiana</i>	1									X						
hairy Solomon's seal	<i>Polygonatum pubescens</i>	3									X						
false Solomon's seal	<i>Smilacina racemosa</i>	6		X	X	X		X	X		X						
rose-twisted stalk	<i>Streptopus roseus</i>	4			X						X						
purple trillium	<i>Trillium erectum</i>	3						X			X						
white trillium	<i>Trillium grandiflorum</i>	5		X	X				X		X						
large-flowered bellwort	<i>Uvularia grandiflora</i>	3									X			X			
IRIS FAMILY	IRIDACEAE																
wild blue flag	<i>Iris versicolor</i>	2	X				X										
little blue-eyed grass	<i>Sisyrinchium montanum</i>	2	X								X						
ORCHID FAMILY	ORCHIDACEAE																
helleborine	<i>Epipactis helleborine</i>	9		X		X		X	X		X			X			X
northern green orchis	<i>Platanthera hyperborea</i>	1							X								
Total Number of Plant Species	320		81	37	61	39	41	53	103	2	162	66	68	54	59	68	14
			Number of Plant Species Per Commu														

APPENDIX C Communities 16 - 21

Common Name	Scientific Name	COMMUNITY NUMBER						
		Total	16	17	18	19	20	21
STONEWORT FAMILY	CHARACEAE							
stonewort	<i>Chara spp.</i>	1				X		
PEAT MOSS FAMILY	SPHAGNACEAE							
sphagnum moss species	<i>Sphagnum spp.</i>	1						
CLUBMOSS FAMILY	LYCOPODIACEAE							
common clubmoss	<i>Lycopodium clavatum</i>	1						
ground-pine	<i>Lycopodium obscurum</i>	1						
HORSETAIL FAMILY	EQUISETACEAE							
field horsetail	<i>Equisetum arvense</i>	4						
water horsetail	<i>Equisetum fluviatile</i>	1						
meadow horsetail	<i>Equisetum pratense</i>	2						
wood horsetail	<i>Equisetum sylvaticum</i>	1						
variegated horsetail	<i>Equisetum variegatum</i>	1						X
ADDER'S-TONGUE FAMILY	OPHIOGLOSSACEAE							
rattlesnake fern	<i>Botrychium virginianum</i>	2	X					
ROYAL FERN FAMILY	OSMUNDACEAE							
cinnamon fern	<i>Osmunda cinnamomea</i>	3						
interrupted fern	<i>Osmunda claytoniana</i>	2		X				
royal fern	<i>Osmunda regalis var. spectabilis</i>	2						
MAIDENHAIR FERN FAMILY	PTERIDACEAE							
northern maidenhair fern	<i>Adiantum pedatum</i>	2						
BRACKEN FERN FAMILY	DENNSTAEDTIACEAE							
hay-scented fern	<i>Dennstaedtia punctilobula</i>	2			X			
eastern bracken fern	<i>Pteridium aquilinum</i>	10	X		X			

		COMMUNITY NUMBER						
Common Name	Scientific Name	Total	16	17	18	19	20	21
BEECH FERN FAMILY	THELYPTERIDAE							
northern beech fern	Phegopteris connectilis	2						
marsh fern	Thelypteris palustris	1						
SPLEENWORT FAMILY	ASPLENIACEAE							
walking fern	Asplenium rhizophyllum	2						
maidenhair spleenwort	Asplenium trichomanes ssp.quadri	6	X					
WOOD FERN FAMILY	DRYOPTERIDACEAE							
northern lady fern	Athyrium filix-femina	2						
bulbet bladder fern	Cystopteris bulbifera	3						
spinulose wood-fern	Dryopteris carthusiana	9	X	X	X			
evergreen wood-fern	Dryopteris intermedia	3		X				
marginal wood-fern	Dryopteris marginalis	6						
oak fern	Gymnocarpium dryopteris	6		X				
ostrich fern	Matteuccia struthiopteris	4						
sensitive fern	Onoclea sensibilis	8			X			
Christmas fern	Polystichum acrostichoides	5	X		X			
POLYPODY FAMILY	POLYPODIACEAE							
rock polypody fern	Polypodium virginianum	2	X					
PINE FAMILY	PINACEAE							
balsam fir	Abies balsamea	13	X	X	X			
tamarack	Larix laricina	3						
white spruce	Picea glauca	13	X			X		
red pine	Pinus resinosa	1	X					
eastern white pine	Pinus strobus	13	X		X			
Scot's pine	Pinus sylvestris	1						
eastern hemlock	Tsuga canadensis	3	X					
CYPRESS FAMILY	CUPRESSACEAE							
common juniper	Juniperus communis var. depressa	9			X			
eastern red cedar	Juniperus virginiana	3						

Common Name	Scientific Name	COMMUNITY NUMBER						
		Total	16	17	18	19	20	21
eastern white cedar	<i>Thuja occidentalis</i>	15	X		X	X		
YEW FAMILY	TAXACEAE							
American yew	<i>Taxus canadensis</i>	1						
BUTTERCUP FAMILY	RANUNCULACEAE							
white baneberry	<i>Actaea pachypoda</i>	2						
red baneberry	<i>Actaea rubra</i>	3		X				
Canada anemone	<i>Anemone canadensis</i>	3						
thimbleweed	<i>Anemone virginiana</i>	6						
wild columbine	<i>Aquilegia canadensis</i>	4						
marsh marigold	<i>Caltha palustris</i>	5						
virgin's bower	<i>Clematis virginiana</i>	5						
goldthread	<i>Coptis trifolia</i>	1						
sharp-lobed hepatica	<i>Hepatica acutiloba</i>	3	X					
round-lobed hepatica	<i>Hepatica americana</i>	3	X					
small-flowered buttercup	<i>Ranunculus abortivus</i>	3						
tall buttercup	<i>Ranunculus acris</i>	3						
cursed crowfoot	<i>Ranunculus sceleratus</i>	1						
early meadow rue	<i>Thalictrum dioicum</i>	7	X	X				
tall meadow rue	<i>Thalictrum pubescens</i>	6						
BARBERRY FAMILY	BERBERIDACEAE							
blue cohosh	<i>Caulophyllum giganteum</i>	3	X	X				
mayapple	<i>Podophyllum peltatum</i>	1						
POPPY FAMILY	PAPAVERACEAE							
bloodroot	<i>Sanguinaria canadensis</i>	1						
ELM FAMILY	ULMACEAE							
American elm	<i>Ulmus americana</i>	10						
NETTLE FAMILY	URTICACEAE							
false nettle	<i>Boehmeria cylindrica</i>	4	X					
wood nettle	<i>Laportea canadensis</i>	2						

		COMMUNITY NUMBER						
Common Name	Scientific Name	Total	16	17	18	19	20	21
WALNUT FAMILY	JUGLANDACEAE							
butternut	Juglans cinerea	4						
black walnut	Juglans nigra	2			X			
BEECH FAMILY	FAGACEAE							
American beech	Fagus grandifolia	1						
white oak	Quercus alba	7			X			
bur oak	Quercus macrocarpa	6						
red oak	Quercus rubra	11						
oak	Quercus sp	1						
BIRCH FAMILY	BETULACEAE							
speckled alder	Alnus rugosa	6						
yellow birch	Betula alleghaniensis Britt.	4						
white birch	Betula papyrifera	13	X	X	X			
blue beech	Carpinus caroliniana	1						
beaked hazel	Corylus cornuta	2			X			
ironwood	Ostrya virginiana	4	X					
PINK FAMILY	CARYOPHYLLACEAE							
Deptford pink	Dianthus armeria	1						
bladder campion	Silene vulgaris	1						
common chickweed	Stellaria media	1						
BUCKWHEAT FAMILY	POLYGONACEAE							
marshpepper smartweed	Polygonum hydropiper	1						
curled dock	Rumex crispus	3						
bitter dock	Rumex obtusifolius	1						
great water dock	Rumex orbiculatus	1						
ST. JOHN'S-WORT FAMILY	GUTTIFERAE							
common St. John's-wort	Hypericum perforatum	2						
marsh St. John's-wort	Triadenum fraseri	2						
LINDEN FAMILY	TILIACEAE							

		COMMUNITY NUMBER						
Common Name	Scientific Name	Total	16	17	18	19	20	21
American basswood	<i>Tilia americana</i>	10	X					
VIOLET FAMILY	VIOLACEAE							
dog violet	<i>Viola conspersa</i>	4	X					
lance-leaved violet	<i>Viola lanceolata</i>	1						
northern white violet	<i>Viola macloskeyi</i>	1		X				
downy yellow violet	<i>Viola pubescens</i>	1						
long-spurred violet	<i>Viola rostrata</i>	2						
GOURD FAMILY	CUCURBITACEAE							
wild cucumber	<i>Echinocystis lobata</i>	1						
WILLOW FAMILY	SALICACEAE							
balsam poplar	<i>Populus balsamifera</i>	10	X					
large-toothed aspen	<i>Populus grandidentata</i>	6			X			
trembling aspen	<i>Populus tremuloides</i>	12	X		X			
Bebb's willow	<i>Salix bebbiana</i>	1						
pussy willow	<i>Salix discolor</i>	3						
slender willow	<i>Salix petiolaris</i>	4				X		
willow species	<i>Salix spp.</i>	1				X		
MUSTARD FAMILY	BRASSICACEAE							
garlic mustard	<i>Alliaria petiolata</i>	1						
tower mustard	<i>Arabis glabra</i>	2						
black mustard	<i>Brassica nigra</i>	1					X	
Pennsylvania bittercress	<i>Cardamine pensylvanica</i>	1			X			
wild mustard	<i>Sinapsis arvensis</i>	3						
HEATH FAMILY	ERICACEAE							
common bearberry	<i>Arctostaphylos uva-ursi</i>	2						
trailing arbutus	<i>Epigaea repens</i>	1						
lowbush blueberry	<i>Vaccinium angustifolium</i>	2						
small cranberry	<i>Vaccinium oxycoccos</i>	1						
INDIAN PIPE FAMILY	MONOTROPACEAE							

Common Name	Scientific Name	COMMUNITY NUMBER						
		Total	16	17	18	19	20	21
indian pipe	<i>Monotropa uniflora</i>	1	X					
PRIMROSE FAMILY	PRIMULACEAE							
fringed loosestrife	<i>Lysimachia ciliata</i>	1						
moneywort	<i>Lysimachia nummularia</i>	2	X		X			
starflower	<i>Trientalis borealis</i>	4		X				
GOOSEBERRY FAMILY	GROSSULARIACEAE							
prickly gooseberry	<i>Ribes cynosbati</i>	5			X			
smooth gooseberry	<i>Ribes hirtellum</i>	1						
bristly black currant	<i>Ribes lacustre</i>	2						
swamp red currant	<i>Ribes triste</i> Pallas	1						
ORPINE FAMILY	CRASSULACEAE							
mossy stonecrop	<i>Sedum acre</i>	4						
SAXIFRAGE FAMILY	SAXIFRAGACEAE							
naked miterwort	<i>Mitella nuda</i>	2	X					
early saxifrage	<i>Saxifraga virginensis</i>	2						
foam flower	<i>Tiarella cordifolia</i>	4						
ROSE FAMILY	ROSACEAE							
agrimony	<i>Agrimonia gryposepala</i>	5						
downy serviceberry	<i>Amelanchier arborea</i>	2						
hawthorn species	<i>Crataegus spp.</i>	6			X			
woodland strawberry	<i>Fragaria vesca</i>	3						
common strawberry	<i>Fragaria virginiana</i>	12	X		X			
yellow avens	<i>Geum aleppicum</i>	6	X					
white avens	<i>Geum canadense</i>	2	X					
silvery cinquefoil	<i>Potentilla argentea</i>	1						
rough cinquefoil	<i>Potentilla norvegica</i>	2						
marsh cinquefoil	<i>Potentilla palustris</i>	1						
sulfur cinquefoil	<i>Potentilla recta</i>	6	X					
Canada plum	<i>Prunus nigra</i>	1						

		COMMUNITY NUMBER						
Common Name	Scientific Name	Total	16	17	18	19	20	21
pin cherry	<i>Prunus pensylvanica</i>	4			X			
black cherry	<i>Prunus serotina</i>	5	X		X			
choke cherry	<i>Prunus virginiana</i>	7						
smooth rose	<i>Rosa blanda</i>	3						
rugosa rose	<i>Rosa rugosa</i>	1						
Alleghany blackberry	<i>Rubus allegheniensis</i>	5			X			
wild red raspberry	<i>Rubus idaeus</i>	14	X		X	X		
purple-flowering raspberry	<i>Rubus odoratus</i>	1						
dwarf raspberry	<i>Rubus pubescens</i>	5						
narrow-leaved meadowsweet	<i>Spiraea alba</i>	4						
barren strawberry	<i>Waldsteinia fragarioides</i>	3						
PEA FAMILY	FABACEAE							
crown-vetch	<i>Coronilla varia</i>	2						
bird's-foot trefoil	<i>Lotus corniculatus</i>	1						
black medick	<i>Medicago lupulina</i>	1						
white sweet-clover	<i>Melilotus alba</i>	3						
low hop clover	<i>Trifolium agrarium</i>	3			X			
red clover	<i>Trifolium pratense</i>	7			X		X	
white clover	<i>Trifolium repens</i>	3						
cow vetch	<i>Vicia cracca</i>	2			X			
OLEASTER FAMILY	ELAEAGNACEAE							
buffalo berry	<i>Shepherdia canadensis</i>	3						
MEZEREUM FAMILY	THYMELAECEAE							
leatherwood	<i>Dirca palustris</i>	4	X		X			
EVENING PRIMROSE FAMILY	ONAGRACEAE							
dwarf enchanter's nightshade	<i>Circaea alpina</i>	1	X					
Canada enchanter's nightshade	<i>Circaea lutetiana</i> L. ssp. <i>canadensi</i>	4	X					
northern willow-herb	<i>Epilobium ciliatum</i> ssp. <i>glandulosu</i>	1						
common evening primrose	<i>Oenothera biennis</i>	1						

		COMMUNITY NUMBER						
Common Name	Scientific Name	Total	16	17	18	19	20	21
DOGWOOD FAMILY	CORNACEAE							
alternate-leaf dogwood	Cornus alternifolia	3						
bunchberry	Cornus canadensis	1						
round-leaved dogwood	Cornus rugosa	3	X					
red-osier dogwood	Cornus stolonifera	9						
STAFF-TREE FAMILY	CELASTRACEAE							
climbing bittersweet	Celastrus scandens	1						
burning bush	Euonymus atropurpurea	2						
SPURGE FAMILY	EUPHORBIACEAE							
cypress spurge	Euphorbia cyparissias	1						
BUCKTHORN FAMILY	RHAMNACEAE							
European buckthorn	Rhamnus cathartica	3						
GRAPE FAMILY	VITACEAE							
Virginia creeper	Parthenocissus inserta	6			X			
wild grape	Vitis riparia	1						
MILKWORT FAMILY	POLYGALACEAE							
fringed polygala	Polygala paucifolia	4	X					
racemed milkwort	Polygala polygama	1						
MAPLE FAMILY	ACERACEAE							
Manitoba maple	Acer negundo	1						
striped maple	Acer pensylvanicum	1						
Norway maple	Acer platanoides	1						
red maple	Acer rubrum	10		X		X		
silver maple	Acer saccharinum	6				X		
sugar maple	Acer saccharum ssp.saccharum	12	X	X	X			
Freeman's maple	Acer x freemanii	2						
CASHEW FAMILY	ANACARDIACEAE							
western poison-ivy	Rhus rydbergii	12	X		X			
staghorn sumac	Rhus typhina	6						

Common Name	Scientific Name	COMMUNITY NUMBER						
		Total	16	17	18	19	20	21
WOOD-SORREL FAMILY	OXALIDACEAE							
European wood-sorrel	<i>Oxalis stricta</i>	1						
GERANIUM FAMILY	GERANIACEAE							
Bicknell's crane's-bill	<i>Geranium bicknellii</i>	1						
wild geranium	<i>Geranium maculatum</i>	2						
herb Robert	<i>Geranium robertianum</i>	1						
TOUCH-ME-NOT FAMILY	BALSAMINACEAE							
spotted jewelweed	<i>Impatiens capensis</i>	7				X		
GINSENG FAMILY	ARALIACEAE							
wild sarsaparilla	<i>Aralia nudicaulis</i>	10	X	X				
spikenard	<i>Aralia racemosa</i>	1						
CARROT FAMILY	APIACEAE							
Queen-Anne's lace	<i>Daucus carota</i>	9	X		X		X	
woolly sweet cicely	<i>Osmorhiza claytonii</i>	2						
black snakeroot	<i>Sanicula marilandica</i>	5	X					
GENTIAN FAMILY	GENTIANACEAE							
bottle gentian	<i>Gentiana andrewsii</i>	2						X
DOGBANE FAMILY	APOCYNACEAE							
spreading dogbane	<i>Apocynum androsaemifolium</i>	5						
MILKWEED FAMILY	ASCLEPIADACEAE							
swamp milkweed	<i>Asclepias incarnata</i>	1						
common milkweed	<i>Asclepias syriaca</i>	2						
swallow-wort	<i>Cynanchum rossicum</i>	1						
NIGHTSHADE FAMILY	SOLANACEAE							
bitter nightshade	<i>Solanum dulcamara</i>	7	X					
black nightshade	<i>Solanum nigrum</i>	1						
WATERLEAF FAMILY	HYDROPHYLLACEAE							
Virginia waterleaf	<i>Hydrophyllum virginianum</i>	2						
BORAGE FAMILY	BORAGINACEAE							

		COMMUNITY NUMBER						
Common Name	Scientific Name	Total	16	17	18	19	20	21
American gromwell	<i>Lithospermum latifolium</i>	2						
common gromwell	<i>Lithospermum officinale</i>	4	X					
LOPSEED FAMILY	PHRYMACEAE							
lopseed	<i>Phryma leptostachya</i>	1	X					
MINT FAMILY	LAMIACEAE							
wild basil	<i>Clinopodium vulgare</i>	6	X		X			
ground ivy	<i>Glechoma hederacea</i>	2						
American water-horehound	<i>Lycopus americanus</i>	3	X			X		
wild mint	<i>Mentha arvensis</i>	5						
spear mint	<i>Mentha spicata</i>	2	X					
wild bergamot	<i>Monarda fistulosa</i>	2						
wild marjoram	<i>Origanum vulgare</i>	4	X					
heal-all	<i>Prunella vulgaris</i> ssp. <i>Lanceolata</i>	6	X		X			
PLANTAIN FAMILY	PLANTAGINACEAE							
narrow-leaved plantain	<i>Plantago lanceolata</i>	7			X	X		
broad-leaved plantain	<i>Plantago major</i>	7			X			
Rugel's plantain	<i>Plantago rugelii</i>	2						
OLIVE FAMILY	OLEACEAE							
white ash	<i>Fraxinus americana</i>	10	X		X			
black ash	<i>Fraxinus nigra</i>	8						
green ash	<i>Fraxinus pennsylvanica</i> var. <i>subint</i>	7	X	X		X		
lilac	<i>Syringa vulgaris</i>	1						
FIGWORT FAMILY	SCROPHULARIACEAE							
slender-leaved agalinis	<i>Agalinis tenuifolia</i>	1						X
square-stemmed monkeyflower	<i>Mimulus ringens</i>	1						
wood betony	<i>Pedicularis canadensis</i>	1						
hairy beardtongue	<i>Penstemon hirsutus</i>	1						
common mullein	<i>Verbascum thapsus</i>	9	X		X			
HAREBELL FAMILY	CAMPANULACEAE							

		COMMUNITY NUMBER						
Common Name	Scientific Name	Total	16	17	18	19	20	21
marsh bellflower	<i>Campanula aparinoides</i>	1						
Indian tobacco	<i>Lobelia inflata</i>	1						
MADDER FAMILY	RUBIACEAE							
rough bedstraw	<i>Galium asprellum</i>	3	X					
white bedstraw	<i>Galium mollugo</i>	4			X			
marsh bedstraw	<i>Galium palustre</i>	2						
sweet scented bedstraw	<i>Galium triflorum</i>	1						
creeping partridge-berry	<i>Mitchella repens</i>	3						
HONEYSUCKLE FAMILY	CAPRIFOLIACEAE							
bush-honeysuckle	<i>Diervilla lonicera</i>	1	X					
fly honeysuckle	<i>Lonicera canadensis</i>	3						
limber honeysuckle	<i>Lonicera dioica</i>	2						
honeysuckle	<i>Lonicera spp. E</i>	1						
tartarian honeysuckle	<i>Lonicera tatarica</i>	4						
common elderberry	<i>Sambucus canadensis</i>	3						
red-berried elderberry	<i>Sambucus racemosa</i>	1						
snowberry	<i>Symphoricarpos albus</i>	3						
narrow-leaved horse-gentian	<i>Triosteum angustifolium</i>	1	X					
scarlet-fruited horse-gentian	<i>Triosteum aurantiacum</i>	3	X					
maple-leaved viburnum	<i>Viburnum acerifolium</i>	1						
nannyberry	<i>Viburnum lentago</i>	2						
downy arrow-wood	<i>Viburnum rafinesquianum</i>	7	X					
high bush cranberry	<i>Viburnum trilobium</i>	1						
ASTER FAMILY	ASTERACEAE							
common yarrow	<i>Achillea millefolium</i>	9	X		X			
common ragweed	<i>Ambrosia artemisiifolia</i>	5						
pearly everlasting	<i>Anaphalis margaritacea</i>	1						
common burdock	<i>Arctium minus</i>	1						
ox-eye daisy	<i>Chrysanthemum leucanthemum</i>	9	X					

Common Name	Scientific Name	COMMUNITY NUMBER						
		Total	16	17	18	19	20	21
chicory	<i>Cichorium intybus</i>	1						
bull thistle	<i>Cirsium vulgare</i>	4	X					
flat top white aster	<i>Doellingeria umbellata</i> var. <i>umbellat</i>	1						
daisy fleabane	<i>Erigeron annuus</i>	1						
Philadelphia fleabane	<i>Erigeron philadelphicus</i> ssp. <i>philad</i>	6	X					
spotted joe-pyeweed	<i>Eupatorium maculatum</i>	5				X		
boneset	<i>Eupatorium perfoliatum</i>	3						X
white snakeroot	<i>Eupatorium rugosum</i>	1						
large-leaved aster	<i>Eurybia macrophylla</i>	6						
grass-leaved goldenrod	<i>Euthamia graminifolia</i>	4						X
wild lettuce	<i>Lactuca canadensis</i>	7	X		X			
balsam ragwort	<i>Packera paupercula</i>	1						
orange hawkweed	<i>Pilosella aurantiaca</i>	1						
field hawkweed	<i>Pilosella caespitosa</i>	1						
king devil hawkweed	<i>Pilosella floribunda</i>	1						
black-eyed Susan	<i>Rudbeckia hirta</i>	2						
tall goldenrod	<i>Solidago altissima</i>	4	X		X			
Canada goldenrod	<i>Solidago canadensis</i>	9	X		X	X		
early goldenrod	<i>Solidago juncea</i>	4						
rough-leaved goldenrod	<i>Solidago patula</i>	1						
rough goldenrod	<i>Solidago radula</i>	1						
field sow thistle	<i>Sonchus arvensis</i>	1	X					
heart-leaved aster	<i>Symphyotrichum cordifolium</i>	8	X					
white heath aster	<i>Symphyotrichum ericoides</i> var. <i>eric</i>	1	X					
panicled aster	<i>Symphyotrichum lanceolatum</i>	4						
calico aster	<i>Symphyotrichum lateriflorum</i> var. <i>la</i>	7	X		X			
New England aster	<i>Symphyotrichum novae-angliae</i>	5	X			X		
purple-stemmed aster	<i>Symphyotrichum puniceum</i>	2						
arrow-leaved aster	<i>Symphyotrichum urophyllum</i>	1						

		COMMUNITY NUMBER						
Common Name	Scientific Name	Total	16	17	18	19	20	21
common dandelion	<i>Taraxacum officinale</i>	4	X					
goat's-beard	<i>Tragopogon dubius</i>	2						
coltsfoot	<i>Tussilago farfara</i>	6	X		X	X		
WATER-PLANTAIN FAMILY	ALISMATACEAE							
broad-leaved arrowhead	<i>Sagittaria latifolia</i>	1						
ARUM FAMILY	ARACEAE							
Jack-in-the-pulpit	<i>Arisaema triphyllum</i>	4	X					
DUCKWEED FAMILY	LEMNACEAE							
common duckweed	<i>Lemna minor</i>	1						
SEDGE FAMILY	CYPERACEAE							
yellow sedge	<i>Carex flava</i>	2						
few-seeded sedge	<i>Carex oligosperma</i>	1						
Pennsylvania sedge	<i>Carex pensylvanica</i>	5	X					
plantain-leaved sedge	<i>Carex plantaginea</i>	1	X					
retorse sedge	<i>Carex retrorsa</i>	1						
awl-fruited sedge	<i>Carex stipata</i>	1						
tussock sedge	<i>Carex stricta</i>	2						
greenish sedge	<i>Carex viridula</i>	1						
wool-grass	<i>Scirpus cyperinus</i>	5				X		
softstem bulrush	<i>Scirpus validus</i>	2						
GRASS FAMILY	POACEAE							
redtop	<i>Agrostis gigantea</i>	1						
rough hair grass	<i>Agrostis scabra</i>	1						
fringed brome grass	<i>Bromus ciliatus</i>	1						
awnless brome grass	<i>Bromus inermis ssp.inermis</i>	1						
Canada bluejoint grass	<i>Calamagrostis canadensis</i>	2				X		
orchard grass	<i>Dactylis glomerata</i>	2					X	
poverty oatgrass	<i>Danthonia spicata</i>	2						
bottle-brush grass	<i>Elymus hystrix</i>	3						

		COMMUNITY NUMBER						
Common Name	Scientific Name	Total	16	17	18	19	20	21
fowl manna grass	<i>Glyceria striata</i>	1						
rice cut grass	<i>Leersia oryzoides</i>	1						
reed canary grass	<i>Phalaris arundinacea</i>	4						
timothy	<i>Phleum pratense</i>	5			X			
BUR-REED FAMILY	SPARGANIACEAE							
broad-fruited bur-reed	<i>Sparganium eurycarpum</i>	1						
CATTAIL FAMILY	TYPHACEAE							
narrow-leaved cattail	<i>Typha angustifolia</i>	1						
common cattail	<i>Typha latifolia</i>	3				X		X
LILY FAMILY	LILIACEAE							
asparagus	<i>Asparagus officinalis</i>	1						
bluebead lily	<i>Clintonia borealis</i>	3		X				
trout lily	<i>Erythronium americanum ssp. ame</i>	2						
tiger lily	<i>Lilium lancifolium</i>	1						
Canada mayflower	<i>Maianthemum canadense</i>	11	X	X	X			
Indian cucumber-root	<i>Medeola virginiana</i>	1						
hairy Solomon's seal	<i>Polygonatum pubescens</i>	3	X	X				
false Solomon's seal	<i>Smilacina racemosa</i>	6						
rose-twisted stalk	<i>Streptopus roseus</i>	4	X	X				
purple trillium	<i>Trillium erectum</i>	3		X				
white trillium	<i>Trillium grandiflorum</i>	5		X				
large-flowered bellwort	<i>Uvularia grandiflora</i>	3		X				
IRIS FAMILY	IRIDACEAE							
wild blue flag	<i>Iris versicolor</i>	2						
little blue-eyed grass	<i>Sisyrinchium montanum</i>	2						
ORCHID FAMILY	ORCHIDACEAE							
helleborine	<i>Epipactis helleborine</i>	9	X		X			
northern green orchis	<i>Platanthera hyperborea</i>	1						

		COMMUNITY NUMBER					
Common Name	<i>Scientific Name</i>	Total	16	17	18	19	20 21
Total Number of Plant Species	320	79	22	47	19	4	6
		Number of Plant Species Per Community					

Appendix D

Rare Plants

APPENDIX D List of Significant Plant Species

Plant species observed by GHD with significant status on national, provincial and relevant regional lists are listed with status codes and where applicable the most current year of publication. Three standard reference works were used for the botanical nomenclature and taxonomy (Newmaster et. al., 1998; Gleason and Cronquist 1991; Voss 1980; 1985). Other published works for botanical names included; ferns (Cody and Britton 1989); grasses (Dore and McNeill 1980); orchids (Whiting and Catling 1986); shrubs (Soper and Heimbürger 1982) and trees (Farrar 1995).

NATIONAL RANKING	Committee on the Status of Endangered Wildlife in Canada (COSEWIC), Government of Canada Species at Risk Act (SARA), SCHEDULE 1 (Subsections 2(1), 42(2) and 68(2)), Government of Canada	
PROVINCIAL RANKING	Species at Risk in Ontario (COSSARO), Government of Ontario Provincial Rank (SRANK), Natural Heritage Information Center, Government of Ontario	
REGIONAL RANKING	Riley, Simcoe	Riley, 1989, Simcoe

STATUS CODES	COSEWIC	END * - Endangered Species	*Year of Status Publication included in Code
	COSSARO	THR * - Threatened Species	
	SARA	SC * - Species of Concern	
	SRANK	S1 - Extremely Rare S2 - Very Rare S3 - Rare to Uncommon	Other national or provincial codes not listed
	Regional Lists	R - Rare native species RS - Regional significant EXP - Extirpated native species	Other Regional codes not listed

		NATIONAL RANKINGS		PROVINCIAL RANKINGS		REGIONAL RANKINGS			
Common Name	Scientific Name	COSEWIC	SARA	COSSARO	SRank	Riley, Simcoe			
meadow horsetail	Equisetum pratense					R			
butternut	Juglans cinerea	END Apr/14	END Mar/13	END Jun/14	S3?				
black walnut	Juglans nigra					R			
purple-flowering raspberry	Rubus odoratus					R			
racemed milkwort	Polygala polygama					R			
European wood-sorrel	Oxalis stricta					R			
wild geranium	Geranium maculatum					R			

Common Name	Scientific Name	COSEWIC	SARA	COSSARO	SRank	Riley, Simcoe					
black ash	Fraxinus nigra	THR Nov/18		END Oct/20							
slender-leaved agalinis	Agalinis tenuifolia					R					
tall goldenrod	Solidago altissima					R					
rough-leaved goldenrod	Solidago patula					R					
white heath aster	Symphytotrichum ericoides var. ericoi				S2	R					
Plants with Ranking	Total: 12	Status List Total	2	1	2		10	0	0	0	0

Appendix E

Bird Species List

APPENDIX E

Bird Status Report - Comprehensive

Bird species observed by GHD are listed in the order followed the American Ornithologists' Union (AOU) Check-list of North American birds (7th edition, 1999, 47th Supplement). Common and scientific nomenclature are based on those used by AOU. Breeding status and breeding evidence code are listed when observed. Any significant status for a species on national and provincial lists is displayed as well as those from relevant regional lists.

List Status :	END - endangered	A wildlife species facing imminent extirpation or extinction.
	END-R -endangered regulated	A wildlife species facing imminent extirpation or extinction in Ontario which has been regulated under Ontario's Endangered Species Act (ESA).
	THR - threatened	A wildlife species likely to become endangered if limiting factors are not reversed.
	SC - special concern	A wildlife species that may become threatened or an endangered species because of a combination of biological characteristics and identified threats.
	YES - Area Sensitive	A wildlife species that requires large areas of suitable habitat in order to sustain their population numbers.

* Other status levels are not displayed

List Sources:	COSEWIC	The Committee on the Status of Endangered Wildlife in Canada, 2024.
	COSSARO	The Committee on the Status of Species at Risk in Ontario, 2023.
	SARA	Species At Risk Act, Schedule 1, Government of Canada,2023.
	Area Sensitive	Significant Wildlife Technical Guide, Appendix C, OMNR, Oct. 2000
	Region 6	Southern Ontario Wetland Evaluation Appendix 11B, Version 3.2, March 2013

Breeding Status: (Observed By GHD)	B	-species observed in breeding season in suitable habitat with some evidence of breeding (confirmed, probable or possible as per Ontario Breeding Bird Atlas, 2002).
	F	-species observed in breeding season but no evidence of breeding or suitable nest sites available on the study site (includes flyovers, migrants and foraging colonial breeders).
	M	-species observed outside of breeding season for that species and in area outside of the known breeding range for that species.

**Breeding Evidence Code:
(Observed By GHD)**

OBSERVED

X -species observed in its breeding season (no evidence of breeding).

POSSIBLE BREEDING

H -species observed in its breeding season in suitable nesting habitat

S -singing male present, or breeding calls heard, in its breeding season in suitable nesting habitat

PROBABLE BREEDING

P -pair observed in their breeding season in suitable nesting habitat

T -permanent territory presumed through registration of territorial song on at least 2days,
a week or more apart, at the same place

D -courtship or display between a male and a female or 2 males, including courtship feeding or copulation

V -visiting probable nest site

A -agitated behaviour or anxiety calls of an adult

B -brood patch on adult female or cloacal protuberance on adult male

N -nest-building or excavation of nest hole

CONFIRMED BREEDING

DD -distraction display or injury feigning

NU -used nest or egg shell found (occupied or laid within the period of study)

FY -recently fledged young or downy young, including young incapable of sustained flight

AE -adults leaving or entering nest site in circumstances indicating occupied nest

FS -adult carrying fecal sac

CF -adult carrying food for young

NE -nest containing eggs

NY -nest with young seen or heard

SOURCE: Ontario Breeding Bird Atlas March 2001

AOU Code	Common Name	Scientific Name	Observed Breeding Status	Breed Evidence Code	COSEWIC	COSSARO	SARA	Area Sensitive	Region 6				
CAGO	Canada Goose	<i>Branta canadensis</i>	B	None				No					
WODU	Wood Duck	<i>Aix sponsa</i>	B	None				No					
MALL	Mallard	<i>Anas platyrhynchos</i>	B	None				No					
COME	Common Merganser	<i>Mergus merganser</i>	B	None				No					
RUGR	Ruffed Grouse	<i>Bonasa umbellus</i>	B	None				No					
WITU	Wild Turkey	<i>Meleagris gallopavo</i>	B	None				No					
COLO	Common Loon	<i>Gavia immer</i>	F	None				No					
AMBI	American Bittern	<i>Botaurus lentiginosus</i>	B	None				No					
TUVU	Turkey Vulture	<i>Cathartes aura</i>	B	None				No					
RSHA	Red-shouldered Hawk	<i>Buteo lineatus</i>	B	None				No					
BWHA	Broad-winged Hawk	<i>Buteo platypterus</i>	B	None				No					
KILL	Killdeer	<i>Charadrius vociferus</i>	B	None				No					
AMWO	American Woodcock	<i>Scolopax minor</i>	B	None				No					
HEGU	Herring Gull	<i>Larus argentatus</i>	F	None				No					
MODO	Mourning Dove	<i>Zenaida macroura</i>	B	None				No					
BAOW	Barred Owl	<i>Strix varia</i>	B	None				No					
CONI	Common Nighthawk	<i>Chordeiles minor</i>	B	None	SC	SC	THR	No					
WPWI	Eastern whip-poor-will	<i>Antrostomus vociferus</i>	B	None	SC	THR	THR	No					
BEKI	Belted Kingfisher	<i>Megaceryle alcyon</i>	B	None				No					
YBSS	Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	B	None				Yes					
DOWO	Downy Woodpecker	<i>Picoides pubescens</i>	B	None				No					
HAWO	Hairy Woodpecker	<i>Picoides villosus</i>	B	None				No					
NOFL	Northern Flicker	<i>Colaptes auratus</i>	B	None				No					
PIWO	Pileated Woodpecker	<i>Dryocopus pileatus</i>	B	None				No					
EWPE	Eastern Wood-Pewee	<i>Contopus virens</i>	B	None	SC	SC	SC	No					
GCFL	Great Crested Flycatcher	<i>Myiarchus crinitus</i>	B	None				No					

EAKI	Eastern Kingbird	<i>Tyrannus tyrannus</i>	B	None				No			
BHVI	Blue-headed Vireo	<i>Vireo solitarius</i>	B	None				Yes	RS		
REVI	Red-eyed Vireo	<i>Vireo olivaceus</i>	B	None				No			
BLJA	Blue Jay	<i>Cyanocitta cristata</i>	B	None				No			
AMCR	American Crow	<i>Corvus brachyrhynchos</i>	B	None				No			
CORA	Common Raven	<i>Corvus corax</i>	B	None				No			
BCCH	Black-capped Chickadee	<i>Poecile atricapillus</i>	B	None				No			
RBNU	Red-breasted Nuthatch	<i>Sitta canadensis</i>	B	None				Yes			
WBNU	White-breasted Nuthatch	<i>Sitta carolinensis</i>	B	None				No			
BRCR	Brown Creeper	<i>Certhia americana</i>	B	None				No			
HOWR	House Wren	<i>Troglodytes aedon</i>	B	None				No			
WIWR	Winter Wren	<i>Troglodytes troglodytes</i>	B	None				Yes			
GCKI	Golden-crowned Kinglet	<i>Regulus satrapa</i>	B	None				No			
VEER	Veery	<i>Catharus fuscescens</i>	B	None				Yes			
HETH	Hermit Thrush	<i>Catharus guttatus</i>	B	None				No			
WOTH	Wood Thrush	<i>Hylocichla mustelina</i>	B	None	THR	SC	THR	No			
AMRO	American Robin	<i>Turdus migratorius</i>	B	None				No			
CEWX	Cedar Waxwing	<i>Bombicilla cedrorum</i>	B	None				No			
TEWA	Tennessee Warbler	<i>Vermivora peregrina</i>	M	None				No	RS		
NAWA	Nashville Warbler	<i>Vermivora ruficapilla</i>	B	None				No			
YEWA	Yellow Warbler	<i>Dendroica petechia</i>	B	None				No			
CSWA	Chestnut-sided Warbler	<i>Dendroica pensylvanica</i>	B	None				No			
MAWA	Magnolia Warbler	<i>Dendroica magnolia</i>	B	None				No			
BTBW	Black-throated Blue Warbl	<i>Dendroica caerulescens</i>	B	None				Yes			
BTGW	Black-throated Green War	<i>Dendroica virens</i>	B	None				Yes			
PIWA	Pine Warbler	<i>Dendroica pinus</i>	B	None				No			
BWWA	Black-and-white Warbler	<i>Mniotilta varia</i>	B	None				No			
OVEN	Ovenbird	<i>Seiurus aurocapillus</i>	B	None				Yes			
NOWA	Northern Waterthrush	<i>Seiurus noveboracensis</i>	B	None				No			
MOWA	Mourning Warbler	<i>Geothlypis philadelphia</i>	B	None				No			

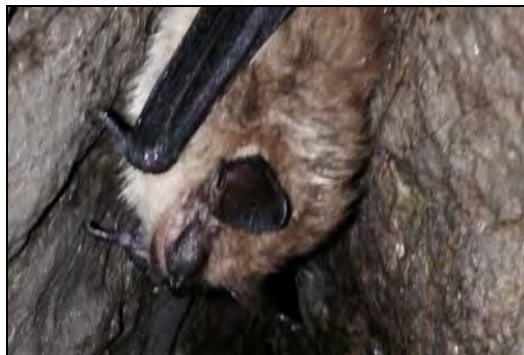
COYE	Common Yellowthroat	<i>Geothlypis trichas</i>	B	None				No				
SCTA	Scarlet Tanager	<i>Piranga olivacea</i>	B	None				Yes				
EATO	Eastern Towhee	<i>Pipilo erythrophthalmus</i>	B	None				No				
CHSP	Chipping Sparrow	<i>Spizella passerina</i>	B	None				No				
SOSP	Song Sparrow	<i>Melospiza melodia</i>	B	None				No				
SWSP	Swamp Sparrow	<i>Melospiza georgiana</i>	B	None				No				
WTSP	White-throated Sparrow	<i>Zonotrichia albicollis</i>	B	None				No				
WCSP	White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	M	None				No				
DEJU	Dark-eyed Junco	<i>Junco hyemalis</i>	B	None				No	RS			
RBGR	Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>	B	None				No				
INBU	Indigo Bunting	<i>Passerina cyanea</i>	B	None				No				
RWBL	Red-winged Blackbird	<i>Agelaius phoeniceus</i>	B	None				No				
COGR	Common Grackle	<i>Quiscalus quiscula</i>	B	None				No				
PUFI	Purple Finch	<i>Carpodacus purpureus</i>	B	None				No				
AMGO	American Goldfinch	<i>Carduelis tristis</i>	B	None				No				
EVGR	Evening Grosbeak	<i>Coccothraustes vespertin</i>	B	None	SC	SC	SC	No				
TOTAL SPECIES OBSERVED:		72	BREEDING SPECIES OBSERVED:		68	5	5	5	9	3	0	0

Appendix F

NEA Bat Letter

BAT ACOUSTIC ANALYSIS FOR CUMBERLAND QUARRY
A TECHNICAL DOCUMENT OF THE RESULTS FOR THE NIGHTS OF
AUGUST 1, 2017 TO AUGUST 10, 2017

Lots 12, 13 & 14 Concession 11
Severn Township
County of Simcoe



E. fuscus
Photo Credit: J. Boxall

Prepared for:

Severn Aggregates Limited Partnership

Prepared by:

Niblett Environmental Associates Inc.
April 17th, 2019

Bat Acoustic Analysis for Cumberland Quarry

A Technical Document of the Results for the Nights of
August 1, 2017 to August 10, 2017

1. Introduction

1.1. Subject Property

The subject property is a proposed limestone quarry on Lots 12, 13 and 14, west half of Concession 11, located north of Orillia and fronting on Nichols Line. The property is located in the Township of Severn, County of Simcoe. The proposed license area encompasses approximately 138 hectares.

The subject property is located north of Highway 11, west of Sparrow Lake Road in the geographic Township of Orillia North Division, now the Township of Severn. The property is owned by 1662947 Ontario Inc. and the present uses are the restoration of farmlands with forestry management taking place from time to time.

1.2. Survey Justification

Bat surveys were conducted to attempt to satisfy the Ontario Ministry of Natural Resources and Forestry (OMNRF) Significant Wildlife Habitat Guidelines. The biological role bats play in the ecosystem is crucial and there is evidence that bats are ideal bioindicators due to their sensitivity to changes in climate, agricultural intensification and fragmentation or loss of forests, water quality and habitat pollution (Jones et al., 2009). Bat acoustic surveys are also one of the only unobtrusive and logistically-viable methods of obtaining data from bats (Stahlschmidt and Brühl, 2012).

2. Materials and Method

2.1. Acoustic Recording

Surveys were conducted using two SM4BAT-FS bioacoustic detectors. These models record in zero-crossing format and then software converts it to a full spectrum format and is not done at the hardware level. Detectors were set to start triggering in the time between ½ hour before sunset and ½ hour after sunrise. A full breakdown of each detector's settings is provided in the Appendix I. Microphones used were the SMM-U1 models and a factory-tested directional horn was placed on one survey location that was along a potential bat commuter route. No accurate microphone "range" can be estimated as there are too many factors that contribute to how sound can travel with respect to atmospheric attenuation (Agranat, 2014;

Kerbiriou et al., 2018). All microphones were tested with a Wildlife Acoustics' ultrasonic calibrator to ensure that they were within the factory specifications of being a higher positive value than -38 dB (Wildlife Acoustic, 2017).

Deployed microphones were placed on thick steel bars approximately 20 feet above the ground as to avoid any anthropogenic interference. A backhoe was used to dig a deep hole which allowed the pole to be imbedded deep in the soil in order to ensure stability. The high placement of the microphones minimizes potential influence from surrounding clutter. The pole also acts as a ground for any potential electrical current that could pass through during a storm. Detectors were installed and left for a period of a minimum of 10 nights to satisfy the MNRF Bat Maternity protocol with fresh batteries and formatted 64 GB memory cards. While at each site, effort was made to ensure that there was at least a 10-15 meter minimum distance from the closest significant reflective surface in order to ensure the quality of the acoustic calls.

2.2. Site Selection

Bat surveys were conducted in two different locations on the nights of August 1st, 2017 to August 10th, 2017 (Figure 1). This satisfies the MNRF protocol of sample time of ten nights. In order to assist in the selection potential sites, potential bat commuter zones were identified in a GIS process and then verified on site (Lausen, 2017). Bat commuter zones are defined as any linear travel routes that bats could potentially use to get to-and-from feeding areas and water. These may include, but are not limited to, steeper elevation changes, edge habitat, wildlife corridors, trails or road features leading through forested habitat. Other factors such as proximity to water and easy feeding access while limiting predation are also considered.

Site specific potential bat commuter routes that would give access to and from the subject property were identified. Sites were predominantly chosen based on their potential for bat use and their potential for high sequence quality and duration length (Kerbiriou et al., 2018). Also key in site selection were locations that were different from a habitat perspective. This would assist in assessing the heterogeneity of the area and increase the likelihood of recording more species diversity (Loeb et al., 2015). Sequence quality can be affected by the frequency and intensity of bat calls, temperature and humidity, and barometric pressure (Brigham et al., 1997; Lausen, 2017; Schnitzler & Kalko, 2001).

2.2.1. Station 1

Station 1 is located approximately 40 m northeast from a deciduous swamp area and is a large disturbed area. Man-made drainages surround the station and there are various pools close by available as a water source. The immediate area is largely open with low-to-moderate clutter present in the forms of tall grasses. A potential commuter zone was identified along the drainages and along the edge of the wooded area to the west.

The site was selected due to its openness and proximity to a wooded edge to the west. Edge habitat has been identified as a factor in roost selection by *Myotis spp.* (Jung 2004, Psyllakis & Brigham 2005). No

Document Name: Figure 1- Bat Acoustic Site Selection_Updated

significant clutter was present to impede acoustic performance. There were no snag or cavity trees present in the immediate area (however there were snags present within 100 m of the forested edge) of the microphone and insects were present in large amounts.



Photo 1. Station 1 facing northwest.

Deployment of a SM4BAT-FS bioacoustic detector was initiated on August 1, 2017 and collected on August 11, 2017 for a total of ten nights. Precise settings for the detector can be found in Appendix I: SM4BAT-FS Settings. Due to equipment availability and the nature of the site, an omni-directional microphone was used in order to ensure that bats were recorded from all directions.

2.2.2. Station 2

Station 2 is located approximately 30 m from the east edge Grass Lake (SE10) PSW and is a large strip of disturbed area. Portions of a tributary of Grass Creek are present to the south and potentially provide drinking water for any bats in the vicinity. The tributary does not flow noticeably and was far enough away that any acoustic noise was mitigated. The immediate area is largely open and with low-to-moderate clutter present in the forms of small shrubs and tall grasses. Along the western of the area, a rock ledge was identified and ran south-to-north. The area above the ledge has been used for selective logging as well as a through-way for potential quarry activities.

The site was selected for a station due to its proximity to open water in the Grass Lake (SE10) provincially significant wetland (PSW), forest edge habitat, as well as appeal for a directional microphone set-up based on potential bat commuting routes. High clutter such as trees were present however, spacing of approximately 30 m was given from the closest large tree to the microphone. There was no snag or cavities present in the immediate vicinity (they were present within the adjacent forested area) and insects were

present in large amounts. The intent of the setup was to capture bat acoustic recordings of bats commuting along linear edge habitat.



Photo 2: Station 2 facing northeast towards Grass Lake PSW.

Deployment of a SM4BAT-FS bioacoustic detector was initiated on August 1, 2017 and collected on August 11, 2017 for a total of ten nights. Precise settings for the detector can be found in Appendix I: SM4BAT-FS Settings. Due to the nature of the site, a directional microphone with a microphone-specific horn was selected in order to ensure sequence quality and to hopefully pick up sequences of bats coming towards the microphone.

2.3. Analysis Methodology

Acoustic analysis was predominantly performed in Wildlife Acoustic's Kaleidoscope Pro software as it has the added functionality of using converted full spectrum analysis. Refer to Appendix I for a full breakdown of the signal parameters that were used for the analysis (Lausen, 2017). Auto ID settings were altered so that only Ontario bat species would be identified. The settings were filtered for the following species: *Myotis septentrionalis* (Northern long-eared myotis), *Myotis lucifugus* (Little brown bat), *Myotis leibii* (eastern small-footed myotis), *Lasiurus borealis* (eastern red bat), *Perimyotis subflavus* (Tri-coloured bat), *Lasionycteris noctivagans* (Silver-haired bat), *Lasiurus cinereus* (Hoary bat), and *Eptesicus fuscus* (Big brown bat). Of special note, *Tadarida brasiliensis* (Mexican free-tailed bat) was excluded from automated identification due to the extremely limited records found in Ontario and Kaleidoscope Pro's tendency to confuse this bat species with others. Wildlife Acoustics' newest classifiers (North American Bats 5.1) were used at the time of this report.

For the purposes of this report, *Lasionycteris noctivagans* and *Eptesicus fuscus* were not manually identified as either-or due to overlapping ranges in spectrum, similarities in sequences (Betts, 1998) and overall time

constraints. The classification of EPFULANO was given in this case. If there was difficulty identifying a bat that was not an EPFULANO, then the classifier of 35KBAT or 40KBAT was given to indicate it was identified as a bat in either the 35 kHz range or a bat in the 40 kHz range. *Myotis lucifugus*, *Myotis leibii*, and *Myotis septentrionalis* were all classified as MYOTIS. There are main reason for this is it can be extremely difficult to differentiate between different species of *Myotis*, especially in areas of higher clutter (Broders, 2004).

Due to automatic identification being insufficient in some cases or just incorrect, manual identification was performed on all files identified as bat sequences for verification. Automatic identification cannot in many cases identify bats correctly due to overlap in frequency ranges as well as multiple number of bats in a sequence. This is a result of technology limitations as well as low amounts of training data for a particular species (Wildlife Acoustics [2], 2017). It is also important to note that bats can have interindividual variation among local populations as well as geographical variations among species (Murray et al., 2001). This could theoretically make it extremely difficult to build quantifiable classifiers.

Once manual classification was completed, these records were cross-referenced with Environment Canada's historical weather data for the Parry Sound weather station CAXX03480 as well as the lunar phase calendar for the sampling time period. Results were analyzed with an emphasis on *Myotis* species and *Perimyotis subflavus* due to their designation as species-at-risk.

Statistical analysis such as probability distributions for each night were not completed due to the small sample size.

3. Results & Analysis

3.1. Station 1

The overall product of this station is a total of 1,185 files. Of these files, approximately nine (9) records contained two or more individual bat sequences (a series of pulses make up a sequence). Raw data is available in Appendix II. Sequence quality was excellent as only 1.4% of the recordings were verified as noise and only 5.43% were treated as non-identifiable due to lack of pulses or pulse strength. Appendix IV contains a complete synopsis of bat counts per hour per night as well as key statistics. As such, discussion will concentrate mostly on Species-at-Risk.

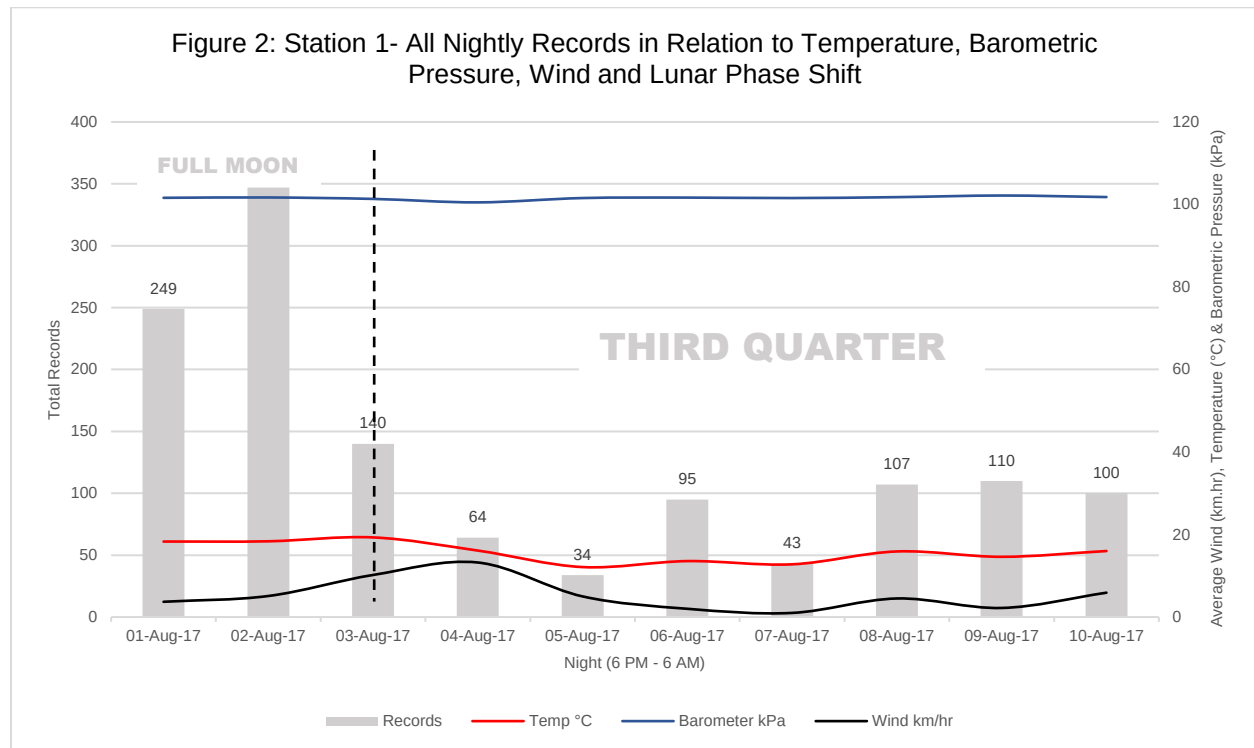
The following table shows a breakdown of species recorded per night (Table 1). Peak records were obtained on August 2, 2017 with a marked drop-off afterward. *Myotis* species were not present in abundance at this station.

Table 1: Bat Records for Station 1 on the Nights of August 1-10, 2017

Night	Records	MYOTIS	PESU	EPFULANO	LACI	LABO	35KBAT	40KBAT
01-Aug-17	249	9	0	59	171	3	0	0
02-Aug-17	347	11	3	110	107	5	0	0
03-Aug-17	140	9	3	76	38	1	0	0
04-Aug-17	64	3	0	32	29	1	0	0
05-Aug-17	34	2	0	2	16	0	0	1
06-Aug-17	95	2	0	40	48	2	0	1
07-Aug-17	43	6	0	17	16	1	0	1
08-Aug-17	107	5	0	41	46	2	0	1
09-Aug-17	110	4	0	49	49	1	0	1
10-Aug-17	100	4	0	44	45	1	0	0
Σ	1289	55	6	470	565	17	0	5

Although there is variation among the number of species recorded, *Eptesicus fuscus*, *Lasionycteris noctivagans* and *Lasiurus cinereus* were largely predominant.

These results were then further cross-referenced with meteorological data obtained from Environment Canada (Figure 2).



3.2. Station 2

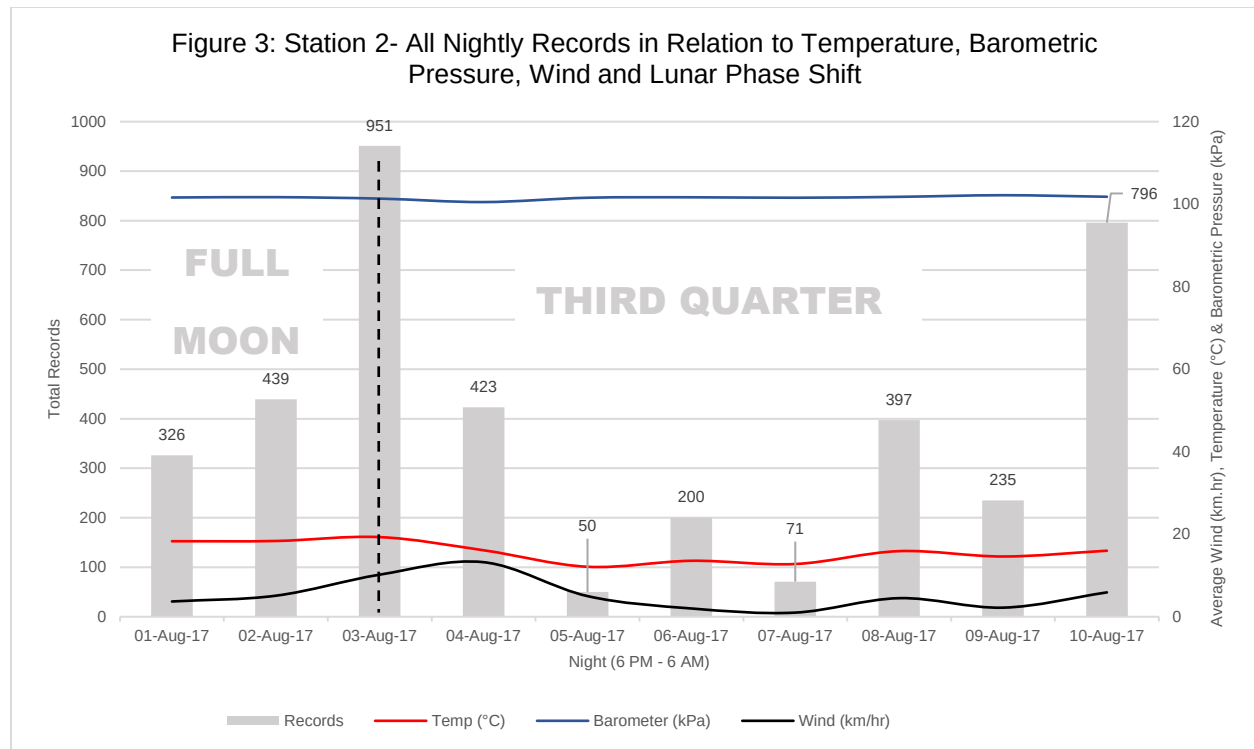
The overall product of this station is a total of 3,694 files. Of these files, approximately 190 records contained two (2) or more individual bat sequences (a series of pulses make up a sequence). Raw data is available in Appendix III. Sequence quality was excellent as only 1.16% of the recordings were verified as noise and 1.98% were treated as non-identifiable due to lack of pulses or pulse strength. Appendix V shows a complete synopsis of bat counts per hour per night. Sequence duration was longer at this station as well as more sequences showing feeding bats as opposed to Station 1 and this may constitute a higher quality bat activity area (Kerbiriou et al., 2018). Due to the prominent presence of *Myotis* species in-depth discussion will be relegated mostly to this species.

The following table shows a breakdown of species recorded per night (Table 2). There is no need for a distribution chart here as it is quite clear that the nights of August 3rd, 2017 and August 10th, 2017 have a significantly higher percentage of bats recorded than in other nights and should be looked at more closely. The data for August 4th, 2017 will also be looked at as well as it also contained active *Myotis* species recordings.

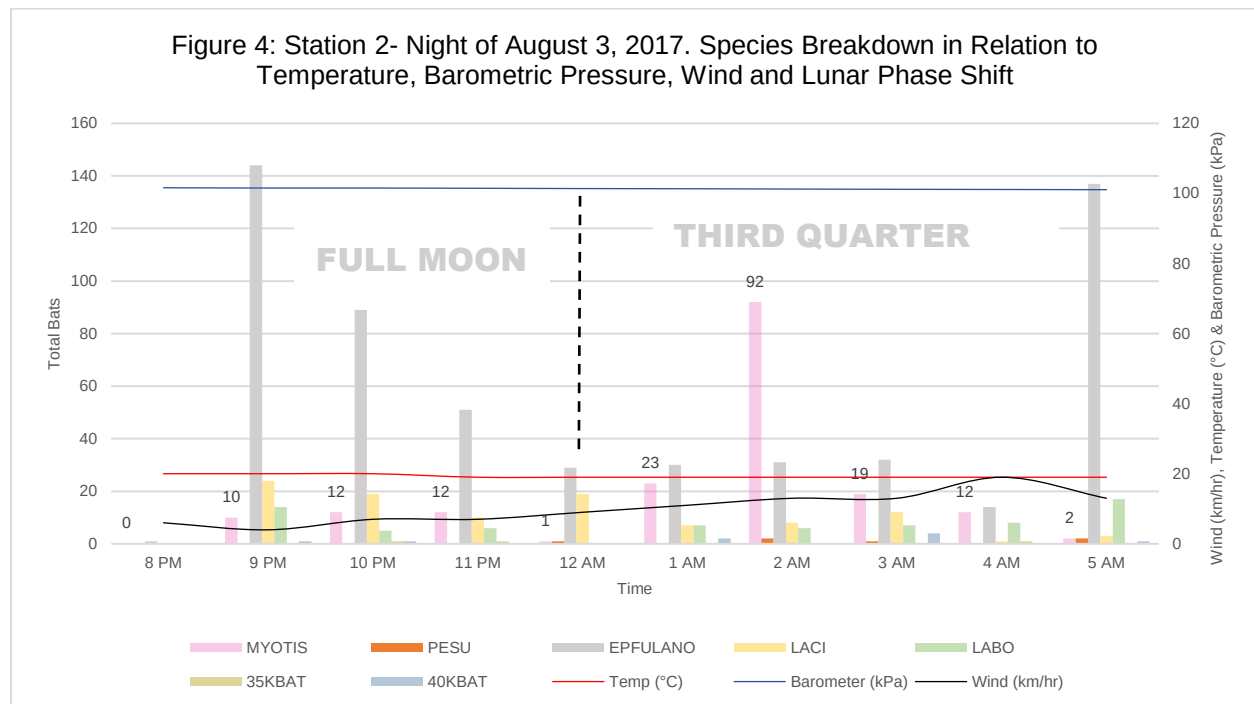
Table 2: Bat Records for Station 2 on the Nights of August 1-10, 2017

Night	Records	MYOTIS	PESU	EPFULANO	LACI	LABO	35KBAT	40KBAT
01-Aug-17	326	15	1	212	75	10	2	1
02-Aug-17	439	27	1	281	94	18	1	5
03-Aug-17	951	183	6	558	103	70	3	9
04-Aug-17	423	64	1	245	85	10	1	7
05-Aug-17	50	10	0	20	8	7	0	1
06-Aug-17	200	8	0	93	75	14	1	0
07-Aug-17	71	12	0	38	13	5	0	0
08-Aug-17	397	73	2	233	45	18	0	9
09-Aug-17	235	10	0	152	43	15	1	2
10-Aug-17	796	59	5	421	247	39	0	7
Σ	3888	461	16	2253	788	206	9	41

There is a clear *Myotis* species presence at this station and further analysis with meteorological data from Environment Canada shows peak activity just after the lunar shift and during a rise in barometric pressure (Figure 3).



Closer examination of the night of August 3rd, 2017 indicates the hours of 2:00 – 3:00 AM as peak activity for *Myotis* species (Figure 4).



Myotis species were present with a total count of 183 bats. The highest frequency of *Myotis* species sequences peaked between the hours of 2:00-3:00 AM with 92 bat acoustic signatures recorded. These

sequences were often in higher clutter (Figure 5) and it is clear from the acoustic signatures that they are traveling from the Grass Lake PSW area.

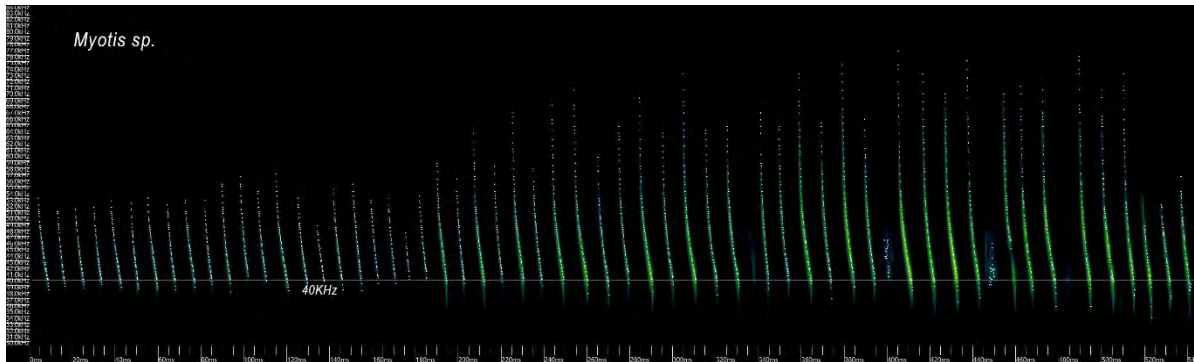
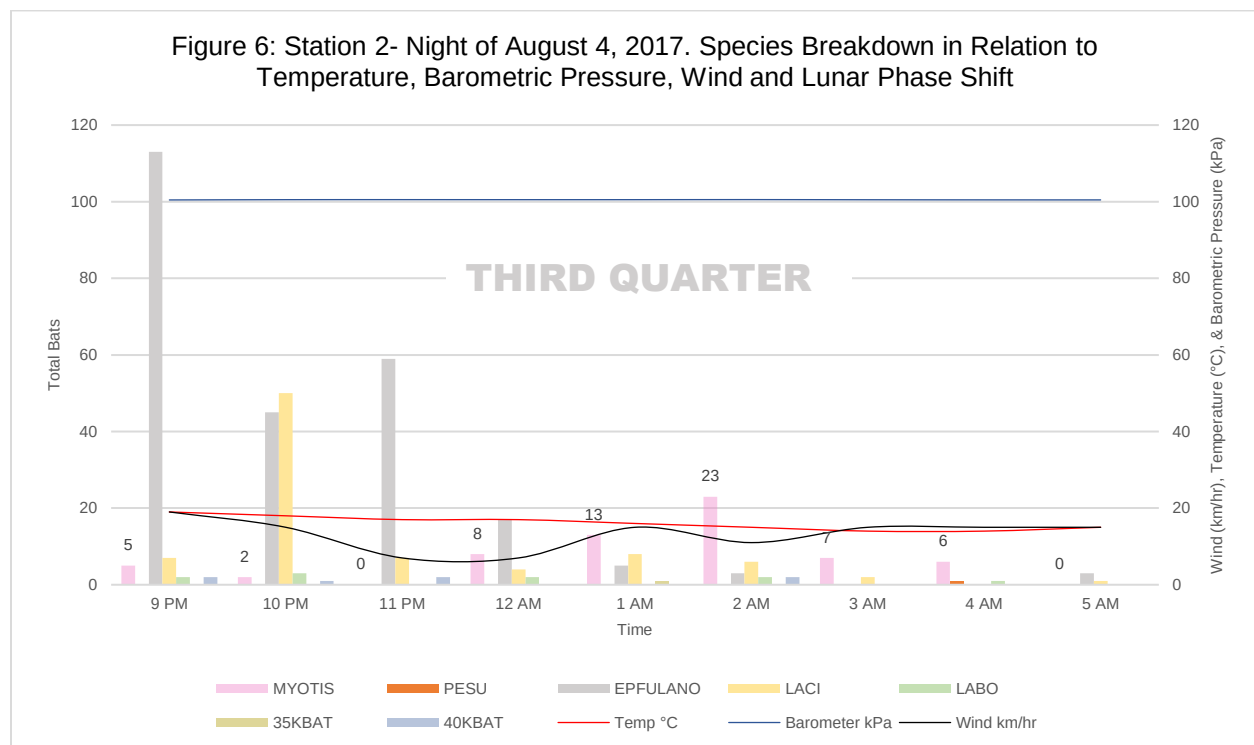


Figure 5: *Myotis* spp. in medium-high clutter. August 04, 2017, 2:18 AM. Part of a longer 11.08s sequence. Pulses=82, Sc=77.32, Fc=41. Entire sequence is regular with little variability typical of *Myotis lucifugus*.

Examination of the night of August 4th, 2017 indicates that *Myotis* species were mostly active between the hours of 1:00-3:00 AM with a total of 36 *Myotis* species sequences recorded (Figure 6).



Bat activity at this station consisted of social calls and feeding. The “feeding buzz” was clearly identifiable in acoustic signatures (Figure 7).

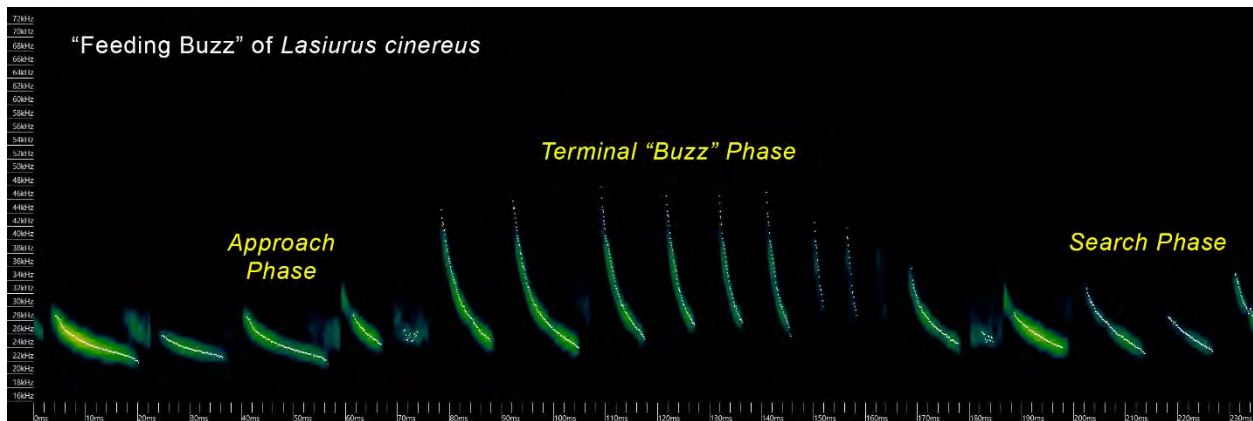
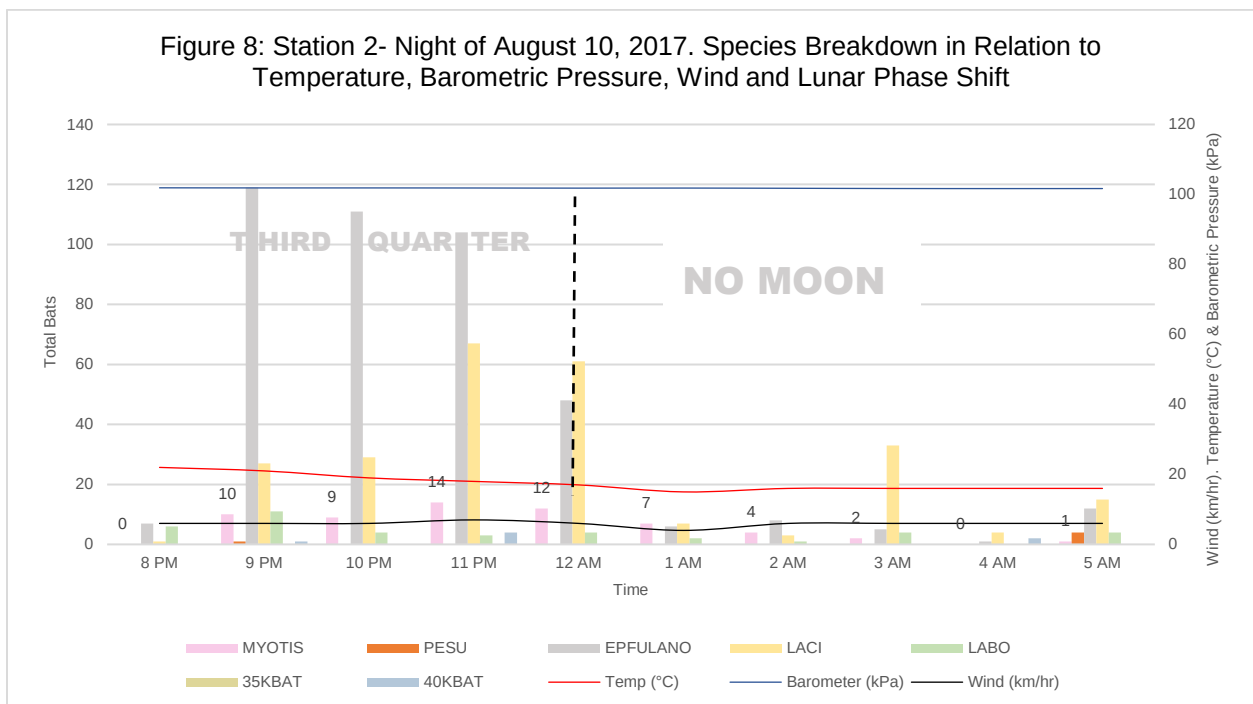


Figure 7: Feeding phase "buzz" of a Hoary bat at Station 2 on the night of August 4, 2017.

The night of August 10th, 2017 was also examined more closely due to the timing of *Myotis* species activity. This data was also cross-referenced with data obtained from Environment Canada (Figure 8).



Myotis species were present with a total count of 59 bats for the entire night. The highest frequency of *Myotis* species sequences peaked between the hours of 9:00 PM–12:00 AM with 45 bats recorded. This is a marked difference than other nights when activity was mostly after the hours of 1:00 AM.

Perimyotis subflavus was present as well with a total count of five (5) bats (Figure 9). The highest frequency coming between the hours of 5:00-6:00 AM with four (4) bats recorded.

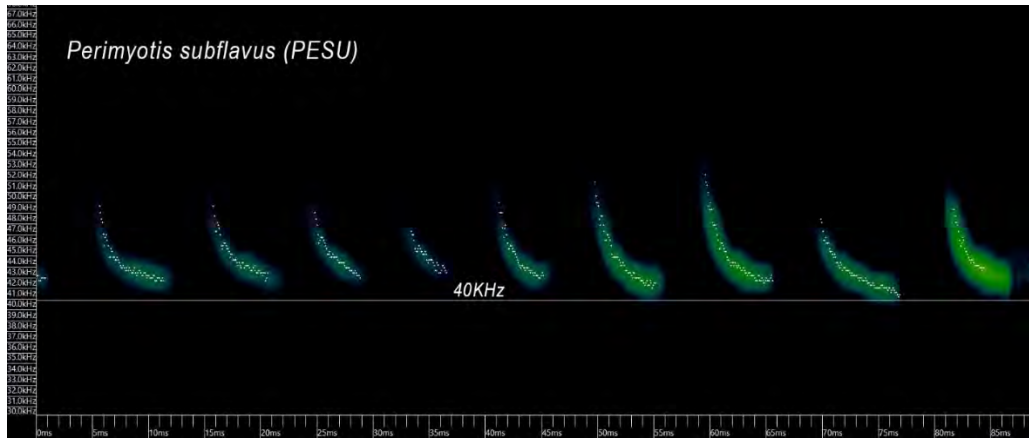


Figure 9: *Perimyotis subflavus* in mid-clutter. August 11, 2017, 5:39 AM. Part of a longer 7.67s sequence. Pulses=43, Sc=13.69, Fc=41. Entire sequence is regular with little variability. The lack of variability across the entire sequences reduces the likelihood of it being *Lasiurus borealis*.

4. Conclusion

Bat surveys on the subject property identified *Eptesicus fuscus*, *Lasionycteris noctivagans*, *Lasiurus borealis*, *Lasiurus cinereus*, *Perimyotis subflavus*, and *Myotis* species.

All target species were active at Station 1, however the number of sequences were low and there were no distinct days of activity that were much more active than others. From a commuting perspective, the majority of sequences at both stations indicated commuting bats however, station 2 had the largest sequence activity among all target species and were clearly using the area for feeding purposes more than Station 1. It is also evident that the *Myotis* species recorded at Station 2 were mostly traveling in a western direction towards the microphone due to the properties of the sequences (i.e. amplitude and wave compression).

5. References

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APPENDIX I

SM4BAT-FS FIELD SETTINGS AND KALEIDOSCOPE PRO ANALYSIS SETTINGS

SM4BAT-FS Unit Settings (applies to both units)

Audio

Gain: 12 db
16k high Filter: On
Sample Rate: 256 khz
Min Duration: 1.5 ms
Max Duration: 50 ms
Min Trigger Frequency: 16 kHz
Trigger Level: 12 db
Trigger Window: 2 s
Max Length: 15 s
Compression: none

Date and Time

Rise: 06:41
Set: 19:50

Sunrise/Sunset

Type: Solar sunrise/sunset

Schedule:

Start: -0:30
Duty: Always
End: +0:30

KALEIDOSCOPE PRO ANALYSIS SETTINGS

Signal Parameters

Signal of Interest: 15 – 120 kHz
1.5 – 50 ms
500 maximum inter-syllable gap (ms)
2 minimum number of pulses

Enhance with Advanced Signal Processing: Yes

Auto ID for Bats

EPTFUS
LASBOR
LASCIN
LASNOC
MYOLEI
MYOLUC
MYOSEP
PERSUB

APPENDIX II

STATION 1 KALEIDOSCOPE-ANALOOK RAW DATA TABLE

APPENDIX II: STATION 1 KALEIDOSCOPE/ANALOOK RAW DATA TABLE

(TOTAL SEQUENCES DO NOT REFLECT TOTAL BAT^S)

* MANUAL ID was used for final verification and results.

IN FILE	DURATION	DATE	TIME	HOUR	DATE-12	TIME-12	HOUR-12	MANUAL ID	AUTO ID	PULSES	MATCHING	MATCH RATIO	MARGIN	ALTERNATES	N	Fc	Sc	Dur	Fmax	Fmin	Fmean	TBC	Fk	Tk	S1	Tc	Qual
S4U02624_20170801_210252.wav	7.408	01/08/2017	21:02:52	21	01/08/2017	9:02:52	9	LACI	LASCIN	19	18	0.947	0.727486	EPTFUS	19	19.347	12.89	12.5	22.03	19.069	20.209	359.685	20.121	6.146	-10.348	11.037	2.2
S4U02624_20170801_211424.wav	3.72	01/08/2017	21:14:24	21	01/08/2017	9:14:24	9	LACI	LASCIN	7	7	1	0.724391	EPTFUS	7	20.586	14.16	7.917	23.552	20.44	21.49	455.247	21.153	4.542	-60.27	7.296	1.32
S4U02624_20170801_211430.wav	6.664	01/08/2017	21:14:30	21	01/08/2017	9:14:30	9	LACI	LASCIN	17	17	1	0.735282	EPTFUS	17	19.936	11.22	8.344	23.503	19.739	20.82	403.299	20.317	5.348	108.708	7.513	3.79
S4U02624_20170801_211821.wav	3.724	01/08/2017	21:18:21	21	01/08/2017	9:18:21	9	LACI	LASCIN	8	8	1	0.756974	LASBOR	8	18.092	6.09	10.5	20.01	18.017	18.568	515.482	18.349	6.487	91.046	9.782	0.95
S4U02624_20170801_211832.wav	5.93	01/08/2017	21:18:32	21	01/08/2017	9:18:32	9	LACI	LASCIN	13	13	1	0.769076	EPTFUS	13	19.355	8.15	11.309	22.257	19.257	20.046	467.637	19.802	5.194	129.329	9.923	1.71
S4U02624_20170801_211841.wav	2.006	01/08/2017	21:18:41	21	01/08/2017	9:18:41	9	LACI	LASCIN	3	2	0.667	0.476983	LASNOC,EPTFUS	3	22.265	8.63	7.728	25.681	22.072	23.151	169.326	22.546	4.375	95.149	6.189	0.57
S4U02624_20170801_211906.wav	15	01/08/2017	21:19:06	21	01/08/2017	9:19:06	9	LACI & EPFULANO	LASCIN	78	33	0.423	0.386974	LASNOC,EPTFUS	78	23.966	15.57	8.386	29.593	23.847	25.212	189.796	24.634	4.931	204.827	7.915	11.48
S4U02624_20170801_211925.wav	3.716	01/08/2017	21:19:25	21	01/08/2017	9:19:25	9	LACI	LASCIN	21	13	0.619	0.526203	EPTFUS,LASNOC	21	23.459	65.9	6.89	43.534	23.03	27.953	173.532	25.423	4.441	458.896	6.51	3.33
S4U02624_20170801_211930.wav	2.612	01/08/2017	21:19:30	21	01/08/2017	9:19:30	9	LACI	LASCIN	6	6	1	0.703096	EPTFUS	6	20.269	6.71	7.706	23.053	20.037	20.981	241.817	20.51	4.933	38.954	7.074	1.57
S4U02624_20170801_211934.wav	15	01/08/2017	21:19:34	21	01/08/2017	9:19:34	9	EPFULANO	LASNOC	64	57	0.891	0.436114	EPTFUS,LASCIN	64	26.489	10.86	7.948	30.477	26.349	27.491	237.039	27.281	3.829	120.076	7.444	10.36
S4U02624_20170801_211951.wav	15	01/08/2017	21:19:51	21	01/08/2017	9:19:51	9	EPFULANO & LACI	NoID	116	0	0	0	LASNOC,LASCIN	116	25.465	11.47	8.983	32.625	25.291	26.847	127.478	26.163	4.851	199.343	8.39	17.85
S4U02624_20170801_212012.wav	6.112	01/08/2017	21:20:12	21	01/08/2017	9:20:12	9	LACI	LASCIN	16	16	1	0.751159	EPTFUS,LASBOR	16	19.223	10.15	9.203	22.203	19.09	19.978	385.039	19.56	6.023	112.793	8.537	3.55
S4U02624_20170801_212115.wav	11.308	01/08/2017	21:21:15	21	01/08/2017	9:21:15	9	LACI	LASCIN	22	22	1	0.740713	EPTFUS	22	19.701	7.24	9.467	22.874	19.614	20.549	472.622	20.067	6.203	96.764	9.007	2.63
S4U02624_20170801_212128.wav	6.35	01/08/2017	21:21:28	21	01/08/2017	9:21:28	9	LACI	LASCIN	17	17	1	0.760364	EPTFUS	17	19.462	9.14	8.486	22.624	19.373	20.34	394.899	19.858	5.464	85.053	8.115	2.4
S4U02624_20170801_212137.wav	2.508	01/08/2017	21:21:37	21	01/08/2017	9:21:37	9	LACI	LASCIN	5	5	1	0.693454	EPTFUS	5	20.811	14.52	7.735	23.426	20.649	21.547	373.855	21.285	4.484	117.158	6.888	0.98
S4U02624_20170801_212143.wav	7.718	01/08/2017	21:21:43	21	01/08/2017	9:21:43	9	LACI	LASCIN	26	23	0.885	0.727359	EPTFUS	26	20.808	14.76	8.491	25.485	20.465	21.814	299.767	21.489	4.472	224.273	7.754	4.19
S4U02624_20170801_212153.wav	3.87	01/08/2017	21:21:53	21	01/08/2017	9:21:53	9	LACI	LASCIN	10	10	1	0.776519	EPTFUS	10	20.78	15.4	10.964	24.199	19.913	21.432	365.89	21.39	5.123	128.188	7.995	1.32
S4U02624_20170801_212221.wav	8.524	01/08/2017	21:22:21	21	01/08/2017	9:22:21	9	LACI	LASCIN	25	24	0.96	0.726078	EPTFUS	24	20.787	9.76	8.032	22.923	20.522	21.222	350.172	21.216	4.2	88.547	6.898	5.79
S4U02624_20170801_212509.wav	2.63	01/08/2017	21:25:09	21	01/08/2017	9:25:09	9	EPFULANO	LASNOC	9	9	1	0.436003	LASCIN,EPTFUS	9	26.743	5.07	7.527	28.372	26.449	27.099	299.249	27.297	2.219	74.45	6.133	1.67
S4U02624_20170801_212619.wav	12.58	01/08/2017	21:26:19	21	01/08/2017	9:26:19	9	EPFULANO & MYOTIS	NoID	47	0	0	0		47	32.828	31.09	8.12	39.18	32.116	34.729	239.125	35.095	3.744	138.329	7.055	13.35
S4U02624_20170801_212918.wav	4.448	01/08/2017	21:29:18	21	01/08/2017	9:29:18	9	LACI	LASCIN	9	9	1	0.776048	EPTFUS	9	20.895	12.08	5.854	23.83	20.705	21.729	521.115	21.117	4.167	101.324	5.351	2.44
S4U02624_20170801_213006.wav	3.27	01/08/2017	21:30:06	21	01/08/2017	9:30:06	9	LACI	LASCIN	5	5	1	0.694619	EPTFUS	5	19.004	5.56	5.561	20.352	18.826	19.33	672.377	19.25	2.839	57.676	5.142	0.77
S4U02624_20170801_213151.wav	4.01	01/08/2017	21:31:51	21	01/08/2017	9:31:51	9	LACI	LASCIN	9	7	0.778	0.622532	EPTFUS	9	20.746	11.71	8.996	25.201	20.619	21.755	345.3	21.333	4.87	136.756	8.302	0.8
S4U02624_20170801_213157.wav	3.748	01/08/2017	21:31:57	21	01/08/2017	9:31:57	9	LACI	LASCIN	8	8	1	0.747498	EPTFUS	8	18.969	6.35	10.415	21.579	18.87	19.579	473.199	19.254	6.45	135.766	9.859	0.77
S4U02624_20170801_213202.wav	7.328	01/08/2017	21:32:02	21	01/08/2017	9:32:02	9	LACI	LASCIN	14	14	1	0.715573	EPTFUS	14	19.248	10.41	8.527	22.62	19.132	20.087	518.253	19.591	5.802	134.251	8.028	2.67
S4U02624_20170801_213234.wav	2.006	01/08/2017	21:32:34	21	01/08/2017	9:32:34	9	NOID	NoID	3	0	0	0	LASNOC,LASCIN	3	26.468	7.16	7.752	27.557	26.006	26.716	979.172	26.786	2.758	10.612	5.519	1.09
S4U02624_20170801_213255.wav	4.086	01/08/2017	21:32:55	21	01/08/2017	9:32:55	9	EPFULANO	LASNOC	13	12	0.923	0.415733	EPTFUS,LASCIN	13	27.571	13.65	6.956	31.752	27.462	28.652	332.18	28.338	3.59	147.277	6.666	2.12
S4U02624_20170801_213316.wav	5.758	01/08/2017	21:33:16	21	01/08/2017	9:33:16	9	EPFULANO	LASNOC	23	18	0.783	0.36705	EPTFUS,LASCIN	23	27.825	23.36	6.123	33.677	27.676	29.303	238.989	28.984	3.103	176.662	5.664	4.41
S4U02624_20170801_213402.wav	11.076	01/08/2017	21:34:02	21	01/08/2017	9:34:02	9	EPFULANO	LASNOC	54	39	0.722	0.385225	EPTFUS,LASCIN	54	27.695	29.05	7.487	37.663	27.4	29.792	204.272	28.964	4.012	266.553	7.046	9.06
S4U02624_20170801_213420.wav	7.758	01/08/2017	21:34:20	21	01/08/2017	9:34:20	9	EPFULANO	LASNOC	32	23	0.719	0.360218	EPTFUS,LASCIN	32	27.301	10.75	8.062	32.083	27.126	28.307	210.862	27.924	4.024	130.899	7.357	8.23
S4U02624_20170801_213446.wav	3.038	01/08/2017	21:34:46	21	01/08/2017	9:34:46	9	EPFULANO	LASNOC	10	7	0.7	0.384415	EPTFUS,LASCIN	10	27.988	14.96	7.471	32.704	27.712	29.031	195.937	28.889	3.328	182.671	6.729	1.68
S4U02624_20170801_213451.wav	12.62	01/08/2017	21:34:51	21	01/08/2017	9:34:51	9	EPFULANO	LASNOC	46	34	0.739	0.369411	EPTFUS,LASCIN	46	27.763	20.08	6.324	33.334	27.613	29.036	229.587	28.541	3.346	163.027	5.896	8.63
S4U02624_20170801_213505.wav	7.194	01/08/2017	21:35:05	21	01/08/2017	9:35:05	9	EPFULANO	LASNOC	27	24	0.889	0.446365	EPTFUS,LASCIN	27	27.402	9.8	7.977	33.247	27.229	28.635	252.157	28.05	4.235	150.224	7.363	5.03
S4U02624_20170801_213529.wav	3.84	01/08/2017	21:35:29	21	01/08/2017	9:35:29	9	EPFULANO	LASNOC	10	9	0.9	0.411215	EPTFUS,LASCIN	10	27.25	14.28	7.387	30.143	27.059	28.032	230.027	27.886	4.206	61.775	6.736	2.21
S4U02624_20170801_213535.wav	8.938	01/08/2017	21:35:35	21	01/08/2017	9:35:35	9	EPFULANO	LASNOC	31	21	0.677	0.350247	EPTFUS,LASCIN	31	27.662	17.55	6.605	31.979	27.504	28.717	243.248	28.477	2.987	138.285	6.065	5.71
S4U02624_20170801_213550.wav	12.262	01/08/2017	21:35:50	21	01/08/2017	9:35:50	9	EPFULANO	LASNOC	80	56	0.7	0.389214	EPTFUS,LASCIN	80	27.526	15.44	8.224	38.624	27.236	29.618	145.905	28.294	4.38	223.335	7.552	15.58
S4U02624_20170801_213607.wav	14.794	01/08/2017	21:36:07	21	01/08/2017	9:36:07	9	EPFULANO	LASNOC	49	44	0.898	0.423402	EPTFUS,LASCIN	49	27.4	13.6	8.023	31.439	27.256	28.336	295.437	28.071	4.103	137.113	7.107	10.64
S4U02624_20170801_213653.wav	5.922	01/08/2017	21:36:53	21	01/08/2017	9:36:53	9	LACI & MYOTIS	NoID	26	0	0	0	LASCIN	26	30.649	22.38	7.667	35.436	29.88	31.951	217.552	32.141	3.995	142.275	6.698	4.95
S4U02624_20170801_213702.wav	5.402	01/08/2017	21:37:02	21	01/08/2017	9:37:02	9	LACI	LASCIN	15	13	0.867	0.637128	EPTFUS	15	21.123	12.92	8.727	24.185	20.941	21.969	381.152	21.674	4.942	116.018	8.059	1.93
S4U02624_20170801_213711.wav	2.006	01/08/2017	21:37:11	21	01/08/2017	9:37:11	9	LACI	LASCIN	5	5	1	0.744746	EPTFUS	5	18.635	16.99	4.055	19.681	18.553	18.891	449.2	18.899	2.01	96.0		

APPENDIX III

STATION 2 KALEIDOSCOPE-ANALOOK RAW DATA TABLE

APPENDIX III: STATION 2 KALEIDOSCOPE/ANALOOK RAW DATA TABLE

(TOTAL SEQUENCES DO NOT REFLECT TOTAL BATTS)

* MANUAL ID was used for final verification and results.

IN FILE	DURATION	DATE	TIME	HOUR	DATE-12	TIME-12	HOUR-12	MANUAL ID*	AUTO ID	ALTERNATES	PULSES	MATCHING	MATCH RATIO	MARGIN	N	Fc	Sc	Dur	Fmax	Fmin	Fmean	TBC	Fk	Tk	S1	Tc	Qual	
S4U02582_20170801_204753.wav	7.762	01/08/2017	20:47:53	20	01/08/2017	8:47:53		8	EPFULANO	LASNOC	EPTFUS;LASCIN	33	32	0.97	0.433959	33	27.154	9.93	6.551	28.935	26.989	27.694	218.745	27.858	1.95	50.413	5.827	6.02
S4U02582_20170801_205820.wav	4.304	01/08/2017	20:58:20	20	01/08/2017	8:58:20		8	EPFULANO	LASNOC	LASCIN;EPTFUS	16	16	1	0.418948	16	26.648	12.42	6.251	27.702	26.466	26.952	278.578	27.02	2.406	50.101	5.103	4.01
S4U02582_20170801_205826.wav	3.882	01/08/2017	20:58:26	20	01/08/2017	8:58:26		8	EPFULANO	LASNOC	EPTFUS;LASCIN	16	15	0.938	0.432811	16	26.927	-4.21	7.985	29	26.671	27.408	150.346	27.281	2.937	50.195	7.251	4.04
S4U02582_20170801_205904.wav	9.018	01/08/2017	20:59:04	20	01/08/2017	8:59:04		8	EPFULANO	LASNOC	EPTFUS;LASCIN	27	27	1	0.443665	27	27.007	11.44	8.664	29.781	26.805	27.765	334.448	27.859	3.059	91.162	7.961	6.44
S4U02582_20170801_210028.wav	15	01/08/2017	21:00:28	21	01/08/2017	9:00:28		9	EPFULANO	LASNOC	EPTFUS;LASCIN	65	57	0.877	0.453594	65	27.138	16.25	8.715	30.598	26.777	28.002	225.245	28.088	3.185	106.864	7.737	13.3
S4U02582_20170801_210100.wav	6.008	01/08/2017	21:01:00	21	01/08/2017	9:01:00		9	EPFULANO	LASNOC	EPTFUS;LASCIN	24	23	0.958	0.406695	24	26.931	9.88	8.647	28.817	26.687	27.458	244.581	27.478	3.938	71.08	7.807	6.84
S4U02582_20170801_210118.wav	15	01/08/2017	21:01:18	21	01/08/2017	9:01:18		9	LACI	LASNOC	EPTFUS;LASCIN	49	43	0.878	0.405367	49	27.136	11.31	8.182	29.737	26.826	27.855	297.179	27.863	3.215	64.438	7.05	8.6
S4U02582_20170801_210139.wav	12.476	01/08/2017	21:01:39	21	01/08/2017	9:01:39		9	EPFULANO	LASNOC	EPTFUS;LASCIN	53	46	0.868	0.420575	53	27.069	10.73	7.621	29.489	26.844	27.748	232.945	27.829	3.036	73.847	7.017	10.41
S4U02582_20170801_210200.wav	3.716	01/08/2017	21:02:00	21	01/08/2017	9:02:00		9	EPFULANO	LASNOC	EPTFUS;LASCIN	9	8	0.889	0.387208	9	27.354	10.71	6.427	29.728	27.138	28.04	287.558	27.947	2.999	42.159	5.882	2.58
S4U02582_20170801_210214.wav	6.616	01/08/2017	21:02:14	21	01/08/2017	9:02:14		9	EPFULANO	LASNOC	EPTFUS;LASCIN	16	14	0.875	0.431644	16	26.921	10.11	7.586	29.011	26.734	27.531	309.129	27.605	3.055	20.406	6.636	3.06
S4U02582_20170801_210231.wav	9.134	01/08/2017	21:02:31	21	01/08/2017	9:02:31		9	EPFULANO	LASNOC	EPTFUS;LASCIN	33	30	0.909	0.456566	33	27.009	11.56	8.976	31.034	26.789	27.966	281.347	27.905	3.324	128.016	7.942	7.2
S4U02582_20170801_210300.wav	3.644	01/08/2017	21:03:00	21	01/08/2017	9:03:00		9	EPFULANO	LASNOC	LASCIN;EPTFUS	9	9	1	0.425438	9	26.838	5.64	8.71	28.756	26.67	27.407	402.158	27.509	3.662	41.192	8.046	1.9
S4U02582_20170801_210318.wav	14	01/08/2017	21:03:18	21	01/08/2017	9:03:18		9	EPFULANO	LASNOC	EPTFUS;LASCIN	66	56	0.848	0.423789	66	26.979	14.21	8.224	30.278	26.615	27.815	199.553	27.892	3.255	110.714	7.364	14.89
S4U02582_20170801_210350.wav	14.62	01/08/2017	21:03:50	21	01/08/2017	9:03:50		9	LACI & EPFULANO	LASCIN	LASNOC;EPTFUS	85	39	0.459	0.420317	85	23.316	17.32	8.588	28.141	23.108	24.552	167.533	24.151	4.632	125.92	7.969	13.2
S4U02582_20170801_210407.wav	6.434	01/08/2017	21:04:07	21	01/08/2017	9:04:07		9	LACI & EPFULANO	NoID	LASNOC;LASCIN	30	0	0	0	30	24.967	13.55	8.3	28.139	24.677	25.846	179.26	25.674	3.951	117.197	7.406	6.48
S4U02582_20170801_210426.wav	6.904	01/08/2017	21:04:26	21	01/08/2017	9:04:26		9	EPFULANO	LASNOC	EPTFUS;LASCIN	22	21	0.955	0.483971	22	26.725	9.36	10.284	29.892	26.525	27.572	266.691	27.605	4.025	98.112	9.319	3.56
S4U02582_20170801_210435.wav	4.856	01/08/2017	21:04:35	21	01/08/2017	9:04:35		9	EPFULANO	LASNOC	EPTFUS;LASCIN	12	9	0.75	0.393172	12	27.178	12.39	8.29	30.189	26.996	28.065	272.632	27.839	4.648	91.36	7.842	2.72
S4U02582_20170801_210520.wav	8.944	01/08/2017	21:05:20	21	01/08/2017	9:05:20		9	EPFULANO	LASNOC	EPTFUS;LASCIN	31	25	0.806	0.392729	31	27.369	11.48	7.613	30.348	27.06	28.183	287.804	28.111	3.354	100.608	6.72	7.03
S4U02582_20170801_210718.wav	6.736	01/08/2017	21:07:18	21	01/08/2017	9:07:18		9	LACI	LASCIN	EPTFUS	15	15	1	0.777576	15	19.315	10.8	9.674	22.168	19.227	20.056	448.596	19.839	5.269	85.527	8.665	1.99
S4U02582_20170801_210736.wav	8.306	01/08/2017	21:07:36	21	01/08/2017	9:07:36		9	EPFULANO	LASNOC	EPTFUS;LASCIN	29	23	0.793	0.390961	29	27.235	15.5	7.205	30.386	26.958	28.066	249.42	27.953	3.677	96.546	6.535	6.84
S4U02582_20170801_210752.wav	11.756	01/08/2017	21:07:52	21	01/08/2017	9:07:52		9	EPFULANO	LASNOC	EPTFUS;LASCIN	42	35	0.833	0.393697	42	27.123	14.72	6.988	29.996	26.883	27.958	268.453	27.921	3.183	61.261	6.424	7.99
S4U02582_20170801_210824.wav	15	01/08/2017	21:08:24	21	01/08/2017	9:08:24		9	EPFULANO	LASNOC	EPTFUS;LASCIN	70	56	0.8	0.400561	70	27.187	15.11	8.261	31.488	26.85	28.34	216.176	28.148	4.046	119.59	7.453	15.01
S4U02582_20170801_210842.wav	6.472	01/08/2017	21:08:42	21	01/08/2017	9:08:42		9	EPFULANO	LASNOC	EPTFUS;LASCIN	18	12	0.667	0.328562	18	27.297	29.5	5.177	31.202	26.878	28.395	262.491	28.579	2.093	126.7	4.651	3.31
S4U02582_20170801_210939.wav	2.482	01/08/2017	21:09:39	21	01/08/2017	9:09:39		9	EPFULANO	NoID	LASNOC;EPTFUS	6	0	0	0	6	27.112	24.1	6.826	31.806	26.869	28.648	100.976	28.213	3.557	107.817	6.187	1.83
S4U02582_20170801_211034.wav	7.782	01/08/2017	21:10:34	21	01/08/2017	9:10:34		9	EPFULANO	LASNOC	EPTFUS;LASCIN	44	33	0.75	0.370332	44	27.305	24.44	7.54	32.173	27.006	28.605	179.985	28.494	3.42	128.406	6.892	8.93
S4U02582_20170801_211043.wav	15	01/08/2017	21:10:43	21	01/08/2017	9:10:43		9	EPFULANO	LASNOC	EPTFUS;LASCIN	61	55	0.902	0.441757	61	27.064	12.06	9.063	31.394	26.757	28.117	246.585	27.894	4.322	127.404	8.196	9.44
S4U02582_20170801_211146.wav	7.218	01/08/2017	21:11:46	21	01/08/2017	9:11:46		9	EPFULANO	EPTFUS	LASNOC;LASCIN	23	17	0.739	0.31464	23	30.152	78.91	4.173	46.579	29.219	34.884	301.991	32.355	2.364	281.538	3.74	5.04
S4U02582_20170801_211157.wav	3.874	01/08/2017	21:11:57	21	01/08/2017	9:11:57		9	EPFULANO	LASNOC	EPTFUS;LASCIN	12	11	0.917	0.418867	12	27.341	7.89	8.843	30.594	27.156	28.202	341.605	27.925	4.032	125.673	7.626	1.93
S4U02582_20170801_211204.wav	15	01/08/2017	21:12:04	21	01/08/2017	9:12:04		9	EPFULANO	LASNOC	EPTFUS;LASCIN	68	53	0.779	0.407536	68	27.11	18.73	7.873	31.678	26.826	28.316	220.407	28.318	3.044	128.742	7.274	12.22
S4U02582_20170801_211223.wav	2.004	01/08/2017	21:12:23	21	01/08/2017	9:12:23		9	NoID	Noise		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S4U02582_20170801_211244.wav	15	01/08/2017	21:12:44	21	01/08/2017	9:12:44		9	EPFULANO & LABO	LASNOC	EPTFUS	93	37	0.398	0.213702	93	30.444	16.89	7.21	36.266	30.24	31.97	146.971	31.53	3.717	165.71	6.827	19.27
S4U02582_20170801_211320.wav	4.118	01/08/2017	21:13:20	21	01/08/2017	9:13:20		9	EPFULANO	LASNOC	EPTFUS;LASCIN	9	9	1	0.398546	9	26.994	6.52	6.442	28.726	26.805	27.487	341.174	27.335	3.656	107.965	5.856	1.72
S4U02582_20170801_211343.wav	5.85	01/08/2017	21:13:43	21	01/08/2017	9:13:43		9	EPFULANO	EPTFUS	LASNOC;LASCIN	36	35	0.972	0.414755	36	26.603	38.91	6.464	41.783	27.769	31.762	145.968	30.375	3.713	239.801	5.886	5.1
S4U02582_20170801_211409.wav	3.342	01/08/2017	21:14:09	21	01/08/2017	9:14:09		9	EPFULANO	NoID	LASNOC;EPTFUS	15	0	0	0	15	27.521	34.92	4.23	33.915	27.204	29.287	175.293	28.85	2.058	172.06	3.895	3.65
S4U02582_20170801_211442.wav	6.52	01/08/2017	21:14:42	21	01/08/2017	9:14:42		9	EPFULANO	NoID	LASNOC;EPTFUS	24	0	0	0	24	26.612	18.22	7.755	34.122	26.378	28.565	180.514	27.614	4.742	187.528	7.321	4.04
S4U02582_20170801_211700.wav	7.094	01/08/2017	21:17:00	21	01/08/2017	9:17:00		9	EPFULANO	EPTFUS	LASNOC	26	20	0.769	0.316142	26	30.295	55.74	3.258	37.419	29.614	32.234	203.65	31.605	1.788	267.979	2.847	5.76
S4U02582_20170801_211709.wav	9.11	01/08/2017	21:17:09	21	01/08/2017	9:17:09		9	EPFULANO	EPTFUS	LASNOC	58	33	0.569	0.295379	58	30.36	40.05	6.58	48.577	29.482	35.057	127.581	31.751	4.138	349.21	5.959	16
S4U02582_20170801_211721.wav	15	01/08/2017	21:17:21	21	01/08/2017	9:17:21		9	EPFULANO	LASNOC	EPTFUS;LASCIN	84	45	0.536	0.314358	84	29.016	25.77	5.766	36.004	28.516	30.86	175.109	30.127	2.997	203.571	5.253	21.71
S4U02582_20170801_211740.wav	4.244	01/08/2017	21:17:40	21	01/08/2017	9:17:40		9	EPFULANO	LASNOC	EPTFUS;LASCIN	17	15	0.882	0.399946	17	26.803	12.37	6.829	29.056	26.518	27.406	262.006	27.308	3.238	70.967	5.987	3.44
S4U02582_20170801_211756.wav	15	01/08/2017																										

APPENDIX IV

STATION 1 - NIGHTLY BAT COUNTS, WEATHER DATA AND LUNAR PHASES

Appendix IV: Station 2 Nightly Bat Counts, Weather Data and Lunar Phases

Weather obtained from Environment Canada historical weather data.

	Records	MYOTIS	PESU	EPFULANO	LACI	LABO	35KBAT	40KBAT	NoID	Noise	Temp (°C)	Barometer (kPa)	Wind (km/hr)	Moon Phase
AUGUST 1, 2017	01/08/2017													
	8 PM	0	0	0	0	0	0	0	0	0	25	101.60	7	Full Moon
	9 PM	71	2	32	35	0	0	0	2	0	23	101.63	7	Full Moon
	10 PM	29	1	9	19	0	0	0	0	0	21	101.68	7	Full Moon
	11 PM	29	0	7	21	0	0	0	1	0	18	101.65	0	Full Moon
	Date Σ	129	3	48	75	0	0	0	3	0	μ = 21.75	μ = 101.64	μ = 5.25	
	02/08/2017													
	12 AM	22	1	3	16	1	0	0	1	0	17	101.64	0	Full Moon
	1 AM	7	0	3	3	1	0	0	0	0	16	101.61	4	Full Moon
	2 AM	7	3	2	2	0	0	0	0	0	16	101.58	0	Full Moon
AUGUST 2, 2017	3 AM	6	1	0	3	1	0	0	1	0	16	101.59	0	Full Moon
	4 AM	5	1	0	0	4	0	0	0	0	16	101.60	6	Full Moon
	5 AM	73	0	1	68	0	0	0	4	0	15	101.59	6	Full Moon
	Date Σ	120	6	9	96	3	0	0	6	0	μ = 16.0	μ = 101.60	μ = 2.67	
	Entire Night Σ	249	9	57	171	3	0	0	9	0	μ = 18.3	μ = 101.62	μ = 3.7	
	03/08/2017													
	8 PM	0	0	0	0	0	0	0	0	0	23	101.59	6	Full Moon
	9 PM	77	0	60	13	1	0	0	3	0	21	101.63	6	Full Moon
	10 PM	132	3	18	11	2	0	0	3	0	20	101.67	6	Full Moon
	11 PM	30	4	11	11	1	0	0	2	0	17	101.65	0	Full Moon
AUGUST 3, 2017	Date Σ	239	7	89	35	4	0	0	8	0	μ = 20.25	μ = 101.64	μ = 4.5	
	03/08/2017													
	12 AM	16	1	9	3	1	0	0	0	1	17	101.71	4	Full Moon
	1 AM	23	2	7	12	0	0	0	1	0	17	101.73	4	Full Moon
	2 AM	2	0	2	0	0	0	0	0	0	17	101.75	6	Full Moon
	3 AM	18	1	1	10	0	0	0	4	2	17	101.72	6	Full Moon
	4 AM	2	0	0	2	0	0	0	0	0	18	101.71	7	Full Moon
	5 AM	47	0	2	45	0	0	0	0	0	18	101.73	7	Full Moon
	6 AM	0	0	0	0	0	0	0	0	0	17	101.79	4	Full Moon
	Date Σ	108	4	21	72	1	0	0	5	3	μ = 17.29	μ = 101.73	μ = 5.42	
AUGUST 4, 2017	Entire Night Σ	347	11	110	107	5	0	0	13	3	μ = 18.36	μ = 101.70	μ = 5.1	
	03/08/2017													
	8 PM	0	0	0	0	0	0	0	0	0	20	101.62	6	Full Moon
	9 PM	14	0	7	5	0	0	0	1	1	20	101.54	4	Full Moon
	10 PM	22	0	13	5	1	0	0	2	1	20	101.54	7	Full Moon
	11 PM	18	2	2	8	0	0	0	3	1	19	101.47	7	Full Moon
	Date Σ	54	2	22	18	1	0	0	6	3	μ = 19.75	μ = 101.54	μ = 6	
	04/08/2017													
	12 AM	8	0	8	0	0	0	0	0	0	19	101.39	9	Third Quarter
	1 AM	21	2	19	0	0	0	0	0	0	19	101.34	11	Third Quarter
AUGUST 5, 2017	2 AM	20	3	12	3	0	0	0	1	1	19	101.25	13	Third Quarter
	3 AM	6	1	4	1	0	0	0	0	0	19	101.18	13	Third Quarter
	4 AM	8	1	1	5	0	0	0	0	0	19	101.13	19	Third Quarter
	5 AM	23	0	10	11	0	0	0	1	1	19	101.07	13	Third Quarter
	Date Σ	86	7	54	20	0	0	0	2	2	μ = 19	μ = 101.23	μ = 13	
	Entire Night Σ	140	9	76	38	1	0	0	8	5	μ = 19.3	μ = 101.35	μ = 10.2	
	04/08/2017													
	9 PM	18	0	9	6	0	0	0	3	0	19	100.46	19	Third Quarter
	10 PM	10	0	5	4	0	0	0	1	0	18	100.53	15	Third Quarter
	11 PM	11	1	3	6	0	0	0	1	0	17	100.54	7	Third Quarter
AUGUST 6, 2017	Date Σ	39	1	17	16	0	0	0	5	0	μ = 18	μ = 100.51	μ = 13.67	
	05/08/2017													
	12 AM	9	0	4	2	1	0	0	1	1	17	100.53	7	Third Quarter
	1 AM	6	2	4	0	0	0	0	0	0	16	100.53	15	Third Quarter
	2 AM	4	0	0	4	0	0	0	0	0	15	100.55	11	Third Quarter
	3 AM	2	0	0	1	0	0	0	1	0	14	100.51	15	Third Quarter
	4 AM	0	0	0	0	0	0	0	0	0	14	100.48	15	Third Quarter
	5 AM	4	0	7	6	0	0	0	1	0	15	100.47	15	Third Quarter
	Date Σ	25	2	15	13	1	0	0	3	1	μ = 15.17	μ = 100.51	μ = 13.67	
	Entire Night Σ	64	3	32	29	1	0	0	8	1	μ = 16.11	μ = 100.51	μ = 13.22	
AUGUST 7, 2017	05/08/2017													
	8 PM	2	0	0	0	0	0	0	1	1	15	101.52	13	Third Quarter
	9 PM	8	0	2	3	0	0	0	2	1	14	101.53	13	Third Quarter
	10 PM	1	0	0	0	0	0	1	0	0	13	101.57	7	Third Quarter
	11 PM	1	0	0	1	0	0	0	0	0	12	101.56	0	Third Quarter
	Date Σ	10	0	2	4	0	0	1	3	2	μ = 13	μ = 101.55	μ = 6.67	
	06/08/2017													
	12 AM	2	0	0	0	0	0	0	1	1	11	101.55	0	Third Quarter
	1 AM	14	1	0	10	0	0	0	3	0	11	101.57	4	Third Quarter
	2 AM	3	0	0	0	0	0	0	1	2	12	101.56	6	Third Quarter
AUGUST 8, 2017	3 AM	2	1	0	0	0	0	0	1	0	11	101.51	4	Third Quarter
	4 AM	3	0	0	2	0	0	0	1	0	13	101.59	7	Third Quarter
	5 AM	0	0	0	0	0	0	0	0	0	12	101.58	4	Third Quarter
	Date Σ	24	2	0	12	0	0	0	7	3	μ = 11.67	μ = 101.56	μ = 4.17	
	Entire Night Σ	34	2	2	16	0	0	1	10	5	μ = 12.11	μ = 101.56	μ = 5.0	
	06/08/2017													
	8 PM	2	0	0	0	0	0	0	0	0	20	101.65	6	Third Quarter
	9 PM	51	1	33	16	0	0	1	0	0	16	101.67	4	Third Quarter
	10 PM	8	0	3	4	0	0	0	1	0	14	101.70	0	Third Quarter
	11 PM	7	1	1	5	0	0	0	0	0	13	101.71	4	Third Quarter
AUGUST 9, 2017	Date Σ	68	2	37	27	0	0	1	1	0				
	07/08/2017													
	12 AM	3	0	0	3	0	0	0	0	0	13	101.69	4	Third Quarter
	1 AM	6	0	3	3	0	0	0	0	0	13	101.70	0	Third Quarter
	2 AM	4	0	0	3	1	0	0	0	0	12	101.67	0	Third Quarter
	3 AM	5	0	0	4	1	0	0	0	0	11	101.67	0	Third Quarter
	4 AM	3	0	0	2	0	0	0	1	0	11	101.64	0	Third Quarter
	5 AM	6	0	0	6	0	0	0	0	0	10	101.62	0	Third Quarter
	Date Σ	27	0	3	21	2	0	0	1	0	μ = 11.8	μ = 101.66	μ = 0.8	
	Entire Night Σ	95	2	40	48	2	0	1	2	0	μ = 13.56	μ = 101.67	μ = 2.0	
AUGUST 10, 2017	07/08/2017													
	Records													
	MYOTIS													
	PESU													
	EPFULANO													
	LACI													
	LABO													
	35KBAT													
	40KBAT													
	NoID													
	Noise													
	Temp °C													
	Barometer kPa													
	Wind km/hr													
	Moon Phase													

AUGUST 7, 2017	8 PM	1	0	0	0	1	0	0	0	0	0	19	101.49	9	Third Quarter
	9 PM	24	0	0	16	7	1	0	0	0	0	15	101.52	0	Third Quarter
	10 PM	2	1	0	1	0	0	0	0	0	0	13	101.58	0	Third Quarter
	11 PM	4	3	0	0	1	0	0	0	0	0	13	101.57	0	Third Quarter
	Date Σ	31	4	0	17	9	1	0	0	0	0	μ = 15	μ = 101.54	μ = 2.25	
	08/08/2017														
	12 AM	3	2	0	0	0	0	0	1	0	0	12	101.58	0	Third Quarter
	1 AM	1	0	0	0	1	0	0	0	0	0	11	101.58	0	Third Quarter
	2 AM	1	0	0	0	0	0	0	0	1	0	11	101.58	0	Third Quarter
	3 AM	1	0	0	0	1	0	0	0	0	0	11	10.59	0	Third Quarter
AUGUST 8, 2017	4 AM	6	0	0	0	5	0	0	0	1	0	11	101.59	0	Third Quarter
	5 AM	0	0	0	0	0	0	0	0	0	0	10	101.58	0	Third Quarter
	Date Σ	12	2	0	0	7	0	0	1	2	0	μ = 11	μ = 101.58	μ = 0	
	Entire Night Σ	43	6	0	17	16	1	0	1	2	0	μ = 12.78	μ = 101.56	μ = 1	
	Records		MYOTIS	PESU	EPFULANO	LACI	LABO	35KBAT	40KBAT	NoID	Noise	Temp °C	Barometer kPa	Wind km/hr	Moon Phase
	08/08/2017														
	8 PM	0	0	0	0	0	0	0	0	0	0	21	101.67	7	Third Quarter
	9 PM	30	0	0	18	10	0	0	0	2	0	17	101.70	0	Third Quarter
	10 PM	13	1	0	6	6	0	0	0	0	0	16	101.72	4	Third Quarter
	11 PM	9	1	0	7	1	0	0	0	0	0	17	101.71	7	Third Quarter
AUGUST 9, 2017	Date Σ	52	2	0	31	17	0	0	0	2	0	μ = 17.75	μ = 101.7	μ = 45	
	09/08/2017														
	12 AM	2	0	0	0	2	0	0	0	0	0	15	101.74	6	Third Quarter
	1 AM	4	0	0	0	3	0	0	1	0	0	16	101.78	6	Third Quarter
	2 AM	5	1	0	1	1	1	0	0	1	0	15	101.79	4	Third Quarter
	3 AM	4	1	0	0	2	1	0	0	0	0	14	101.83	0	Third Quarter
	4 AM	12	1	0	3	3	0	0	0	3	2	14	101.89	0	Third Quarter
	5 AM	28	0	0	6	18	0	0	0	3	1	14	101.91	6	Third Quarter
	Date Σ	55	3	0	10	29	2	0	1	7	3	μ = 14.67	μ = 101.82	μ = 3.67	
	Entire Night Σ	107	5	0	41	46	2	0	1	9	3	μ = 15.9	μ = 101.78	μ = 4.5	
AUGUST 10, 2017	Records		MYOTIS	PESU	EPFULANO	LACI	LABO	35KBAT	40KBAT	NoID	Noise	Temp °C	Barometer kPa	Wind km/hr	Moon Phase
	09/08/2017														
	8 PM	4	0	0	3	1	0	0	0	0	0	21	102.09	6	Third Quarter
	9 PM	31	2	0	19	8	1	0	0	1	0	18	102.15	4	Third Quarter
	10 PM	19	0	0	9	8	0	0	1	1	0	15	102.18	0	Third Quarter
	11 PM	10	1	0	4	4	0	0	0	1	0	15	102.19	4	Third Quarter
	Date Σ	64	3	0	35	21	1	0	1	3	0	μ = 17.25	μ = 102.15	μ = 3.5	
	10/08/2017														
	12 AM	16	0	0	7	9	0	0	0	0	0	14	102.19	4	Third Quarter
	1 AM	17	0	0	2	15	0	0	0	0	0	14	102.20	0	Third Quarter
AUGUST 10, 2017	2 AM	4	1	0	0	1	0	0	0	1	1	13	102.20	0	Third Quarter
	3 AM	6	0	0	2	3	0	0	0	1	0	12	102.16	0	Third Quarter
	4 AM	2	0	0	2	0	0	0	0	0	0	12	102.15	0	Third Quarter
	5 AM	1	0	0	1	0	0	0	0	0	0	12	102.14	4	Third Quarter
	Date Σ	46	1	0	14	28	0	0	0	2	1	μ = 12.83	μ = 102.17	μ = 1.33	
	Entire Night Σ	110	4	0	49	49	1	0	1	5	1	μ = 14.6	μ = 102.17	μ = 2.2	
	Records		MYOTIS	PESU	EPFULANO	LACI	LABO	35KBAT	40KBAT	NoID	Noise	Temp °C	Barometer kPa	Wind km/hr	Moon Phase
	10/08/2017														
	8 PM	0	0	0	0	0	0	0	0	0	0	22	101.90	6	Third Quarter
	9 PM	15	0	0	14	1	0	0	0	0	0	21	101.87	6	Third Quarter
AUGUST 10, 2017	10 PM	7	0	0	5	0	0	0	0	1	1	19	101.87	6	Third Quarter
	11 PM	14	2	0	7	4	1	0	0	0	0	18	101.85	7	Third Quarter
	Date Σ	36	2	0	26	5	1	0	0	1	1	μ = 20	μ = 101.87	μ = 6.25	
	11/08/2017														
	12 AM	17	0	0	7	9	0	0	0	1	0	17	101.81	6	No Moon
	1 AM	14	0	0	8	6	0	0	0	0	0	15	101.83	4	No Moon
	2 AM	6	1	0	3	2	0	0	0	0	0	16	101.77	6	No Moon
	3 AM	6	0	0	0	5	0	0	0	1	0	16	101.70	6	No Moon
	4 AM	5	0	0	0	5	0	0	0	0	0	16	101.68	6	No Moon
	5 AM	16	1	0	0	13	0	0	0	2	0	16	101.69	6	No Moon
	Date Σ	64	2	0	18	40	0	0	0	4	0	μ = 16	μ = 101.75	μ = 5.67	
	Entire Night Σ	100	4	0	44	45	1	0	0	5	1	μ = 17.6	μ = 101.80	μ = 5.9	
	All Records Σ	1289	55	6	468	565	17	0	5	70	18				
	% of Noise Records	1.40%													
	% of NoID Records	5.43%													
	% of Call ID	93.17%													

APPENDIX V

STATION 2 - NIGHTLY BAT COUNTS, WEATHER DATA AND LUNAR PHASES

Appendix V: Station 2 Nightly Bat Counts, Weather Data and Lunar Phases

Weather obtained from Environment Canada historical weather data.

		AUGUST 1, 2017													
		Records	MYOTIS	PESU	EPFULANO	LACI	LABO	35KBAT	40KBAT	NoID	Noise	Temp (°C)	Barometer (kPa)	Wind (km/hr)	Moon Phase
	01/08/2017														
	8 PM	4	0	0	4	0	0	0	0	0	0	25	101.60	7	Full Moon
	9 PM	112	2	0	87	18	2	2	0	0	1	23	101.63	7	Full Moon
	10 PM	60	2	0	35	20	1	0	0	0	2	21	101.68	7	Full Moon
	11 PM	43	3	0	22	15	1	0	0	1	1	18	101.65	0	Full Moon
	Date Σ	219	7	0	148	53	4	2	0	1	4	μ = 21.75	μ = 101.64	μ = 5.25	
	02/08/2017														
	12 AM	13	3	1	2	5	1	0	1	0	0	17	101.64	0	Full Moon
	1 AM	11	2	0	5	2	2	0	0	0	0	16	101.61	4	Full Moon
	2 AM	18	2	0	7	8	1	0	0	0	0	16	101.58	0	Full Moon
	3 AM	13	1	0	4	5	1	0	0	1	1	16	101.59	0	Full Moon
	4 AM	12	0	0	10	2	0	0	0	3	0	16	101.60	6	Full Moon
	5 AM	40	0	0	36	0	1	0	0	0	1	15	101.59	6	Full Moon
	Date Σ	107	8	1	64	22	6	0	1	4	2	μ = 16.0	μ = 101.60	μ = 2.67	
	Entire Night Σ	326	15	1	212	75	10	2	1	5	6	μ = 18.3	μ = 101.62	μ = 3.7	
	02/08/2017														
	8 PM	3	0	0	3	0	0	0	0	0	0	23	101.59	6	Full Moon
	9 PM	137	2	0	117	15	2	0	0	0	1	21	101.63	6	Full Moon
	10 PM	132	0	0	90	37	4	0	0	2	1	20	101.67	6	Full Moon
	11 PM	44	2	0	20	19	1	0	0	2	0	17	101.65	0	Full Moon
	Date Σ	316	4	0	230	71	7	0	0	4	2	μ = 20.25	μ = 101.64	μ = 4.5	
	03/08/2017														
	12 AM	16	4	1	5	5	0	0	1	0	0	17	101.71	4	Full Moon
	1 AM	33	6	0	14	6	2	1	3	0	2	17	101.73	4	Full Moon
	2 AM	4	1	0	1	2	0	0	0	0	0	17	101.75	6	Full Moon
	3 AM	11	5	0	1	0	4	0	0	0	1	17	101.72	6	Full Moon
	4 AM	24	4	0	8	6	2	0	1	3	2	18	101.71	7	Full Moon
	5 AM	33	3	0	22	4	3	0	0	1	0	18	101.73	7	Full Moon
	6 AM	2	0	0	0	0	0	0	0	0	2	17	101.79	4	Full Moon
	Date Σ	123	23	1	51	23	11	1	5	4	7	μ = 17.29	μ = 101.73	μ = 5.42	
	Entire Night Σ	439	27	1	281	94	18	1	5	8	9	μ = 18.36	μ = 101.70	μ = 5.1	
	03/08/2017														
	8 PM	1	0	0	1	0	0	0	0	0	0	20	101.62	6	Full Moon
	9 PM	196	10	0	144	24	14	0	1	2	0	20	101.54	4	Full Moon
	10 PM	129	12	0	89	19	5	1	1	1	1	20	101.54	7	Full Moon
	11 PM	82	12	0	51	10	6	1	0	2	1	19	101.47	7	Full Moon
	Date Σ	408	34	0	285	53	25	2	2	5	2	μ = 19.75	μ = 101.54	μ = 6	
	04/08/2017														
	12 AM	52	1	1	29	19	0	0	0	2	0	19	101.39	9	Third Quarter
	1 AM	72	23	0	30	7	7	0	2	3	0	19	101.34	11	Third Quarter
	2 AM	143	92	2	31	8	6	0	0	3	1	19	101.25	13	Third Quarter
	3 AM	75	19	1	32	12	7	0	4	0	0	19	101.18	13	Third Quarter
	4 AM	38	12	0	14	1	8	1	0	0	2	19	101.13	19	Third Quarter
	5 AM	163	2	2	137	3	17	0	1	1	0	19	101.07	13	Third Quarter
	Date Σ	543	149	6	273	50	45	1	7	9	3	μ = 19	μ = 101.23	μ = 13	
	Entire Night Σ	951	183	6	558	103	70	3	9	14	5	μ = 19.3	μ = 101.35	μ = 10.2	
	04/08/2017														
	9 PM	132	5	0	113	7	2	0	2	1	1	19	100.46	19	Third Quarter
	10 PM	102	2	0	45	50	3	0	1	0	1	18	100.53	15	Third Quarter
	11 PM	69	0	0	59	7	0	0	2	1	0	17	100.54	7	Third Quarter
	Date Σ	303	7	0	217	64	5	0	5	2	2	μ = 18	μ = 100.51	μ = 13.67	
	05/08/2017														
	12 AM	35	8	0	17	4	2	0	0	3	1	17	100.53	7	Third Quarter
	1 AM	28	13	0	5	8	0	1	0	0	1	16	100.53	15	Third Quarter
	2 AM	36	23	0	3	6	2	0	2	0	0	15	100.55	11	Third Quarter
	3 AM	9	7	0	0	2	0	0	0	0	0	14	100.51	15	Third Quarter
	4 AM	8	6	1	0	0	1	0	0	0	0	14	100.48	15	Third Quarter
	5 AM	4	0	0	3	1	0	0	0	0	0	15	100.47	15	Third Quarter
	Date Σ	120	57	1	28	21	5	1	2	3	2	μ = 15.17	μ = 100.51	μ = 13.67	
	Entire Night Σ	423	64	1	245	85	10	1	7	5	4	μ = 16.11	μ = 100.51	μ = 13.22	
	05/08/2017														
	9 PM	25	3	0	17	2	2	0	0	1	0	14	101.53	13	Third Quarter
	10 PM	6	3	0	2	0	1	0	0	0	0	13	101.57	7	Third Quarter
	11 PM	4	2	0	0	0	2	0	0	0	0	12	101.56	0	Third Quarter
	Date Σ	35	8	0	19	2	5	0	0	1	0	μ = 13	μ = 101.55	μ = 6.67	
	06/08/2017														
	12 AM	4	1	0	0	1	0	0	0	1	1	11	101.55	0	Third Quarter
	1 AM	1	0	0	0	1	0	0	0	0	0	11	101.57	4	Third Quarter
	2 AM	2	1	0	0	0	1	0	0	0	0	12	101.56	6	Third Quarter
	3 AM	1	0	0	0	1	0	0	0	0	0	11	101.51	4	Third Quarter
	4 AM	6	0	0	1	3	0	0	1	0	1	13	101.59	7	Third Quarter
	5 AM	1	0	0	0	0	1	0	0	0	0	12	101.58	4	Third Quarter
	Date Σ	15	2	0	1	6	2	0	1	1	2	μ = 11.67	μ = 101.56	μ = 4.17	
	Entire Night Σ	50	10	0	20	8	7	0	1	2	2	μ = 12.11	μ = 101.56	μ = 5.0	
	06/08/2017														
	8 PM	9	0	0	9	0	0	0	0	0	0	20	101.65	6	Third Quarter
	9 PM	97	6	0	51	28	6	1	0	5	0	16	101.67	4	Third Quarter
	10 PM	33	1	0	16	16	0	0	0	0	0	14	101.70	0	Third Quarter
	11 PM	22	0	0	15	5	2	0	0	0	0	13	101.71	4	Third Quarter
	Date Σ	161	7	0	91	49	8	1	0	5	0				
	07/08/2017														
	12 AM	9	0	0	1	5	2	0	0	1	0	13	101.69	4	Third Quarter
	1 AM	23	0	0	0	19	1	0	0	1	2	13	101.70	0	Third Quarter
	2 AM	3	0	0	0	2	1	0	0	0	0	12	101.67	0	Third Quarter
	4 AM	1	0	0	1	0	0	0	0	0	0	11	101.64	0	Third Quarter
	5 AM	3	1	0	0	0	2	0	0	0	0	10	101.62	0	Third Quarter
	Date Σ	39	1	0	2	26	6	0	0	2	2	μ = 11.8	μ = 101.66	μ = 0.8	
	Entire Night Σ	200	8	0	93	75	14	1	0	7	2	μ = 13.56	μ = 101.67	μ = 2.0	
	07/08/2017														
	8 PM	6	0	0	6	0	0	0	0	0	0	19	101.49	9	Third Quarter
	9 PM	38	3	0	22	7	4	0	0	1	1	15	101.52	0	Third Quarter
	10 PM	12	4	0	5	3	0	0	0	0	0	13	101.58	0	Third Quarter
	11 PM	4	2	0	2	0	0	0	0	0	0	13	101.57	0	Third Quarter
	Date Σ	60	9	0	35	10	4	0	0	1	1	μ = 15	μ = 101.54	μ = 2.25	

AUGUST	08/08/2017	12 AM	3	1	0	2	0	0	0	0	0	12	101.58	0	Third Quarter	
		1 AM	1	1	0	0	0	0	0	0	0	11	101.58	0	Third Quarter	
		2 AM	2	0	0	1	0	0	0	0	0	11	101.58	0	Third Quarter	
		4 AM	2	0	0	0	1	1	0	0	0	11	101.59	0	Third Quarter	
		5 AM	3	1	0	0	2	0	0	0	0	10	101.58	0	Third Quarter	
		Date Σ	11	3	0	3	3	1	0	0	0	1	μ = 11	μ = 101.58	μ = 0	
		Entire Night Σ	71	12	0	38	13	5	0	0	1	2	μ = 12.78	μ = 101.56	μ = 1	
AUGUST 8, 2017		Records	MYOTIS	PESU	EPFULANO	LACI	LABO	35KBAT	40KBAT	NoID	Noise	Temp °C	Barometer kPa	Wind km/hr	Moon Phase	
	08/08/2017	8 PM	2	0	0	2	0	0	0	0	0	21	101.67	7	Third Quarter	
		9 PM	97	5	0	77	6	6	0	0	2	1	17	101.70	0	Third Quarter
		10 PM	72	5	1	52	12	2	0	0	0	0	16	101.72	4	Third Quarter
		11 PM	66	13	0	40	2	4	0	5	2	0	17	101.71	7	Third Quarter
		Date Σ	237	23	1	171	20	12	0	5	4	1	μ = 17.75	μ = 101.7	μ = 45	
	09/08/2017	12 AM	39	11	0	17	4	0	0	2	3	2	15	101.74	6	Third Quarter
		1 AM	25	10	0	10	2	0	0	0	2	1	16	101.78	6	Third Quarter
		2 AM	35	9	0	18	3	2	0	2	0	1	15	101.79	4	Third Quarter
		3 AM	18	10	0	4	1	1	0	0	2	0	14	101.83	0	Third Quarter
		4 AM	13	7	0	1	3	1	0	0	1	0	14	101.89	0	Third Quarter
		5 AM	30	3	1	12	12	2	0	0	0	0	14	101.91	6	Third Quarter
		Date Σ	160	50	1	62	25	6	0	4	8	4	μ = 14.67	μ = 101.82	μ = 3.67	
		Entire Night Σ	397	73	2	233	45	18	0	9	12	5	μ = 15.9	μ = 101.78	μ = 4.5	
AUGUST 9, 2017		Records	MYOTIS	PESU	EPFULANO	LACI	LABO	35KBAT	40KBAT	NoID	Noise	Temp °C	Barometer kPa	Wind km/hr	Moon Phase	
	09/08/2017	8 PM	12	0	0	10	1	0	0	0	1	21	102.09	6	Third Quarter	
		9 PM	119	5	0	83	14	9	1	1	4	1	18	102.15	4	Third Quarter
		10 PM	48	0	0	40	8	0	0	0	0	0	15	102.18	0	Third Quarter
		11 PM	23	4	0	9	6	2	0	1	0	1	15	102.19	4	Third Quarter
		Date Σ	202	9	0	142	29	11	1	2	4	3	μ = 17.25	μ = 102.15	μ = 3.5	
	10/08/2017	12 AM	5	1	0	2	2	0	0	0	0	14	102.19	4	Third Quarter	
		1 AM	4	0	0	0	1	1	0	0	1	0	14	102.20	0	Third Quarter
		2 AM	8	0	0	3	4	1	0	0	0	0	13	102.20	0	Third Quarter
		3 AM	7	0	0	2	3	2	0	0	0	0	12	102.16	0	Third Quarter
		4 AM	4	0	0	2	2	0	0	0	0	0	12	102.15	0	Third Quarter
		5 AM	5	0	0	1	2	0	0	0	1	0	12	102.14	4	Third Quarter
		Date Σ	33	1	0	10	14	4	0	0	2	0	μ = 12.83	μ = 102.17	μ = 1.33	
		Entire Night Σ	235	10	0	152	43	15	1	2	6	3	μ = 14.6	μ = 102.17	μ = 2.2	
AUGUST 10, 2017		Records	MYOTIS	PESU	EPFULANO	LACI	LABO	35KBAT	40KBAT	NoID	Noise	Temp °C	Barometer kPa	Wind km/hr	Moon Phase	
	10/08/2017	8 PM	15	0	0	7	1	6	0	0	0	1	22	101.90	6	Third Quarter
		9 PM	170	10	1	119	27	11	0	1	1	0	21	101.87	6	Third Quarter
		10 PM	156	9	0	111	29	4	0	0	3	0	19	101.87	6	Third Quarter
		11 PM	195	14	0	104	67	3	0	4	1	2	18	101.85	7	Third Quarter
		Date Σ	536	33	1	341	124	24	0	5	5	3	μ = 20	μ = 101.87	μ = 6.25	
	11/08/2017	12 AM	127	12	0	48	61	4	0	0	2	0	17	101.81	6	No Moon
		1 AM	23	7	0	6	7	2	0	0	1	0	15	101.83	4	No Moon
		2 AM	16	4	0	8	3	1	0	0	0	0	16	101.77	6	No Moon
		3 AM	49	2	0	5	33	4	0	0	5	0	16	101.70	6	No Moon
		4 AM	7	0	0	1	4	0	0	2	2	4	16	101.68	6	No Moon
		5 AM	38	1	4	12	15	4	0	0	2	0	16	101.69	6	No Moon
		Date Σ	260	26	4	80	123	15	0	2	12	4	μ = 16	μ = 101.75	μ = 5.67	
		Entire Night Σ	796	59	5	421	247	39	0	7	17	7	μ = 17.6	μ = 101.80	μ = 5.9	
	All Records Σ	3888	461	16	2253	788	206	9	41	77	45					
	% of Noise Records	1.16%														
	% of NoID Records	1.98%														
	% of Call ID	96.86%														

Appendix G

Herpetofauna List

APPENDIX G Herpetozoa Status Report

Project ID: 10-015

Herpetozoa (amphibian and reptile) species observed by GHD are listed by class then by family taxonomic grouping. These species are identified by the common and scientific name used by the Natural heritage information Centre (NHIC). Any significant status for a species on national and provincial lists is displayed as well as those from relevant regional lists.

List Status :	END - endangered	A wildlife species facing imminent extirpation or extinction.
	END-R -endangered regulated	A wildlife species facing imminent extirpation or extinction in Ontario which has been regulated under Ontario's Endangered Species Act (ESA).
	THR - threatened	A wildlife species likely to become endangered if limiting factors are not reversed.
	SC - special concern	A wildlife species that may become threatened or an endangered species because of a combination of biological characteristics and identified threats.
	YES - Area Sensitive	A wildlife species that requires large areas of suitable habitat in order to sustain their population numbers.
* Other status levels are not displayed		

List Sources:	COSEWIC	The Committee on the Status of Endangered Wildlife in Canada, October, 2021.
	COSSARO	The Committee on the Status of Species at Risk in Ontario, January, 2021.
	SARA	Species At Risk Act, Schedule 1, Government of Canada, 2022.
	Area Sensitive	Significant Wildlife Technical Guide, Appendix C, OMNR, Oct. 2000

Amphibian

Common Name	Scientific Name	COSEWIC	COSSARO	SARA	Area Sensitive
Newts and Old World Salamander	<i>Salamandridae</i>				
Red-spotted Newt	<i>Notophthalmus viridescens viride</i>				No
Lungless Salamanders	<i>Plethodontidae</i>				
Eastern Red-backed Salamander	<i>Plethodon cinereus</i>				No
Toads	<i>Buфонidae</i>				
American Toad	<i>Anaxyrus americanus</i>				No
Treefrogs	<i>Hylidae</i>				
Spring Peeper	<i>Pseudacris crucifer</i>				No
Gray Treefrog	<i>Hyla versicolor</i>				No
True Frogs	<i>Ranidae</i>				
Wood Frog	<i>Lithobates sylvatica</i>				No
Northern Leopard Frog	<i>Lithobates pipiens</i>				No
Mink Frog	<i>Lithobates septentrionalis</i>				No
Green Frog	<i>Lithobates clamitans</i>				No
American Bullfrog	<i>Lithobates catesbeiana</i>				Yes
No. of Species Observed:	10	0	0	0	1

Reptiles

Common Name	Scientific Name	COSEWIC	COSSARO	SARA	Area Sensitive
Typical Snakes	<i>Colubridae</i>				
Smooth Greensnake	<i>Opheodrys vernalis</i>				No
Northern Red-bellied Snake	<i>Storeria occipitomaculata occipito</i>				No
Eastern Ribbonsnake	<i>Thamnophis sauritus</i>	SC	SC	SC	No
Common Gartersnake	<i>Thamnophis sirtalis</i>				No
No. of Species Observed:	4	1	1	1	0

No. of Species Observed in Projec 14

Appendix H

Mammals

APPENDIX H Mammal Status Report

Mammal species observed by GHD are listed. These species are identified by the common and scientific name used by the Natural heritage information Centre (NHIC). Any significant status for a species on national and provincial lists is displayed as well as those from relevant regional lists.

List Status :	END - endangered	A wildlife species facing imminent extirpation or extinction.
	END-R -endangered regulated	A wildlife species facing imminent extirpation or extinction in Ontario which has been regulated under Ontario's Endangered Species Act (ESA).
	THR - threatened	A wildlife species likely to become endangered if limiting factors are not reversed.
	SC - special concern	A wildlife species that may become threatened or an endangered species because of a combination of biological characteristics and identified threats.
	YES - Area Sensitive	A wildlife species that requires large areas of suitable habitat in order to sustain their population numbers.
* Other status levels are not displayed		

List Sources:	COSEWIC	The Committee on the Status of Endangered Wildlife in Canada, 2023.
	COSSARO	The Committee on the Status of Species at Risk in Ontario, 2024.
	SARA	Species At Risk Act, Schedule 1, Government of Canada, 2023.
	Area Sensitive	Significant Wildlife Technical Guide, Appendix C, OMNR, Oct. 2000

Common Name	Scientific Name	COSEWIC	COSSARO	SARA	Area Sensitive
White-tailed Deer	<i>Odocoileus virginianus</i>				No
Red Squirrel	<i>Tamiasciurus hudsonicus</i>				No
Red Fox	<i>Vulpes vulpes</i>				No
Moose	<i>Alces alces</i>				Yes
Long-tailed Weasel	<i>Mustela frenata</i>				No
Eastern Chipmunk	<i>Tamias striatus</i>				No
Coyote	<i>Canis latrans</i>				No
Common Raccoon	<i>Procyon lotor</i>				No
Common Porcupine	<i>Erethizon dorsatum</i>				No
Black Bear	<i>Ursus americanus</i>				No
American Beaver	<i>Castor canadensis</i>				No
No. of Species Observed in Project	11	0	0	0	1

Appendix I

Significant Wildlife Habitat

Appendix IX: Candidate Significant Wildlife Habitat-EcoRegion 6E

Candidate Significant Wildlife Habitat- Eco-Region 6E			
Wildlife Habitat	Present in or within 120m of proposed license	Rationale	Carried forward to determine Confirmed SWH through field visit.
Waterfowl Stopover and Staging Areas (Terrestrial)	No	No ELC Ecosite Codes relevant to this wildlife habitat	No
Waterfowl Stopover and Staging Areas (Aquatic)	Yes	Two ELC Ecosite Codes relevant to this property (MAM3 & SWD)	Yes
Shorebird Migratory Stopover Area	No	No ELC Ecosite Codes relevant to this wildlife habitat	No
Raptor Wintering Area	No	Study area does not contain any field communities suitable for Raptor wintering areas	No
Bat Hibernacula	No	No observed caves, horizontal mine shafts or limestone bedrock present within the study area	No
Maternity Colonies	No	Forests present are early successional forests with no dominant trees greater than 80 years	No
Bat Migratory Stopover Area	No	No records	No
Turtle Wintering Areas	Possible	Contains suitable habitat for turtle wintering areas within wetland community 1	Yes
Reptile Hibernaculum	Possible	Rock barren present including areas of broken rock, wetlands	Yes
Colonial-Nesting Bird Breeding Habitat (Bank and Cliff)	No	No soil or sand banks, cliffs were made of rock	No
Colonially-Nesting Bird Breeding Habitat (Tree/Shrubs)	Possible	ELC Ecosite Codes relevant to this wildlife habitat (SWD)	Yes
Colonially-Nesting Bird Breeding Habitat (Ground)	No	Not located on an island or peninsula	No
Deer Yarding Areas	Yes	ELC Ecosite Codes relevant to this wildlife habitat within communities 6,9,14 & 16	No
Migratory Butterfly Stopover	No	No large open field meadows with milkweed	No
Land Bird Migratory Stopover	No	Not within 5km of Lake Ontario	No
Deer Winter Congregation Area	Possible	Potential for Deer yard therefore possible Winter Congregation Area	Yes
Cliffs and Talus Slopes	No	No ELC Ecosite Codes relevant	No

		to this wildlife habitat	
Sand Barren	No	No ELC Ecosite Codes relevant to this wildlife habitat	No
Alvar	No	No ELC Ecosite Codes relevant to this wildlife habitat	No
Old Growth Forest	No	No ELC Ecosite Codes relevant to this wildlife habitat	No
Tall Grass Prairie	No	No ELC Ecosite Codes relevant to this wildlife habitat	No
Savannah	No	No ELC Ecosite Codes relevant to this wildlife habitat	No
Waterfowl Nesting Area	No	No large diameter trees, forests present in early succession	No
Bald Eagle and Osprey Nesting, Foraging and Perching Habitat	No	Pond and wetlands and forested area located within the study area however no super canopy trees	No
Woodland Raptor Nesting Habitat	Yes	Greater than 30 ha of SWC and SWD with at least 10 ha of interior habitat	Yes
Turtle and Lizard Nesting Areas	Possible	Limited sand and gravel for turtle nesting, however wetlands exist	Yes
Seeps and Springs	No	No Seeps or Springs	No
Amphibian Breeding Habitat (Woodland)	Possible	Presence of a wetland and pond >500m ² adjacent a woodland	Yes
Amphibian Breeding Habitat (Wetland)	No	wetlands are closer than 120m to woodlands	No
Mast Producing Areas	No	No mast producing tree species	No
Marsh Bird Breeding Habitat	Possible	Wetlands found within study area	Yes
Open Country Bird Breeding Habitat	No	No large grasslands present within the study area	No
Shrub/Early Successional Bird Habitat	No	No ELC Ecosite Codes relevant to this wildlife habitat	No
Special Concern and Rare Wildlife Species	Possible	Special concern species found on property	Yes
Amphibian Movement Corridor	Possible	Possible amphibian breeding areas	Yes
Deer Movement Corridor	Possible	Possible Deer wintering habitat	Yes

Appendix J

Aquatic Habitat Assessment

Appendix J



Table 1 Aquatic Habitat Observations and Survey Type (2012, 2013 and 2014)

Site #	Collection Date	Survey Type (*)	Substrate Composition	Percent In-stream Cover	Riparian Habitat Cover	Average Wetted Width (m)	Average Depth (m)	Direct or Indirect Habitat
1	June 3 and 4, 2012	FC	50% sand 20% clay 30% fine organics	5% large woody debris 5% overhanging vegetation	30% shrubs	1.5	0.43	Direct
	Oct 24,2012	BC & WQ						
	June 4, 2013	WQ						
2	Oct. 24, 2012	BC	50% gravel 20% sand 20% detritus	5% submergent vegetation 5% emergent vegetation 15% undercut banks	5% shrubs 5% woody debris 10% undercut banks	7.5	0.50	Direct
		WQ						
	Oct. 15, 2014	BC						
3	Oct. 24, 2012	BS & WQ	10% sand 80% fine organics 10% vegetation	60% emergent vegetation	5% dead trees 2% shrubs 2% woody debris	30	0.35	Direct
	June 3 and 4, 2013	FC						
	June 4, 2013	WQ						
4	June 3 and 4, 2013	FC	50% fine organics 50% detritus	80% algae	20% tree stumps	3.5	0.69	Direct
	June 4, 2013	WQ						
5	June 4, 2013	FC	70% clay 30% detritus	10% vegetation 30% algae	2% shrubs	3.5	0.46	Direct
		WQ						
6	June 3 and 4, 2013	FC	100% sand	15% emergent vegetation	10% trees 5% terrestrial vegetation	2.2	0.13	Direct
	June 4. 2013	WQ						
7	June 3 and 4, 2013	FC	20% sand 40% clay 20% silt 20% fine organics	2% submergent vegetation 1% emergent vegetation 1% boulders 1% undercut banks	2% trees 10% shrubs 3% non woody vegetation 1% undercut banks	4.0	0.3	Direct
	June 4, 2013	WQ						
Note: * FC=Fish Community, BC=Benthic Collection and WQ=Water Quality								

Appendix K

Fish Community Assessment

Appendix K



Table 1 Fish Community Sampling, Gear, Dates, Efforts and Catch by Site (June 3rd & 4th 2013)

Family Name	Common Name	Scientific Name	Site 1 Sample 1	Site 3 Sample 1	Site 4 Sample 1	Site 5 Sample 1	Site 6 Sample 1	Site 6 Sample 2	Site 6 Sample 3	Site 7 Sample 1
Centrarchidae	Pumpkinseed	<i>Lepomis gibbosus</i>	1	0	0	0	0	0	0	0
Cyprinidae	Brassy Minnow	<i>Hybognathus hankinsoni</i>	0	4	0	0	0	0	0	8
	Creek Chub	<i>Semotilus atromaculatus</i>	0	0	0	0	0	2	0	1
	Northern Redbelly Dace	<i>Chrosomus neogaeus</i>	1	3	0	10	0	0	0	0
Gasterosteidae	Brook Stickleback	<i>Culaea inconstans</i>	0	0	1	10	0	0	0	0
Umbridae	Central Mudminnow	<i>Umbra limi</i>	0	0	0	10	0	0	0	0
Catch Summary										
		Abundance	2	7	1	30	0	2	0	9
		Species Diversity	2	2	1	3	0	1	0	2
Environmental Conditions										
		Air Temperature (°C)	24.0	15	19	19	15.4	15.5	15.4	18
		Stream Temperature (°C)	21.4	13.7	14.5	18.5	23.4	21.8	23.4	23.1
Sample Attributes										
Seine (SN), Minnow Trap (MT), Hoop Net (HN), Mini Hoop Net (MFN)		Gear Type	MT	HN	MT	MHN	SN	MHN	SN	SN
		Gear Details	16'5", 21" opening, 1.5"	40' x 5'	16'5", 21" opening, 1.5"	5' wings 1/4" mesh	15' x 4'	5' wings 1/4" mesh	15' x 4'	15' x 4'
		Site Length (m)	N/A	12	N/A	3	5	3	3	5
		Average Wetted Width (m)	1.5	1.5	3.5	1.5	1.5	1.5	1.5	4
		Average Depth (m)	0.43	1.0	0.69	0.5	0.3	0.3	0.3	0.25

Table 4 Fish Species Habitat Preferences (Becker, 1983) (Scott & Crossman, 1973).

Common Name	Scientific Name	Thermal Regime	Preferred Temp	Spawning Temp	Time Of Spawning	Spawning/Nesting Description
Brassy Minnow	<i>Hybognathus hankinsoni</i>	warm	26 °C	14-29 °C	May-July	no nests are constructed, eggs are deposited and fertilized on aquatic vegetation sometimes in flooded marshes
Northern Redbelly Dace	<i>Phoxinus eos</i>	cool	25.3 °C	13-21 °C	June-August	no nest are constructed, eggs are deposited and fertilized on filamentous algae
Creek Chub	<i>Semotilus atromaculatus</i>	cool	unknown	13-17 °C	May-July	trench like nest 25-30 cm wide 76 cm long excavated in fine gravel
Brook Stickleback	<i>Culaea inconstans</i>	cool	23.8 °C	20-27 °C	June-August	globular nests 1.5-5 cm diameter, constructed of organic debris, filamentous algae and/or other materials by the male
Central Mudminnow	<i>Umbra limi</i>	warm	29 °C	16-29 °C	May-August	no nest are constructed, eggs are laid directly on leaves of plants in flooded areas
Pumpkinseed	<i>Lepomis gibbosus</i>	warm	18-24°C	20-28 °C	May-August	pit nest 10-40 cm in diameter excavated by males

Appendix L

Benthos Data

Appendix L

Table X *Benthos Habitat for Site 1, Site 2 and Site 3 (24-Oct-12 & 15-Oct-14).*

Sampling Year	2012			2012		2012			2014		
Site	1			2		3					
Sample	1			1		1			2		
Sub Sample	A	B	C	A/B (1)	A/B (2)	A	B	C	A	B	C
Air Temp °C	12	12	12	13.8	13.8	12.7	12.7	12.7	15.3	15.3	15.3
Water Temp °C	10.7	10.7	10.7	10.2	10.2	10.9	10.9	10.9	15.5	15.5	15.5
Max Depth (m)	0.11	0.20	0.23	0.50	0.5	0.33	0.41	0.29	0.32	0.56	0.34
Wetted Width (m)	2.25	2.65	1.55	8.90	6.80	N/A (wetland)			N/A (wetland)		
Average Velocity (m/sec)	0.25	0.32	0.4	0.04	0.05	0	0	0	0	0	0
Gear Type	kick net			D-net		D-net			D-net		
Sample Method	stationary kick			travelling kick		stationary kick			travelling kick		
Habitat Type	Riffle			Run		Wetland			Wetland		
Dominate Substrate (mm)	Sand (0.06-2)	Cobble (65-250)	Cobble (65-250)	Gravel (2-65)	Detritus (<0.002)	Silt (<0.06-2)	Silt (<0.06-2)	Silt (<0.06-2)	Silt (<0.06-2)	Silt (<0.06-2)	Silt (<0.06-2)
2 nd Dominate Substrate	Cobble (65-250)	Gravel (2-65)	Gravel (2-65)	Sand (0.06-2)	Silt (<0.06-2)	Clay (<0.002)	Clay (<0.002)	Clay (<0.002)	Sand (0.06-2)	Sand (0.06-2)	Sand (0.06-2)
Canopy Cover (%)	0-24	0-24	25-49	0-24	0-24	0-24	0-24	0-24	0-24	0-24	0-24
Sample Area	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	5.7	6.5	5.5
Sample Time (sec)	180	180	180	180	180	120	120	120	180	180	180

Appendix M

Benthos Raw Data

Appendix M

Table 1 Benthos Raw Abundance Data and Community Analysis from Grass Lake Tributary (24-Oct-12 & 15-Oct-14).

Sampling Year	2012			2012		2012			2014			Hilsenhoff Tolerance Value
Site Code	1			2		3						
Sample	1			1		1			2			
SubSample	A	B	C	A/B (1)	A/B (2)	A	B	C	A	B	C	
Amphipoda (Scuds)												
Crangonyctidae	0	0	0	0	22	0	0	0	0	0	0	4
Gammaridae	0	0	0	23	23	0	0	0	0	0	0	4
Hyalellidae	0	0	0	33	13	0	0	0	0	0	0	8
Bivalvia (Clam)												
Sphaeriidae	2	2	0	2	1	0	0	0	5	3	8	8
Coleoptera (Beetles)												
Dysticidae	0	0	0	2	2	0	0	0	0	0	0	5
Haliplidae	0	0	0	0	1	0	0	0	2	1	0	5
Crustacea												
Cladocera	0	0	0	0	0	7	0	0	0	0	0	8
Cyclopoida	0	0	0	0	0	15	1	0	1	0	0	8
Ostracoda	0	0	0	0	0	2	0	0	0	0	0	8
Diptera (Flies)												
Ceratopogoidae	24	5	8	0	0	20	17	4	22	29	10	6
Chironomidae	30	16	16	26	10	61	65	51	67	63	59	6
Dolicholodidae	0	0	0	0	0	2	1	0	0	0	0	4
Empididae	1	0	0	0	0	0	0	0	0	0	0	6
Simuliidae	0	0	1	0	0	0	0	0	0	0	0	6
Stratiomyidae	0	0	0	0	0	2	5	23	0	0	0	7

Sampling Year	2012			2012		2012			2014			Hilsenhoff Tolerance Value
Site Code	1			2		3						
Sample	1			1		1			2			
SubSample	A	B	C	A/B (1)	A/B (2)	A	B	C	A	B	C	
Tabanidae	1	4	0	0	0	0	1	3	0	2	2	6
Tipulidae	3	0	0	0	0	0	3	0	0	0	0	3
Ephemeroptera (Mayfly)												
Ephemerellidae	0	0	0	0	0	0	0	0	0	3	2	1
Heptageniidae	0	0	0	0	0	0	0	0	2	0	0	4
Siphonuridae	0	0	0	0	0	0	0	0	0	0	4	7
Hemiptera (True Bugs)												
Corixidae	0	0	1	2	5	0	0	0	0	1	0	5
Notonectidae	0	0	0	0	0	0	1	0	0	0	0	no tolerance value
Hirudinea (Leech)												
Hirudinea	0	1	0	0	2	0	0	0	0	0	3	10
Isopoda (Sowbugs)												
Asellidae	0	0	0	9	18	0	0	0	0	1	0	8
Mollusca-Gastropoda (Snail)												
Basommatophora												
Lymnaeidae	0	0	0	0	0	1	1	0	0	0	0	6
Physidae	19	19	7	0	0	0	0	0	0	0	2	8
Planorbidae	0	0	0	0	1	0	1	0	0	0	0	7
Mesogastropoda												
Hydrobiidae	12	10	4	5	6	0	0	3	0	0	0	7
Odonata (Dragonfly)												
Gomphidae	0	2	0	0	0	0	0	0	0	0	0	1
Libellulidae	0	0	0	0	0	1	2	1	1	0	0	9
Odonata (Damselflies)												

Sampling Year	2012			2012		2012			2014			Hilsenhoff Tolerance Value
Site Code	1			2		3						
Sample	1			1		1			2			
SubSample	A	B	C	A/B (1)	A/B (2)	A	B	C	A	B	C	
<i>Lestidae</i>	0	0	0	2	2	0	1	3	0	0	0	9
Oligochaeta (Aquatic Worms)												
<i>Tubificidae</i>	7	6	11	0	0	5	0	10	1	1	9	8
Plecoptera (Stoneflies)												
<i>Perlodidae</i>	0	50	68	0	0	0	0	0	0	0	0	2
Tricoptera (Caddisfly)												
<i>Glossosomatidae</i>	1	0	0	0	0	0	0	0	0	0	0	0
<i>Limnephilidae</i>	0	0	0	0	0	0	0	2	0	0	1	4
<i>Phryganeidae</i>	0	0	0	1	0	0	1	0	1	0	0	4
OTHER												
Nematomorpha	0	0	0	0	0	2	0	0	0	0	0	no tolerance value
Community Analysis												
Number of Organisms	100	115	116	105	106	118	100	100	101	103	100	
Simpsons Diversity Index	0.20	0.24	0.38	0.21	0.14	0.31	0.45	0.32	0.48	0.45	0.37	
Richness (Number of Taxa)	10	10	8	10	13	11	13	9	9	9	10	
Percent of dominant taxa	30	21.85	78.88	34.65	24.38	71.98	65	51	67.67	64.89	59	
Percent of <i>Oligochaeta</i>	7.00	5.22	9.48	0.00	0.00	4.24	0.00	10.00	0.99	0.97	9.00	
Percent of <i>Chironomidae</i>	30.00	13.91	13.79	24.76	9.43	51.69	65.00	51.00	66.34	61.17	59.00	
Percent of EPT	1.00	43.48	58.62	0.95	0.00	0.00	1.00	2.00	2.97	2.91	7.00	
Ratio of EPT to <i>Chironomidae</i>	0.03	3.13	4.25	0.04	0.00	0.00	0.02	0.04	0.04	0.05	0.12	
Percent of ETO	8.00	5.22	9.48	0.95	0.00	4.24	1.00	12.00	3.96	3.88	16.00	

Appendix N

Surface Water Quality Results

Appendix N



Table 1 Surface Water Quality Results

Water Quality Parameters	Site 1	Site 1	Site 2	Site 3	Site 3	Site 4	Site 5	Site 6	Site 7	Parameter Range
	Sample 1	Sample 2	Sample 1	Sample 1	Sample 2	Sample 1	Sample 1	Sample 1	Sample 1	
Date (dd/mm/yy)	Oct 17, 2012	June 4, 2013	Oct 24, 2012	Oct 24, 2012	June 4, 2013	June 4, 2013	June 4, 2013	June 4, 2013	June 4, 2013	N/A
Time (hh:mm)	12:50	14:18	12:43	14:47	10:01	15:00	14:28	11:36	12:30	N/A
Weather conditions	Cloudy	Clear	Overcast	Overcast	Sunny windy	Sunny	Sunny	Sunny	Sunny	N/A
Sample Depth (m)	N/A	0.18	N/A	N/A	0.2	0.2	0.2	0.1	0.1	N/A
Air Temperature (°C)	12	24	13.8	12.7	13.7	19	19	15.5	18	N/A
Water Temperature (°C)	10.7	21.4	10.2	10.9	15	18.5	18.5	21.8	23.1	N/A
Dissolved Oxygen (mg/L)	11	8.45	5.91	3.77	1.91	8.53	22.69	9.99	14.04	5.5-9.5 mg/L
Total Dissolved Solids (mg/L)	749	612	472	172.7	168.3	205	290.4	176.3	168.4	N/A
Conductivity (SPC·us/cm)	1153	880	276	265.7	209.1	252.2	392	251.9	251.8	N/A
Salinity (ppt)	N/A	0.5	N/A	N/A	0.1	0.2	0.2	0.1	0.1	N/A
pH	7.81	8.04	7.08	7.08	6.9	8.21	8.36	7.74	8.45	6.5-8.5
Turbidity (NTU)	2.09	N/A	0.56	1.78	1.01	N/A	N/A	11.1	N/A	N/A. Required background NTU for comparison

Note: N/A no CCME guidelines associated with water parameter.

¹ **Dissolved O2** (mg/L) Lowest acceptable dissolved oxygen concentrations. Warm water early life stages = 6mg/L. Warm water other life stages = 5.5 mg/L. Cold water early life stage 9.5mg/L. Cold water other life stage 6.5mg/L.

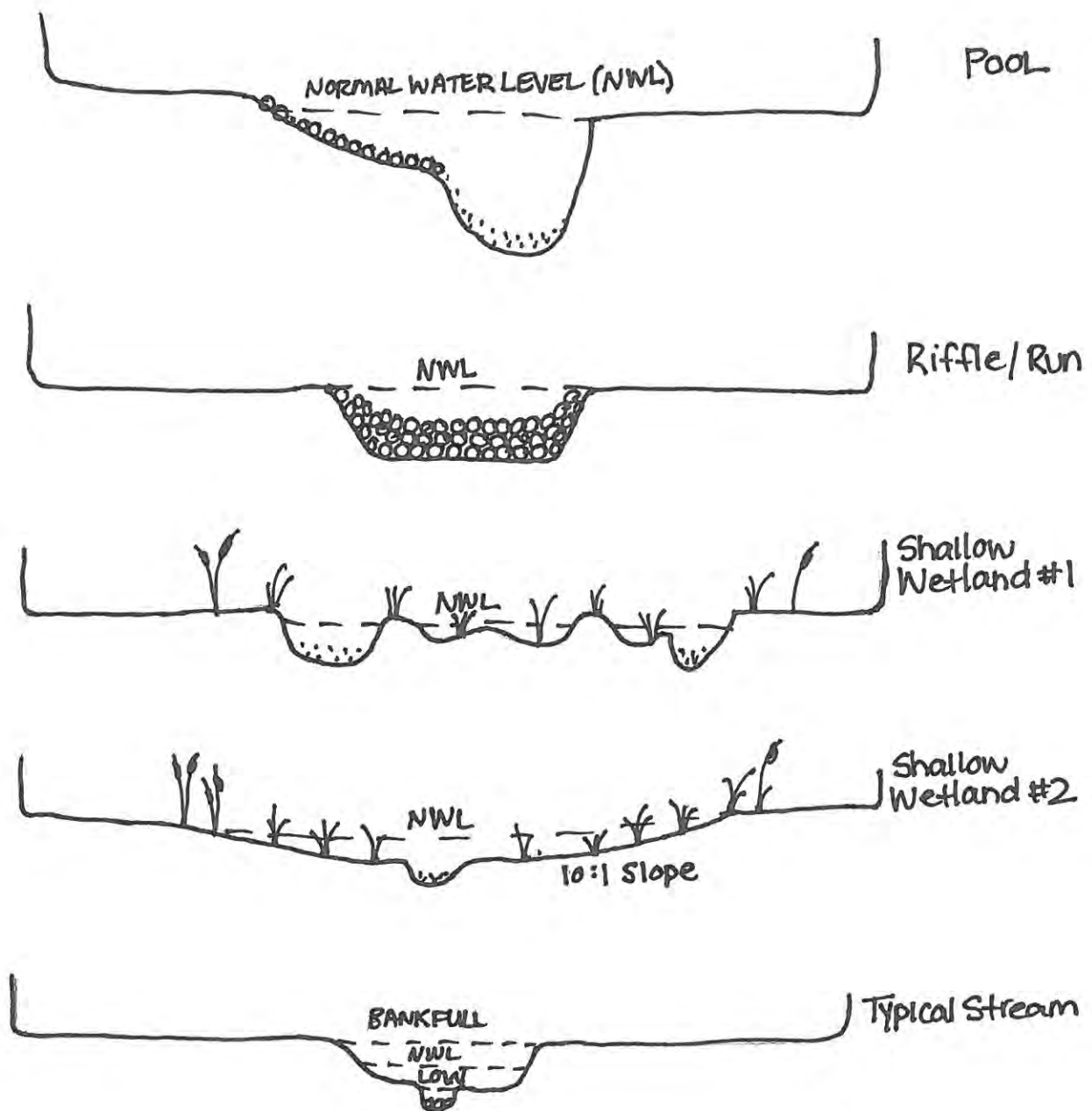
² **Total Suspended Solids** (TSS) CCME Guidelines. Clear Flow: Maximum increase of 25mg/L from background levels for any short-term exposure (e.g., 24-h period). Maximum average increase if 5mg/L from background levels for longer term exposures (e.g., inputs lasting between 24 h and 30d. High flow: Maximum increase of 25mg/L from background levels at any time when background are between 25 and 250 mg/L. Should not increase more than 10% of background levels when background is ≥ 250mg/L.

³**pH** Acceptable pH range for aquatic life is 6.5-8.5 as outlined in the Provincial Water Quality Guidelines (PWQO).

⁴**Turbidity** CCME Guidelines. Clear flow: Maximum increase of 8 NTUs from background levels for a short-term exposure (e.g., 24-h period). Maximum average increase of 2 NTUs from background levels for a longer-term exposure (e.g., 30-d period). High flow or turbid waters: Maximum increase of 8 NTUs from background levels at any one time when background levels are between 8 and 80 NTUs. Should not increase more than 10% of background levels when background is >80 NTUs.

Appendix O

Channel Cross-Section

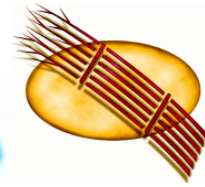


CONCEPTUAL CHANNEL CROSS-SECTIONS FOR THE
PROPOSED COMPENSATION CHANNEL, WATERCOURSE #1

Appendix P

Fascines

Fascines



Description

Fascines can be best described as a rope-shaped bundle of live cuttings, lashed together with twine. Fascines have many other names including brush wattles, faggots, wattles, wattling bundles, and live fascines. Fascines grow rapidly when constructed from live materials. The resulting root systems work well to secure soils and to hold the fascine in place. They are simple and effective, require little time to build and can be installed with little site disturbance.

Purpose

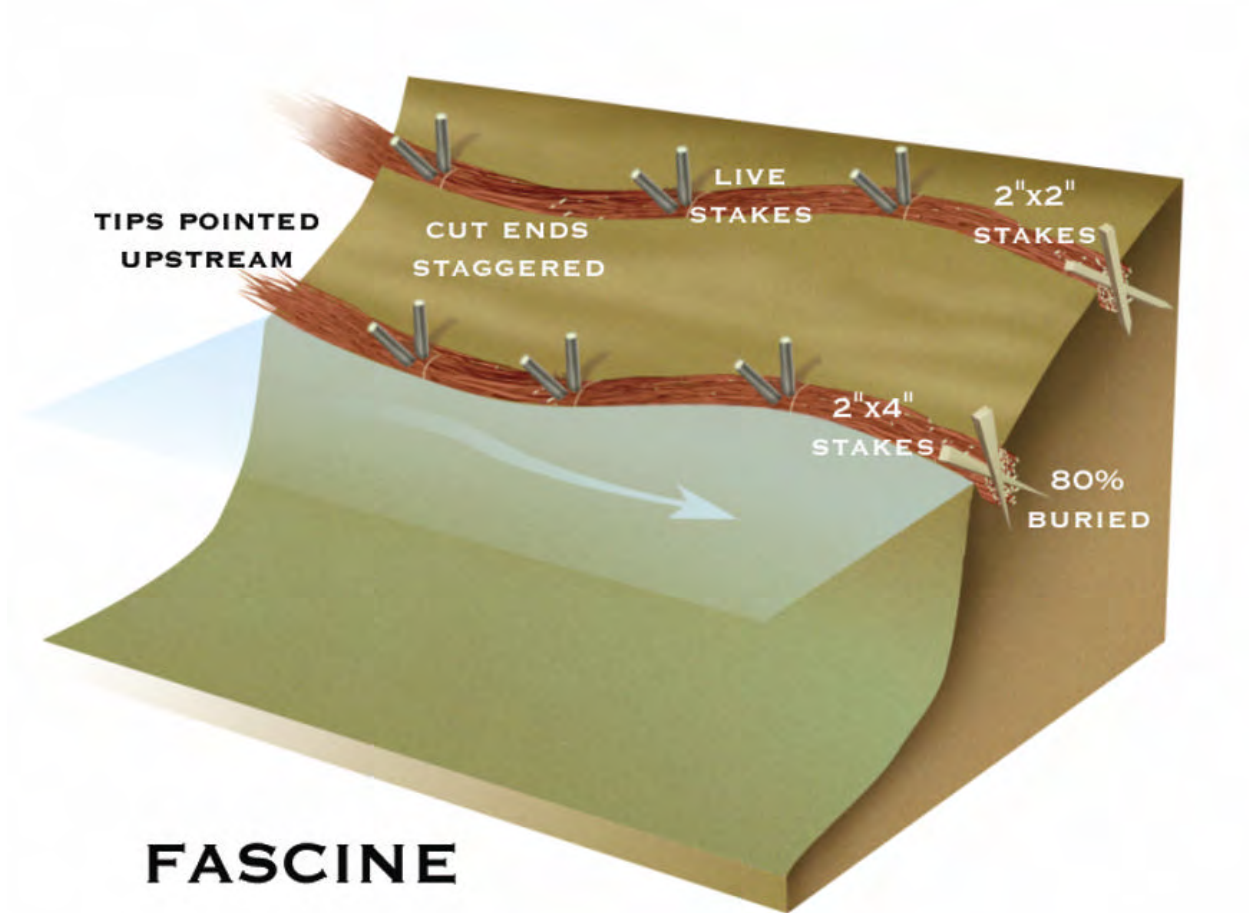
Fascines can be used to perform a wide variety of functions. They can be used on their own to provide erosion protection on small streams, and to bench eroded slopes or gullies. They are very effective in preventing surface erosion. They can also be used in conjunction with many other soil bioengineering techniques, habitat improvement measures or conventional methods of erosion control. Structurally, fascines can provide immediate protection once installed. This feature is enhanced once the fascine begins to grow.

Application

When used on their own as a streambank erosion control measure, fascines are placed in a shallow trench excavated at the waters edge, typically along the outside bends of small streams. Fascines can be used to stabilize slopes where the toe or base of the slope is stable or protected. In this case the fascines would be installed across the slope to reduce runoff and trap sediment. Fascines can also be used as drains to conduct runoff or bank seeps.

When used on stream banks, fascines should be restricted to sites that are experiencing surface erosion (shallow sloughing of soil) **NOT** mass wasting (mass wasting is when large, deep sections of a slope shift, or fail at the same time). Nor should they be used in situations where they would experience rapid undercutting, such as along the outside bends of deep pools cut into soils that are highly erosive. This method is best suited to small streams less than 5 metres wide with bank heights less than 1.5 metres. Fascines in this function can be used in most channel types. In conjunction with other methods, fascines can be used to protect the toe of brush mattresses, and the top leading edge of cribwalls. They can also be used to "soften" existing rock rip-rap, gabion baskets, or concrete blocks, by placing them along the top edge of the stone, or if possible, along the waters edge.





Construction Guidelines

Make sure the toe is stable when using fascines on slopes. If the toe is not stable, erosion can move up the slope, undermining the fascines and causing failure. Should the toe be experiencing erosion, you will need to remedy the situation by using one of the other appropriate methods in this manual. Once this has been addressed, you can then place the fascines on the slope. The following steps should be followed when placing fascines on slopes:

- install the first fascine at the bottom of the slope.
- move upslope, placing fascines using the recommended spacing of 1 metre for 1:1 slopes (height:vertical), 1.5 metre for 2:1, 2 metres for 3:1, and 3 metres for 4:1 slopes.
- on dry slopes fascines can be placed level or on contour.
- on wet slopes fascines can be placed on slight angles to facilitate drainage of runoff.
- place long straw on the slope between fascines (on slopes 1.5:1 or flatter), steeper



FASCINES

slopes would require the use of an erosion control fabric. This fabric would be anchored in place by tucking the leading edge into the trench, and staking the fascine on top.

To build a fascine:

1. Harvest and stockpile an assortment (being different species, ages and lengths) of live, dormant cuttings. Fascines can be built from a wide range of cuttings, but are best built from slim relatively unbranched cuttings (coppice) because they are the easiest to work with and produce the densest fascines. If the cuttings have multiple, hard to bend side branches, prune them, being sure to use the trimmings
2. Fascines are easier to build in a set of saw horses. Lay the cuttings on the sawhorses, with the growing tips facing in the same direction, and with the cut ends staggered throughout.
3. Tightly tie the fascines together tight with rope or twine. The distance between ties can vary. You should be able to carry, bend, and not be able to pull apart, a properly tied fascine. If your first attempt fails, make sure the cut ends are staggered, and that the ties are tight, and frequent. Fascines can be constructed in varying lengths and diameters, but work best if they are tied so they are dense.

To install a fascine:

1. Dig a shallow trench, slightly less wide and deep than the diameter of the fascine. The fascine should be approximately 20% exposed once installed.
2. Place the fascine in the trench, and stake into place. The growing tips should point upstream, or if placed on angles on slopes, pointed uphill. There are several methods of staking. Livestakes are recommended as they will grow, providing extra strength in the long run for the structure. In compact soils such as clays and clay/shales, UNTREATED 2"x2" stakes, or 2"x4"s cut on a diagonal work well. Place the stakes every 1-1.5 metres. You should not be able to lift the fascine out of the trench.
3. Care should be taken to make sure the upstream end of the fascine is "returned" to the streambank. This means tucking the upstream end into the bank, and staking it securely so that the current cannot dislodge it. If the upstream end of the fascine is pulled away the entire structure could fail.
4. Bury the fascine by placing soil around and on top of it, tamping gently into place. Make sure you fill in all of the air spaces. Large air spaces around the fascine should be avoided, as they will promote desiccation of the live material.

Materials

- rope or twine, strong enough to tie the fascines together, and resilient enough to



FASCINES

last 1 year. Hemp rope, heavy bailer twine, or plastic utility cord are good examples.

- ample quantities of live cuttings, for example a 4 m long fascine 25 cm in diameter will use approximately 5 bundles of cuttings (bundles being 20-30 cm in diameter, and 2 m long). Fascines should be constructed with a minimum of 2 different species. This will optimize the chances of successful growth.

Recommended species:

Small streams - Heartleaf willow, Sandbar willow, Shining willow, Pussy willow, all of the dogwoods.

Large streams - Black willow, Peachleaf willow, Pussy willow, Sandbar willow, Heartleaf willow, Carolina poplar, Balsam poplar, all of the dogwoods.

- shovels, rakes, deadblow and sledge hammers, pruning shears, utility knife, sawhorses.
- stakes, depending upon the application, from live stakes, to untreated 2"x2"s, to 2"x4"s cut into wedges.
- straw (for mulching on slopes), or an erosion control blanket (jute, coir, or a straw mix).

Cost and Maintenance Needs

Fascines cost very little, especially if the live materials are cut for free. Costs can be reduced even further if livestakes are used to anchor the fascine. The main expense is the time required to harvest live cuttings, transport them, and construct the fascines. Time required to install varies from 0.5 - 1 hour per linear metre. Fascines should be inspected periodically in the first year. Once the fascine is growing, they require little maintenance.

Integration

Fascines can be easily integrated into many types of projects such as:

- brush mattresses
- live crib walls
- log/brush shelters
- rock rip-rap
- joint planting
- native material revetment

Demonstrations

This type of habitat structure has been applied in the following demonstration projects:

- Project #15, Black Ash Creek Rehabilitation Project
- Project #24, Brault Property



FASCINES

- Project #42, Soper Park - Mill Creek
- Project #44, Strausberg Creek
- Project #46, Kolb Creek
- Project #47, Schneider Creek
- Project #50, Colonial Creek
- Project #51, Bechtel Park
- Project #64, Highland Creek Rehabilitation Project
- Project #91, Tioga Wildlife Area - Pine River
- Project #93, Glen Huron
- Project #94, Martin Property - MacIntyre Creek
- Project #100, Scott's Plains Park
- Project #113, Harvey Brown's
- Project #114, Curcio's Bypass
- Project #115, Dixon Hill Tributary
- Project #117, Harding Property
- Project #121, Christian Blind Mission

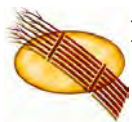
For more information

Please refer to the following authors and their respective publications located in the bibliography:

Gray and Sotir, 1996

Schiechtl and Stern, 1996

210-EFH, 1992



Appendix Q

Sweepers

Sweepers



Description

A fallen cedar tree, partially submerged in water, provides an abundance of nooks and crannies for aquatic insects. Natural sweepers are common in the upper reaches of Ontario rivers like the Sydenham, Saugeen, Nottawasaga and Credit. The branches collect twigs and needles amongst other pieces of organic debris which add to habitat complexity. The greater the number of branches, the greater the accumulation of debris. These secluded spaces provide cover for juvenile fish and a wealth of insect forage for them. Once colonized with a bounty of life, larger fish are attracted to the prospect of engulfing an unsuspecting minnow. The sweeper, sometimes referred to as a submerged brush shelter, is used to mimic this natural habitat by introducing a thick mass of instream cover in the form of an entire tree, crown or large branches.

Purpose

Sweepers are used to attract juvenile fish by providing dense cover and food in the form of aquatic organisms. Cut locally and cabled in place, they can be used to create nursery cover where it is limited and deflect bank erosion. Eastern white cedar or hemlock are the proven species for durability and longevity although white spruce can be used with less confidence in surviving several years. In contrast with other woody cover structures, sweepers tend to be most suited for streams that have high flows, serious sediment movement, or potential for ice damage.

Application

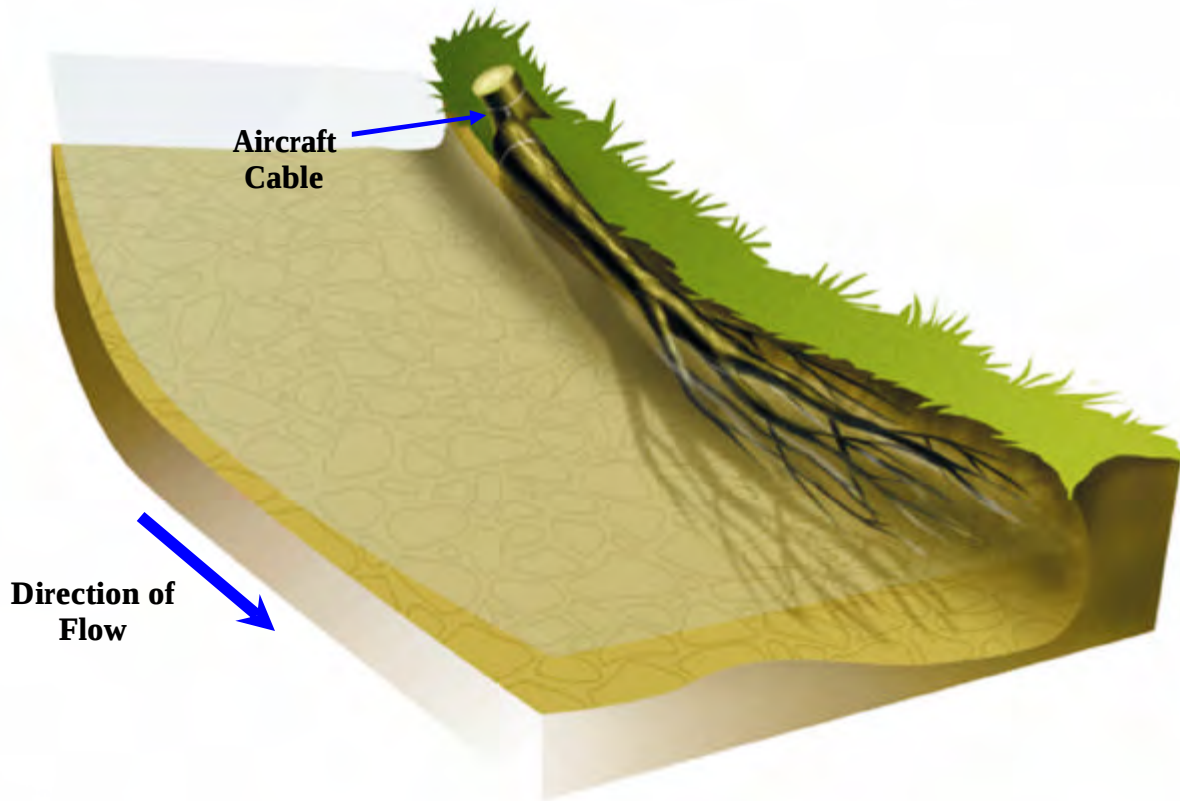
There is a great deal more flexibility in the application of this type of cover structure when we consider location and channel characteristics. Sweepers are well suited to a variety of streams and rivers that exhibit fluctuating water levels, inherent ice accumulation and moderate bedload. Target reaches have sparse cover. They can be placed on the outside of a meander or along a straight section of channel. A single point of attachment to the bank allows the sweeper to move up and down with the flow while deflecting the erosive energy of the water away from the bank.

Having determined your basic knowledge of the physical characteristics within a reach of stream, determining suitability and placement is relatively easy. These structures work equally well in meanders or straight sections. In watercourses containing bedrock, cobble, gravel, sand or silt/clay base as the dominant substrate combined with slopes less than 4% and light to moderate bedload, sweepers are well suited in straight reaches. The meanders within B, C, E and F channels composed of substrates of bedrock, cobble or silt/clay are where placement should be focused along the outside of a bend.

Construction Guidelines

Sweepers are natural and inexpensive habitat enhancements that are anchored to the bank of the

river using steel posts and aircraft cable or simply cabled to the stump from where it fell. Cedar or hemlock are the species which are most resilient to decay although hardwoods will also suffice. Sweepers should have at least a 15 to 40 cm butt diameter and 4.0 metres or more in length. More branches mean more cover and be sure to orient the tree in the current such that the branches trail downstream.



There are two ways of securing a sweeper. The hinged method involves selecting a tree that leans toward the edge of the river. Using a chainsaw, cut toward the river to the point where it starts to fall. Be sure to step back well away from the tree at this point. As it falls, the remaining uncut section will act as a hinge and secure the tree to the stump. Wrapping and securing aircraft cable to the stump and tree will provide additional strength.

In the second method, a previously cut tree is dragged to the site. Using a 1.5 cm diameter wood auger, drill a hole through the trunk at least 20 cm from the thickest end. Insert a 3.0 metre long piece of aircraft cable through the hole, around the trunk and back through the other end of the hole. Be careful to leave a 10 cm section for the crimp to the main cable. Using the crimping tool, fasten them together and fix the wrapped section of cable to the trunk with the fence staples. You should have 1-1.5 m of cable leftover. The anchor should be secured to the bank between the low flow and bankfull elevations. This prevents the sweeper from being deposited outside of the bankfull channel after a flood. Pound the 2.0 metre T bar post into the bank at a slight angle upstream. A 10 cm section of post with a pre-drilled 0.6 cm diameter hole located 5 cm from the top should remain for cable attachment. Drag the sweeper into position and carefully insert cable



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through the hole in the anchor, just enough to loop around and crimp. There should be 0.5 - 1.0 metre of cable between the T bar post and the butt of the sweeper. Once released, it should float freely in the current.

Materials

You will need the following tools for installing sweepers:

- sledge hammer and post pounder
- chainsaw and personal safety gear
- drill with 1.5 cm auger bit, at least 30 cm long
- 3.0 metres of 0.3 cm diameter stainless steel aircraft cable
- matching 0.3 cm diameter crimps or clamps
- crimping tool or cable cutting tool and pliers
- cedar, hemlock or hardwood trees at least 4.0 metres long, 15-40 cm diameter with dense branches
- 2.0 metre T bar post
- hammer and 3.5 cm fencing staples

Cost and Maintenance Needs

Sweepers are a natural and cost-effective technique that can be easily installed by a crew of two in an hour. Cost is less than \$15.00 per unit. The expected life of the structure is 3 to 5 years provided the recommended type of wood is used. Expect the submerged portion of the sweeper to become waterlogged in time. Frequent monitoring is needed to ensure proper installation and continued function.

Integration

Sweepers can be integrated into other stream rehabilitation projects such as:

- cabled log jams
- native material bank revetments
- live crib walls
- L.U.N.K.E.R.S.
- log cover

Demonstrations

This type of habitat structure has been applied in the following demonstration projects:

- Project #14, Bighead River Demonstration Project
- Project #91, Tioga Wildlife Area - Pine River
- Project #94, Martin Property - MacIntyre Creek



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- Project #104, Collingwood Shipyards - CSL Property
- Project #109, Morningside Tributary Aquatic Habitat Rehabilitation Project
- Project #113, Harvey Brown's
- Project #117, Harding Property
- Project #123, Rocky Saugeen Silt Spill Rehabilitation Project

For More Information

Please refer to the following authors and their respective publications located in the bibliography:

Buchanan, R. A. , D. A. Scruton and T. C. Anderson 1989

Forder, D. R. et al, 1997

Rosgen, D. 1996



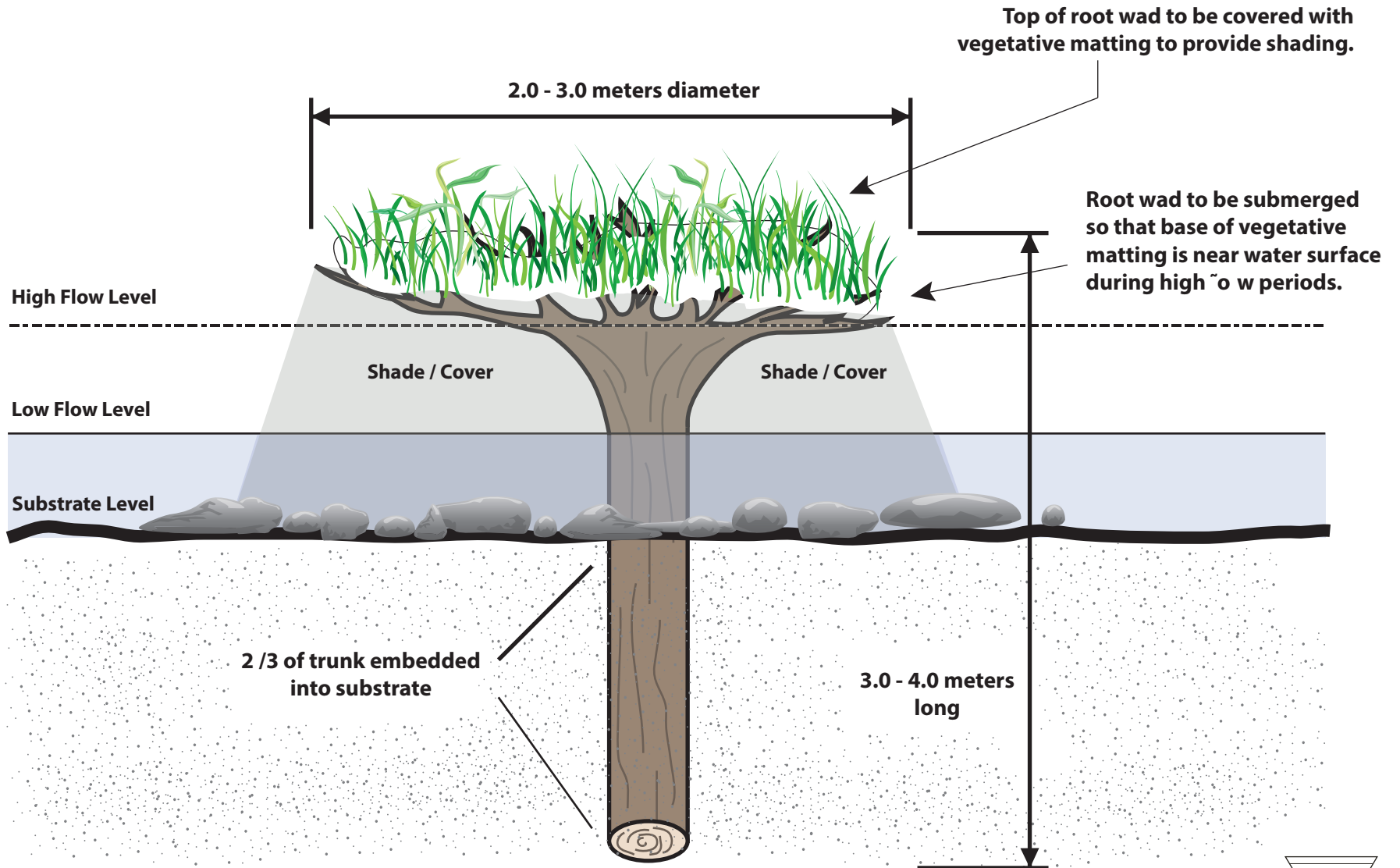
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Appendix R

Root Wads

Inverted Root Wad

Section View





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