Biological Assessment

Great Lakes Tunnel Project

Mackinac and Emmet Counties, Michigan

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1.0 INTRODUCTION

This biological assessment (BA) is prepared in accordance with legal requirements set forth under section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1536 (c)) (ESA) and applicable guidance documents. The purpose of this BA is to review the proposed Great Lakes Tunnel Project (Project) in sufficient detail to determine to what extent the proposed action may affect the federally threatened and endangered species listed below:

- Piping plover (*Charadrius melodius*) - Endangered
- Rufa red knot (*Calidris canutus rufa*) - Threatened
- Canada lynx *(Lynx canadensis*) - Threatened
- Northern long-eared bat (*Myotis septentrionalis*) - Threatened
- Hart's tongue fern (*Asplenium scolopendrium var. americanum*) - Threatened
- Pitcher's thistle (*Cirsium pitcher*) - Threatened
- Houghton's goldenrod (*Solidago houghtonii*) – Threatened
- Dwarf lake iris (*Iris lacustris*) - Threatened
- Lakeside daisy (*Hymenoxy acaulis var. glabra*) – Threatened
- Michigan Monkey-flower (*Mimulus michiganensis*) – Endangered
- Eastern massasauga rattlesnake (*Sistrurus catenatus*) – Threatened
- Hine's emerald dragonfly (*Somatochlora hineana*) – Endangered
- Hungerford's crawling water beetle (*Brychius hungerfordi*) – Endangered

Designated Critical Habitat

There is no federally designated critical habitat, as listed by the U.S. Fish and Wildlife Service (USFWS), located within the Action Area (see Section 2.0).

1.1 Proposed Federal Action

The proposed federal action is issuance of a U.S. Army Corps of Engineers (USACE) and Michigan Department of Environmental, Great Lakes and Energy (EGLE) Section 404/401 permit to authorize replacement of the Line 5 dual pipelines (Dual Pipelines) by means of a tunnel within a federally managed water body (Straits of Mackinac). The USACE will also review the proposed Project for compliance with Section 10 of the Rivers and Harbors Act.

1.2 Effects Analysis

Section 3.0 analyzes the direct, indirect, and cumulative effects of the Project on federally threatened and endangered species. As per the Endangered Species Consultation Handbook (USFWS and NMFS 1998), direct, indirect, and cumulative effects, as they apply to section 7 analyses, are defined as:

- Direct Effects – Direct or immediate effects of the project on the species or its habitat
- Indirect Effects – Effects that are caused by or will result from the project and are at a later time, but are still reasonably certain to occur
- Cumulative Effects – Effects of future State, Tribal, local, or private activities (excluding federal activities) that are reasonably certain to occur within the Action Area

1.3 Project Description

1.3.1 Project Purpose and Description

The Project is an underground tunnel that will be constructed and operated by Enbridge and owned, upon the completion of its construction, by the Mackinac Straits Corridor Authority (Authority). The Tunnel is being pursued in accordance with the "Tunnel Agreement" that was executed by Enbridge and the Authority on December 19, 2018. That Agreement was entered in furtherance of Public Act 359, through which the State of Michigan established the Authority and delegated to it the right to acquire, construct, maintain, improve, repair, and manage a utility tunnel across the Straits of Mackinac (Straits).

The proposed tunnel alignment extends below the lakebed of the Straits, between Mackinac and Emmet counties, Michigan (Figure 1). Specifically, the Tunnel would cross below the lakebed of the Straits, connecting Point La Barbe in Michigan's Upper Peninsula to McGulpin Point in Michigan's Lower Peninsula in Mackinac and Emmet Counties, respectively. The distance between these two land points is approximately 3.58 miles and represents the shortest distance between Michigan's Upper and Lower Peninsulas. The Tunnel would extend as near as practicable to Enbridge's existing Line 5 station (North Straits Facility) located on the north shoreline of the Straits to an opening point as near as practicable to Enbridge's existing Line 5 Mackinaw Station located on the south shoreline of the Straits.

Except for the opening points on either side of the Straits, the Tunnel will be constructed entirely underground, approximately 60 to 250 feet beneath the lake bottom of the Straits. The Tunnel will be approximately 21 feet in finished diameter, or other appropriate diameter determined through final design. The Tunnel will accommodate the replacement of that portion of Enbridge's Line 5 pipeline (1) (Line 5) that crosses the Straits and will provide the potential to accommodate other utilities. The Tunnel will be constructed with a structural lining, providing secondary containment to prevent any leakage of fluids from Line 5 or other utility lines into the lakebed or the Straits.

The Project will include clearing of trees, brush, and vegetation, including stumps within the limits of disturbance (LOD) on both the north (Mackinac County) and south (Emmet County) sides to facilitate construction of the tunnel. The LOD is located entirely within the Action Area (Figures 2a and 2b). If practical, site clearing and grading will be completed during the winter months (i.e., October 30 to March 15) to minimize effects to environmental features such as nesting birds and roosting bats. Both the north and south side LOD will be cleared, graded, and covered with three (3) to six (6) inches of crushed aggregate in preparation for construction activities. Pending receipt of all regulatory approvals, the LODs are anticipated to be cleared in the fall of 2022. Access road improvements to Boulevard Drive on the north side will occur during the site preparation period.

A 21-foot inside-diameter tunnel will be constructed using a tunnel boring machine (TBM), starting on the south side. A tunnel receiving shaft will be located on the north side. The south side LOD will house workspaces for a pipeline portal, slurry and water treatment system, stormwater detention basins, and a variety of necessary construction equipment, vehicles, storage areas and trailers. (see Section 1.3.2).

The start date of construction will depend on a number of factors including receipt of all regulatory approvals. The proposed Project activity durations are presented in Table 1-1.

Table 1-1. Proposed project schedule

Project Activity[1]	Approximate Duration
Vegetation clearing, grading, and fencing of the north and south side LODs (access roads will not be fenced)	6 months
Portal excavation, TBM assembly, and other preparations for construction	6 months
Tunnel construction, equipment and temporary utility removal, and cleanup	2 years
Pipeline installation in tunnel and tie-into existing system	8 months
Backfill portal, construct above ground facilities, finalize site clean-up	6 months

[1] Some activities will take place concurrently (e.g., the pipeline can be put into service while the site cleanup and completion of above ground facilities are ongoing)

1.3.2 Proposed Construction Activities

The construction activities will occur within the LOD on both the north and south sides (Figure 2a) and beneath the lakebed of the Straits. Once tunnel construction begins within the south side LOD, construction activities are anticipated to occur 24 hours per day, 6 days per week. Under some circumstances and for limited duration, construction activities may occur seven days per week. Construction activities on the north side are anticipated to occur up to 12 hours per day, with the exception of some activities that will require operation 24 hours per day, including TBM hole through, at tunnel completion, and TBM removal.

Pipeline Portal Structure

The TBM (cutterhead, shield, and trailing gear) will be assembled at the surface on Enbridge-owned property on the south side, in a shallow launch portal, which is the opening to the tunnel. To begin, or launch the TBM, an elongated open trench with vertical sidewalls (portal) will be constructed within the south side LOD. The portal will be approximately 60 feet wide by up to 1,000 feet long and 75 feet deep at its northern end, where the TBM will start boring.

The receiving end of the TBM will be a vertical shaft within the north side LOD. The shaft will be circular, approximately 70 feet in diameter and extend to a depth of approximately 100 feet. Around the shaft will be the necessary construction support equipment such as a crane, electrical building, parking, office space, and a sediment basin.

Haul and Access Roads

Access to the north side LOD will utilize Boulevard Drive (Figure 2a). Segments of the unpaved portions of Boulevard Drive will need to be improved or widened to accommodate construction traffic. To minimize potential impacts to the shoreline of Lake Michigan, widening/improvements will take place on the landward side (north and west) of the road. Access to the south side LOD will utilize existing Headlands Road and no improvements to the road are anticipated.

The access roads will accommodate large equipment turn-around, provide access for equipment and vehicles to the LOD, and carry internal traffic within the construction site. The access roads will carry traffic required to develop the construction site area and will deliver the TBM and supporting components needed to construct the tunnel. Construction traffic on the access roads during initial site development will include hauling wetland dredge spoils and excavated material from uplands, the initial hauling and placement of fill material for leveling and preparing the construction site and hauling excavated material from the initial construction of the pipeline portal and shaft. During tunneling by the TBM, the access roads will be used to remove excavated materials from tunnel construction ("tunnel muck") from the site for offsite disposal (see

Section 2.0 and Figure 2b), as well as for general access to the site for delivery of permanent materials for other construction activities to build and support the tunnel.

Hauling of materials (i.e., fill, backfill, and aggregate material) along access roads within the Action Area is anticipated to occur over approximately 6 months. Within that timeframe, an estimated truck volume of 80 trucks per day within the north side LOD and 30 trucks per day within the south side LOD is anticipated. In addition, excavated material from the tunnel, shaft, and portal will be hauled off-site to disposal sites. An average of 9 trucks per day is estimated along the anticipated travel routes from the north side LOD to the disposal sites on the north side over a period of 6 months, and an average of 61 trucks per day is estimated along the anticipated travel routes from the south side LOD to the disposal sites on the south side over a period of 2.5 years.

Other Construction Activities

While all construction activities will occur within the LOD, there may be a need for off-site storage of materials. Enbridge has committed to using existing commercial or industrial properties for this purpose. Within the LOD, equipment and construction activities include:

- Muck bin and slurry dewatering and temporary storage
- Temporary storage of muck, dewatering, and other materials
- Power substation
- Mechanics' shop and utility storage
- Precast tunnel lining segment storage
- Field offices and parking
- 30-inch pipe stockpile
- Up to a 650-ton crane (and other support cranes and underground excavation support equipment)
- Pipeline tie-in and pipe stringing area

Water Discharge and Water Intake Structures - Three water discharge structures (outfall structures) to Lake Michigan (two on the north side, and one on the south side) will be constructed as part of the Project. Two temporary water intake structures (one on the north side and one on the south side) will be used during construction and will be removed once tunnel construction is complete. A concept of these structures and approximate dimensions are provided in Appendix A. Enbridge will secure all necessary approvals for the discharge structures.

TBM Retrieval Shaft – A TBM retrieval shaft will be constructed within the north side LOD. It will be approximately 70 feet in diameter and 100 feet in depth. The retrieval shaft will be a circular reinforced concrete diaphragm wall, constructed using slurry wall construction methods. In slurry wall construction, a trench is excavated in panel segments with a hydromill, with the excavation maintained open with a bentonite slurry that prevents water inflow. Steel reinforcement is placed in each panel and concrete is placed by tremie methods. After the diaphragm wall is complete, the rock at the base of the shaft will be grouted to limit the potential for upward flow of water into the shaft. By minimizing groundwater flow into the shaft during construction, changes to the surrounding groundwater flow regime are minimized.

The watertight shaft construction means that only minimal leakage must be managed by sump-and-pump methods within the shaft, with negligible potential effects on the groundwater levels or gradient outside the immediate shaft perimeter. New impervious surface and permanent fill placement are limited to the western portion of the site (approximately 1.5 acres). Due to the limited area of permanent site development, and the high permeability of the surrounding ground, site development is anticipated to have no influence on the groundwater regime outside the immediate area of the approximately 70-foot-diameter permanent shaft. Therefore, no effects to listed species are anticipated as a result of minor changes to the groundwater regime, and these changes are not analyzed further in this document.

Stormwater Ponds – Four stormwater ponds will be constructed for the Project. The ponds will temporarily hold stormwater and/or treated process water and are designed to hold and release water over a 24-hour period. During construction, the bottom of the ponds will consist of the native subsoil and the banks may

be native subsoil or may be lined with crushed aggregate surface. During operation, the permanent stormwater ponds will be vegetated on both the banks and the bottom of the basin. Riprap will be placed at the inflow and outflow channels. No permanent water is anticipated within the limits of the temporary or permanent ponds.

Two stormwater ponds will be present within the north side LOD during construction. It is anticipated that the operational water surface of one of the ponds will be approximately 13,000 square feet and the other will be approximately 10,000 square feet. Each will have an operational water depth of 1 foot (12 inches). During operations, there will be one permanent stormwater pond within the north side LOD. The operational water surface of the permanent pond will be approximately 5,000 square feet and will have an operational water depth of 1 foot (12 inches).

One temporary stormwater pond will be present within the south side LOD during construction, and one permanent stormwater pond will be present during operations. It is anticipated these ponds will have a surface area of 10,000 to 13,000 square feet and an operational water depth of approximately 3-5 feet.

Treated Process Water - Treated process water from construction and operation of the tunnel will be discharged into Lake Michigan via Outfalls 001 and 003 (Figure 2a). Outfall 002 will discharge non-regulated stormwater only and discharges will be in compliance with all applicable permits. Enbridge was issued a National Pollutant Discharge Elimination System (NPDES) permit from EGLE for Project discharges on January 29, 2021. Treated process water from Outfalls 001 and 003 will meet or exceed all water quality standards set by EGLE and monitoring requirements set forth in the permit will be met. Parameters and limitations provided by EGLE are included in Appendix B. Several water treatment additives (WTA) will likely be used during construction to help remove slurry materials and rock particles from slurry water. All WTAs will be pre-approved by EGLE prior to their use. Water will be recycled to the extent practical. Excess water will be treated in accordance with EGLE guidelines and brought to within acceptable water quality standards prior to discharge. Discharged water will be monitored prior to discharge to ensure compliance with water quality parameters set by EGLE.

The source of the water to be discharged is groundwater infiltration into the tunnel or portal/shaft or water that is directly withdrawn from Lake Michigan for use in tunnel construction. Given the strong currents and wind and wave actions of the Straits, the discharged water is expected to dissipate rapidly. No changes to temperature, turbidity or water chemistry are likely to occur from the discharges, additionally there are no federally protected aquatic species within the Straits. Therefore, effects to water quality within the Straits are not evaluated further in this document.

Construction Noise - Potential effects to noise levels as a result of the Project were evaluated in the Joint CWA Section 404/401 permit application submitted in April 2020 (Joint Permit Application (USACE File No. LRE-2010-00463-56-A19) (Appendix C). The results of the noise analyses indicate the increase in noise levels during construction is considered negligible (Appendix C). Project construction activities will result in a short-term and localized increase to noise levels within the LOD. In general, construction equipment (e.g., a backhoe) has a sound pressure level between 75 and 85 decibels (dBA) at a distance of 50 feet. Additional noise impacts may occur if blasting is required. Blasting events would occur one to two times per day and would be limited to daytime hours. Blasting activities are anticipated to produce a sound pressure level between 84 and 89 dBA at a distance of 50 feet. For comparison, the sound pressure level of a typical vacuum cleaner to the person operating it is between 84 and 89 dBA. Noise levels as a result of Project construction would be expected to decline further at a distance beyond 50 feet.

The increase in noise levels resulting from construction equipment will be temporary (limited to the duration of construction activities) and will occur primarily during daylight hours. Significant noise and/or vibration from the controlled blasts are not expected to be felt or heard by the public outside of the general construction area. Further, the proposed facility upgrades will not result in an increase of noise levels when in service. Enbridge will work with neighbors to address specific noise concerns.

Construction Lighting - Round-the-clock construction activities would require temporary nighttime lighting. Lighting would conform to Occupational Safety and Health Administration illumination standards for

construction intended to ensure that specific work areas are provided with lighting that is sufficient to enable the workers to see hazardous conditions and avoid injury. Temporary, exterior lighting features proposed for use during construction would be downward facing and it is anticipated that lights would be directed toward construction and not facing outward from the construction area, therefore minimizing lighting effects outside of the immediate construction area. Permanent operational lighting would include low-level constant lighting at building access locations and motion-detected lighting around the exterior of the building for security purposes. Generally, all exterior lighting would be downward-facing and include hooded lights to prevent skyglow. Permanent perimeter lighting is not anticipated. Lighting as a result of operation and maintenance of the Project would be similar to that already associated with the existing pipeline.

1.3.3 Deactivation of Existing Dual Pipelines

Once the Project is constructed, and the Line 5 replacement segment is placed into service within the Tunnel, Enbridge will cease operation of the existing Dual Pipelines and permanently take the Dual Pipelines out of service by deactivating them in place (referred to herein as "deactivation"). Enbridge will deactivate in place the Dual Pipelines in accordance with the Pipeline and Hazardous Materials Safety Administration's (PHMSA) regulations. See 49 C.F.R. § 195.402(c)(10) (requiring pipeline operators to include procedures for the deactivation of pipeline facilities in their maintenance and operation plans); 49 C.F.R. § 195.59 (setting forth reporting requirements for deactivated pipeline facilities that cross over, under, or through a navigable waterway). Such activities will also be conducted in accordance with ASME B31.4-2016, paragraph 457 guidelines concerning the abandonment of pipeline systems. The procedures that Enbridge has established in accordance with Section 195.402(c)(10) require that the Dual Pipelines will be deactivated by:

(a) purging/cleaning all ~21,000 feet of each pipeline
(b) plugging/grouting the ends; and
(c) monitoring in place the remaining deactivated sections via use of the existing cathodic protection system.

Further details regarding these activities are as follows:

- Purging and Isolating the Dual Pipelines: A set of cleaning pigs will be propelled through each of the Dual Pipelines through the injection of Nitrogen gas. The cleaning pigs will push any remaining product in the Dual Pipelines to those portions of Line 5 that will continue to operate in conjunction with the Line 5 replacement segment. This initial purge is generally effective at removing a significant percentage (~99%) of the remaining product in the pipe.
- Pipeline Cleaning: After the purging process is complete, cleaning trains will then be propelled through each of the Dual Pipelines through the injection of Nitrogen gas. This process will remove any residual product that remains following the purging process. The pigs utilized for the cleaning train are steel-mandrel cup and disc pigs that may also include brushes and a cavity for electronic transmitters to allow for pig tracking.
- Pipeline Isolation: Each end of the remaining deactivated segment of the Dual Pipelines will be disconnected from the active Line 5 infrastructure that will continue to operate in conjunction with the Line 5 replacement segment. The ends will be capped, thereby creating a permanent physical barrier to separate the remaining segments of the Dual Pipelines from active Line 5 infrastructure.
- Pipeline Cathodic Protection System: The existing cathodic protection system on the Dual Pipelines will remain in place and operational following the completion of the decommissioning activities. The activities described above will occur within the boundaries of the existing Enbridge right-of-way (ROW), and on land owned by Enbridge. No additional temporary workspace is required.

Deactivation of the Dual Pipelines is the only activity that is certain to occur once the Project has been constructed and after the Line 5 replacement segment has been placed into service within the Tunnel. Article 7.2 of the Third Agreement that was entered with the State on December 19, 2018 states that "…At a minimum, any portion of the Dual Pipelines that remains in place after deactivation shall be thoroughly cleaned of any product or residue thereof and the ends shall be permanently capped to the satisfaction of

the State, which shall not be unreasonably withheld." It is possible that the State of Michigan may require, at some future point, that the exposed, unburied segments of the Dual Pipelines be removed from the Straits. Enbridge has not initiated discussions with the State of Michigan regarding the removal of the Dual Pipelines. Absent the State of Michigan requiring their removal, which it has not done to date, the removal of the Dual Pipelines is speculative, not reasonably foreseeable, and not part of the Project. To the extent that the State chooses, at some future point, to require removal of the exposed, unburied segments of the Dual Pipelines, Enbridge would at that time apply for any permits or authorizations required for that activity.

Should at some future point the State of Michigan require removal of the Dual Pipelines, such a requirement would entail the removal of those portions of the existing Dual Pipelines that are fully or partially exposed and not fully buried along the shorelines of the Straits. Portions of the Dual Pipelines located in water less than 65 feet in depth are buried in accordance with the 1953 Easement, and would thus remain deactivated in place under this option.

Removal of the fully or partially exposed sections of the existing Dual Pipelines would entail:

(a) purging/cleaning all ~21,000 feet of each Pipeline;
(b) cutting all existing screw anchor supports at/near the mudline;
(c) "jet sledding", or similar approach, the partially covered portions of the Dual Pipelines and screw anchor supports to remove sediment to allow for cutting and removal;
(d) cutting each of the Dual Pipelines into segments for safe removal via divers or ROV;
(e) capping the ends of the remaining, buried portions of the Dual Pipelines that are to be abandoned in place;
(f) hoisting the cut segments of pipe to the surface to load onto a barge or other vessel; and
(g) transporting the segments to a scrap metal, recycling, or licensed disposal facility

The removal of the fully or partially exposed sections of the existing Dual Pipelines would involve disturbance of the lake bottom; however, there are no federally listed species present within the Straits of Mackinac. Additionally, no on-shore work would be required; therefore, no effect to federally listed species would be anticipated.

1.4 Consultation History

The following is a summary of correspondence with, and material submitted by Enbridge to the USACE regarding the Project:

June 6, 2019: *A pre-application meeting for the Joint Clean Water Act (CWA) Section 404/401 permit application was held with the USACE, USFWS, Enbridge, and Stantec Consulting Services Inc. (Stantec). At that meeting, the USACE requested that Enbridge prepare a Biological Assessment.*

August 2019: *Submittal of Preliminary Jurisdictional Determination Request to USACE.*

April 8, 2020: *The Joint CWA Section 404/401 permit application was submitted for the Project.*

April 14, 2020: *The USACE requested the BA provide specific information regarding effects to federally listed threatened and endangered species, including how stem counts were estimated for the Houghton's goldenrod and dwarf lake iris.*

August 19, 2020: *The USACE provided a letter to Enbridge requesting additional information prior to initiating formal consultation with the USFWS.*

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January 26, 2021: *Following a review of the draft BA (dated October 20, 2020), the USACE provided a letter to Enbridge requesting additional information prior to initiating formal consultation with the USFWS. The comment letter included correspondence from the USFWS and the Bay Mills Indian Community.*

June 10, 2021: *The USACE provided a letter to Enbridge requesting additional information prior to initiating formal consultation with the USFWS. The comment letter included correspondence from the USFWS.*

2.0 ACTION AREA

The Action Area includes all areas that will be directly and indirectly affected by the Project. As described in Section 1.3, the Project includes onshore construction within the LOD (i.e., Project footprint), construction of a tunnel under the Straits, and deactivation of the existing Dual Pipelines. As such, the Action Area (Figures 2a and 2b) is defined as:

- The LOD on both the north and south sides of the Straits, which includes all workspaces, access roads, water discharge structures (i.e., outfall structures), and temporary water intake structures, as well as a 100-foot buffer of the LOD on both the north and south sides;
- The deactivation of the existing Dual Pipelines plus a 100-foot buffer;
- The proposed tunnel alignment under the lakebed plus a 100-foot buffer;
- Off-site disposal areas and anticipated travel routes to these potential disposal sites (Figure 2b); and,
- Plant Mitigation Areas (see Section 5.0)

A 100-foot buffer around Project components was chosen for the Action Area because no direct or indirect effects as a result of the Project are anticipated to occur beyond this distance (see Section 1.3.2).

North Side LOD (16.1 acres) - To minimize the extent of impacts to natural resources on the north side, Enbridge has sited the LOD directly adjacent to the existing North Straits Station (Figure 2a). Higher quality forested wetlands to the east and west of the north side LOD have been avoided (Figure 3). Wetlands within the north side LOD are a mix of medium quality forested, and emergent vegetation wetlands. Approximately 0.13 acre of wetland will be impacted within the north side LOD. Enbridge has located the north side LOD at least 50 feet from the shoreline of Lake Michigan, with the exceptions of vehicle entranceways off the existing Boulevard Drive and two water discharge structures (Appendix A). The footprint of the two water discharge structures is approximately 0.009 acre and 0.003 acre, respectively. A temporary water intake structure will be installed during construction and removed once construction activities are complete (Appendix A).

South Side LOD (25.5 acres) - On the south side, Enbridge has designed the LOD to avoid residential properties they do not own, Headlands International Dark Sky Park, McGulpin Point Lighthouse, and electric and natural gas transmission infrastructure. The south side LOD includes areas adjacent to and within Enbridge's existing Mackinaw Station. Enbridge will maintain a buffer of 115 feet from the south shoreline of Lake Michigan with the exception the water discharge structure (approximately 0.04 acre) and a temporary water intake structure (Appendix A).

Tunnel Under the Straits - The proposed tunnel will extend below the lakebed between the north and south side LOD. No disturbance of the lakebed will occur except for the small footprints of the temporary intake structures (Appendix A). No permanent impacts to the aquatic habitats above the tunnel will occur. The temporary water intake structures will be removed following construction of the tunnel and will have no permanent effects to aquatic habitat within the lake (see Appendix A).

Off-Site Disposal Sites – The tunnel contractor will be responsible for identifying off-site disposal sites for materials excavated during tunnel construction; however, Enbridge has identified five potential disposal

sites for inclusion in the Action Area, including two potential sites on the north side and three potential sites on the south side (Figure 2b). Anticipated travel routes to these disposal sites have also been identified for the purposes of analyzing potential effects to listed species (see Section 3.0).

For the purposes of this BA, it is assumed any site chosen will meet the following criteria:

- The site will be located within 25 miles of the Project and public roads will be used to access the site(s).
- The site will be an active quarry or sand and gravel mining site and have all necessary environmental clearances to be used as a disposal site.
- No new ground disturbance will be needed to accept the excavated material.

At present, all five sites currently under consideration meet these criteria. Any additional sites, should they be needed, that do not meet these criteria will not be selected without coordinating with the appropriate resource agencies.

3.0 SPECIES ACCOUNTS, EFFECTS, AND DETERMINATIONS

Federally threatened and endangered species that the USFWS has indicated may occur in the Action Area are discussed in this section. The effects determinations for each of these species are summarized in Section 5.0.

3.1 Piping Plover

Current Status

The piping plover was listed as federally threatened by the USFWS on December 11, 1985 (50 FR 50726). A USFWS Great Lakes & Northern Great Plains Piping Plover Recovery Plan was developed and signed on May 12, 1988 (USFWS 1988). It was later decided that the two populations would benefit from separate recovery plans and on September 8, 2003 the USFWS released the final Recovery Plan for the Great Lakes Piping Plover (USFWS 2003). On May 7, 2001 USFWS released a final determination of critical habitat for the Great Lakes Breeding Population of the Piping Plover (50 FR 22938). The piping plover is also listed as endangered by the state of Michigan (Michigan Natural Features Inventory [MNFI] 2009a).

Species Description

Piping plovers are stout birds with large, rounded heads, short thick necks, and a stubby bill. They have a body length of about 6.7 inches, weigh between 1.6 and 2.3 ounces, and have a wingspan of 4.3 to 5.0 inches. Adults have a sand-colored upper body, white undersides, and orange legs. A white wing stripe and white rump are visible in flight. During the breeding season, adults acquire a single black band across their forehead, a black breast band, and orange bills. The breast band is usually thicker in males. They are difficult to see when standing still as they blend well with open, sandy beach habitats (USFWS 1988).

Habitat

Historically, piping plovers bred across three geographic regions: the northern Great Plains from Alberta to Manitoba and south to Nebraska, the Great Lakes beaches, and the Atlantic coastal beaches from Newfoundland to North Carolina. Currently, the species' range remains similar to the historic range, except that breeding populations have almost disappeared from the Great Lakes beaches. Piping plovers winter along the Gulf of Mexico, the southern Atlantic coast, and the Caribbean (USFWS 1988).

Piping plovers live the majority of their life on open sandy beaches or rocky shores, often in high, dry sections away from water. They are known to breed along prairie rivers, alkali wetlands, sandy beaches along Great Lakes shorelines, and on vast Atlantic coast beaches (USFWS 1988). The majority of the

remaining Great Lakes breeding population's suitable habitat is in Michigan, with records from 12 Michigan counties (USFWS 2003).

Habitat destruction and alteration, the major threats to the species, are primarily due to the stabilization of the rivers for navigation, hydropower, irrigation, and flood control. River stabilization has resulted in the loss of much of the suitable breeding habitat for this species and left many of the remaining sandbars used for breeding unsuitable and degraded (USFWS 1988).

Life History

Piping plovers are migratory shorebirds that spend approximately three to four months at breeding sites in the northern U.S. and southern Canada. Birds begin arriving on breeding grounds in mid-April to mid-May. Territories are actively defended by both sexes. Nests are shallow depressions lined with small pebbles or shell fragments. Clutches are typically laid the second or third week of May and usually include four eggs. Both sexes share in incubation duties and eggs hatch after 25 to 31 days, often in late May to mid-June. Fledging time varies from 21 days to 35 days. Adults leave breeding grounds in mid-July to early August and juveniles depart a few weeks later (USFWS 1988).

During the fall migration, inland populations of piping plovers are thought to migrate nonstop to the Gulf of Mexico or the Atlantic coast, as sightings are rare at seemingly appropriate stopover sites (Elliott-Smith and Haig 2004). Some individuals may migrate east to the Atlantic coast prior to beginning their southern migration, though that theory is based on a single observation (Elliott-Smith and Haig 2004). Spring migration patterns appear to be similar for inland populations, with a single nonstop flight being likely (Elliott-Smith and Haig 2004). Piping plovers congregate prior to migration in large flocks of up to 100 birds, though they arrive and leave in small groups of 3 to 6 individuals (Elliott-Smith and Haig 2004).

Status in the Action Area

Michigan Natural Features Inventory (MNFI) data indicate suitable habitat for this species within 1.5 miles of the Action Area (MNFI 2019a; Appendix D). Approximately 1.4 acres of suitable habitat (i.e., limestone cobble shore) is present within Action Area (0.89 acre on the north side and 0.47 acre on the south side) (Stantec 2019, 2020; Appendix E). Approximately 0.008 acre (0.002 acre on the north side and 0.006 acre on the south side) of limestone cobble shore is present with in the LOD. Additional suitable habitat for the piping plover (i.e., sand and gravel beach and limestone cobble shore) was observed immediately adjacent to the Action Area along the Lake Michigan shoreline during field surveys for the Project (Stantec 2019, 2020; Appendix E); however, eBird data indicate no records within or immediately adjacent to the Action Area (Sullivan et al. 2009).

3.1.1 Direct and Indirect Effects

Approximately 0.008 acre of suitable habitat (i.e., limestone cobble shore) will be cleared as a result of the Project (0.002 acre in the north side LOD and 0.006 acre in the south side LOD). With the exception of two water discharge structures on the north side (approximately 0.009 acre and 0.003 acre, respectively) construction activities will occur at least 50 feet from the north shoreline to avoid and/or minimize physical impacts to suitable foraging and nesting habitat for this species. In addition, with the exception of a water discharge structure (approximately 0.04 acre in size), construction activities will occur at least 115 feet from the south shoreline.

Individuals that may use the shoreline as stopover or nesting habitat may avoid the area due to construction and increased human activity. There is potential for mortality as a result of collision with construction equipment; however, this is unlikely given the minimal suitable habitat within the Action Area. No risk is anticipated from equipment and vehicles traveling along anticipated travel routes to and from off-site disposal areas.

Stormwater ponds will be created as part of the Project (see Section 1.3.2); however, due to disturbance during construction, and low habitat suitability overall, the constructed ponds will not provide suitable habitat

for the piping plover (i.e., sand and gravel beach and limestone cobble shore). Of the four ponds, two will contain only stormwater runoff and groundwater. The other two ponds will contain stormwater runoff and intermittently will receive treated wastewater during construction. Although there is potential for piping plovers to drink water from these ponds (if water is present), stormwater runoff discharged to these ponds will be non-regulated and will not encounter industrial processes. The wastewater will be treated and discharged in compliance with the requirements of the NPDES permit issued for the Project (Permit No. MI0060278). Therefore, no direct or indirect effects to the piping plover will occur as a result of construction or maintenance of the stormwater ponds.

3.1.2 Cumulative Effects

No plans for future State, tribal, local, or private projects within or immediately adjacent to the Action Area are known; therefore, no cumulative effects are anticipated.

3.1.3 Conservation Measures

With the exception of the water discharge structures and temporary water intake structures (Appendix A), construction activities will occur at least 50 feet from the north shoreline and at least 115 feet from the south shoreline to avoid and minimize physical impacts to suitable foraging and nesting habitat for this species. No additional conservation measures are proposed for this species.

3.1.4 Determination of Effect

The Project may affect but is not likely to adversely affect the piping plover because any effects, should they occur, will be insignificant or discountable.

3.2 Rufa Red Knot

Current Status

The rufa red knot is a shorebird that was listed as federally threatened by the USFWS on December 11, 2014 (79 FR 73706). Threats to the rufa red knot include sea level rise, coastal development, shoreline stabilization, reduced food availability at stopover sites, and human disturbance by vehicles, people, dogs, aircraft, and boats. A primary factor in the recent decline of this species was reduced food supplies in Delaware Bay and other stopover sites along the Atlantic coast due to commercial harvest of horseshoe crabs ((*Limulus polyphemus*). In addition, coastal wind farms and climate change represent emerging threats (USFWS 2014a). No critical habitat has been designated for this species. The rufa red knot is not listed as endangered or threatened in the state of Michigan.

Species Description

The rufa red knot is a 9 to 11-inch long, bulky sandpiper with a short, straight, black bill. During the breeding season, the legs are dark brown to black, and the breast and belly are a characteristic russet color that ranges from salmon-red to brick-red. Males are generally brighter shades of red, with a more distinct line through the eye. When not breeding, both sexes look the alike – plain gray above and dirty white below with faint, dark streaking (USFWS 2014b).

Habitat

Rufa red knots breed in the Arctic and migrate to nonbreeding areas in South America (Baker et al. 2013). They are also known to occupy nonbreeding habitats along the U.S. Atlantic coast (Delaware Riverkeeper Network et al. 2005). During migration, rufa red knots generally follow the Atlantic coast and stop in only a few key sites for feeding. One stopover site frequently visited during migration is the Delaware Bay in New Jersey, with many of the birds having flown directly from wintering habitats in South America (Baker et al. 2013).

Stopover habitats must be rich in easily digested foods, with thin to no shells, such as juvenile clams and mussels, and horseshoe crab eggs. They time their visits to stopover sites to follow the spawning seasons of intertidal invertebrates (USFWS 2013a). The rufa red knot is considered to be a rare transient throughout the Great Lakes region, and little is known about its use of stopover sites in the area.

Life History

The rufa red knot makes one of the longest annual migrations of any bird, traveling between Arctic breeding grounds in northern latitudes to nonbreeding areas in South America, flying up to 4,900 miles without stopping. Long-distance migrant shorebirds are highly dependent on the continued existence of quality habitat at a few key staging areas (Baker et al. 2013).

Rufa red knots are attracted to the Delaware Bay in the spring because the bay annually hosts large congregations of spawning horseshoe crabs, the eggs of which represent a major food source to migrating rufa red knots (Niles et al. 2007). Mussel beds along the U.S. Atlantic coast are also an important food source for migrating knots. Birds arrive at stopover areas with depleted energy reserves and must quickly rebuild their body fat to complete their migration to Arctic breeding areas (Niles et al. 2007). During their brief 10 to 14-day spring stay in the mid-Atlantic, rufa red knots can nearly double their body weight. Red knots feed on invertebrates, especially small clams, mussels, and snails, but they also feed on crustaceans, marine worms, and horseshoe crab eggs. On the breeding grounds, knots mainly eat insects (Niles et al. 2007).

Status in the Action Area

MNFI data indicate suitable habitat for this species within 1.5 miles of the Action Area (MNFI 2019a; Appendix D). Approximately 1.4 acres of suitable habitat (i.e., limestone cobble shore) is present within the Action Area (0.89 acre on the north side and 0.47 acre on the south side). Approximately 0.008 acre (0.002 acre on the north side and 0.006 acre on the south side) of limestone cobble shore is present within the LOD. Additional suitable stopover habitat for the rufa red knot (i.e., sand and gravel beach and limestone cobble shore) was observed immediately adjacent to the Action Area along the Lake Michigan shoreline during field surveys for the Project (Stantec 2019, 2020; Appendix E). Given the small amount of suitable habitat within the Action Area and that this species is a rare migrant within the Great Lakes region, it is unlikely to be observed in the Action Area.

3.2.1 Direct and Indirect Effects

Approximately 0.008 acre of suitable habitat (i.e., limestone cobble shore) will be cleared as a result of the Project (0.002 acre in the north side LOD and 0.006 acre in the south side LOD). With the exception of two water discharge structures on the north side (approximately 0.009 acre and 0.003 acre, respectively) construction activities will occur at least 50 feet from the north shoreline to avoid and/or minimize physical impacts to suitable foraging and nesting habitat for this species. In addition, with the exception of a water discharge structure (approximately 0.04 acre in size), construction activities will occur at least 115 feet from the south shoreline. Rufa red knots are known to migrate along the Atlantic coast and are only rare transients in the Great Lakes region, making the probability of the species occurring in the Action Area during migration possible, but unlikely.

Individuals that may use the shoreline as stopover habitat may avoid the area due to construction and increased human activity. There is potential for mortality as a result of collision with construction equipment; however, this is unlikely given the small amount of suitable habitat within the Action Area. No risk is anticipated from equipment and vehicles traveling along anticipated travel routes to and from off-site disposal areas.

Stormwater ponds will be created as part of the Project (see Section 1.3.2); however, due to disturbance during construction, and low habitat suitability overall, the constructed ponds will not provide suitable habitat for the rufa red knot (i.e., sand and gravel beach and limestone cobble shore). Of the four ponds, two will

contain only stormwater runoff and groundwater. The other two ponds will contain stormwater runoff and intermittently will receive treated wastewater during construction. Although there is potential for rufa red knots to drink water from these ponds (if water is present), stormwater runoff discharged to these ponds will be non-regulated and will not encounter industrial processes. The wastewater will be treated and discharged in compliance with the requirements of the NPDES permit issued for the Project (Permit No. MI0060278). Therefore, no direct or indirect effects to the rufa red knot will occur as a result of construction or maintenance of the stormwater ponds.

3.2.2 Cumulative Effects

No direct or indirect effects to this species will occur as a result of the Project; therefore, no cumulative effects will occur.

3.2.3 Conservation Measures

With the exception of the water discharge structures and temporary water intake structures (Appendix A), construction activities will occur at least 50 feet from the north shoreline and at least 115 feet from the south shoreline to avoid and minimize physical impacts to suitable foraging and nesting habitat for this species. No additional conservation measures are proposed for this species.

3.2.4 Determination of Effect

The Project may affect but is not likely to adversely affect the rufa red knot because any effects, should they occur, will be insignificant or discountable.

3.3 Canada Lynx

Current Status

The Canada lynx was listed as threatened by the USFWS on March 24, 2000 (65 FR 16051). A USFWS Recovery Outline for the Contiguous United States Population Segment of Canada Lynx was approved on September 14, 2005. No signed recovery plan has been implemented for this species. On January 11, 2018, the USFWS announced the completion of a scientific review that concluded the Canada lynx may no longer warrant protection under the ESA and should be considered for delisting due to recovery of the species (USFWS 2018a). The recommendation was informed by the Species Status Assessment for the Canada Lynx (*Lynx canadensis*) released in October of 2017 (USFWS 2017). Final critical habitat was designated on September 12, 2014 for this species (79 FR 54781). The Canada lynx is listed as endangered in the state of Michigan (MNFI 2009a).

Species Description

The Canada lynx is a medium sized carnivore found in boreal forests. They weigh 15 to 30 pounds and are 30 to 35 inches long with snowy light brown or gray fur with minimal spotting (USFWS 2013b). They have a similar appearance to the common bobcat except the lynx has long black ear tufts, a short, black-tipped tail, and exceptionally large paws and long hind legs (USFWS 2013b).

Habitat

In the Great Lakes states, the lynx may inhabit areas of coniferous and mixed coniferous/deciduous vegetation types dominated by pine (*Pinus* spp.), balsam fir (*Abies balsamea)*, black spruce (*Picea mariana),* white spruce (*P. glauca)*, northern white cedar (*Thuja occidentalis)*, tamarack (*Laris laricina)*, aspen (*Populus* spp.), paper birch (*Betula papyrifera)*, northern hardwoods, conifer bogs and shrub swamps (Ruediger et al. 2000) Lynx are closely associated with the habitats and populations of its primary prey, the snowshoe hare. Red squirrels may also be an important alternate prey species, especially during periods where snowshoe hare populations are low. Lynx den sites are found in forests with large coarse woody debris including downed logs or root wads (Ruediger et al. 2000). Older forests with a substantial

understory of conifers or small patches of shrubs and young trees that provide dense cover that touches the snow in winter, generally also provide good quality lynx foraging habitat (Ruediger et al. 2000).

The Great Lakes region is on the southern periphery of boreal forest vegetation and begins to transition to deciduous temperate forest, creating discontinuous, patchy boreal forest landscapes. Evidence shows that these landscapes within Michigan do not support resident lynx populations (USFWS 2017) but have the potential to support dispersing lynx (USDI FWS 2003 as cited in USDA FS 2006, Ruediger et al. 2000).

Life History

Canada lynx are generally solitary animals that mate in March and April with 1 to 6 kittens born in late April to mid-June (USFWS 2013b). The litter size and survival of kittens is highly dependent on the abundance of snowshoe hares (Ulev 2007). Young remain with their mothers for 9 to 10 months to nurse and learn to hunt, dispersing late April to early May (Ulev 2007). Lynx population cycles often follow those of the snowshoe hare, fluctuating on approximately a 10-year cycle. In periods of snowshoe hare decline, lynx populations can decline up to 90% due to starvation, dispersal, and recruitment collapse (Ulev 2007).

Lynxes occupy a large home range, with size varying greatly, from 10 to 140 square miles depending on food availability, sex, age, and population density. Home ranges of lynx of different ages and sexes can overlap, but adults of the same sex are usually hostile towards each other and maintain exclusive home ranges (Ulev 2007). Lynx are most common during dusk and dawn and often hide during the day, preferring dense coniferous forest habitat (Ulev 2007).

Status in the Action Area

MNFI data indicate suitable habitat for this species within 1.5 miles of the Action Area (MNFI 2019a; Appendix D); however, no suitable habitat for the Canada lynx (i.e., continuous boreal forest) is present within the Action Area (Stantec 2019; Appendix E).

3.3.1 Direct and Indirect Effects

No suitable habitat for the Canada lynx is found within the LOD or the Action Area immediately adjacent to the LOD (Figure 2a). Canada lynx are elusive and, if present, individuals will likely avoid the area due to the lack of habitat and the increased human activity during Project construction, including the use of lights if construction occurs at night which further reduces the likelihood the lynx would be present. Although this species could be present within the remainder of the Action Area, it is extremely unlikely due to the disturbed nature of the off-site disposal sites and human disturbance along existing roadways. Therefore, the risk of mortality due to vehicle strikes on anticipated travel routes as a result of Project equipment and vehicles traveling to and from off-site disposal areas will be discountable.

3.3.2 Cumulative Effects

No direct or indirect effects to this species will occur as a result of the Project; therefore, no cumulative effects will occur.

3.3.3 Conservation Measures

No conservation measures are proposed or required for this species.

3.3.4 Determination of Effect

The Project may affect but is not likely to adversely affect the Canada lynx given the lack of suitable habitat within the LOD and the low risk of mortality within the Action Area due to vehicle strikes on public roads as a result of Project equipment and vehicles traveling to and from off-site disposal areas. Therefore, effects to Canada lynx are extremely unlikely to occur (i.e., are discountable).

3.4 Northern Long-eared Bat

Current Status

On April 2, 2015, the USFWS published a final rule in the Federal Register (80 FR 17974) designating the northern long-eared bat (NLEB) as a threatened species under the ESA throughout its geographic range, which includes Michigan. The listing became effective on May 4, 2015. On April 26, 2016, the USFWS issued a ruling that designation of critical habitat for the NLEB is not prudent (81 FR 24707). The species is listed as a species of conservation concern by the state of Michigan (MNFI 2009a).

The USFWS issued a final 4(d) rule for this species effective February 16, 2016. Under the final 4(d) rule, all incidental take within hibernacula is prohibited within the white-nose syndrome zone (which includes the action area) (USFWS 2018b). All other incidental take is allowed under the final 4(d) rule, unless it is caused by tree removal that occurs within 0.25-mile of a known hibernaculum or is within a 150-foot radius of a known occupied maternity roost and will occur during the pup season (June 1 through July 31).

Species Description

The NLEB is distinguished by its long ears, especially when compared to other *Myotis* species. They are a medium-sized bat of about 3 to 3.7 inches, with a wingspan of 9 to 10 inches. The fur color ranges from medium to dark brown on the back, and tawny to pale brown on the underside (USFWS 2015).

Habitat

The NLEB uses a wide variety of forested habitats for roosting, foraging, and traveling, and may also utilize some adjacent and interspersed non-forested habitat such as emergent wetlands and edges of fields. This species has also been found roosting in structures like barns and sheds (particularly when suitable tree roosts are unavailable) (USFWS 2014c).

Roosting habitat includes forested areas with live trees and/or snags with a diameter at breast height (DBH) of at least 3 inches with exfoliating bark, cracks, crevices, and/or other cavities. Individual trees are considered suitable if they meet those requirements and are located within 1,000 feet of another suitable roost tree, woodlot, or wooded fencerow (USFWS 2014c). Suitable summer habitat includes roosting habitat, as well as foraging and travel habitat such as adjacent edges of agricultural fields, old fields, pastures, fencerows, riparian forests, and other wooded corridors (USFWS 2014c). Maternity habitat is any portion of suitable summer habitat that is used by juveniles and reproductive females. Winter habitat includes underground caves and cave-like structures such as abandoned or active mines and railroad tunnels with significant cracks and cervices (USFWS 2014c).

Life History

This species breeds in late summer and early fall when large numbers of bats congregate in and near the entrances of caves and mines. Females will store sperm during hibernation and the gestation period ranges between 50 and 60 days. Females give birth to one pup the following spring (CBD 2010).

The NLEB is a generalist predator of aerial invertebrates (CBD 2010). The species forages at night in forested areas, riparian zones, along forest edges, and in clearings. They feed on moths, flies, leafhoppers, caddisflies, and beetles, which they catch while in flight using echolocation. This bat also feeds by gleaning motionless insects from vegetation and water surfaces (USFWS 2015).

Status in the Action Area

The USFWS indicates no known NLEB maternity roosts in Mackinac or Emmet counties (USFWS 2016a). One hibernaculum is known from Mackinac County; however, it is located in Hendricks Township outside

of the Action Area (USFWS 2016a). No hibernacula have been identified in Emmet County (USFWS 2016a).

MNFI data indicate suitable habitat for this species within 1.5 miles of the Action Area (MNFI 2019a; Appendix D). Approximately 35.7 acres of suitable summer bat habitat (i.e., forested areas with live trees and/or snags with a DBH of at least 3 inches with exfoliating bark, cracks, crevices, and/or other cavities) are present within the Action Area, 10.8 acres of which are present within the LOD. No winter habitat is found within the Action Area.

3.4.1 Direct and Indirect Effects

Suitable summer habitat for this species is present within and adjacent to the Action Area; however, no known roost trees are located within or adjacent to the Action Area. In addition, no winter hibernacula will be affected by the Project.

Approximately 10.8 acres of suitable summer habitat will be cleared within the LOD as a result of the Project. A Presence/Probable Absence survey using methods described in the 2020 Rangewide Indiana Bat Survey Guidelines (USFWS 2020) will be conducted for the Project in July 2021. If the NLEB is detected during the survey, tree clearing will occur during the winter months (i.e., October 30 to March 15) when the bats are not present. If the result of the survey is probable absence of the NLEB, tree clearing may occur during the bats' active season.

Despite the loss of 10.8 acres of suitable summer habitat as a result of the Project, large blocks of contiguous forest are located immediately adjacent to the Action Area; these woodlands also provide suitable summer bat habitat. No habitat loss will occur outside of the LOD.

Project construction noise and lighting (including both temporary and permanent lighting) could cause bats to avoid, or leave, the Action Area. Construction noise could cause individual bats to flee day roosts resulting in increased energy expenditure or increased risk of predation to individuals. Given the proposed lighting will be similar to that currently used at the site for operation and maintenance of the existing pipeline, effects to bats as a result of Project lighting are anticipated to be minimal.

A review of aerial photographs indicates suitable summer bat habitat is likely present along anticipated travel routes between the LOD and offsite disposal areas. Although there will be a temporary increase in truck traffic over the course of the Project, there will be no habitat loss along the anticipated travel routes to disposal sites (i.e., no road improvement will be required to accommodate Project traffic outside of the LOD) as a result of Project. If bats are present in trees adjacent to these roads, individuals could be affected by the increase in traffic; however, effects to the NLEB along the travel routes are extremely unlikely to occur (i.e., are discountable).

3.4.2 Cumulative Effects

No plans for future State, tribal, local, or private projects within or immediately adjacent to the Action Area are known; therefore, no cumulative effects are anticipated.

3.4.3 Conservation Measures

No conservation measures are proposed for this species.

3.4.4 Determination of Effect

If the NLEB is detected during 2021 Presence/Probable Absence survey conducted for the Project, tree clearing will occur in the winter months (i.e., October 30 to March 15) when the bats are not present. However, if the result of the survey is probable absence of the NLEB, clearing of suitable summer habitat may occur at any time of year, including during the bats' active season. Under either scenario, the Project may affect, but is not likely to adversely affect the NLEB.

3.5 Hart's Tongue Fern

Current Status

Hart's tongue fern was listed as threatened by the USFWS on July 14, 1989 (50 CFR 29726). A recovery plan for the species was developed and signed on September 15, 1993 (USFWS 1993). No critical habitat has been designated for this species. The hart's tongue fern is listed as endangered in the state of Michigan (MNFI 2009b).

Species Description

Hart's tongue fern has elongated, untoothed evergreen strap-shaped fronds 7 to 16 inches long with a pointed tip and strong lobes at the base (Penskar and Higman 1996). The fronds arise in a cluster form a scaly rhizome often in number of 10 to 40 but can number as much as 100 per rootstalk. Located on the underside of the leaf, along the veins, are linear, brown, ocular sori (spore-bearing organs) (Penskar and Higman 1996).

Habitat

This species requires areas with high humidity, shade, moist substrate, and high magnesium limestone (USFWS 1993). It is often found along dolomitic limestone outcrops, in coulees, gorges, and in cool limestone sinkholes in mature forests (USFWS 1997a). In Michigan, the fern occurs on north or east-facing slopes of Niagran Dolomite (Penskar and Higman 1996).

Life History

Hart's tongue fern fronds remain green throughout the winter, producing new fronds at the beginning of each growing season. Reproduction occurs through spores, requiring moist, sheltered conditions for sporeling establishment (Penskar and Higman 1996). It is vulnerable to disturbance and has been threatened by the removal of shade trees due to logging, quarrying, and recreational and residential development, among other activities (USFWS 1997a).

Status in the Action Area

MNFI data indicate suitable habitat for this species within 1.5 miles of the Action Area (MNFI 2019a; Appendix D); however, no suitable habitat was observed within the LOD or the Action Area immediately adjacent to the LOD and the species was not observed during the 2019 or 2020 plant surveys (Stantec 2019, 2020; Appendix E). These surveys were conducted during the optimal survey period (i.e., third week of May through third week of October) by a qualified Stantec botanist with experience identifying this species in the field. No plant surveys were conducted along anticipated travel routes between the LOD and off-site disposal areas within the Action Area (Figure 2b).

3.5.1 Direct and Indirect Effects

No suitable habitat for this species was observed within the LOD or the Action Area immediately adjacent to the LOD (Appendix E). There will be no habitat loss along the anticipated travel routes to the disposal sites (i.e., no road improvement will be required to accommodate Project traffic outside of the LOD) as a result of Project and no effects to the existing road ROW will occur. Therefore, no direct or indirect effects to the Hart's tongue fern will occur as a result of the Project.

3.5.2 Cumulative Effects

No direct or indirect effects to this species will occur as a result of the Project; therefore, no cumulative effects will occur.

3.5.3 Conservation Measures

No conservation measures are proposed or required for this species.

3.5.4 Determination of Effect

Given the lack of suitable habitat within the LOD and the Action Area immediately adjacent to the LOD and the lack of impacts to this species elsewhere in the Action Area, the Project will have no effect on the Hart's tongue fern.

3.6 Pitcher's Thistle

Current Status

The pitcher's thistle was listed as threatened by the USFWS on July 18, 1988 (53 FR 27137). A USFWS Pitcher's Thistle Recovery Plan was developed and signed on September 20, 2002 (USFWS 2002). No critical habitat has been designated for this species. Pitcher's thistle is listed as threatened by the state of Michigan (MNFI 2009b).

Species Description

Pitcher's thistle is a perennial, herbaceous plant with woolly-white stems and leaves. The leaves are toothed with lobes less than 0.4-inch wide and up to 1.6 inches long. Minute spines are concentrated along the base of the leaf edge, with few spines between outer lobes (USFWS 2002). The flowering stems can be up to 3 feet tall and have up to 12 scattered leaves. There is typically one branching flowering stem per individual with cream or pinkish flowering heads (USFWS 2002).

Habitat

Pitcher's thistle is endemic to the dune ecosystem of the Great Lakes, occurring in all non-forested dune systems, but usually found in the near-shore plant community (USFWS 2002).

Life History

Pitcher's thistle is perennial and flowers and sets seed only once, generally after a 5 to 8-year juvenile stage, requiring 70% open sand for successful seedling establishment and survival (USFWS 2002). Seed dispersal begins in late July through August by way of seed blowing or falling to the ground. Germination occurs in May and June, depending on rainfall (USFWS 2002).

Status in the Action Area

MNFI data indicate documented occurrences for this species within 1.5 miles of the Action Area (MNFI 2019a; Appendix D). Approximately 0.7 acre of suitable habitat for this species (i.e., sand and gravel beach) was observed during the 2019 plant survey (Stantec 2019; Appendix E); however, no suitable habitat was observed within the LOD or the Action Area immediately adjacent to the LOD and the species was not observed during the 2019 or 2020 plant surveys (Stantec 2019, 2020; Appendix E). These surveys were conducted during the optimal survey period (i.e., third week of June through third week of September) by a qualified Stantec botanist with experience identifying this species in the field. No plant surveys were conducted along anticipated travel routes between the LOD and off-site disposal areas within the Action Area (Figure 2b).

3.6.1 Direct and Indirect Effects

This species was not observed within the LOD or the Action Area immediately adjacent to the LOD during detailed field surveys conducted for the Project in 2019 or 2020 (Stantec 2019, 2020; Appendix E). Although

there is potential for this species to be present along the shoreline during periods of low lake levels, with the exception of two water discharge structures on the north side (approximately 0.009 acre and 0.003 acre, respectively), construction activities will occur at least 50 feet from the north shoreline to avoid and/or minimize physical impacts to suitable habitat for this species. In addition, with the exception of a water discharge structure (approximately 0.04 acre in size), construction activities will occur at least 115 feet from the south shoreline. There will be no habitat loss along the anticipated travel routes to the disposal sites (i.e., no road improvement will be required to accommodate Project traffic outside of the LOD) as a result of Project and no effects to the existing road ROW will occur. Therefore, no direct or indirect effects to the pitcher's thistle are anticipated as a result of the Project.

3.6.2 Cumulative Effects

No direct or indirect effects to this species will occur as a result of the Project; therefore, no cumulative effects will occur.

3.6.3 Conservation Measures

No conservation measures are proposed or required for this species.

3.6.4 Determination of Effect

Given the lack of suitable habitat within the LOD and the Action Area immediately adjacent to the LOD, and the lack of impacts to this species elsewhere in the Action Area, the Project will have no effect on the pitcher's thistle.

3.7 Houghton's Goldenrod

Current Status

Houghton's goldenrod was listed as threatened by the USFWS on July 18, 1988 (53 FR 27134). A USFWS Houghton's Goldenrod Recovery Plan was developed and signed on September 17, 1997 (USFWS 1997b). No critical habitat has been designated for this species. The species is listed as threatened by the state of Michigan (MNFI 2009b).

Species Description

Houghton's goldenrod is a perennial plant with smooth, slender, sometimes reddish, stems that can grow up to 29 inches and are frequently clumped (USFWS 1997b). A top the stem are many small, completely bright yellow flower heads resembling daisies. The flowers are arranged in a flat-topped branched cluster. The species has few, narrow leaves up to 4.5 inches long that grow at the base of the flower cluster stem (USFWS 2018c) that continue down the stem in a linear, scattered manner to cluster around the base of the stem (USFWS 1997b). The flower stalks within each flower cluster are covered with small, fine hairs (USFWS 1997b, USFWS 2018c).

Habitat

The Houghton's goldenrod is endemic to the northern Great Lakes shoreline and is found most often in or near interdunal wetlands; moist, sandy beaches and shallow depressions between low sand ridges along the shoreline (USFWS 2018c). It can also be found along rocky shores, beach flats, marl pond edges, seasonally wet limestone pavement, and marl fen (USFWS 1997b).

Life History

Vegetative propagation is an important form of reproduction for Houghton's goldenrod. The species is insect pollinated and flowers from late July to October (USFWS 1997b). Fruiting and seed dispersal occur from

August to November with seeds that are not viable for more than one year. Successful germination requires light and an obligate overwintering period (USFWS 1997b).

Status in the Action Area

MNFI data indicate documented occurrences for this species within 1.5 miles of the Action Area (MNFI 2019a; Appendix D). Houghton's goldenrod was observed within the LOD and the Action Area immediately adjacent to the LOD on the north side but was not observed within the LOD or the Action Area immediately adjacent to the LOD on the south side (Stantec 2019, 2020; Appendix E) (Figure 4). No plant surveys were conducted along anticipated travel routes between the LOD and off-site disposal areas within the Action Area (Figure 2b).

3.7.1 Direct and Indirect Effects

Within the north side LOD, Houghton's goldenrod was found in the coastal fen, limestone bedrock glade, and limestone cobble shore natural communities (Stantec 2019; Appendix E). These communities combined comprise approximately 8.3 acres of the north side LOD, all of which would be cleared as a result of the Project.

Meander surveys for Houghton's goldenrod were completed by a qualified Stantec botanist in 2019 and 2020 (Appendix E). During these surveys, if Houghton's goldenrod was encountered, a visual estimation of the number of stems (i.e., individual plants) at each location was made. This species was observed in groups ranging from a few stems to up to a hundred or more scattered stems. Each group was mapped in the field and the estimated number of stems was recorded at each location. Following the fieldwork, the results were tallied using GIS attribute data to determine an approximate number of stems within the Action Area, as well as the approximate number of stems within the north side LOD.

During 2019 surveys, approximately 16,405 Houghton's goldenrod stems were observed within the 108.8-acre study area on the north side (includes the LOD and Action Area immediately adjacent to the LOD; Stantec 2019, Appendix E). Approximately 6,682 Houghton's goldenrod stems are located within the north side LOD and the Action Area immediately adjacent to the LOD, of which, approximately 3,777 Houghton's goldenrod stems are located within the north side LOD and will be cleared or relocated as a result of the Project. No Houghton's goldenrod was observed within the south side LOD or the Action Area immediately adjacent to the south side LOD (Appendix E). Conservation measures will be implemented to avoid and minimize direct and indirect effects to this species outside of the LOD (see Section 3.7.3). Given these conservation measures, which include sediment and erosion control measures, installation of exclusionary fencing to discourage pedestrian and vehicular traffic in areas where Houghton's goldenrod is known to occur within the Action Area, and mitigation measures, no adverse direct or indirect effects to the Houghton's goldenrod are anticipated outside of the LOD. However, the proposed mitigation measures will be an overall beneficial effect to this species. A plant mitigation plan has been developed to mitigate for Project effects to Houghton's goldenrod (see Section 5.0 and Appendix F). Table 3-1 summarizes the anticipated number of Houghton's goldenrod stems to be replaced as a result of the plant mitigation measures.

Table 2-1. Plant mitigation success criteria compared to approximate total stem counts of impacts to Houghton's goldenrod within the LOD

Stem Counts	Houghton's Goldenrod
Impacts within LOD*	3,777
Total stem count in Enhancement Areas at Year 5	3,020
Total Stem count in Re-Vegetation Areas at Year 3	760
Anticipated Stem Counts: Mitigation Total	3,780

*Estimated based on 2019 visual surveys. Actual impacts will be updated based on 2021 baseline surveys.

The estimated expected change in acreage of suitable habitat for Houghton's goldenrod is summarized in Table 3-2.

Table 3-2. Estimated suitable habitat for Houghton's goldenrod (acres)*

Area	Suitable Habitat Pre-Construction	Suitable Habitat After Mitigation	Gain/Loss of Suitable Habitat
Limits of Disturbance	7.0	4.5	-2.5
Enhancement Areas	1.6	5.2	3.6
Total	8.6	9.7	1.1

*Estimated based on 2019 visual surveys by qualified botanists.

No plant surveys were conducted along anticipated travel routes between the LOD and off-site disposal areas within the Action Area; however, there will be no habitat loss along the anticipated travel routes to disposal sites (i.e., no road improvement will be required to accommodate Project traffic outside of the LOD) as a result of Project and no effects to the existing road ROW will occur. Therefore, no effects to the Houghton's goldenrod are anticipated as a result of the Project traffic along the anticipated travel routes.

3.7.2 Cumulative Effects

No plans for future State, tribal, local, or private projects within or immediately adjacent to the Action Area are known; therefore, no cumulative effects are anticipated.

3.7.3 Conservation Measures

Enbridge has sited the north side LOD to avoid wetlands and protected species to the extent practical while still allowing enough space for a technically feasible and safe construction area. Additionally, Enbridge will implement sediment and erosion control measures to minimize and avoid impacts to Houghton's goldenrod outside of the LOD. Measures include the installation of berms and silt fence along the LOD boundary and silt fence along the boundary of improvements to Boulevard Drive. Enbridge will also install exclusionary signage at two-track roads to the northwest of the LOD and exclusionary fence along the western edge of the LOD to discourage pedestrian and vehicular traffic in areas where Houghton's goldenrod is present within the Action Area. Post-construction, Enbridge will install barriers along the western property boundary and the southern edge along Boulevard Drive to prevent unauthorized access to protect future transplant

and re-vegetation areas of protected species (Figure 5). Barrier installation and materials will be planned to avoid removal of trees and fill of wetland areas.

A plant mitigation plan is provided in Appendix F.

3.7.4 Determination of Effect

The Project will result in clearing of approximately 8.3 acres of suitable habitat for the Houghton's goldenrod. Approximately 3,777 individual Houghton's goldenrod plants will be cleared or relocated from the LOD resulting in an adverse effect to this species. However, proposed mitigation activities will offset the effects and no long-term adverse effects to this species are anticipated.

3.8 Dwarf Lake Iris

Current Status

Dwarf lake iris was listed as threatened by the USFWS on September 28, 1988 (53 FR 37972). A USFWS Dwarf Lake Iris Recovery Plan was developed and signed on August 1, 2013 (USFWS 2013c). No critical habitat has been designated for this species. The species is listed as threatened by the state of Michigan (MNFI 2009b).

Species Description

Dwarf lake iris is a low growing perennial with shallow, slender, creeping rhizomes that produce wide, flat, sword-like leaves up to 6.5 inches long in a fan-like clustered arrangement. Stems protrude less than 2 inches from the ground and produce single flowers that are 1 to 1.5 inches wide and 1.5 to 2.5 inches tall (USFWS 2018d).

Habitat

The dwarf lake iris is endemic to the Great Lakes shoreline and is found in cool, moist air, on sand or in thin soil over limestone-rich gravel or bedrock along old beach ridges or behind open dunes (USFWS 2018d). Sunlight is a critical growth factor and partly shaded or sheltered forest edges are optimal. The iris is most commonly associated with shoreline coniferous forests dominated by balsam fir and northern white cedar (USFWS 2013c).

Life History

Dwarf lake iris flowers from mid-May to early June and sometimes produces rounded seed capsules that are approximately 0.5 inch long (USFWS 2018d). Individual flowers remain open for 1 to 3 days to be pollinated by insects (USFWS 2013c). The seed capsules contain an average of 22 small seeds. Successful germination requires several months of cold temperatures and the seeds can remain viable for up to 15 years (USFWS 2013c).

Status in the Action Area

MNFI data indicate documented occurrences for this species within 1.5 miles of the Action Area (MNFI 2019a; Appendix D). Dwarf lake iris was observed within the Action Area on the north side but was not observed on the south side (Stantec 2019, 2020; Appendix E) (Figure 4). No plant surveys were conducted along anticipated travel routes between the LOD and off-site disposal areas within the Action Area (Figure 2b).

3.8.1 Direct and Indirect Effects

Within the north side LOD, the dwarf lake iris was found in the coastal fen, limestone bedrock glade, and limestone cobble shore natural communities (Stantec 2019). These communities combined comprise approximately 8.3 acres of the north side LOD, all of which would be cleared as a result of the Project.

Meander surveys for the dwarf lake iris were completed by a qualified Stantec botanist in 2019 and 2020 (Appendix E). During these surveys, if dwarf lake iris was encountered, a visual estimation of the number of stems (i.e., individual plants) at each location was made. This species spreads by rhizomes and can form large colonies covering extensive areas within suitable habitats. Within the north side LOD, some groups of this species were estimated to have greater than 1,000 individual plants (Stantec 2019). Each group was mapped in the field and the estimated number of stems was recorded at each location. Following the fieldwork, the results were tallied using GIS attribute data to determine an approximate number of stems within the north side LOD.

During 2019 surveys, approximately 27,075 dwarf lake iris stems were observed within the 108.8-acre study area on the north side (includes the LOD and Action Area immediately adjacent to the LOD; Stantec 2019, Appendix E). Approximately 19,544 dwarf lake iris stems are located within the north side LOD and the Action Area immediately adjacent to the LOD, and of those, approximately 7,757 dwarf lake iris stems located within the north side LOD will be cleared or relocated as a result of the Project. No dwarf lake iris was observed within the south side LOD or the Action Area immediately adjacent to the south side LOD (Appendix E). Conservation measures will be implemented to avoid and minimize direct and indirect effects to this species outside of the LOD (see Section 3.8.3). Given these conservation measures, which include sediment and erosion control measures, installation of exclusionary fencing to discourage pedestrian and vehicular traffic in areas where dwarf lake iris is known to occur within the Action Area, and mitigation measures, no adverse direct or indirect effects to the dwarf lake iris are anticipated outside of the LOD. However, the proposed mitigation measures will be an overall beneficial effect to this species. A plant mitigation plan has been developed to mitigate for Project effects to dwarf lake iris (see Section 5.0 and Appendix F). Table 3-3 summarizes the anticipated number of dwarf lake iris stems to be replaced as a result of the plant mitigation measures.

Table 4-3. Plant mitigation success criteria compared to approximate total stem counts of impacts to dwarf lake iris within the LOD

Stem Counts	Dwarf Lake Iris
Impacts within LOD*	7,757
Total stem count in Enhancement Areas at Year 5	6,210
Total Stem count in Re-Vegetation Areas at Year 3	1,550
Anticipated Stem Counts: Mitigation Total	7,760

*Estimated based on 2019 visual surveys. Actual impacts will be updated based on 2021 baseline surveys.

The estimated expected change in acreage of suitable habitat for dwarf lake iris is summarized in Table 3-4.

Table 5-4. Estimated suitable habitat for dwarf lake iris (acres)*

Area	Suitable Habitat Pre-Construction	Suitable Habitat After Mitigation	Gain/Loss of Suitable Habitat
Limits of Disturbance	7.0	4.5	-2.5
Enhancement Areas	1.6	5.2	3.6
Total	8.6	9.7	1.1

*Estimated based on 2019 visual surveys by qualified botanists.

No plant surveys were conducted along anticipated travel routes between the LOD and off-site disposal areas within the Action Area; however, there will be no habitat loss along the anticipated travel routes to the disposal sites (i.e., no road improvement will be required to accommodate Project traffic outside of the LOD) as a result of Project and no effects to the existing road ROW will occur. Therefore, no effects to the dwarf lake iris are anticipated as a result of the Project traffic along the anticipated travel routes.

3.8.2 Cumulative Effects

No plans for future State, tribal, local, or private projects within or immediately adjacent to the Action Area are known; therefore, no cumulative effects are anticipated.

3.8.3 Conservation Measures

Enbridge has sited the LOD to avoid wetlands and protected species to the extent practical while still allowing enough space for a technically feasible and safe construction area. Additionally, Enbridge will implement sediment and erosion control measures to minimize and avoid impacts to dwarf lake iris off-site. Measures include the installation of berms and silt fence along the LOD boundary and silt fence along the boundary of improvements to Boulevard Drive. Enbridge will also install exclusionary signage at two-track roads to the northwest of the LOD and exclusionary fence along the western edge of the LOD to discourage pedestrian and vehicular traffic in areas where dwarf lake iris is present within the Action Area. Post-construction, Enbridge will install barriers along the western property boundary and the southern edge along Boulevard Drive to prevent unauthorized access to protect future transplant and re-vegetation areas of protected species (Figure 5). Barrier installation and materials will be planned to avoid removal of trees and fill of wetland areas.

A plant mitigation plan is provided in Appendix F.

3.8.4 Determination of Effect

The Project will result in clearing of approximately 8.3 acres of suitable habitat for the dwarf lake iris. Approximately 7,757 individual dwarf lake iris plants will be cleared or relocated from the LOD resulting in an adverse effect to this species. However, proposed mitigation activities will offset the effects and no long-term adverse effects to this species are anticipated.

3.9 Lakeside Daisy

Current Status

Lakeside daisy was listed as threatened by the USFWS on June 23, 1988 (53 FR 23742). A USFWS lakeside daisy Recovery Plan was developed and signed on September 19, 1990 (USFWS 1990). USFWS conducted a 5-year review of the species in 2010 and again in 2016 (USFWS 2016c). No critical habitat has been designated for this species. The species is listed as endangered by the state of Michigan (MNFI 2009b).

Species Description

The lakeside daisy is an herbaceous perennial that forms clumps and produces solitary, daisy-like flowers on short, hairy stalks. The leaves arise from a short, thin, branching base to form rosettes (Penskar and Higman 2002). The leaves are narrow, dark green, and one-nerved ranging to about 6.3 inches long. They are thick in texture and punctate (i.e., marked with dots or tiny spots). Flowers arise on stout, hairy peduncles that elongate through the flowering period, reaching 4 to 16 inches at the time of seed dispersal (Penskar and Higman 2002). The flowers are bright yellow in color and resemble daisies and are composed of both central and outer florets, with the outer florets being 3-toothed on the margin (Penskar and Higman 2002).

Habitat

Lakeside daisy is found in dry limestone prairies, alvar habitat and modified alvar habitat. This habitat consists of limestone or dolomite bedrock, sometimes in the form of gravel, with thin to no soil, few to no trees, and seasonal drought (USFWS 2016c). These habitats are often found along quarrying sites (USFWS 2016c). The species is rarely found in shaded sites (USFWS 1990). In Michigan, this species is known from a single locality in Mackinac County at the edge of a white cedar forest in marly soil over limestone (Voss and Reznicek 2012).

Life History

Lakeside daisy is a perennial that blooms from late April to early June (USFWS 1990). Clumps expand by producing additional rosettes at the tip of the caudex. As the plant ages, florets at the center senesce and new ones are added to the periphery, creating a donut shape. The species is self-incompatible and is pollinated by wind and bees (Penskar and Higman 2002). An average of 49 seeds are produced per flower and are wind dispersed (USFWS 1990). There is no seed dormancy, and germination occurs as soon as moisture is available (USFWS 1990).

Status in the Action Area

MNFI data indicate suitable habitat for this species within 1.5 miles of the Action Area (MNFI 2019a; Appendix D). Suitable habitat for this species (i.e., limestone bedrock glade) was observed within the LOD and the Action Area immediately adjacent to the LOD on the north side but not within the LOD or the Action Area immediately adjacent to the LOD on the south side. This species was not observed during the 2019 or 2020 plant surveys (Stantec 2019, 2020; Appendix E). The surveys were conducted during the optimal survey period (i.e., May through the third week of June) by a qualified Stantec botanist with experience identifying this species in the field. No plant surveys were conducted along anticipated travel routes between the LOD and off-site disposal areas within the Action Area (Figure 2b).

3.9.1 Direct and Indirect Effects

This species was not observed within the LOD or the Action Area immediately adjacent to the LOD (Stantec 2019, 2020; Appendix E). There will be no habitat loss along the anticipated travel routes to disposal sites (i.e., no road improvement will be required to accommodate Project traffic outside of the LOD) as a result of Project and no effects to the existing road ROW will occur. Therefore, no direct or indirect effects to the lakeside daisy are anticipated as a result of the Project.

3.9.2 Cumulative Effects

No direct or indirect effects to this species will occur as a result of the Project; therefore, no cumulative effects will occur.

3.9.3 Conservation Measures

No conservation measures are proposed or required for this species.

3.9.4 Determination of Effect

This species was not observed within the LOD or the Action Area immediately adjacent to the LOD during plant surveys conducted for the Project (Stantec 2019, 2020; Appendix E). In addition, no impacts to this species are anticipated elsewhere within the Action Area therefore, the Project will have no effect on the lakeside daisy.

3.10 Michigan Monkey-flower

Current Status

Michigan monkey-flower was listed as endangered by the USFWS on June 21, 1990 (55 FR 25596). A USFWS Michigan monkey-flower Recovery Plan was developed and signed on September 17, 1997 (USFWS 1997c). No critical habitat has been designated for this species. The species is also listed as endangered by the state of Michigan (MNFI 2009b).

Species Description

The Michigan monkey-flower is a semi-aquatic perennial forb that grows through the formation of mats. Leaves are roundish and opposite with coarsely sharp toothed margins. Stems grow up to 15.7 inches long and recline at the base, rooting freely at lower leaf nodes to produce additional shoots. The 0.6 to 1.1-inch flower is bright yellow and tubular with red spots on the lower lip and tube. The fruit, albeit seldom produced, is an 0.3 to 0.4-inch oblong, pointed capsule that contains oval seeds with longitudinal striations (USFWS 1997c).

Habitat

Michigan monkey-flower is endemic to Michigan and is found along cold alkaline springs, seeps, and streams often in close association with northern white cedar along the Great Lakes shorelines (USFWS 1997c). It flowers most abundantly when in full sunlight, flourishing in tree canopy openings and along forest edges (USFWS 1997c).

Life History

Very little is known about the life history of the Michigan monkey-flower, but it has been observed to be almost completely dependent on vegetative propagation. It was also observed to die back in the fall, becoming more or less dormant and then re-initiating growth in the spring (USFWS 1997c).

Status in the Action Area

MNFI data indicate no suitable habitat within 1.5 miles of the Action Area (MNFI 2019a; Appendix D). No suitable habitat (i.e., cold, calcareous springs, seeps and streams through northern white cedar forests, and the base of bluffs near Great Lakes shorelines) was observed within the LOD or the Action Area immediately adjacent to the LOD and the species was not observed during the 2019 or 2020 plant surveys (Stantec 2019, 2020; Appendix E). No plant surveys were conducted along anticipated travel routes between the LOD and off-site disposal areas within the Action Area (Figure 2b).

3.10.1 Direct and Indirect Effects

No suitable habitat for this species was observed within the LOD or the Action Area immediately adjacent to the LOD (Stantec 2019, 2020; Appendix E). There will be no habitat loss along the anticipated travel routes to disposal sites (i.e., no road improvement will be required to accommodate Project traffic outside of the LOD) as a result of Project and no effects to the existing road ROW will occur. Therefore, no direct or indirect effects to the Michigan monkey-flower are anticipated as a result of the Project.

3.10.2 Cumulative Effects

No direct or indirect effects to this species will occur as a result of the Project; therefore, no cumulative effects will occur.

3.10.3 Conservation Measures

No conservation measures are proposed or required for this species.

3.10.4 Determination of Effect

Given the lack of suitable habitat within the LOD and the Action Area immediately adjacent to the LOD and the lack of impacts to this species elsewhere in the Action Area, the Project will have no effect on the Michigan monkey-flower.

3.11 Eastern Massasauga Rattlesnake

Current Status

The eastern massasauga rattlesnake (EMR) was listed as federally threatened by the USFWS on September 30, 2016 (81 FR 67193-67214). There is no recovery plan for the species. Critical habitat was deemed not prudent due to threat of increased collection and persecution (81 FR 67193). The EMR is also listed as a species of special concern by the state of Michigan (MNFI 2009a).

Species Description

The EMR is a small (24 – 30 inches), thick-bodied rattlesnake with brown or grayish black to black blotches on the back alternating with two or three rows of brown to black blotches on a gray ground color. A small pit is located on each side of head between eye and nostril, nine large scales are present on top of the head, and a small rattle is present on the tail. The belly is chiefly black. The body scales are strongly keeled and the anal plate single.

Habitat

The EMR is found in a variety of habitats, including bogs, fens, marshes, upland old fields, prairies, sedge meadows, shrub carr and wet grasslands adjacent to bottomland forest, but tend to avoid heavily wooded areas (Wright 1941; Reinert and Kodrich 1982; Seigel 1986; Weatherhead and Prior 1992). Suitable habitat includes moderate to large open canopy wetland habitats (such as wet meadow, sedge meadow, or wet prairie) with substantial adjacent open upland or wet/mesic meadows for foraging; small wetland habitats of various types with little to no adjacent open canopy for foraging may also be used but have lower suitability.

The snakes use a combination of wetland and upland habitats throughout the year, with overwintering occurring in wetland areas, hibernation occurring primarily in crayfish or small animal burrows, and summer foraging occurring in wetlands and upland or mesic grasslands.

Life History

Szymanski et al. (2015) indicate the typical life history for the EMR consists of two seasons: the active season and the winter dormant season. The beginning of the active season varies by latitude but generally it begins in March or April when the snakes emerge from hibernation and move to their summer habitat where mating and eventual birth of young occur. Generally, males and non-gravid females spend the active season foraging, while gravid females travel less and thermoregulate to obtain the optimal body temperatures for development of their young. In fall, the snakes return to their winter areas to hibernate.

Status in the Action Area

MNFI data indicate no suitable habitat for this species within 1.5 miles of the Action Area (MNFI 2019a; Appendix D). No suitable habitat is found within the LOD or the Action Area immediately adjacent to the LOD. No habitat surveys were conducted along anticipated travel routes between the LOD and off-site disposal areas within the Action Area (Figure 2b).

3.11.1 Direct and Indirect Effects

No suitable habitat is found within the LOD or the Action Area immediately adjacent to the LOD; however, if suitable habitat for this species is present along travel routes between the north side or south side LOD and the chosen disposal site(s), potential for road mortality exists.

3.11.2 Cumulative Effects

No plans for future State, tribal, local, or private projects within or immediately adjacent to the Action Area are known; therefore, no cumulative effects are anticipated.

3.11.3 Conservation Measures

The following conservation measures for the eastern massasauga rattlesnake will be implemented within the south side LOD in accordance with recommendations from the USFWS:

- Enbridge will use wildlife-safe materials for erosion control and site restoration throughout the south side LOD. Erosion control products containing plastic mesh netting or other similar material that could entangle EMR will not be used. Erosion and control measures may include net-less erosion control blankets (for example, made of excelsior), loose mulch, hydraulic mulch, soil binders, unreinforced silt fences, and straw bales. Other measures may include materials made from natural fibers (such as jute) and loosely woven together (often called Leno weave) such that wildlife is able to free itself.
- To increase human safety and awareness of EMR, construction contractors will first watch MDNR's "60-Second Snakes: The Eastern Massasauga Rattlesnake" video (available at https://youtu.be/~PFnXe_e02w), or review the EMR factsheet (available at https://www.fws.gov/midwest/endangered/reptiles/eama/pdf/EMRfactsheetSep2016.pdf), or call (517) 351-2555.
- During project implementation, Enbridge will report sightings of federally listed species, including EMR, to the USFWS within 24 hours.

3.11.4 Determination of Effect

The Project may affect but is not likely to adversely affect the EMR given the lack of suitable habitat within the LOD and the Action Area immediately adjacent to the LOD and the low risk of mortality due to vehicle strikes on anticipated travel routes as a result of Project equipment and vehicles traveling to and from off-site disposal areas. Therefore, effects to EMR are extremely unlikely to occur (i.e., are discountable).

3.12 Hine's Emerald Dragonfly

Current Status

Hine's emerald dragonfly (HED) was listed as federally endangered by the USFWS on January 26, 1995 (60 FR 5267). A Hine's Emerald Dragonfly (*Somatochlora hineana*) Recovery Plan was developed and signed on September 27, 2001 (USFWS 2001). On April 23, 2010, USFWS released a final determination of critical habitat for the HED (75 FR 21394). HED is also listed as endangered by the state of Michigan (MNFI 2009a).

Species Description

The HED is an averaged sized dragonfly ranging from 2.3 to 2.5 inches in length with a wingspan of 3.5-3.7 inches. When the HED first emerges as an adult, the eyes are brown, turning green in the first 1 to 3 days. It has a dark metallic green thorax with two yellow lateral lines. The wings are clear with an amber tinge towards the base of the hind wings though wings may turn opaque towards the end of the life span. Males have a distinctively claw-like terminal appendage and females have a pointer-like ovipositor, distinguishing the HED from other dragonflies (USFWS 2001).

Habitat

The HED is a wetland dragonfly, living in slow flowing marshes and sedge meadows dominated by grass or grass-like plants that are groundwater fed with underlying dolomitic bedrock or calcareous limestone. These wetland complexes are generally open, vegetated areas with nearby forest edge habitat. In Michigan, these nearby forest habitats are generally conifer swamps and forests and the predominant substrate is marl (USFWS 2001). Natural community types in which they are found in Michigan include bog, coastal fen, emergent marsh, great lakes marsh, northern fen, patterned fen, poor fen, and rich conifer swamp in which they require a 1st or 2nd order headwater stream that contains a pool (MNFI 2019b).

Historically, loss of habitat to agriculture and development has been the primary cause of the species' decline. Today, continued habitat loss along with changes in successional stages and disruption of ecological and hydrological process threaten current populations (USFWS 2001).

Life History

The HED has three life stages: aquatic egg, aquatic larva, and a terrestrial/aerial adult. Once the egg is hatched, larva spend two to four years in small streams. Once larval development is complete, the larvae begin to emerge as adults, as early as May in Illinois and June in Wisconsin, continuing throughout the summer. Adults live at least 14 days and may live up to 4 to 6 weeks. During their time as adults, HEDs feed, establish territories, mate, and lay eggs. A female will likely lay more than 500 eggs throughout her lifetime (USFWS 2001).

Status in the Action Area

MNFI data indicate no suitable habitat for this species within 1.5 miles of the Action Area (MNFI 2019a; Appendix D). No suitable habitat (i.e., slow flowing marsh and sedge meadow) for this species was observed within the LOD or the Action Area immediately adjacent to the Action Area during field surveys conducted for the Project (Stantec 2019, 2020; Appendix E). No habitat surveys were conducted along anticipated travel routes between the LOD and off-site disposal areas within the Action Area (Figure 2b).

3.12.1 Direct and Indirect Effects

No suitable habitat is found within the LOD or the Action Area immediately adjacent to the LOD; therefore, no direct or indirect effects to the HED are anticipated within the LOD or the Action Area immediately adjacent to the LOD.

If suitable habitat for this species is present along anticipated travel routes between the north side or south side LOD and the chosen disposal site(s), potential for road mortality to this species exists.

3.12.2 Cumulative Effects

No direct or indirect effects to this species will occur as a result of the Project; therefore, no cumulative effects will occur.

3.12.3 Conservation Measures

No conservation measures are proposed or required for this species.

3.12.4 Determination of Effect

The Project may affect but is not likely to adversely affect the HED given the lack of suitable habitat within the LOD and the Action Area immediately adjacent to the LOD and the low risk of mortality due to vehicle strikes on public roads as a result of Project equipment and vehicles traveling to and from off-site disposal areas. Therefore, effects to HED are extremely unlikely to occur (i.e., are discountable).

3.13 Hungerford's Crawling Water Beetle

Current Status

The Hungerford's crawling water beetle was listed as federally endangered by the USFWS on March 2, 1994 (59 FR 10580). A Hungerford's Crawling Water Beetle (*Brychius hungerfordi*) Recovery Plan was approved on September 28, 2006 (USFWS 2006). No critical habitat has been designated for this species. The Hungerford's crawling water beetle is also listed as endangered by the state of Michigan (MNFI 2009a).

Species Description

As larvae, Hungerford's crawling water beetles are yellowish-brown with cylindrical shaped bodies that taper to a hooked tail. They have short legs with modified forelegs. Their third antennal segment is shorter than the second segment and they are approximately 0.5 inch long (USFWS 2006). As adults, Hungerford's crawling water beetles retain their yellowish-brown coloring and are small torpedo-shaped beetles with irregular dark markings (USFWS 2006). They have narrow, longitudinal, finely perforated stripes on the wing coverings and the basal two-thirds of the pronotum are nearly parallel, distinguishing it from similar species (USFWS 2006).

Habitat

While the habitat components are not well understood, Hungerford's crawling water beetles are generally found in well aerated riffles and plunge pools of cool, clean, moderate to fast flowing streams with inorganic substrate and slightly alkaline conditions. They are often found just downstream of debris dams, culverts, human-made impoundments, and other structures that create similar conditions (USFWS 2006).

They are thought to be herbivorous, likely feeding on algae and periphyton and the presence of algae seems to be an important factor in determining suitable habitat. They are only known from a few streams in northern Michigan, including two in Emmet County (Carp Lake River and East Branch of the Maple River). Threats to the species include any activities that degrade water quality or remove/disrupt the pools and riffle environment of streams in which they live (USFWS 2006).

Life History

Very little is known about the life history of the Hungerford's crawling water beetle, however, there is life history information for other haliplids. The Hungerford's crawling water beetle, like all beetles, has four distinct life stages: larval, pupae, adult, and egg laying. Hungerford's crawling water beetle larvae spend most of their time in the stream and likely burrow into sediment to overwinter. The pupal stage has not been described for Hungerford's crawling water beetle, but similar species pupae develop within a chamber constructed in the soil, the only terrestrial stage, and emerge as adults in the spring after two to three weeks. Adults then mate in the summer and egg laying likely occurs within aquatic vegetation within the stream (USFWS 2006).

Status in the Action Area

MNFI data indicate no suitable habitat for this species within 1.5 miles of the Action Area (MNFI 2019a; Appendix D). No suitable habitat (i.e., alkaline streams with riffles and plunge pools) for this species was observed within the LOD or the Action Area immediately adjacent to the LOD during field surveys conducted for the Project (Stantec 2019, 2020; Appendix E). No habitat surveys were conducted along anticipated travel routes between the LOD and off-site disposal areas within the Action Area (Figure 2b).

3.13.1 Direct and Indirect Effects

No suitable habitat is found within the LOD or the Action Area immediately adjacent to the LOD. No habitat loss will occur as a result of Project travel along anticipated travel routes to disposal sites (i.e., no road improvement will be required to accommodate Project traffic outside of the LOD). In addition, no risk of road mortality is anticipated as a result of the Project. Therefore, no direct or indirect effects to the Hungerford's crawling water beetle are anticipated as a result of the Project.

3.13.2 Cumulative Effects

No direct or indirect effects to this species will occur as a result of the Project; therefore, no cumulative effects will occur.

3.13.3 Conservation Measures

No conservation measures are proposed or required for this species.

3.13.4 Determination of Effect

Given the lack of suitable habitat within the LOD and the Action Area immediately adjacent to the LOD and the lack of impacts to this species elsewhere in the Action Area, the Project will have no effect on the Hungerford's crawling water beetle.

4.0 CONSERVATION MEASURES

With the exception of the water discharge structures and temporary water intake structures (Appendix A), construction activities will occur at least 50 feet from the north shoreline and at least 115 feet from the south shoreline to avoid and minimize physical impacts to suitable foraging and nesting habitat for shorebirds (piping plover and rufa red knot).

Enbridge has sited the north side LOD to avoid wetlands and protected plant species to the extent practical while still allowing enough space for a technically feasible and safe construction area. Additionally, Enbridge will implement sediment and erosion control measures to minimize and avoid impacts to wetlands and protected plant species outside of the LOD. Measures include the installation of berms and silt fence along the LOD boundary and silt fence along the boundary of improvements to Boulevard Drive. Enbridge will also install exclusionary signage at two-track roads to the northwest of the LOD and exclusionary fence along the western edge of the LOD to discourage pedestrian and vehicular traffic in areas with existing protected plants within the Action Area. Post-construction, Enbridge will install barriers along the western property boundary and the southern edge along Boulevard Drive to prevent unauthorized access to protect transplant and re-vegetation areas of protected plant species (Figure 5). Barrier installation and materials will be planned to avoid removal of trees and fill of wetland areas.

If practical, site clearing and grading will be completed during the winter months (i.e., October 30 to March 15) to minimize effects to environmental features such as nesting birds and roosting bats.

Conservation measures specific to the eastern massasauga rattlesnake are described in Section 3.12.3.

5.0 MITIGATION AND MONITORING

A plant mitigation plan was developed to mitigate for direct effects to Houghton's goldenrod and dwarf lake iris within the north side LOD. The plant mitigation plan is provided in Appendix F and is summarized in this section.

Enbridge proposes to relocate approximately 80 percent of the estimated stem count of each species within the north side LOD. Approximately 3,020 Houghton's goldenrod and 6,210 dwarf lake iris will be relocated based on the 2019 estimates of approximately 3,777 Houghton's goldenrod and 7,757 dwarf lake iris. Relocation is anticipated to take place in spring or fall of 2022. The plants will be relocated to appropriate habitat within proposed Protected Species Enhancement Areas (Enhancement Areas) on Enbridge property surrounding the LOD (see Figure 2 in Appendix F) within the Action Area. The Enhancement Areas total approximately 5.2 acres. Habitat improvement activities will be performed prior to relocation, and may include selectively thinning woody vegetation, garbage and debris removal, and invasive species removal.

Additionally, following completion of construction, stockpiled topsoil will be applied within approximately 4.5 acres of selected Re-Vegetation Areas within the LOD to re-establish Houghton's goldenrod and dwarf lake iris within the Action Area (see Figure 2 in Appendix F). Enbridge will also implement invasive species management in those areas to encourage the re-establishment of both Houghton's goldenrod and dwarf lake iris.

Enbridge proposes both qualitative and quantitative monitoring on a bi-annual basis during the growing season for the first year after relocation in the Enhancement Areas, and once annually during Years 2 through 5. In the Re-Vegetation Areas, Enbridge proposes monitoring on a bi-annual basis during the first growing season for Year 1 and once annually during monitoring events in Year 2 and Year 3. The purpose of the monitoring is to quantify stems of DLI and HG within the Enhancement and Re-Vegetation Areas relative to baseline conditions. Monitoring will also be used to identify signs of site damage, including unauthorized access, vandalism, herbivory, plant desiccation, inundation, or significant plant mortality.

Following an adaptive management approach, Enbridge may apply management interventions to address issues identified in periodic monitoring observations of the Enhancement and Re-Vegetation Areas. Actions will be determined based on the severity of observed issues, but may include invasive species treatment, barrier repair, seeding with DLI and HG, the planting of live plugs, and/or additional thinning of woody vegetation.

Unauthorized access and ATV use has been an ongoing issue within the proposed Enhancement Areas and vicinity. To improve habitat to existing plants and protect relocated plants, Enbridge will install gates, blockades, barriers, fencing, and/or other means to help limit unauthorized access to both the Enhancement and Re-Vegetation Areas.

An overview of plant mitigation as it relates to the overall Project schedule is provided in Table 5-1.

Table 5-1. Proposed plant mitigation schedule

Project Activity	Anticipated Schedule*
Baseline Plant Surveys	Summer 2021
Enhancement Area site preparation and habitat enhancement and plant relocation	May – September 2022
Site grading within the LOD and stockpile of topsoil	Anticipated Duration – 3 Months
Project Construction	2022 through 2025
Final site cleanup and redistribution of topsoil in the Revegetation Areas	2025/2026

*Anticipated dates pending permit approvals.

6.0 SUMMARY OF EFFECTS DETERMINATIONS

Table 6-1 provides a summary of effects determinations for all species covered in this BA.

Table 6-1. Summary of effects determinations

Species	No Effect	May Affect but Not Likely to Adversely Affect	Likely to Adversely Affect	Justification
Piping Plover		X		- Approximately 1.36 acres of suitable habitat for this species are present within the Action Area; however, minimal suitable habitat (approximately 0.008 acre of limestone cobble shore) is present within the LOD. - Individuals that may use the shoreline may avoid the area due to Project activities. - Project activities will occur at least 50 feet from the north shoreline (with the exception of two water discharge structures measuring less than 0.01 acre combined) and 115 feet from the south shoreline (with the exception of a water discharge structure approximately 0.04 acre in size) to avoid and/or minimize physical impacts to suitable foraging and nesting habitat for this species. - No risk to this species is anticipated from equipment and vehicles traveling to and from off-site disposal areas.
Rufa Red Knot		X		- Approximately 1.36 acres of suitable habitat for this species are present within the Action Area; however, minimal suitable habitat (approximately 0.008 acre of limestone cobble shore) is present within the LOD. - This species is a rare transient in the Great Lakes region. - If present, individuals that may use the shoreline for stopover habitat may avoid the area due to Project activities. - Project activities will occur at least 50 feet from the north shoreline (with the exception of two water discharge structures measuring less than 0.01 acre combined) and 115 feet from the south shoreline (with the exception of a water discharge structure approximately 0.04 acre in size) to avoid and/or minimize physical impacts to suitable foraging and nesting habitat for this species. - No risk to this species is anticipated from equipment and vehicles traveling to and from off-site disposal areas.
Canada Lynx		X		- No suitable habitat for this species is present within the LOD.

Species	No Effect	May Affect but Not Likely to Adversely Affect	Likely to Adversely Affect	Justification
				- Canada lynx are elusive and, if present, individuals will likely avoid the Action Area due to increased human activity during Project activities. - It is anticipated that the risk of mortality due to vehicle strikes on public roads as a result of equipment and vehicles traveling to and from off-site disposal areas will be discountable.
Northern Long-eared Bat			X	- The USFWS indicates no known NLEB maternity roosts in Mackinac or Emmet counties and no hibernacula have been identified in Emmet County - Approximately 10.8 acres of suitable summer habitat will be cleared as a result of the Project. - If the NLEB is detected during 2021 Presence/Probable Absence survey conducted for the Project, tree clearing will occur in the winter months (i.e., October 30 to March 15) when the bats are not present. However, if the result of the survey is probable absence of the NLEB, clearing of suitable summer habitat may occur during the bats' active season. Under either scenario, the Project may affect, but is not likely to adversely affect the NLEB. Although there will be a temporary increase in truck traffic over the course of the Project, there will be no habitat loss along anticipated travel routes to disposal sites (i.e., no road improvement will be required to accommodate Project traffic outside of the LOD) as a result of Project. If bats are present in trees adjacent to these roads, individuals could be affected by the increase in traffic; however, any effects of Project traffic to the bats, should they occur, will be discountable.
Hart's Tongue Fern	X			- No suitable habitat for this species is present within the LOD or the Action Area immediately adjacent to the LOD. - This species was not observed within the LOD or the Action Area immediately adjacent to the LOD. - There will be no habitat loss along the anticipated travel routes to disposal sites (i.e., no road improvement will be required to accommodate Project traffic outside of the LOD) as a result of Project and no effects to the existing road ROW will occur. - No direct or indirect effects to the Hart's tongue fern will occur as a result of the Project.
Pitcher's Thistle	X			- No suitable habitat for this species is present within the LOD or the Action Area immediately adjacent to the LOD.

Species	No Effect	May Affect but Not Likely to Adversely Affect	Likely to Adversely Affect	Justification
				- This species not observed within the LOD or the Action Area immediately adjacent to the LOD during plant surveys conducted for the Project. - There will be no habitat loss along the anticipated travel routes (i.e., no road improvement will be required to accommodate Project traffic) as a result of Project and no effects to the existing road ROW will occur. - No direct or indirect effects to the pitcher's thistle will occur as a result of the Project.
Houghton's Goldenrod			X	- Approximately 8.3 acres of suitable Houghton's goldenrod and approximately 3,777 stems will be cleared or relocated within the north side LOD. - There will be no habitat loss along the anticipated travel routes to disposal sites (i.e., no road improvement will be required to accommodate Project traffic outside of the LOD) as a result of Project and no effects to the existing road ROW will occur. - No adverse direct or indirect effects to the Houghton's goldenrod will occur outside of the LOD. - A plant mitigation plan has been developed that outlines mitigation and monitoring activities proposed for listed plants. - The plan includes relocation of approximately 3,020 Houghton's goldenrod plants to a 5.2-acre Enhancement Area. In addition, HG in approximately 4.5 acres of the north side LOD will be re-established by the redistribution of stockpiled topsoil.
Dwarf Lake Iris			X	- Approximately 8.3 acres of suitable dwarf lake iris habitat and approximately 7,757 stems will be cleared or relocated within the north side LOD. - There will be no habitat loss along the anticipated travel routes to disposal sites (i.e., no road improvement will be required to accommodate Project traffic outside of the LOD) as a result of Project and no effects to the existing road ROW will occur. - No adverse direct or indirect effects to the dwarf lake iris will occur outside of the LOD. - A plant mitigation plan has been developed that outlines mitigation and monitoring activities proposed for listed plants. - The plan includes relocation of approximately 6,210 dwarf lake iris plants to a 5.2-acre Enhancement Area. In addition, DLI in approximately 4.5 acres of the north side LOD will

Species	No Effect	May Affect but Not Likely to Adversely Affect	Likely to Adversely Affect	Justification
				be re-established by the redistribution of stockpiled topsoil.
Lakeside Daisy	X			- Suitable habitat is present within the LOD and the Action Area immediately adjacent to the LOD; however, this species was not observed during Project surveys. - There will be no habitat loss along the anticipated travel routes to disposal sites (i.e., no road improvement will be required to accommodate Project traffic outside of the LOD) as a result of Project and no effects to the existing road ROW will occur. - No direct or indirect effects to the lakeside daisy will occur as a result of the Project.
Michigan Monkey-flower	X			- No suitable habitat for this species is present within the LOD or the Action Area immediately adjacent to the LOD. - There will be no habitat loss along the anticipated travel routes to disposal sites (i.e., no road improvement will be required to accommodate Project traffic outside of the LOD) as a result of Project and no effects to the existing road ROW will occur. - No direct or indirect effects to the Michigan monkey-flower will occur as a result of the Project.
Eastern Massasauga Rattlesnake		X		- No suitable habitat for this species is present within the LOD or the Action Area immediately adjacent to the LOD. - If suitable habitat for this species is present along travel routes between the north side or south side LOD and the chosen disposal site(s), potential for road mortality exists.
Hine's Emerald Dragonfly		X		- No suitable habitat for this species is present within the LOD or the Action Area immediately adjacent to the LOD; therefore, no direct or indirect effects to the HED are anticipated within the LOD or the Action Area immediately adjacent to the LOD. - If suitable habitat for this species is present along travel routes between the north side or south side LOD and the chosen disposal site(s), potential for road mortality exists.
Hungerford's Crawling Water Beetle	X			- No suitable habitat for this species is present within the LOD or the Action Area immediately adjacent to the LOD. - No risk of road mortality is anticipated as a result of the Project.

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APPENDIX A

Concept Drawings of Water Discharge Structures and Temporary Intake Structures

Concept of temporary water in-take (NORTH SIDE)

* The temporary in-take setup will be used only during the construction of the tunnel. Everything shown in the drawing will be removed at the end of construction.

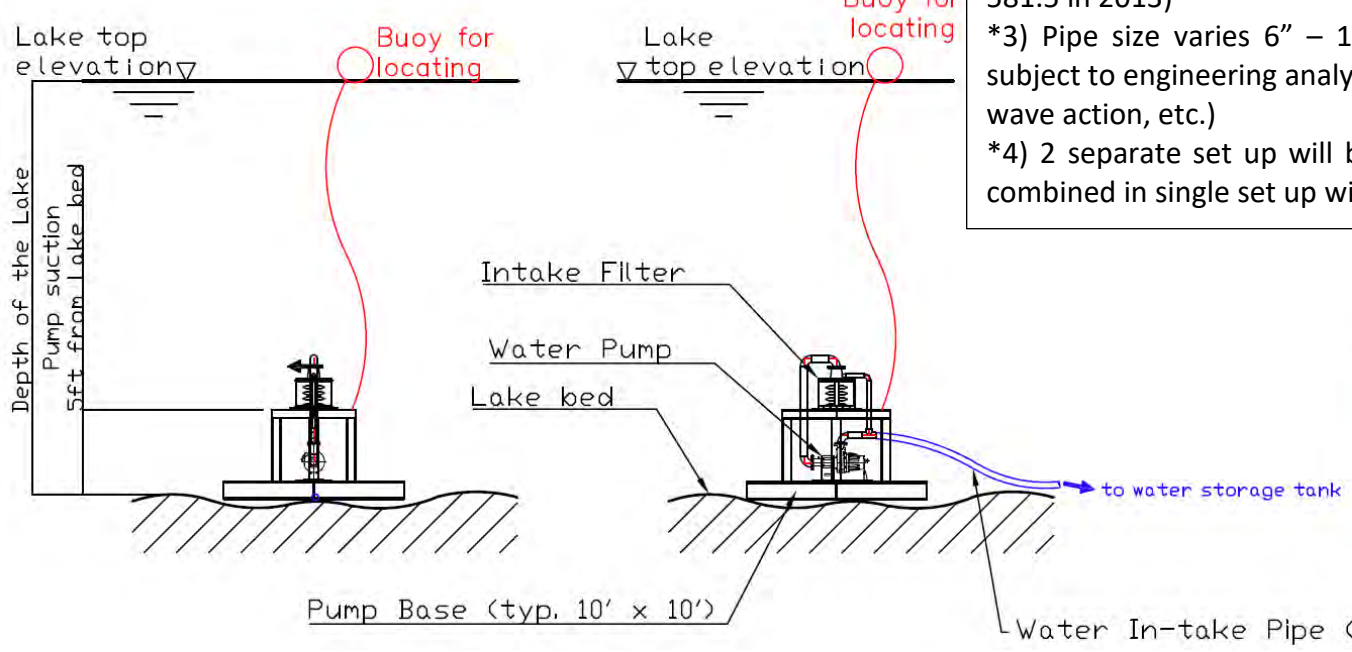
- Note -

*1) The current intake location is based on an approximate 10ft water depth, as shown in the profile below. The location is subject to adjustment based on the actual contour of lake bed.

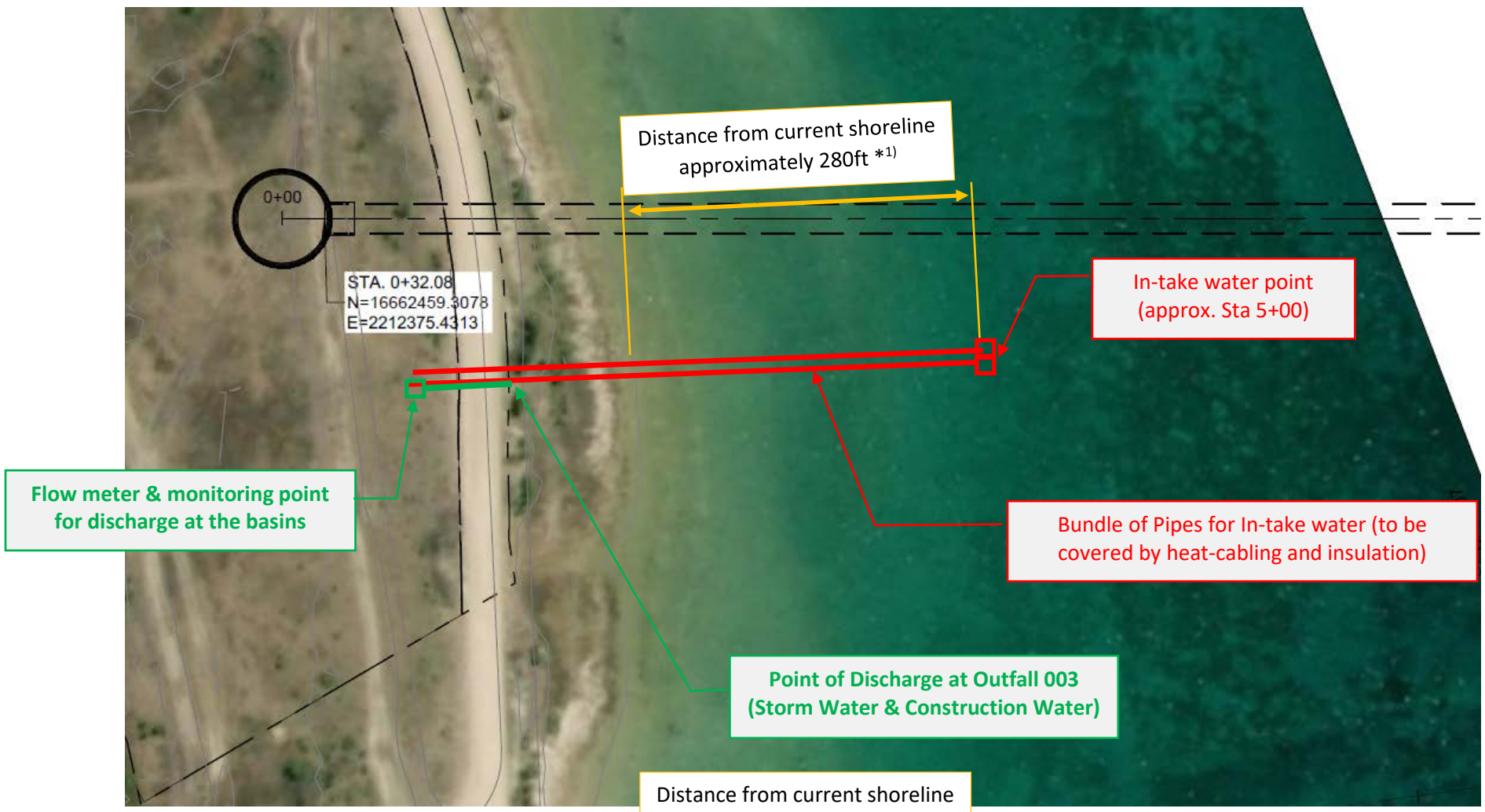
*2) Allowance of minimum 5 ft between bottom of filter and lake bed. Expected lake water depth of 10ft +/- (historical low is 5.5 ft below 581.5 in 2013)

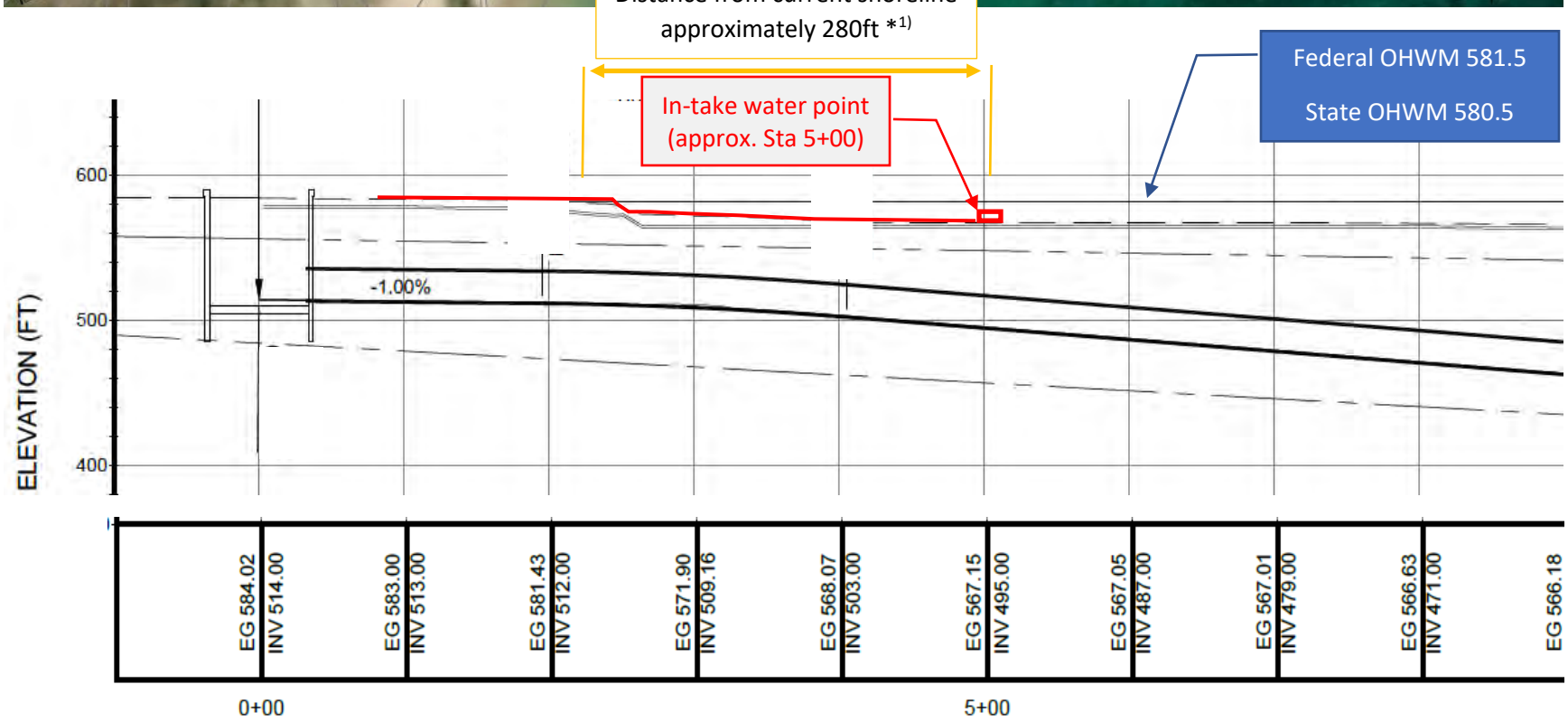
*3) Pipe size varies 6" – 12", Pump Base approximately 10' x 10' subject to engineering analysis (water flow hydraulic, stability against wave action, etc.)

*4) 2 separate set up will be installed for redundancy, but may be combined in single set up with larger Pump base 20' x 10' +



Typ. Intake Filter

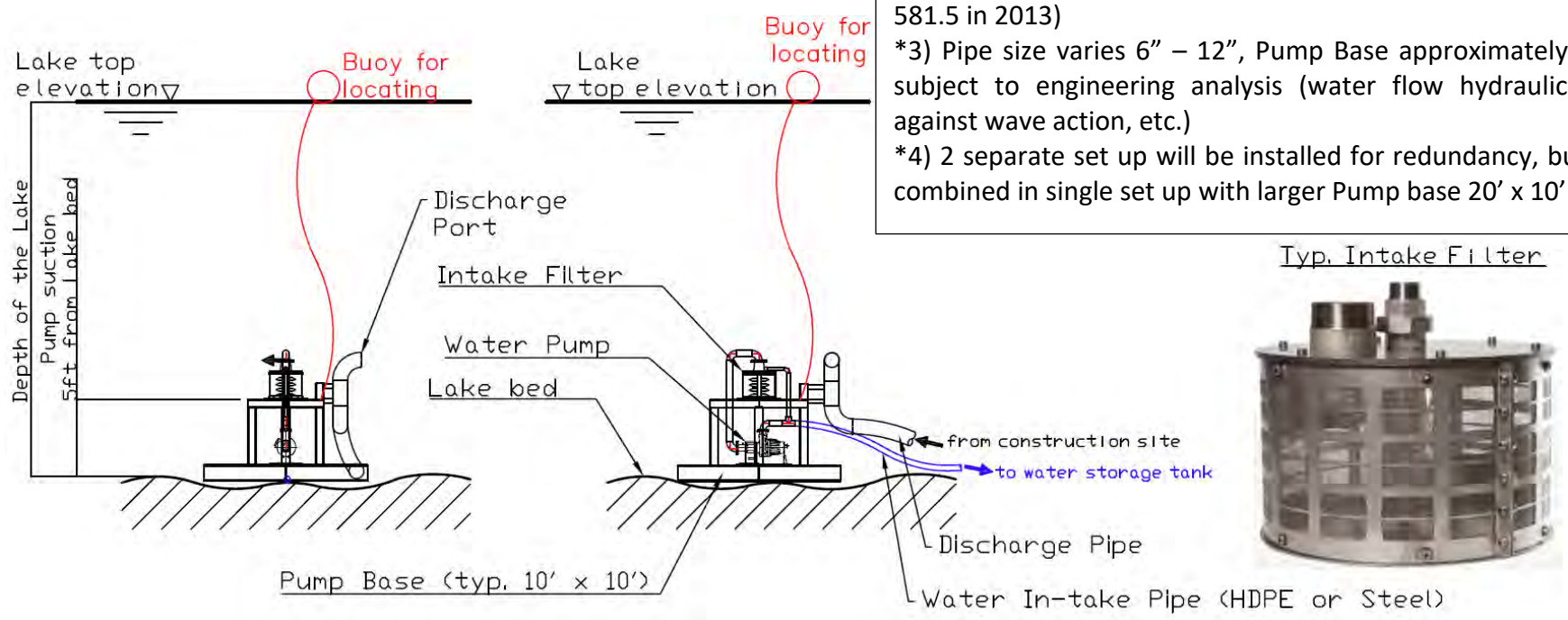


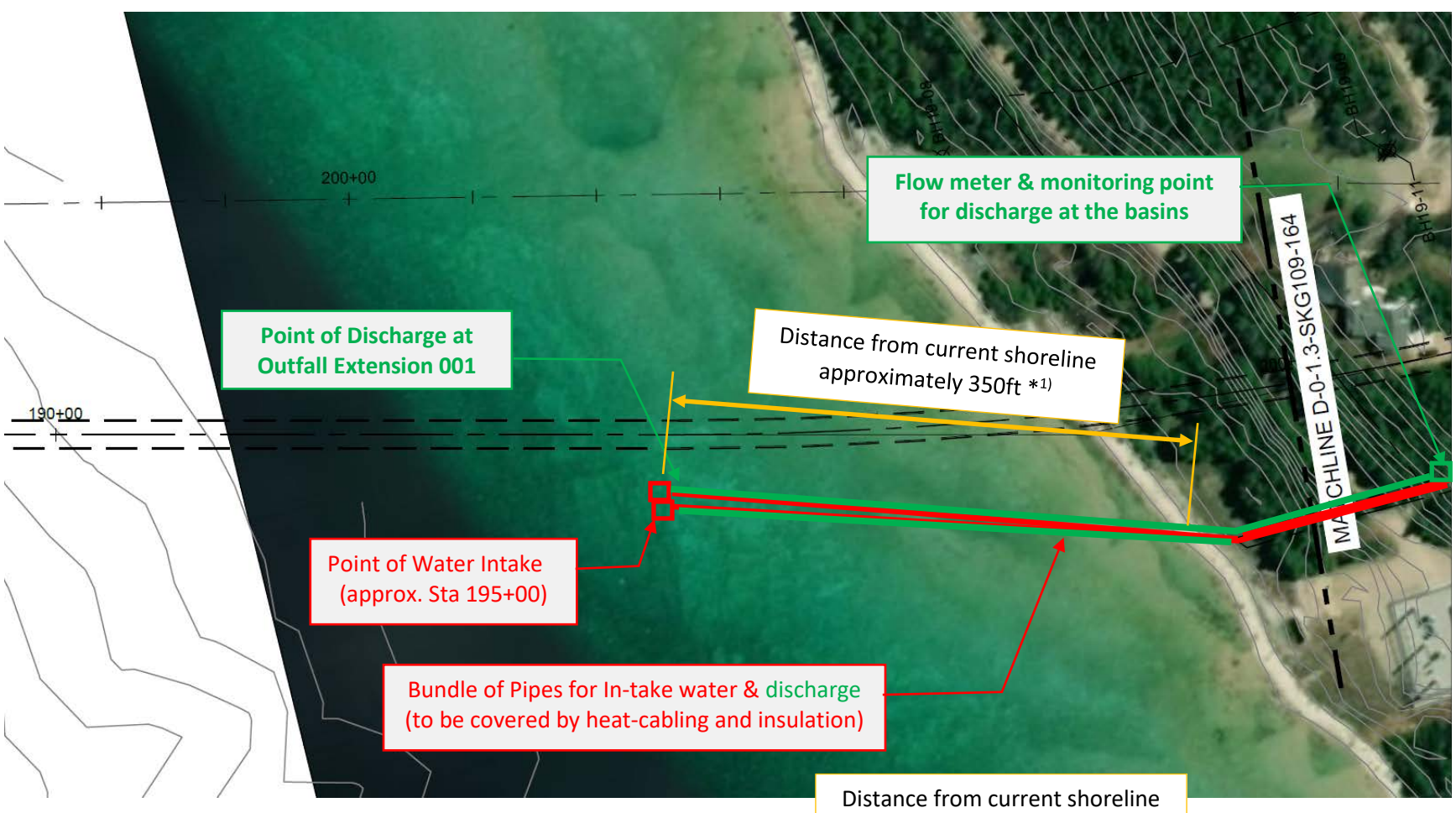


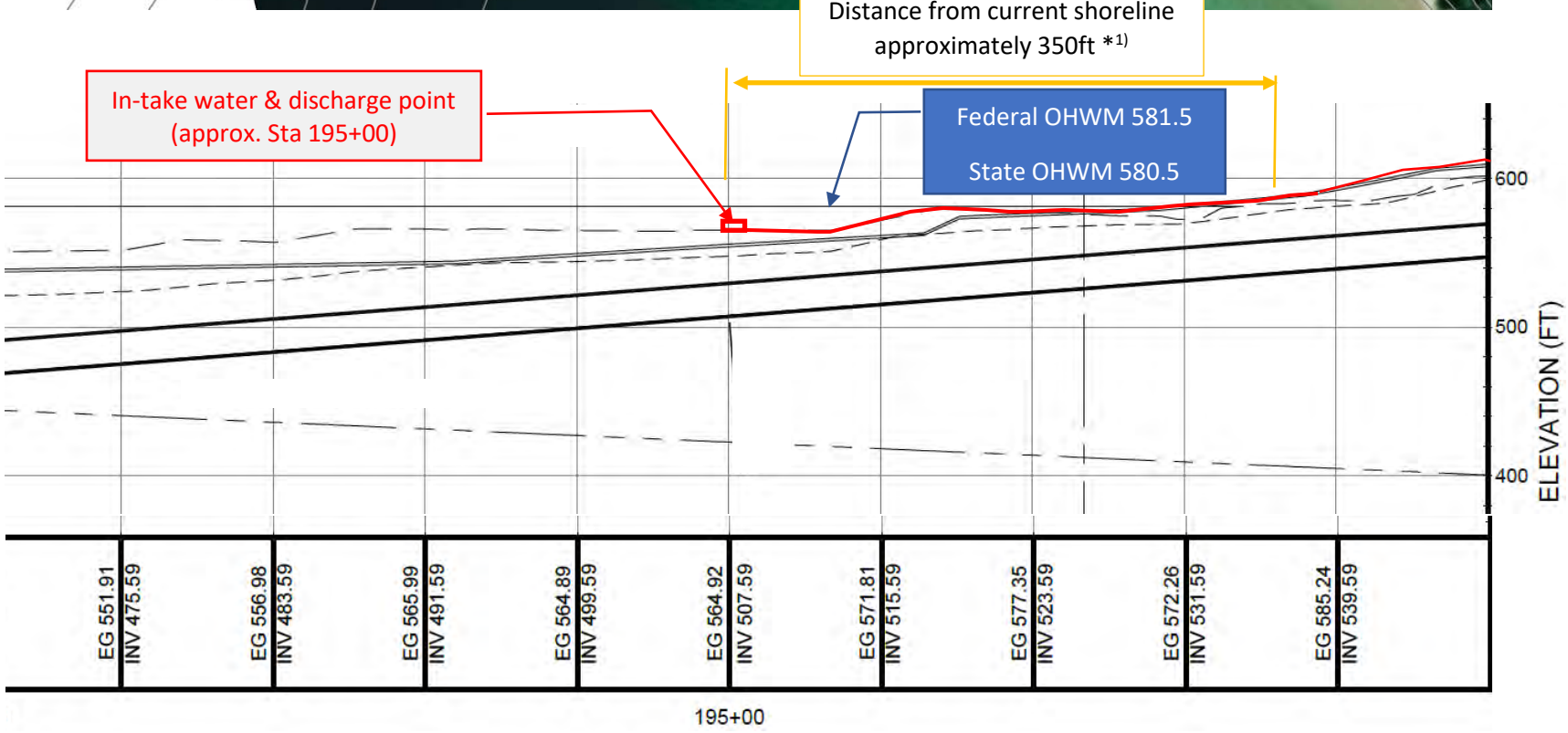
Concept of temporary water in-take and discharge outfall 001 extension (SOUTH SIDE)

* The temporary in-take and discharge outfall setup will be used only during the construction of the tunnel. Everything shown in the drawing will be removed at the end of construction.

- Note -
*1) The current intake location is based on an approximate 17ft water depth, as shown in the profile below. The location is subject to adjustment based on the actual contour of lake bed.
*2) Allowance of minimum 5 ft between bottom of filter and lake bed.
Expected lake water depth of 17ft +/- (historical low is 5.5 ft below 581.5 in 2013)
*3) Pipe size varies 6" – 12", Pump Base approximately 10' x 10' subject to engineering analysis (water flow hydraulic, stability against wave action, etc.)
*4) 2 separate set up will be installed for redundancy, but may be combined in single set up with larger Pump base 20' x 10' +







APPENDIX B

EGLE Parameters – Water Quality

BASIS FOR DECISION MEMO

Permit Processor: Jessica Stiles
Date: July 31, 2020
Permit No. MI0060278
Designated Site Name: Enbridge Energy-Line 5-Straits of Mackinac

Monitoring Point 001A (During Construction): Authorization to discharge 5 MGD of treated noncontact cooling water, tunnel/portal construction water, tunnel boring machine air intervention water, slurry treatment facility wastewater, tunnel drainage, groundwater seepage, and an unspecified amount of storm water from Monitoring Point 001A through Outfall 001. Outfall 001 discharges to Lake Michigan.

	Maximum Limits for Quantity or Loading			Maximum Limits for Quality or Concentration			Monitoring Frequency	Sample Type	Basis for Limits
Parameter	**Monthly**	**Daily**	**Units**	**Monthly**	**Daily**	**Units**			
Flow	**(report)**	**(report)**	**MGD**	**---**	**---**	**---**	**Daily**	**Report Total Daily Flow**	**PWJ**
Outfall Observation	**(report)**	**---**	**---**	**---**	**---**	**---**	**Daily**	**Visual**	**PWJ**
Equipment Inspection	**(report)**	**---**	**---**	**---**	**---**	**---**	**Daily**	**Visual**	**PWJ**
Acute Toxicity	**---**	**---**	**---**	**---**	**1.0**	**TU_A**	**See Permit Requirements**	**3-Portion Composite**	**WQBEL**
Oil and Grease	**---**	**---**	**---**	**---**	**15**	**mg/l**	**Weekly**	**Grab**	**BPJ**
Temperature									
Intake	**---**	**---**	**---**	**---**	**(report)**	**°F**	**Daily**	**Reading**	**WQC**
Effluent	**---**	**---**	**---**	**---**	**85**	**°F**	**Daily**	**Reading**	**WQBEL**
Total Suspended Solids	**---**	**---**	**---**	**40**	**70**	**mg/l**	**3X Weekly**	**3-Portion Composite**	**BPJ**
Total Dissolved Solids	**---**	**---**	**---**	**(report)**	**(report)**	**mg/l**	**Weekly**	**3-Portion Composite**	**WQC**
Chlorides	**---**	**---**	**---**	**(report)**	**(report)**	**mg/l**	**Weekly**	**3-Portion Composite**	**WQC**
Thermal Discharge									
November-May	**57**	**---**	**mBTU/hr**	**---**	**---**	**---**	**Daily**	**Calculation**	**WQBEL**
				Minimum Daily					
pH	**---**	**---**	**---**	**6.5**	**9.0**	**S.U.**	**3X Weekly**	**Grab**	**WQS**

Monitoring Point 001A (Postconstruction): Authorization to discharge 0.075 MGD of treated groundwater seepage and an unspecified amount of storm water from Monitoring Point 001A through Outfall 001. Outfall 001 discharges to Lake Michigan.

	Maximum Limits for Quantity or Loading			Maximum Limits for Quality or Concentration			Monitoring Frequency	Sample Type	Basis for Limits
Parameter	**Monthly**	**Daily**	**Units**	**Monthly**	**Daily**	**Units**			
Flow	**(report)**	**(report)**	**MGD**	**---**	**---**	**---**	**Daily**	**Report Total Daily Flow**	**PWJ**
Outfall Observation	**(report)**	**---**	**---**	**---**	**---**	**---**	**Daily**	**Visual**	**PWJ**
Equipment Inspection	**(report)**	**---**	**---**	**---**	**---**	**---**	**Daily**	**Visual**	**PWJ**
Oil and Grease	**---**	**---**	**---**	**---**	**15**	**mg/l**	**Weekly**	**Grab**	**BPJ**
Total Suspended Solids	**---**	**---**	**---**	**(report)**	**(report)**	**mg/l**	**Weekly**	**Grab**	**PWJ**
Total Dissolved Solids	**---**	**---**	**---**	**(report)**	**(report)**	**mg/l**	**Monthly**	**Grab**	**WQC**
Chlorides	**---**	**---**	**---**	**(report)**	**(report)**	**mg/l**	**Monthly**	**Grab**	**WQC**
				Minimum Daily					
pH	**---**	**---**	**---**	**6.5**	**9.0**	**S.U.**	**Monthly**	**Grab**	**WQS**

Monitoring Point 001B: Authorization to discharge 0.944 MGD of hydrostatic pressure test water from Monitoring Point 001B through Outfall 001. Outfall 001 discharges to Lake Michigan.

	Maximum Limits for Quantity or Loading			Maximum Limits for Quality or Concentration			Monitoring Frequency	Sample Type	Basis for Limits
Parameter	**Monthly**	**Daily**	**Units**	**Monthly**	**Daily**	**Units**			
Discharge Flow Rate	**(report)**	**(report)**	**gallons per minute**	**---**	**---**	**---**	**Daily**	**Report Total Daily Flow**	**PWJ**
Total Discharge Volume	**---**	**(report)**	**gallons**	**---**	**---**	**---**	**Per Event**	**Calculation**	**PWJ**
Total Suspended Solids									
Intake	**---**	**---**	**---**	**---**	**(report)**	**mg/l**	**Daily**	**3-Portion Composite**	**PWJ**
Discharge	**---**	**---**	**---**	**---**	**(report)**	**mg/l**	**Daily**	**3-Portion Composite**	**PWJ**
Net	**---**	**---**	**---**	**---**	**30**	**mg/l**	**Daily**	**Calculation**	**BPJ**
Oil and Grease	**---**	**---**	**---**	**---**	**15**	**mg/l**	**3X Daily**	**Grab**	**BPJ**
Outfall Observation	**(report)**	**---**	**---**	**---**	**---**	**---**	**3X Daily**	**Visual**	**PWJ**

	Maximum Limits for Quantity or Loading			Maximum Limits for Quality or Concentration			Monitoring Frequency	Sample Type	Basis for Limits
Parameter	Monthly	Daily	Units	Monthly	Daily	Units			
Equipment Inspection	(report)	---	---	---	---	---	3X Daily	Visual	PWJ
				Minimum Daily					
pH	---	---	---	6.5	9.0	S.U.	3X Daily	Grab	WQS
Dissolved Oxygen	---	---	---	4.0	---	mg/l	3X Daily	Grab	WQS

Monitoring Point 003A (During Construction): Authorization to discharge 1 MGD of treated slurry treatment facility wastewater, tunnel drainage, groundwater seepage, and tunnel/portal construction water, and an unspecified amount of storm water from Monitoring Point 003A through Outfall 003. Outfall 003 discharges to Lake Michigan.

	Maximum Limits for Quantity or Loading			Maximum Limits for Quality or Concentration			Monitoring Frequency	Sample Type	Basis for Limits
Parameter	Monthly	Daily	Units	Monthly	Daily	Units			
Flow	(report)	(report)	MGD	---	---	---	Daily	Flow	PWJ
Outfall Observation	(report)	---	---	---	---	---	Daily	Visual	PWJ
Equipment Inspection	(report)	---	---	---	---	---	Daily	Visual	PWJ
Acute Toxicity	---	---	---	---	1.0	TU_A	See Permit Requirements	3-Portion Composite	WQBEL
Oil and Grease	---	---	---	---	15	mg/l	Weekly	Grab	BPJ
Total Suspended Solids	---	---	---	40	70	mg/l	3X Weekly	3-Portion Composite	BPJ
Total Dissolved Solids	---	---	---	(report)	(report)	mg/l	Weekly	3-Portion Composite	WQC
Chlorides	---	---	---	(report)	(report)	mg/l	Weekly	3-Portion Composite	WQC
				Minimum Daily					
pH	---	---	---	6.5	9.0	S.U.	3X Weekly	Grab	WQS

Monitoring Point 003A (Postconstruction): Authorization to discharge 0.0015 MGD of groundwater seepage and an unspecified amount of storm water from Monitoring Point 003A through Outfall 003. Outfall 003 discharges to Lake Michigan.

	Maximum Limits for Quantity or Loading			Maximum Limits for Quality or Concentration			Monitoring Frequency	Sample Type	Basis for Limits
Parameter	**Monthly**	**Daily**	**Units**	**Monthly**	**Daily**	**Units**			
Flow	**(report)**	**(report)**	**MGD**	**---**	**---**	**---**	**Daily**	**Flow**	**PWJ**
Outfall Observation	**(report)**	**---**	**---**	**---**	**---**	**---**	**Daily**	**Visual**	**PWJ**
Equipment Inspection	**(report)**	**---**	**---**	**---**	**---**	**---**	**Daily**	**Visual**	**PWJ**
Oil and Grease	**---**	**---**	**---**	**---**	**15**	**mg/l**	**Weekly**	**Grab**	**BPJ**
Total Suspended Solids	**---**	**---**	**---**	**(report)**	**(report)**	**mg/l**	**Weekly**	**Grab**	**PWJ**
Total Dissolved Solids	**---**	**---**	**---**	**(report)**	**(report)**	**mg/l**	**Monthly**	**Grab**	**WQC**
Chlorides	**---**	**---**	**---**	**(report)**	**(report)**	**mg/l**	**Monthly**	**Grab**	**WQC**
				Minimum Daily					
pH	**---**	**---**	**---**	**6.5**	**9.0**	**S.U.**	**Monthly**	**Grab**	**WQS**

PERMIT CONDITIONS:

Final Effluent Limitations for Monitoring Point 001A (During Construction), Final Effluent Limitations for Monitoring Point 001A (Post Construction), Final Effluent Limitations for Monitoring Point 001B, Final Effluent Limitations for Monitoring Point 003A (During Construction), Final Effluent Limitations for Monitoring Point 003A (Post Construction), Additional Monitoring Requirements, Request for Approval to Use Water Treatment Additives, Quantification Levels and Analytical Methods for Selected Parameters, Cold Shock Prevention, Intake Screen Backwash – Outfalls 001 and 003, Facility Contact, Continuous Monitoring, Engineering Review, Operation and Maintenance Manual, Storm Water Pollution Prevention (not required)

NOTES:
The application indicates there is an alternate outfall for outfall 001 which is only to be used if there are contingency actions preventing the use of the primary outfall 001. The monitoring requirements and effluent limits listed in monitoring points 001A (during and after construction) and/or 001B apply to the alternate outfall location.

Certain portions of the Plan for the Discharge of Hydrostatic Pressure Test Water requirements noted in MIG670000 are not included in this individual permit. An indication of whether Oil and Grease is being monitored has been left out because the individual permit requires sampling of Oil and Grease, whereas MIG670000 does not require sampling for Oil and Grease by every permittee. Oil and Grease monitoring is reviewed for applicability for each permittee. A description of the wastewater disposal is not required under this plan as the application indicates the type of treatment the hydrostatic pressure test water will receive prior to discharge.

Initially, the applicant included an estimated maximum temperature of 90°F. The Water Quality Based Effluent Limit (WQBEL)-Toxics memo recommends a daily maximum temperature limitation due to the reported observation of *Physella magnalacustris* noted in the Michigan Natural Features Inventory database. This species was last observed in 1988. Since Permits Section was not able to locate information regarding temperature threshold/effects on this specific species, the recommended limitation of 85 °F is based on a similar species. Permits Section requested more information as to how the applicant determined the estimated temperature of 90ºF. The applicant provided the requested information and recalculated the temperature estimate to be a maximum daily of 80 °F in the application. Due to the estimated temperature being lower than the recommended limitation, the limitation is not included but monitoring is required. Note: additional information was provided by commenters and an additional review was performed and the update is discussed below under “Changes made to the permit after public notice.”

The WQBEL-Toxics memo recommends a monthly monitoring condition for mercury. This proposed discharge is not expected to contain mercury aside from mercury potentially present in the source water which is Lake Michigan. The Additional Monitoring Requirements condition requires sampling for many parameters including mercury. Data submitted to the Department in compliance with this condition will be reviewed to determine if a permit update is needed.

The WQBEL-Conventional memo recommends limitations for Total Dissolved Solids (TDS) and chlorides. Limitations for TDS have not been included in the permit due to potential toxicity concerns associated with the calculated concentrations. An acute toxicity limitation has been added to address potential toxicity concerns associated with elevated TDS concentrations and Water Treatment Additive use. Monitoring requirements for TDS are included to provide additional data for future review. The limitation recommended for chlorides is 430 mg/l which was calculated based on R323.1051(2). This limitation is not included in the permit due to the following: The proposed wastewater discharged is not expected to contain high concentrations of chlorides given that the source water is primarily Lake Michigan and groundwater. A report from the United States Geological Survey in 1987 (“Michigan Ground-Water Quality”, USGS Open File Report 87-0732, accessed 6/10/2020) indicates that the median groundwater chloride concentration in the state is 2.2 mg/l. The 90th percentile concentration is 54 mg/l. Even on the higher end of the observed scale, chlorides are not expected to approach the calculated limits without significant additives containing chlorides. Likewise, the background concentration of chloride in Lake Michigan is low. The University of Illinois at Urbana-Champaign reported in 2012 using EPA data that average spring chloride concentration in Lake Michigan is below 12 mg/l (https://www.isws.illinois.edu/pubdoc/B/ISWSB-74.pdf. Accessed 6/10/2020). Monitoring requirements for chloride are included to provide additional for future review.

Changes made to permit after public notice:

The applicant noted that the flow rate for Outfall 003 (post construction) was incorrectly stated in the permit. Instead of 0.015 MGD the maximum flow expected from Outfall 003 after construction is 0.0015 MGD. This flow rate has been updated in the permit and other corresponding documents.

Limitations and monitoring requirements for Oil and Grease have been added to Outfalls 001 and 003 for the post-construction discharge.

Based on comments received during the public notice period concerning possible issues with over pressurization during the tunneling process and the Department's determination to ensure the maximum authorized flow during construction is not exceeded two conditions have been added to the permit: Engineering Review and Operation and Maintenance Manual. The Engineering Review condition requires that a professional engineer review and approve the wastewater treatment system(s). The Operation and Maintenance Manual condition requires the permittee to have plans and procedures in place to account for any upset or bypass scenarios. The condition requires a notification and report from the permittee if flow from Outfall 001 exceeds 3.3 MGD. This value is based on 75% of the maximum expected flow of 4.36 MGD from treated Tunnel Drainage and Groundwater Inflow indicated in the water flow diagram included with the application. The Operation and Maintenance Manual condition was added by the Department to assure the maximum authorized flow of 5 MGD will not be exceeded due to excessive inflows in the tunnel during construction. This condition was also reviewed by tunnel construction experts through Michigan Department of Transportation.

Comments were received during the public comment period concerning whether Rule 323.1070(1) and Rule 323.1070(2) were applied to this permit. Information provided in the comments indicated that the ambient water temperatures listed in Rule 323.1070(2) are not accurate and the current ambient temperature in the Straits of Mackinac are lower than listed in the Rule. Based on the additional information provided by commenters, Rule 323.1070(2) was reevaluated. Rule 323.1070(1) states the Great Lakes and connecting waters shall not receive a heat load which would warm the receiving water at the edge of the mixing zone more than 3 degrees Fahrenheit above the existing natural water temperature. During this reevaluation, it was determined that an error existed in the initial temperature review and was corrected. Estimated temperature values provided by the applicant were compared to the results of the revised calculations completed to determine if Rules 70 is met. Based on the results of this reevaluation, using ambient data and the corrected equation, EGLE had determined monthly average heat addition (Thermal Discharge) limits are needed to meet Rule 70. The recommended thermal discharge limits are now included in the permit from November through May. Daily Monitoring requirements for Intake Temperature are now included due to the addition of the Thermal Discharge limitation. In addition, a maximum daily limitation of 85 degrees Fahrenheit is also included in the permit with daily monitoring requirements.

Based on comments received from the public, clarification was requested from Enbridge on the transportation and storage of bentonite clay and the sizing of the storm water basins. The information provided by Enbridge after the public comment period did not require changes to the permit.

Limit Change Key
Normal Type = existing requirement - carried over from previous version of permit
Bold Type = new requirement - not in previous version of permit
Italic = deleted requirement - not carried over from previous version of permit

Basis for Limits Key
BPJ - Best Professional Judgment of appropriate treatment technology-based effluent limits in the absence of applicable federal guidelines
WQBEL - Water Quality-Based Effluent Limit
WQC - Water Quality Concern
WQS - Water Quality Standard
PWJ - Permit Writer's Judgment

APPENDIX C

Noise Analysis (Supplemental Information from Joint Permit Application (USACE File No. LRE-2010-00463-56-A19)

2.7.2 Mineral Needs

The Michigan Basin is an important source of crude oil, natural gas, salt, gypsum, and limestone, as well as brines containing bromine, magnesium, and other elements that are the basis for much of the chemical industry in the State (University of Michigan 2003b). The rock units in the vicinity of the Project provide present-day resources such as salt, limestone and dolomite, and oil and gas in the Silurian bedrock located north of the Straits; and limestone, shale, oil and gas in the Devonian bedrock primarily located south of the Straits (University of Michigan 2003b).

Mineral resources identified in the vicinity of the Project include sand and gravel. There are known sand and gravel pits located greater than 0.5 mile north and northeast of the north side LOD. One gravel pit is located near the south side LOD, approximately 0.5 miles to the south. No current or former mineral resource mines are located within 200 feet of the LODs (USGS 2019). Per the EGLE GeoWebFace program, there are no mines, mineral deposits, or oil and gas wells located within 200 feet of the Project (EGLE 2019).

2.8 AIR AND NOISE QUALITY

2.8.1 Air Quality

The Clean Air Act (CAA) of 1970, 42 U.S. Code Part 7401 et seq., amended in 1977 and 1990, is the basic federal statute governing air quality. The provisions of the CAA that are potentially relevant to construction emission sources include the following:

- Prevention of Significant Deterioration;
- Nonattainment Area New Source Review;
- New Source Performance Standards;
- National Emission Standards for Hazardous Air Pollutants; and
- Title V Operating Permits.

The Project is neither subject to nor triggers any of the requirements listed above.

Construction of the Project will result in intermittent and temporary emissions of criteria pollutants during pipeline installation. These emissions will generally include dust (PM_{10} and $PM_{2.5}$) generated from vehicle traffic during construction. The amount of dust generated during construction will be a function of vehicle numbers and types, vehicle speeds and roadway characteristics and precipitation events. Dust emissions will be greater during dry periods and in areas of fine-textured soils. Enbridge will use the following measures as needed to control dust emissions:

- Watering access roads, storage piles and disturbed surfaces;
- Placement of construction stone on unpaved areas, as practicable;
- Imposing speed restrictions for vehicles driving on unpaved areas; and
- Installing gravel tracking pads at entrances to the LOD to help remove dirt from tires and tracks.

If blasting is required, additional dust mitigation will be implemented, including the use of fog cannons to spray atomized water across the excavation area. The excavation area may also be pre-soaked with water and blasting mats may be used, as necessary.

Construction also results in combustion emissions from diesel and gasoline-fueled vehicles and construction equipment, such as a welding truck, used in various construction activities. Combustion-related emissions will include NO_x, CO, Volatile Organic Compounds, SO_2, PM, and small amounts of hazardous air pollutants. Construction equipment also emits greenhouse gases. Gasoline and diesel engines must comply with the USEPA mobile source regulations for on-road and non-road engines in 40 CFR Parts 85 to 90 and Parts 1033 to 1054. These regulations are designed to minimize emissions from all types of compression ignition and spark ignition engines. The USEPA requires manufacturers of on- and non-road engines to certify their products to engine emission standards based on the year of manufacture and develop manufacturers' recommendations for maintenance of the engines. Enbridge contractors will maintain all fossil-fueled construction equipment in accordance with manufacturer's recommendations to minimize construction-related emissions.

Air emissions from the construction of the Project will be localized, intermittent, and short-term. Emissions from fugitive dust and construction equipment combustion will be controlled to the extent required by state and federal agencies. Emissions from the modified pump stations and piping will be negligible.

2.8.2 Noise Impacts

Construction of the Project would represent an intermittent, short-term noise source and may result in noise impacts. The level of construction noise at any one time would vary over the course of the entire construction period and would be highly dependent on the type of equipment being used, amount of equipment used, and activities being conducted. Concentrated construction activities would only occur at periodic intervals.

The primary sound generation would be construction equipment and vehicular traffic into, on, and off of the worksite. According to studies performed by the United States Department of Transportation ("DOT"), almost all construction equipment has a sound pressure level between 75 and 85 decibels ("dBA") at a distance of 50 feet (DOT 2011). Additional noise impacts may occur if blasting is required. Blasting events would occur one to two times per day and would be limited to daylight hours. Blasting activities are anticipated to produce a sound pressure level between 84 and 89 dBA at a distance of 50 feet. For comparison, the sound pressure level of a typical vacuum cleaner to the person operating it is between 84 and 89 dBA (NPC 2020). Sound attenuates (loses intensity) over distance.

When noise is created by a source such as a backhoe, it attenuates at 6 dBA per doubling of distance from a source. So, if the backhoe has a sound pressure level of 80 dBA at 50 feet, it has a sound pressure level of 74 dBA at 100 feet, a sound pressure level of 68 dBA at 200 feet, and a sound pressure level of 50 dBA at 1,600 feet. The construction workspaces will be 2,400 feet or greater from the nearest residential structures on the north side; therefore, noise impact at these

residences is anticipated to be less than 50 dBA. The construction workspaces will be 350 feet or greater from the nearest residential structures on the south side; therefore, noise impacts at these residences is anticipated to be approximately 59 dBA or less.

Internet searches were conducted to identify applicable noise regulations for the proposed pipeline installation activities. None were found for Mackinac County or Emmet County, Michigan, or the township of Wawatam. Moran Township Performance Standards and Provisions Ordinance (Article 16) states that for all uses in addition to the site development standards and performance criteria required, the intensity level of sounds shall not exceed 55 dBA at the common lot line for residential dwellings.

The State of Michigan has established a motor vehicle noise regulation under Act 300 Section 257.707 Michigan Compiled Laws that requires all motor vehicles to be operated with a muffler. Enbridge will mitigate sound impacts to the neighbors by requiring that no equipment would have unmuffled exhausts. All contractors will utilize sound control devices no less effective than those provided by the manufacturer and maintain equipment in accordance with manufacturer's recommendations. On-site vehicle idle time while in the construction area would be minimized for all equipment.

Project construction activities will create a temporary increase in sound levels attributable to construction equipment. The increase in noise levels resulting from construction will be temporary, localized, and generally considered negligible. The proposed facility upgrades will not result in an increase of noise levels when in service.

2.9 SAFETY

At Enbridge, safety is a core value and Enbridge addresses safety and integrity by various means including, but not limited to, initial system design, materials, construction practices, and operation, maintenance and inspection procedures. Enbridge is committed to operating and maintaining the Project in a manner that protects the environment and protects the safety of the public, contractors, and employees.

During construction, the applicable requirements of the U.S. and Michigan Occupational Safety and Health Administrations (OSHAs) will be followed by all construction contractors and Enbridge staff. All applicable requirements for construction set forth under 49 CFR Part 192 and 29 CFR Parts 1910 and 1926 will be emphasized by Enbridge to all employees and contractors as part of general practices. Enbridge will utilize safety inspectors to ensure safe work practices and controls are in place during construction activities. Enbridge does not anticipate any public safety concerns associated with construction or operation of the Project.

Enbridge will restrict the public from LODs to ensure public safety and Project site security. Temporary safety fencing and barriers will be installed around areas of active construction until permanent perimeter fencing is in place. Access to the LODs will be limited to Enbridge and its contractors. Materials will be stockpiled within the LODs and secure off-site industrial or

APPENDIX D

Michigan Natural Features Inventory Rare Species Review #2103 Section 7 Compliance Comments

Rare Species Review #2103
Section 7 Compliance Comments

Stantec Consulting Services, Inc.
Enbridge – Line 5 Straits of Mackinac
Emmet & Mackinac counties, MI
February 7, 2018

For projects involving federal funding or a federal agency authorization

The following information is provided to assist you with Section 7 compliance of the Federal Endangered Species Act (ESA). The ESA directs all Federal agencies "to work to conserve endangered and threatened species. Section 7 of the ESA, called "Interagency Cooperation," is the means by which Federal agencies ensure their actions, including those they authorize or fund, do not jeopardize the existence of any listed species."

The project falls within the range of fifteen (15) federally listed/proposed species which have been identified by the U.S. Fish and Wildlife Service (USFWS) to occur in Emmet & Mackinac counties, Michigan:

Federally Endangered

Piping plover (*Charadrius melodus*) – There appears to be suitable habitat within the 1.5-mile search buffer. In the Great Lakes region, the piping plover commonly nests and forages on sparse or non-vegetated sand-pebble beaches, averaging 100 feet in width. Vegetative cover is usually less than 5 %. Associated bodies of water and interdunal wetlands enhance these areas by increasing food availability. Optimal foraging areas are especially crucial along Lake Superior, where shoreline and benthic invertebrate communities are known to be naturally sparse. Nests are generally placed in level areas between the water's edge and the first dune. While feeding, open shoreline is preferred to vegetated beach areas. Piping plovers begin arriving in mid- to late-April. The nesting season is under way by mid-May and lasts until mid-August. The nests are simple depressions in the sand and are difficult to see. This species is declining throughout the Midwest due to habitat destruction and disturbance. People walking on the beach may inadvertently destroy nests. Dogs on the beach can be especially dangerous for chicks and adults.

Gray wolf (*Canis lupis*) - There appears to be suitable habitat within the 1.5-mile search buffer. The gray wolf is the largest member of the Canid (dog) family, which includes coyotes, red fox and gray fox. Gray wolves require large extensive tracts of contiguous forests in which to range; home ranges are over 100 mi^2. Gray wolves feed primarily on white-tail deer and supplement their diet with snowshoe hare, beavers and other small mammals such as woodchucks and muskrats.

Kirtland's warbler (*Setophaga kirtlandii*) **–** There does not appear to be suitable habitat within the 1.5-mile search buffer. The Kirtland's warbler is dependent upon large, relatively homogenous stands of jack pine with scattered small openings. Stands less than 80 acres in size are seldom occupied. Warblers will start using a jack pine stand when the height of the trees reaches 5 to 7 feet. Nests are built on the ground, concealed in the low cover of grasses, sedges, blueberries, and other ground cover vegetation. Once jack pines reach a height greater than 18 feet, the lower branches begin to die and the ground cover vegetation changes in composition, thereby leading to unfavorable nesting conditions. Kirtland's

warbler feed on flying insects, larvae, and ripe berries. The majority of male Kirtland's warblers arrive on Michigan breeding grounds in early to mid-May. The warbler migrates to the Bahama Archipelago in late August and September.

Hine's emerald dragonfly (*Somatochlora hineana*) - There does not appear to be suitable habitat within the 1.5-mile search buffer. The federal and state endangered Hine's emerald dragonfly has bright emerald-green eyes and a metallic green body, with yellow stripes on its sides. Its body is about 2.5 inches long; its wingspan reaches about 3.3 inches. This species is known from only a few sites in Illinois, Wisconsin, Michigan, and Missouri. The Hine's emerald dragonfly lives in calcareous (high in calcium carbonate) marshes overlaying dolomite bedrock. Little is known about the dragonflies 3 life stages. The larval or nymph stage occurs in small streams, where nymphs grow slowly for several years prior to emerging as adults. The stream sites are associated with wetland habitat and emergent vegetation. Many larval sites regularly dry above ground during late summer months. The larvae persist at these locations in crayfish burrows or in moisture under leaf layers or woody debris. The adults may live only 4-5 weeks. Flight dates last year were mid-July to mid-August.

Hungerford's crawling water beetle (*Brychius hungerfordi*) – There does not appear to be suitable habitat within 1.5 miles of the project site. Hungerford's crawling water beetles are found in cool riffles of clean, slightly alkaline streams. This species seems to prefer streams with moderate to fast water flow, good aeration, inorganic substrate, and alkaline water conditions. High population densities have been found below beaver dams and other similar impounded areas. This beetle is known from only five isolated locations in Michigan and Ontario, Canada. Hungerford's crawling water beetles are less than ¼ inch long, yellowish brown with irregular dark markings and stripes on back.

Michigan monkey-flower (*Mimulus michiganensis*) – There does not appear to be suitable habitat within 1.5 miles of the project site. Michigan monkey-flower favors alkaline (calcareous) habitats, growing along marly springs, in cold streams through cedar swamps, on calcareous shores, and in associated ditches. Nearly all known populations of the monkey-flower occur near present or past shorelines of the Great Lakes. Michigan monkey flower, flowers from mid-June through July. Recreational and residential development is the main threats to this aquatic and semi-aquatic species. Increased construction along lakes and streams has destroyed monkey-flower habitat, including three known populations of the flower. Because the monkey-flower needs flowing spring water, road construction and other activities that affect water drainage patterns also affect the species.

Lakeside daisy (*Hymenoxy acaulis var. glabra*) – There appears to be suitable habitat within the 1.5-mile search buffer. The federally threatened and state endangered lakeside daisy is found in gravelly or sandy thin-soiled fields and alvars with dolomitic or limestone bedrock at or near the surface. It occurs only in open sites with full sun. It flowers in late May or early June. This species is threatened by development and limestone quarrying, which are common in lakeside daisy habitat. Fire suppression has resulted in expansion of shrubs and trees, which threaten lakeside daisy habitat. Collectors may also pose a threat, since the daisy is now found in just a handful of sites.

<u>Federally Threatened</u>

Northern long-eared bat (*Myotis septentrionalis)* – Northern long-eared bat numbers in the northeast US have declined up to 99 percent. Loss or degradation of summer habitat, wind turbines, disturbance to hibernacula, predation, and pesticides have contributed to declines in Northern long-eared bat populations. However, no other threat has been as severe to the decline as White-nose Syndrome

(WNS). WNS is a fungus that thrives in the cold, damp conditions in caves and mines where bats hibernate. The disease is believed to disrupt the hibernation cycle by causing bats to repeatedly awake thereby depleting vital energy reserves. This species was federally listed in May 2015 primarily due to the threat from WNS.

There is a documented occurrence (1975) and there appears to be suitable habitat within 1.5 miles of the project area. In addition, this activity occurs within the designated WNS zone (i.e., within 150 miles of positive counties/districts impacted by WNS. In addition, suitable habitat does exist in and outside of our 1.5-mile search buffer. The USFWS has prepared a dichotomous key to help determine if this action may cause prohibited take of this bat. Please consult the USFWS Endangered Species Page for more information.

Also called northern bat or northern myotis, this bat is distinguished from other *Myotis* species by its long ears. In Michigan, northern long-eared bats hibernate in abandoned mines and caves in the Upper Peninsula; they also commonly hibernate in the Tippy Dam spillway in Manistee County. This species is a regional migrant with migratory distance largely determined by locations of suitable hibernacula sites.

Northern long-eared bats typically roost and forage in forested areas. During the summer, these bats roost singly or in colonies underneath bark, in cavities or in crevices of both living and dead trees. These bats seem to select roost trees based on suitability to retain bark or provide cavities or crevices. Common roost trees in southern Lower Michigan included species of ash, elm and maple. Foraging occurs primarily in areas along woodland edges, woodland clearings and over small woodland ponds. Moths, beetles and small flies are common food items. Like all temperate bats this species typically produces only 1-2 young per year.

Conservation strategies: When there are no known roost trees or hibernacula in the project area, we encourage you to conduct tree-cutting activities and prescribed burns in forested areas during October 1 through March 31 when possible, but you are not required by the ESA to do so. When that is not possible, we encourage you to remove trees prior to June 1 or after July 31, as that will help to protect young bats that may be in forested areas, but are not yet able to fly.

Rufa red knot (*Calidris canutus rufa*) – There appears to be suitable habitat within the 1.5-mile search buffer**.** The rufa red knot is one of the longest-distance migrants in the animal kingdom, flying some 18,000 miles annually between its breeding grounds in the Canadian Arctic to the wintering grounds at the southern-most tip of South America. Primarily occurring along the Atlantic and Gulf coasts, small groups of this shorebird regularly use the interior of the United States such as the Great Lakes during the annual migration. The Great Lakes shorelines provide vital stopover habitat for resting and refueling during their long annual journey.

The largest concentration of rufa red knots is found in May in Delaware Bay, where the birds stop to gorge on the eggs of spawning horseshoe crabs; a spectacle attracting thousands of birdwatchers to the area. In just a few days, the birds nearly double their weight to prepare for the final leg of their long journey to the Arctic. This species may be especially vulnerable to climate change which affects coastal habitats due to rising sea levels.

Dwarf lake iris (*Iris lacustris*) – There are documented occurrences within the 1.5-mile search buffer. Dwarf lake iris usually occurs near Great Lakes shorelines on sand or in thin soils over calcareous gravel or bedrock. It tolerates full sun to nearly complete shade, but appears to flower best in semi-open edge

or ecotonal habitats, typically amongst scattered trees or on shoreline forest margins where is occurs with northern white cedar (*Thuja occidentalis*) and balsam fir (*Abies balsamea*). Dwarf lake iris is almost invariably associated with northern white cedar, though spruce (principally white spruce, *Picea glauca*), balsam fir, and trembling aspen *(Populus tremuloides)* may also be present in the overstory. This species has demonstrated that under certain conditions it can readily spread into artificially cleared areas with dryish, calcareous substrates, where it may clone aggressively. This species usually flowers from mid-May to early June, depending on site exposure and annual weather variations. Each flower remains open approximately three days.

Houghton's goldenrod (*Solidago houghtonii*) – There are documented occurrences within the 1.5-mile search buffer. Occurring primarily along the northern shores of Lake Huron and Lake Michigan, Houghton's goldenrod is restricted to calcareous beach sands, rocky and cobbly shores, beach flats, and shallow, trough-like interdunal wetlands paralleling shoreline areas. It also occurs on seasonally wet limestone pavement, its more typical habitat in the eastern portion of its range, particularly in Ontario. In the Crawford County locality, Houghton's goldenrod occurs in an unusual northern wet prairie habitat within the jack pine barrens. There it occupies seasonally inundated areas and old interdunal depressions in an outwash landscape, where it occurs with such species as jack pine, big bluestem, lobelia, Indian paintbrush, etc. Flowering occurs primarily in August and early September, but some plants may flower as late as October.

Pitcher's thistle (*Cirsium pitcheri*) **–** There are documented occurrences within the 1.5-mile search buffer. Pitcher's thistle grows on the open and grassland sand dunes and along the shorelines of Lakes Michigan, Superior and Huron. It is occasionally found on lag gravel associated with dunes. It is mainly found in near-shore plant communities but can also grow in all non-forested areas of a dune system. This monocarpic (once-flowering) plant produces a rosette that will mature to flowering in 2-8 years, after which the plant dies. Seeds germinate in June, and most seedlings (rosettes) appear within 1-3 meters of parent plants. The taproot of this thistle, which can reach 2 m in length, enhances its ability to survive the often desiccating conditions of its dune habitat. Pitcher's thistle blooms from approximately late-June to early September. The blooms are pollinated by insects mainly bees; some thirty insect species have been observed visiting the blooms.

Hart's tongue fern (*Asplenium scolopendrium var. americanum*) – There appears to be suitable habitat within the 1.5-mile search buffer. The Hart's-tongue fern occurs in cool limestone sinkholes in mature hardwood forests. In Michigan, this fern occurs on north or east-facing topographic slopes on shaded, moist boulders and ledges of Niagaran Dolomite. All sites lie on prominent highlands of the Niagara escarpment (rising 30-100 m above the surrounding lowlands) which were islands in Glacial Lake Algonquin approximately 10,500 years ago.

Fronds of Hart's-tongue fern remain green throughout the winter, and new fronds are produced at the start of each growing season, though most of the old fronds stay green and functional for most of the succeeding season. Although the effects of forest cutting on this fern have not been well documented, it has been able to colonize young aspen forests in Ontario, presumably becoming established from nearby spore sources. The predilection of this species for low boulders and crevices suggests that moist, sheltered conditions are required for sporeling establishment.

Preservation of this extremely rare fern will depend, in the short term, on protection of its habitat from major disturbances and from unscrupulous collectors. To discourage collecting, locations of colonies should remain confidential. Before long-term management can be undertaken, much more needs to be learned about this

fern's life history and its response to habitat changes (especially overstory reduction vs. shading). Close monitoring of Michigan's hart's-tongue colonies should be an essential component of any future management.

Canada lynx (*Lynx canadensis*) – There appears to be suitable habitat within the 1.5-mile search buffer. With its large paws and long hind legs, the Canada lynx is adapted to hunting its primary prey, the snowshoe hare (*Lepus americanus*). Lynx and hares are associated with moist, cool, boreal spruce-fir forests. Hares require forests with dense understories that provide food and cover, especially during periods of deep snow. Snowshoe hares comprise a majority of the lynx diet throughout its range. Lynx prey opportunistically on other small mammals, particularly red squirrels (*Tamiasciurus hudsonicus*), and birds, especially when hare numbers are low. Canada lynx experience widespread food shortages and many die of starvation or abandon home ranges to search for adequate prey.

Eastern massasauga rattlesnake (*Sistrurus catenatus*) – There does not appear to be suitable habitat within the 1.5-mile search buffer. Michigan's only venomous snake is found in a variety of wetland habitats including bogs, fens, shrub swamps, wet meadows, marshes, moist grasslands, wet prairies, and floodplain forests. Eastern massasaugas occur throughout the Lower Peninsula but are not found in the Upper Peninsula. Populations in southern Michigan are typically associated with open wetlands, particularly prairie fens, while those in northern Michigan are better known from lowland coniferous forests, such as cedar swamps. These snakes normally overwinter in crayfish or small mammal burrows often close to the groundwater level and emerge in spring as water levels rise. During late spring, these snakes move into adjacent uplands they spend the warmer months foraging in shrubby fields and grasslands in search of mice and voles, their favorite food.

Often described as "shy and sluggish", these snakes avoid human confrontation and are not prone to strike, preferring to leave the area when they are threatened. However, like any wild animal, they will protect themselves from anything they see as a potential predator. Their short fangs can easily puncture skin and they do possess potent venom. Like many snakes, the first human reaction may be to kill the snake, but it is important to remember that all snakes play vital roles in the ecosystem. Some may eat harmful insects. Others like the massasauga, consider rodents a delicacy and help control their population. Snakes are also a part of a larger food web and can provide food to eagles, herons, and several mammals. Any sightings of these snakes should be reported to the Michigan Department of Natural Resources, Wildlife Division. If possible, a photo of the live snake is also recommended.

USFWS Section 7 Consultation Technical Assistance can be found at:

https://www.fws.gov/midwest/endangered/section7/s7process/index.html

The website offers step-by-step instructions to guide you through the Section 7 consultation process with prepared templates for documenting "no effect." as well as requesting concurrence on "may affect, but not likely to adversely affect" determinations.

Please let us know if you have questions.

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APPENDIX E

Rare Plants and Natural Communities Reports – Great Lakes Tunnel Project

Rare Plants and Natural Communities Report – Line 5 Replacement and Tunnel Project

Stantec Project #: 193705885

Prepared for:

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October 22, 2019

Revision	Description	Author		Quality Check		Independent Review	

Please note that Figures 3 and 4 included in this report depict locations of protected species and thus are confidential. This report may not be made public unless the confidential information is redacted.

Prepared by _____
(signature)

Larissa Mottl, Ecologist, MS

Prepared by _____
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Approved by _____
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1.0 INTRODUCTION

Stantec Consulting Services Inc. (Stantec) performed targeted rare plant species surveys for two federally-threatened species, dwarf lake iris (*Iris lacustris;* DLI) and Houghton's goldenrod (*Solidago houghtonii;* HG), and assessed habitat suitability for other state and federally listed species at Point La Barbe near the north shore of the Straits of Mackinac, in Moran Township, Mackinac County, and near the south shore in Wawatam Township, Emmet County, Michigan (together, comprising the "Study Area") on behalf of Enbridge Energy Limited Partnership (Enbridge; "the Client"). The survey for dwarf lake iris was conducted June 17—June 20, 2019. The survey for Houghton's goldenrod was conducted August 27—August 30, 2019. The survey periods for dwarf lake iris and Houghton's goldenrod coincide with typical peak flowering for each species. Habitat suitability assessments were performed concurrently with the dwarf lake iris and Houghton's goldenrod surveys.

The objective of the field survey was to map rare plant occurrences, and natural communities to assess habitat suitability for state and federally listed species with potential to occur in the Study Area based on data in the Michigan Natural Features Inventory (MNFI) and U.S. Fish and Wildlife Service county databases.

The Study Area is comprised of approximately 108.8 acres within the northern portion of the Study Area, located in Mackinac County north of the Straits of Mackinac (Straits) (the "North AOI"), and 37.4 acres in the southern portion, located in Emmet County (the "South AOI") (Figure 1). The North AOI is generally bounded by Boulevard Drive on the east, west, and south and includes a narrow portion of Enbridge's Line 5 pipeline right-of-way (ROW), south of U.S. Highway 2. The North AOI also includes a road corridor along Boulevard Drive from Densmore Road on the east to the first residence west of Point La Barbe.

The South AOI is located south of the Straits and comprises the Enbridge station, the pipeline corridor from the station north to the shoreline, and several additional nearby parcels on the east and west sides of Headlands Road (Figure 1).

The surveys were completed by Stantec scientists Josh Sulman (Botanist, MS, PWS) and Larissa Mottl (Ecologist, MS). Both Mr. Sulman and Ms. Mottl have extensive previous experience conducting rare plant and vegetation surveys in the Midwest and Michigan. Ms. Mottl conducted preliminary HG and DLI surveys within a portion of the North AOI in September 2018. Mr. Sulman assessed habitat suitability within both portions of the Study Area, and mapped DLI during June 2019. Both staff completed HG and DLI mapping and habitat assessments during the August 2019 surveys. Survey methods and results are described below.

2.0 METHODS

A rare species review was conducted for the Study Area in February 2018 by Michael Sanders, environmental review specialist/zoologist, with the Michigan State University Extension, Michigan Natural Features Inventory Program (MNFI 2018). The rare species review indicated that there are records for several legally protected plant species within the vicinity of the Study Area (Table 1). The federally-listed plant species with records from Emmet or Mackinac Counties, Michigan are included in Table 1. For state-listed species (Michigan status of Endangered, Threatened, or Special Concern), Table 1 includes plant species recorded from within 1.5 miles of the Study Area. Table 2 includes natural communities that are known to occur within or adjacent to the Study Area and are considered rare in Michigan (MNFI 2018). These natural communities may provide suitable habitat for several of the rare species known to occur within the vicinity of the Study Area.

Natural communities were identified and characterized using meander field observations and according to the characteristics described in *A Field Guide to the Natural Communities of Michigan* (Cohen et al. 2015). The distribution and approximate extent of natural communities within the Study Area were sketched onto maps in the field and were later digitized in Geographical Information System (GIS) software. The natural community types were mapped based on the plant composition and hydrology present at the time of the survey. Species lists for each natural community were compiled and Floristic Quality Index was computed using the Michigan FQA Database (Reznicek et al. 2014). The structure and composition of some communities such as those along portions of transmission line and pipeline corridors, in proximity to those corridors or to roads, or in areas of historic disturbance, have been altered by clearing of woody canopy species, soil disturbance, and/or introduction and spread of weedy and non-native or invasive species. In these areas, vegetation structure and/or plant species composition have shifted away from natural community types recognized by MNFI and were therefore classified as “degraded” communities.

Meander surveys for state and federally listed species were conducted throughout the Study Area. Surveys were focused on the rare plant species listed in Table 1 (the “focal species”). The August survey coincides with survey timing recommended for the 12 focal species (Table 3). The survey for dwarf lake iris was conducted during peak bloom, June 17 through June 19, 2019. The survey for Houghton’s goldenrod was conducted August 27 through August 30, 2019. Houghton’s goldenrod was early in the flowering period during that time period while a similar-looking species, Ohio goldenrod (*Solidago ohioensis*), was in full bloom. Occurrences of DLI and HG were mapped with a Global Positioning System (GPS) capable of sub-meter accuracy and mapped using GIS.

Table 1. Records of federally and state-listed plant species identified in Rare Species Review of the Study Area and vicinity (MNFI 2018)

Species Name	Common Name	Federal Status*	State Status^
Asplenium scolopendrium var. americanum	Hart's tongue fern	LT	E
Calypso bulbosa	Calypso or fairy-slipper	--	T
Cirsium pitcheri	Pitcher's thistle	LT	T
Cypripedium arietinum	Ram's head lady's-slipper	--	SC
Iris lacustris	Dwarf lake iris (DLI)	LT	T
Mimulus michiganensis	Michigan monkeyflower	LE	E
Pinguicula vulgaris	Butterwort	--	SC
Potamogeton hillii	Hill's pondweed	--	T
Pterospora andromedea	Pine-drops	--	T
Solidago houghtonii	Houghton's goldenrod (HG)	LT	T
Tanacetum huronense	Lake Huron tansy	--	T
Tetraneuris herbacea	Lakeside daisy	LE	E

*LT = listed threatened in the United States (U.S.); LE = listed endangered in the U.S.
^T = threatened status in Michigan, E = endangered status in Michigan, SC = special concern status in Michigan.

Table 2. Occurrences of rare natural communities within 1.5 miles of the Study Area (MNFI 2018)

Natural Community	G-RANK	S-RANK
Boreal Forest	GU	S3
Coastal Fen	G1G2	S2
Great Lakes Marsh	G2	S3
Limestone Cobble Shore	G2G3	S3
Rich Conifer Swamp	G4	S3
Wooded Dune and Swale Complex	G3	S3

Table 3. Recommended Survey Periods (MNFI 2019)

Common Name	Recommended Survey Period (MNFI)					
	May	June	July	Aug	Sept	Oct
Butterwort		X	X	X		
Calypso or fairy-slipper	X	X				
Dwarf lake iris (DLI)	X	X	X	X		
Hart's tongue fern	X	X	X	X	X	X
Hill's pondweed			X	X		
Houghton's goldenrod (HG)				X	X	
Lake Huron tansy		X	X	X		
Lakeside daisy	X	X				
Michigan Monkeyflower		X	X	X		
Pine-drops		X	X	X	X	
Pitcher's thistle		X	X	X	X	
Ram's head lady's-slipper	X	X				

3.0 RESULTS

3.1 NATURAL COMMUNITIES AND RARE PLANTS

Several natural communities were identified, and their approximate extent was mapped within the Study Area (Table 3). Representative meander species lists for each community are included in Appendix A. Representative photos of each community are included in Appendix B.

A total of two state and federally listed plant species were observed during the surveys: Dwarf lake iris and Houghton's goldenrod. Both species were observed within the North AOI only. More detailed results and observations regarding these species are included within the natural community descriptions in the following sections, and in Section 3.2. Discussions of potential habitat suitability for the other focal rare plant species are included within the natural community descriptions and in Section 3.2.

Table 4. Natural Communities in the Study Area

Natural Community	G-RANK	S-RANK	Estimated extent within Study Area (acres)
Boreal Forest (includes degraded)	GU	S3	5.9
Coastal Fen	G1G2	S2	2.8
Limestone Bedrock Glade	G2G4	S2	19.7
Limestone Cobble Shore	G2G3	S3	2.5

Natural Community	G-RANK	S-RANK	Estimated extent within Study Area (acres)
Mesic Northern Forest (includes degraded)	G4	S3	8.4
Northern Shrub Thicket	G4	S5	1.7
Northern Wet Meadow	G4	S4	4.3
Rich Conifer Swamp	G4	S3	2.4
Sand and Gravel Beach	G3	S3	0.7
Wet Meadow/Northern Shrub Thicket	G4	S4/S5	4.0
Wooded Dune and Swale Complex	G3	S3	36.2
Upland Meadow (includes degraded)	N/A	N/A	23.4

3.1.1 Boreal Forest

Boreal Forest is a coniferous or mixed conifer-deciduous forest characteristic of northern Michigan, especially along Great Lakes shorelines, and may occur on wetland and upland sites (Cohen et al. 2015). This community is found within both the North and South AOI. Boreal Forest comprises the dune/ridge community component of the Wooded Dune and Swale Complex, and also occurs as a contiguous community within portions of the Study Area. Typical canopy dominants observed within the Boreal Forest include northern white cedar (*Thuja occidentalis*), balsam fir (*Abies balsamea*), and white spruce (*Picea glauca*). Typical understory and shrub species include striped maple (*Acer pensylvanicum),* mountain maple (*A. spicatum),* Canadian fly honeysuckle (*Lonicera canadensis),* and Canada yew (*Taxus canadensis).* Herbaceous species include starflower (*Trientalis borealis),* wild basil (*Clinopodium vulgare),* and sweet coltsfoot (*Petasites frigidus).*

This community has been identified by MNFI as potentially suitable habitat for calypso, ram's head lady slipper, dwarf lake iris, and pine-drops.

3.1.2 Coastal Fen

Coastal Fen is an herbaceous or shrubby wetland community that occurs on calcareous substrates near Great Lakes shorelines of northern Michigan (Cohen et al. 2015). This community occurs in subtle topographic depressions, swales, and basins within and adjacent to the Limestone Bedrock Glade community in the North AOI. Typical species observed within the community included shrubby cinquefoil (*Dasiphora fruticosa),* grass of parnassus (*Parnassia glauca),* Ohio goldenrod (*Solidago ohioensis),* bog lobelia (*Lobelia kalmii),* pitcher plant (*Sarracenia purpurea),* and false asphodel (*Triantha glutinosa).*

Both DLI and HG were widespread and often abundant within the Coastal Fen community. This community has been identified by MNFI as potentially suitable habitat for DLI, HG, and butterwort.

3.1.3 Limestone Bedrock Glade

Limestone Bedrock Glade occurs within the North AOI (Figure 4). This community is generally a savanna or open woodland with scattered trees and shrubs formed on flat expanses of calcareous bedrock near the shores of the Great Lakes (Cohen et al. 2015). Limestone Bedrock Glade in the Study Area has a species composition and structure characteristic for this community. Dominant species observed within the community included stunted northern white cedar, little bluestem (*Schizachyrium scoparium*), bearberry (*Arctostaphylos uva-ursi),* and junipers (*Juniperus communis, J. horizontalis*). Other frequent species included white camas (*Anticlea elegans),* bastard toadflax (*Comandra umbellata),* yellow lady-slipper (*Cypripedium parviflorum),* and ebony sedge (*Carex eburnea).*

Both DLI and HG are widely distributed within the Limestone Bedrock Glade.

Limestone Bedrock Glade is identified by MNFI as potentially suitable habitat for calypso, ram's head lady's-slipper, DLI, and possibly for lakeside daisy, though data on habitat preferences for this species is limited.

3.1.4 Limestone Cobble Shore

Limestone Cobble Shore occurs along the shorelines of both the North and the South AOIs. This community consists of sparse vegetation growing between exposed cobbles of dolomite (Cohen et al. 2015). Vegetation observed in the Study Area consisted of a mix of native and non-native species, and included sapling-size northern white cedar, soapberry (*Shepherdia canadensis),* starry false Solomon's seal (*Maianthemum stellatum),* white camas, baltic rush (*Juncus balticus),* and Queen Anne's Lace (*Daucus carota).* High water in Lake Michigan has reduced the extent of this community within the Study Area. Both HG and DLI occur frequently in the Limestone Cobble Shore, along the North AOI shoreline. HG stems were observed flowering in inundated stretches of cobble shore at the time of the August survey.

Limestone Cobble Shore is identified by MNFI as potentially suitable habitat for DLI, butterwort, HG, and Lake Huron Tansy.

3.1.5 Mesic Northern Forest

Mesic Northern Forest is a deciduous or mixed conifer-deciduous upland forest found across northern Michigan, with typical canopy dominants including sugar maple (*Acer saccharum)* and American Beech (*Fagus grandifolia)* (Cohen et al. 2015). This community is found in portions of the North and South AOI. Canopy dominants observed onsite include sugar maple, American beech, and basswood (*Tilia americana).* Groundlayer species included blue cohosh (*Caulophyllum thalictroides),* yellow trout lily (*Erythronium americanum),* and large-flowered trillium (*Trillium grandiflorum).* No listed plant species were observed in areas of Mesic Northern Forest in the Study Area. This community has been identified by MNFI as potentially suitable habitat for DLI, pine-drops, and hart's tongue fern.

3.1.6 Northern Shrub Thicket and Northern Wet Meadow

Northern Shrub Thicket and Northern Wet Meadow are wetland communities that were present primarily within the pipeline corridor of the North AOI, as well as occurring as small pockets associated with other open and forested communities. Northern Shrub Thicket consists of a wetland community dominated by shrubby species, especially speckled alder (*Alnus incana),* and is often associated with willows (*Salix* spp.) and dogwoods (*Cornus* spp.) (Cohen et al. 2015). Saplings of northern white cedar, tamarack (*Larix laricina),* and black ash (*Fraxinus nigra*) were present. Northern Wet Meadow is a sedge and grass-dominated wetland which may succeed to Northern Shrub Thicket over time. Common species observed in Northern Wet Meadow included joe pye weed (*Eutrochium maculatum),* wool-grass (*Scirpus cyperinus),* and swamp aster (*Symphyotrichum puniceum).*

Northern Shrub Thicket and Northern Wet Meadow are not identified by MNFI as potentially suitable habitats for the focal species.

3.1.7 Rich Conifer Swamp

Rich Conifer Swamp (also known as “Cedar Swamp”) is a groundwater-influenced, forested wetland dominated by conifers, particularly northern white cedar (Cohen et al. 2015). The Rich Conifer Swamp occurs as a contiguous community within wetland basins along Boulevard Dr. and as the wetland component of the Dune and Swale Complex, within swales. In the Study Area, Rich Conifer Swamp is dominated by a canopy of northern white cedar with lesser cover by black spruce (*Picea mariana*), white spruce, balsam fir, and tamarack (*Larix laricina*) and scattered occurrences of hardwoods including quaking aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), green ash (*Fraxinus pennsylvanica*), red maple (*Acer rubrum*), and paper birch (*Betula papyrifera*).

Rich Conifer Swamp is identified by MNFI as potentially suitable habitat for dwarf lake iris, calypso, and ram’s head lady’s-slipper.

3.1.8 Sand and Gravel Beach

The shorelines of the Study Area are predominantly composed of limestone cobble shore. Within the Study Area, sand and gravel beach is limited to a small portion of the west shoreline of the North AOI. The extent of this community within the Study Area is likely limited by current high lake levels. Because of wind and water action, this community is mostly open, with sparse vegetation (Cohen et al. 2015). Species observed within the sand and gravel beach included marram grass (*Ammophila breviligulata),* sand cherry (*Prunus pumila),* and Gillman’s goldenrod (*Solidago simplex).* Houghton’s goldenrod was recorded within this community.

Limestone Bedrock Glade is identified by MNFI as potentially suitable habitat for Pitcher’s thistle, DLI, butterwort, HG, and Lake Huron Tansy.

3.1.9 Wooded Dune and Swale Complex

Wooded Dune and Swale Complex is a community comprised of alternating bands of wetland and upland forest that have established on a series of parallel ridges and swales formed by receding lake levels over time (Cohen et al. 2015). This community is a unique feature of Great Lakes shorelines. Within the Study Area, the alternating bands of upland forest and forested wetland are visible in aerial photography (Figure 1). Rather than sand dune ridges as is typical of the community as described by MNFI, the ridges of this complex within the Study Area appear to be largely composed of dolomite cobbles.

The forested swales through the complex are comprised of Rich Conifer Swamp. The swales are dominated by native wetland species. The forested ridges are comprised of Boreal Forest. Due to the topographical complexity of this complex, ridges and swales were not mapped out separately, and are depicted together on Figure 4 as the Wooded Dune and Swale Complex. Meander species lists for Wooded Dune and Swale Complex, however, were collected separately for the ridge and swale components. The ridge species list is included as Boreal Forest, and the swale component is included as Rich Conifer Swamp, in Appendix A.

Wooded Dune and Swale Complex is identified by MNFI as potentially suitable habitat for calypso, Pitcher's thistle, ram's head lady slipper, DLI, butterwort, pine-drops, HG, and Lake Huron tansy. Within the Study Area, DLI and HG were observed to occur locally within canopy openings, or at the edges of this community.

3.1.10 Other Land Cover

In addition to the natural communities described above, the Study Area is composed of other land cover types. The other land cover types have been altered and modified as a result of human activities including past and ongoing land use, including active commercial, utility, transportation, agricultural, or recreational uses. Land use has altered the vegetation composition. These areas have been assessed and mapped as degraded or developed areas. Representative species lists for upland meadow, degraded upland meadow and degraded boreal forest are included in Appendix A. Altered land cover types in the North AOI include developed infrastructure associated with electrical transmission lines, gravel roads, and pipeline facilities. Portions of the Study Area also are composed of degraded communities that have been altered by past land use or are actively maintained via vegetation management for pipeline or electrical transmission corridors. The pipeline ROW within the North AOI crosses several ridges and swales. Ongoing ROW maintenance activities have resulted in the removal of forest canopy and establishment of a variety of open and shrub-dominated communities. Portions of these meadows are similar in composition and structure to the Limestone Bedrock Glade community, while others were degraded and dominated by non-native species. Occurrences of both HG and DLI were recorded and mapped in the pipeline ROW.

Much of the land cover in the South AOI is composed of paved or gravel roads, pipeline facilities, residential properties, and degraded land cover such as upland meadow, horse pasture, and mowed lawn areas which are dominated by non-native grasses. Canopy cover associated with residences in the South AOI is generally a mix of trees and shrubs characteristic of Boreal Forest and Northern Mesic Forest, with

very sparse occurrences of native forest ground layer species. Some roadside stretches next to Headlands Road and David Drive have native forest ground layer species where there is adjacent forest cover, but no rare plant species were observed.

3.2 RARE PLANT SPECIES

During the survey of the Study Area, two listed species, dwarf lake iris and Houghton's goldenrod, were recorded and their occurrences were mapped. No additional state or federally listed plant species were found during the survey. The rare plant species, their distribution within the Study Area (if found), and descriptions of potential habitat suitability within the Study Area, are summarized in the following sections.

3.2.1 Dwarf lake iris

Dwarf lake iris has a range restricted to the northern Lake Michigan and Lake Huron shorelines of northern Michigan, Wisconsin, and Ontario (Voss and Reznicek 2012). DLI is widespread and locally abundant within the North AOI (Figure 2). This species was found most frequently within the Limestone Bedrock Glade, Coastal Fen, and Limestone Cobble Shore communities, especially within areas of low vegetation and open canopy, or under partial shade of northern white cedars. DLI was also found locally within cleared portions of the pipeline and transmission line corridors, at the margins of Rich Conifer Swamp and Wooded Dune and Swale, and along the edges of roadways and developed areas, on suitable calcareous substrates. This species spreads by rhizomes and can form large colonies covering extensive areas within suitable habitats. Some colonies within the North AOI were visually estimated to have more than 1,000 stems (Figure 2, Appendix C).

3.2.2 Houghton's goldenrod

Houghton's goldenrod is found only along the northern shorelines of Lakes Michigan and Huron and is almost entirely restricted to Michigan (Voss and Reznicek 2012). It is widespread and fairly abundant within the North AOI (Figure 3). This species is found most frequently within the Limestone Bedrock Glade, Coastal Fen, and Limestone Cobble Shore communities, especially within open areas of low vegetation and no tree canopy. It is also found locally within the cleared pipeline and transmission line corridors. This species occurs in populations of a few stems up to a hundred or more scattered stems (Figure 3, Appendix C).

3.2.3 Butterwort

Suitable habitat types for butterwort include Limestone Cobble Shore, Wooded Dune and Swale Complex, Sand and Gravel Beach, and Coastal Fen. Although potentially suitable habitat may occur, this species was not found during the surveys.

3.2.4 Calypso

Suitable habitats for calypso include Boreal Forest, Limestone Bedrock Glade, Rich Conifer Swamp, and Wooded Dune and Swale Complex. Although potentially suitable habitat may occur, this species was not found during the surveys.

3.2.5 Hart's tongue fern

Hart's tongue fern is a species with highly specialized habitat requirements, occurring in Mesic Northern Forests on large moss-covered dolomite boulders and usually above 800 ft elevation in the Niagara Escarpment region (MNFI 2019). There are small areas of Mesic Northern Forest in the Study Area, but large boulders of dolomite are not present. Therefore, suitable habitats for this species appear to be absent from the Study Area. Hart's tongue fern was not observed in the Study Area.

3.2.6 Hill's pondweed

Although there is one record of Hill's pondweed within 1.5 miles of the Study Area, there does not appear to be suitable habitat for this aquatic plant species within the Study Area. The pondweed is typically found in cold, alkaline streams in water up to one meter in depth (MNFI 2019).

3.2.7 Lake Huron tansy

Suitable habitats for Lake Huron tansy include Limestone Cobble Shore, Sand and Gravel Beach, Open Dune, and Wooded Dune and Swale Complex along Great Lakes shorelines. Although potentially suitable habitat may occur, this species was not found during the surveys.

3.2.8 Lakeside daisy

Suitable habitats for lakeside daisy may include the Limestone Bedrock Glade community (MNFI 2019). In Michigan, this species is known from a single locality in Mackinac County at the edge of a northern white cedar forest in marly soil over limestone (Voss and Reznicek 2012). The Limestone Bedrock Glade in the Study Area has several of the plant species associated with lakeside daisy habitat, including northern white cedar, white spruce, shrubby cinquefoil, ebony sedge, and black-eyed Susan. Although potentially suitable habitat may occur, this species was not found during the surveys.

3.2.9 Michigan Monkeyflower

Suitable habitats for Michigan monkeyflower are cold, calcareous springs, seeps and streams through northern white cedar forests, and the base of bluffs near Great Lakes shorelines (MNFI 2019). There are no records of Michigan monkeyflower within 1.5 miles of the Study Area, and there does not appear to be suitable habitat for this species within 1.5 miles of the Study Area (MNFI 2018). Due to the lack of suitable habitat, it is unlikely for this species to be found in the Study Area and none was found during the surveys.

3.2.10 Pine-drops

Pine-drops are root parasites that depend on mycorrhizal fungus associations with coniferous trees. Its variable dormancy and appearance above ground from year to year can make it difficult to detect. Potentially suitable habitats for this species comprise forests with significant components of conifers, especially pines, but also spruce, fir, and northern white cedar (Voss and Reznicek 2012). Although limited extent of potentially suitable habitat may occur, this species was not found during the surveys.

3.2.11 Pitcher's thistle

Suitable habitats for Pitcher's thistle include Wooded Dune and Swale Complex, Sand and Gravel Beach, Great Lakes Barrens, and Open Dunes. Potential suitable habitat for this species within the Study Area is limited, and this species was not found during the surveys.

3.2.12 Ram's head lady's-slipper

Suitable habitat for ram's head lady's-slipper include Boreal Forest, Limestone Bedrock Glade, Rich Conifer Swamp, and Wooded Dune and Swale Complex in the Study Area. Although potentially suitable habitat may occur, this species was not found during the surveys.

4.0 CONCLUSIONS

Ten natural communities, and two rare plant species, were observed and mapped in the Study Area. In addition to the two federally threatened plant species recorded, potentially suitable habitats for an additional seven state or federally listed species may occur in portions of the Study Area. Surveys of the Study Area during June and August 2019 were timed to occur during the optimal survey periods recommended for the 12 focal rare plant species. Of the focal rare plant species, only dwarf lake iris and Houghton's goldenrod were observed.

Appropriate measures to avoid and minimize potential impacts to rare species and/or suitable habitats identified during the survey, may be required under federal and/or state law.

Invasive plant species are abundant and widespread throughout the natural communities that support Houghton's goldenrod and dwarf lake iris in the Study Area. Invasive species are a known threat for populations of these rare plants. Controlling invasive plants is an important management activity for the protection and conservation of the rare plants and rare natural communities in the Study Area.

5.0 CITED REFERENCES

Cohen, J.G., Kost, M.A., Slaughter, B.S. and Albert, D.A., 2015. *A Field Guide to the Natural Communities of Michigan*. Michigan State University Press.

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FIGURES

Figure No.
1

Title
2019 Survey Area - North Shore

Client/Project
Enbridge - Line 5 Replacement and Tunnel Project
2019 Survey

Project Location
Mackinac County, Michigan

193705885
Prepared by JM on 2019-05-15
Technical Review by MP on 2019-05-15
Independent Review by JS on 2019-09-09

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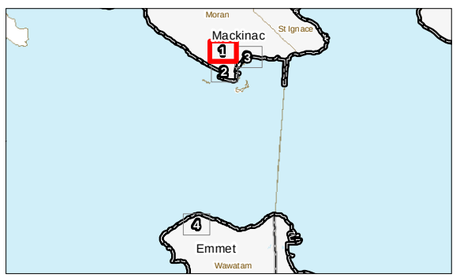
Legend
Survey Area
County Boundary



Notes
1. Coordinate System: NAD 1983 StatePlane Michigan North FIPS 2111 Feet
2. Data Sources Include: Stantec, Enbridge, USGS, NADS
3. Orthophotography: 2018 NAIP

Stantec

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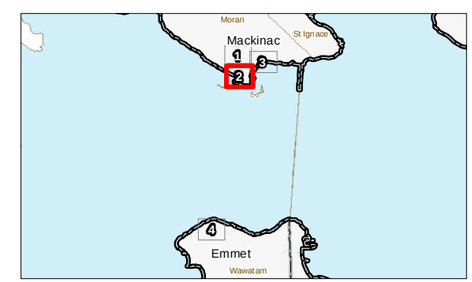

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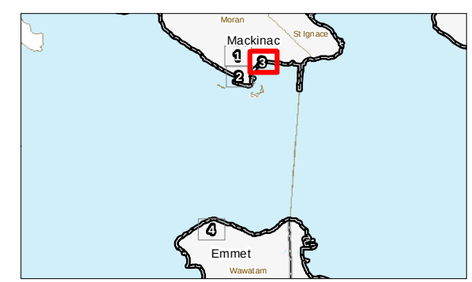

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2. Data Sources Include: Stantec, Enbridge, USGS, NADS
3. Orthophotography: 2018 NAIP

Stantec

Figure No.
1

Title
2019 Survey Area - South Shore

Client/Project
Enbridge - Line 5 Replacement and Tunnel Project
2019 Survey

Project Location
Emmet County, Michigan

193705885
Prepared by JM on 2019-05-15
Technical Review by MP on 2019-05-15
Independent Review by JS on 2019-09-09

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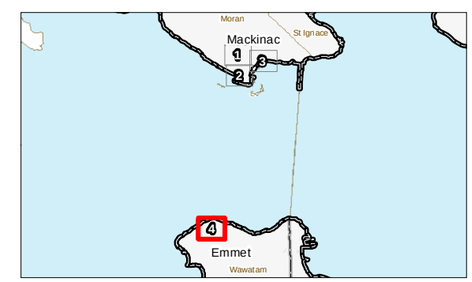
Legend
- Survey Area
- County Boundary



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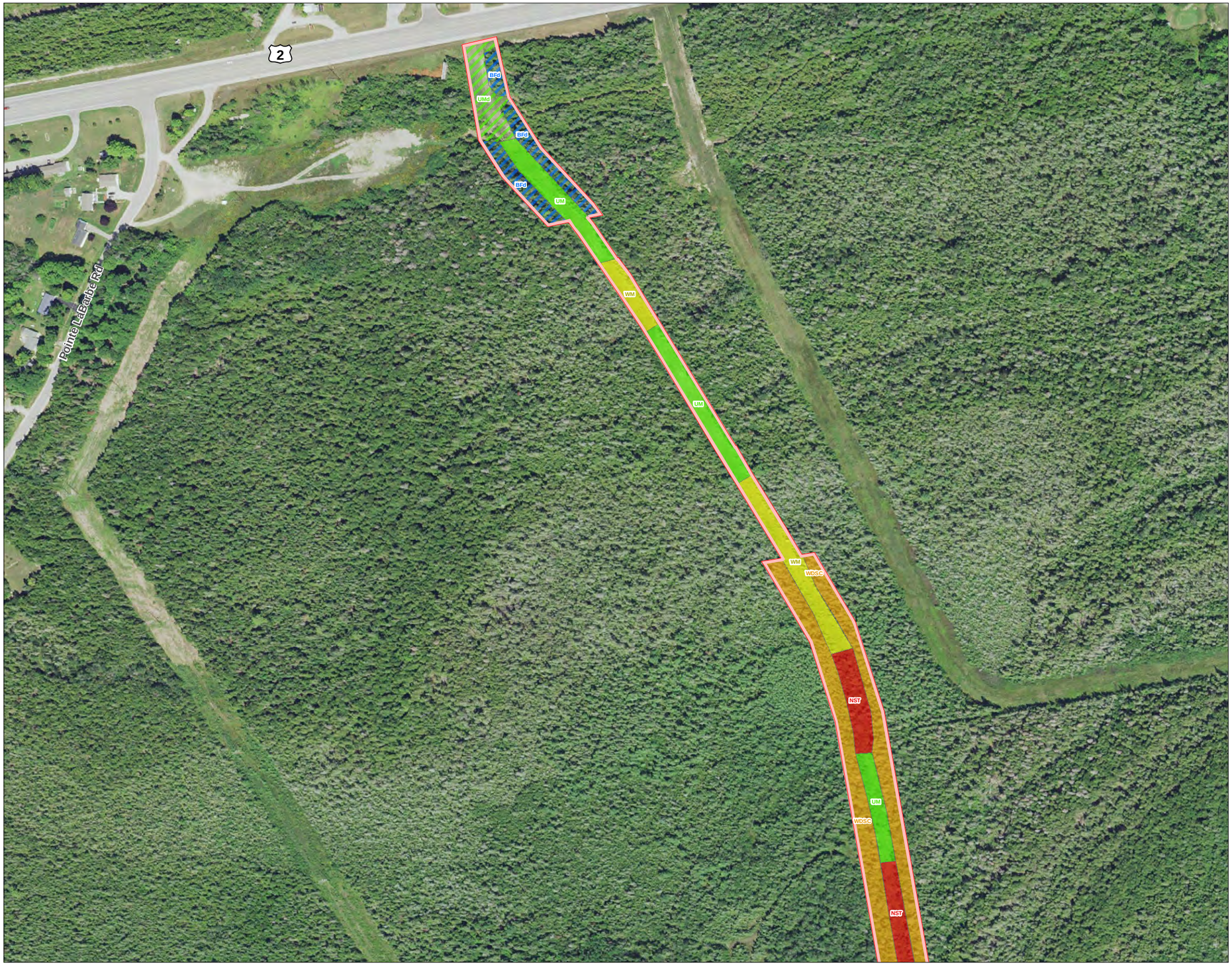

Figure No.
4

Title
Natural Communities
North Shore

Client/Project
Enbridge - Line 5 Replacement and Tunnel Project
June & August 2019 Survey

Project Location
Mackinac County, Michigan

193705885
Prepared by JM on 2019-09-18
Technical Review by NF on 2019-09-19
Independent Review by LM on 2019-09-23

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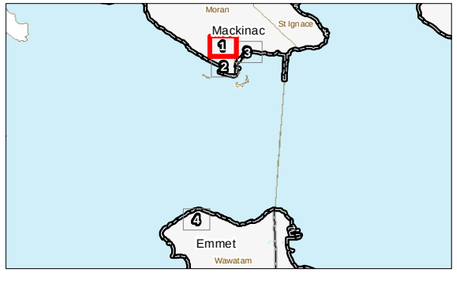
Legend

- Survey Area
- County Boundary
- Field Delineated Waterway

Community Type

- Boreal Forest - BF
- Boreal Forest (Degraded) - BFd
- Coastal Fen - CF
- Limestone Bedrock Glade - LBG
- Limestone Cobble Shore - LCS
- Mesic Northern Forest - MNF
- Mesic Northern Forest (Degraded) - MNFd
- Northern Shrub Thicket - NST
- Rich Conifer Swamp - RCS
- Sand & Gravel Beach - SGB
- Upland Meadow - UM
- Upland Meadow (Degraded) - UMd
- Wet Meadow - WM
- Wet Meadow/Northern Shrub Thicket - WM/NST
- Wooded Dune & Swale Complex - WDSC



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3. Orthophotography: 2018 NAIP

Stantec

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Figure No.
4

Title
Natural Communities
North Shore

Client/Project
Enbridge - Line 5 Replacement and Tunnel Project
June & August 2019 Survey

Project Location
Mackinac County, Michigan

193705885
Prepared by JM on 2019-09-18
Technical Review by NF on 2019-09-19
Independent Review by LM on 2019-09-23

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N

Legend

- Survey Area
- County Boundary
- Field Delineated Waterway

Community Type

- Boreal Forest - BF
- Boreal Forest (Degraded) - BFd
- Coastal Fen - CF
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- Limestone Cobble Shore - LCS
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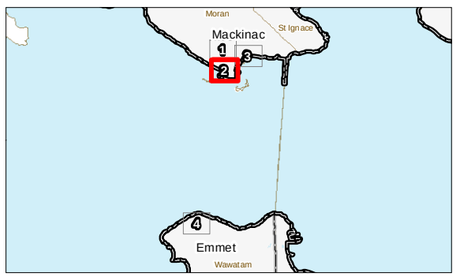

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3. Orthophotography: 2018 NAIP

Stantec

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Figure No.
4

Title
Natural Communities
North Shore

Client/Project
Enbridge - Line 5 Replacement and Tunnel Project
June & August 2019 Survey

Project Location
Mackinac County, Michigan

193705885
Prepared by JM on 2019-09-18
Technical Review by NF on 2019-09-19
Independent Review by LM on 2019-09-23

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- Survey Area
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Community Type

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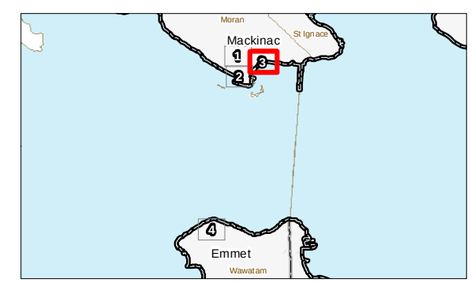

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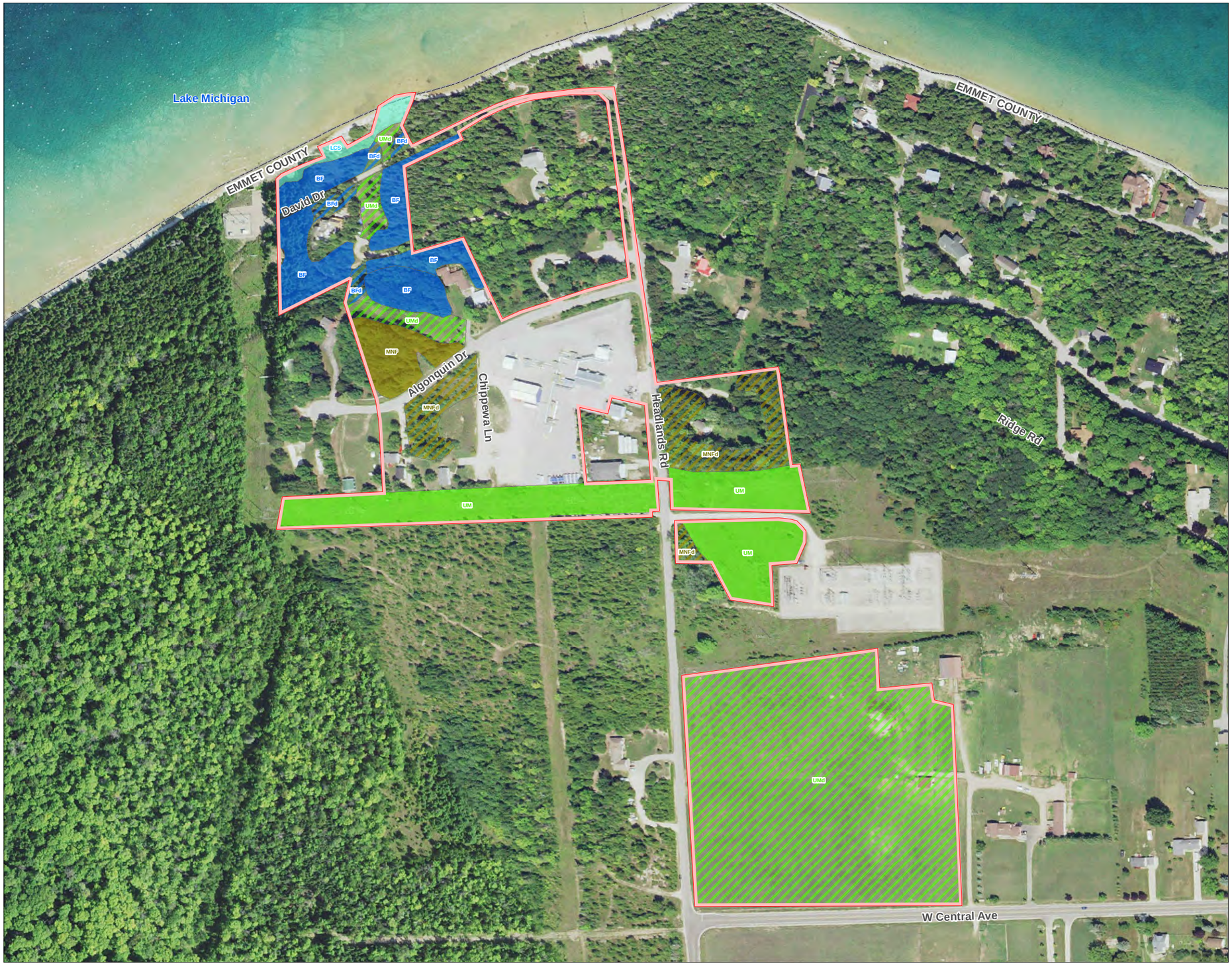

Figure No.
4

Title
Natural Communities
South Shore

Client/Project
Enbridge - Line 5 Replacement and Tunnel Project
June & August 2019 Survey

Project Location
Emmet County, Michigan

193705885
Prepared by JM on 2019-09-18
Technical Review by NF on 2019-09-19
Independent Review by LM on 2019-09-23

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Legend

- Survey Area
- County Boundary
- Field Delineated Waterway

Community Type

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- Boreal Forest (Degraded) - BFd
- Coastal Fen - CF
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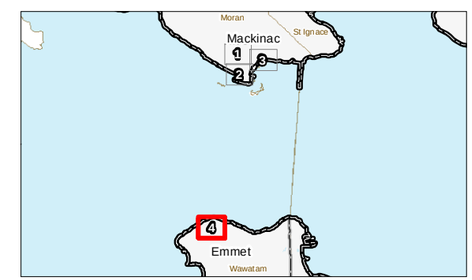

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Appendix A NATURAL COMMUNITY MEANDER SPECIES LISTS

Meander Species List - Boreal Forest (including ridge component of Wooded Dune and Swale)

Scientific Name	Common Name	Native	Physiognomy	Coefficient of Conservatism
Abies balsamea	balsam fir	native	tree	3
Acer pensylvanicum	striped maple	native	tree	5
Acer spicatum	mountain maple	native	tree	5
Actaea pachypoda	dolls-eyes	native	forb	7
Actaea rubra	red baneberry	native	forb	7
Agrimonia gryposepala	tall agrimony	native	forb	2
Apocynum androsaemifolium	spreading dogbane	native	forb	3
Aquilegia canadensis	wild columbine	native	forb	5
Aralia nudicaulis	wild sarsaparilla	native	forb	5
Arctostaphylos uva-ursi	bearberry	native	shrub	8
Arisaema triphyllum	jack-in-the-pulpit	native	forb	5
Betula papyrifera	paper birch	native	tree	2
Campanula rotundifolia	harebell	native	forb	6
Cardamine diphylla	two-leaved toothwort	native	forb	5
Carex arctata	sedge	native	sedge	3
Carex deweyana	sedge	native	sedge	3
Carex eburnea	sedge	native	sedge	7
Carex pedunculata	sedge	native	sedge	5
Circaea alpina	small enchanters-nightshade	native	forb	4
Clinopodium vulgare	wild-basil	native	forb	3
Comandra umbellata	bastard-toadflax	native	forb	5
Corallorhiza striata	striped coral-root	native	forb	6
Cornus rugosa	round-leaved dogwood	native	shrub	6
Corylus cornuta	beaked hazelnut	native	shrub	5
Cypripedium parviflorum	yellow lady-slipper	native	forb	5
Cystopteris bulbifera	bulblet fern	native	fern	5
Diervilla lonicera	bush-honeysuckle	native	shrub	4
Dryopteris intermedia	evergreen woodfern	native	fern	5
Dryopteris marginalis	marginal woodfern	native	fern	5
Epipactis helleborine	helleborine	non-native	forb	0
Equisetum scirpoides	dwarf scouring rush	native	fern	7
Erythronium americanum	yellow trout lily	native	forb	5
Eurybia macrophylla	big-leaved aster	native	forb	4
Fraxinus pennsylvanica	red ash	native	tree	2
Galeopsis tetrahit	hemp-nettle	non-native	forb	0
Galium triflorum	fragrant bedstraw	native	forb	4
Geranium robertianum	herb robert	native	forb	3
Gymnocarpium dryopteris	oak fern	native	fern	5
Hieracium kalmii	kalms hawkweed	native	forb	3
Hieracium piloselloides	king devil	non-native	forb	0
Linnaea borealis	twinflower	native	forb	6
Lithospermum officinale	gromwell	non-native	forb	0
Lonicera canadensis	canadian fly honeysuckle	native	shrub	5
Lonicera dioica	red honeysuckle	native	vine	5
Maianthemum canadense	canada mayflower	native	forb	4
Maianthemum stellatum	starry false solomon-seal	native	forb	5
Mycelis muralis	wall lettuce	non-native	forb	0
Ostrya virginiana	ironwood; hop-hornbeam	native	tree	5
Petasites frigidus	sweet-coltsfoot	native	forb	10
Picea glauca	white spruce	native	tree	3
Picea mariana	black spruce	native	tree	6
Polygala paucifolia	gay-wings	native	forb	7
Polygonatum pubescens	downy solomon seal	native	forb	5
Populus balsamifera	balsam poplar	native	tree	2
Populus tremuloides	quaking aspen	native	tree	1
Prunella vulgaris	self-heal	native	forb	0
Prunus virginiana	choke cherry	native	shrub	2
Pteridium aquilinum	bracken fern	native	fern	0
Rubus pubescens	dwarf raspberry	native	shrub	4
Rubus strigosus	wild red raspberry	native	shrub	2

Meander Species List - Boreal Forest (including ridge component of Wooded Dune and Swale)

Scientific Name	Common Name	Native	Physiognomy	Coefficient of Conservatism
Sambucus racemosa	red-berried elder	native	shrub	3
Schizachne purpurascens	false melic	native	grass	5
Shepherdia canadensis	soapberry	native	shrub	7
Solidago hispida	hairy goldenrod	native	forb	3
Streptopus lanceolatus	rose twisted-stalk	native	forb	5
Symphoricarpos albus var. albus	snowberry	native	shrub	5
Symphyotrichum ciliolatum	northern heart-leaved aster	native	forb	4
Symphyotrichum lateriflorum	calico aster	native	forb	2
Taxus canadensis	yew	native	shrub	5
Thuja occidentalis	arbor vitae	native	tree	4
Tilia americana	basswood	native	tree	5
Trientalis borealis	star-flower	native	forb	5
Trillium cernuum	nodding trillium	native	forb	5
Tsuga canadensis	hemlock	native	tree	5
Veronica officinalis	common speedwell	non-native	forb	0
Viola blanda	sweet white violet	native	forb	5

FQA Metrics	Species Richness	Mean C Value	FQI
Native	70	4.5	37.6
All Species	76	4.1	35.7

Meander Species List - Mesic Northern Forest (degraded)

Scientific Name	Common Name	Native	Physiognomy	Coefficient of Conservatism
Acer saccharum	sugar maple	native	tree	5
Agrostis gigantea	redtop	non-native	grass	0
Alliaria petiolata	garlic mustard	non-native	forb	0
Anemone canadensis	canada anemone	native	forb	4
Anemone virginiana	thimbleweed	native	forb	3
Asclepias syriaca	common milkweed	native	forb	1
Calamagrostis canadensis	blue-joint	native	grass	3
Circaea canadensis	enchanters-nightshade	native	forb	2
Cirsium arvense	canada thistle	non-native	forb	0
Clinopodium vulgare	wild-basil	native	forb	3
Cornus rugosa	round-leaved dogwood	native	shrub	6
Cornus sericea	red-osier	native	shrub	2
Diervilla lonicera	bush-honeysuckle	native	shrub	4
Elymus repens	quack grass	non-native	grass	0
Eurybia macrophylla	big-leaved aster	native	forb	4
Fragaria virginiana	wild strawberry	native	forb	2
Frangula alnus	glossy buckthorn	non-native	shrub	0
Fraxinus pennsylvanica	red ash	native	tree	2
Hieracium kalmii	kalms hawkweed	native	forb	3
Hypericum perforatum	common st. johns-wort	non-native	forb	0
Lonicera tatarica	tartarian honeysuckle	non-native	shrub	0
Maianthemum stellatum	starry false solomon-seal	native	forb	5
Malus pumila	apple	non-native	tree	0
Pastinaca sativa	wild parsnip	non-native	forb	0
Physocarpus opulifolius	ninebark	native	shrub	4
Picea glauca	white spruce	native	tree	3
Populus balsamifera	balsam poplar	native	tree	2
Populus tremuloides	quaking aspen	native	tree	1
Prunus pensylvanica	pin cherry	native	tree	3
Prunus virginiana	choke cherry	native	shrub	2
Ranunculus acris	tall or common buttercup	non-native	forb	0
Rhamnus cathartica	common buckthorn	non-native	tree	0
Ribes americanum	wild black currant	native	shrub	6
Ribes hirtellum	swamp gooseberry	native	shrub	6
Rubus pubescens	dwarf raspberry	native	shrub	4
Rubus strigosus	wild red raspberry	native	shrub	2
Shepherdia canadensis	soapberry	native	shrub	7
Solanum dulcamara	bittersweet nightshade	non-native	vine	0
Solidago canadensis	canada goldenrod	native	forb	1
Solidago gigantea	late goldenrod	native	forb	3
Symphyotrichum lanceolatum	panicled aster	native	forb	2
Thuja occidentalis	arbor vitae	native	tree	4
Toxicodendron radicans	poison-ivy	native	vine	2
Urtica dioica	stinging nettle	native	forb	1
Veronica officinalis	common speedwell	non-native	forb	0
Viburnum opulus	european highbush-cranberry	non-native	shrub	0
Viola blanda	sweet white violet	native	forb	5

FQA Metrics	Species Richness	Mean C Value	FQI
Native	33	3.2	18.4
All Species	47	2.3	15.8

Meander Species List - Coastal Fen

Scientific Name	Common Name	Native	Physiognomy	Coefficient of Conservatism
Abies balsamea	balsam fir	native	tree	3
Agalinis purpurea	purple false foxglove	native	forb	7
Calamagrostis canadensis	blue-joint	native	grass	3
Calamagrostis stricta	narrow-leaved reedgrass	native	grass	10
Campanula aparinoides	marsh bellflower	native	forb	7
Carex buxbaumii	sedge	native	sedge	10
Carex crawei	sedge	native	sedge	10
Carex lasiocarpa	sedge	native	sedge	8
Carex stricta	sedge	native	sedge	4
Castilleja coccinea	indian paintbrush	native	forb	8
Comandra umbellata	bastard-toadflax	native	forb	5
Dasiphora fruticosa	shrubby cinquefoil	native	shrub	8
Eleocharis rostellata	spike-rush	native	sedge	10
Eupatorium perfoliatum	boneset	native	forb	4
Euthamia graminifolia	grass-leaved goldenrod	native	forb	3
Eutrochium maculatum	joe-pye-weed	native	forb	4
Gentianopsis virgata	small fringed gentian	native	forb	8
Hypericum kalmianum	kalms st. johns-wort	native	shrub	10
Iris lacustris	dwarf lake iris	native	forb	9
Juncus alpinoarticulatus	rush	native	rush	5
Juncus balticus	rush	native	rush	4
Lathyrus palustris	marsh pea	native	vine	7
Lilium philadelphicum	wood lily	native	forb	7
Lobelia kalmii	bog lobelia	native	forb	10
Maianthemum stellatum	starry false solomon-seal	native	forb	5
Myrica gale	sweet gale	native	shrub	6
Packera paupercula	balsam ragwort	native	forb	3
Parnassia glauca	grass-of-parnassus	native	forb	8
Potentilla anserina	silverweed	native	forb	5
Prenanthes racemosa	glaucous white lettuce	native	forb	8
Rhamnus alnifolia	alder-leaved buckthorn	native	shrub	8
Rhynchospora capillacea	beak-rush	native	sedge	10
Rudbeckia hirta	black-eyed susan	native	forb	1
Salix candida	hoary willow	native	shrub	9
Salix myricoides	blueleaf willow	native	shrub	9
Sarracenia purpurea	pitcher-plant	native	forb	10
Schizachyrium scoparium	little bluestem	native	grass	5
Schoenoplectus pungens	threesquare	native	sedge	5
Shepherdia canadensis	soapberry	native	shrub	7
Solidago houghtonii	houghtons goldenrod	native	forb	10
Solidago ohioensis	ohio goldenrod	native	forb	8
Solidago uliginosa	bog goldenrod	native	forb	4
Symphyotrichum pilosum	hairy aster	native	forb	1
Thuja occidentalis	arbor vitae	native	tree	4
Triantha glutinosa	false asphodel	native	forb	10
Triglochin maritima	common bog arrow-grass	native	forb	8

FQA Metrics	Species Richness	Mean C Value	FQI
Native	46	6.7	45.4
All Species	46	6.7	45.4

Meander Species List - Limestone Bedrock Glade

Scientific Name	Common Name	Native	Physiognomy	Coefficient of Conservatism
Achillea millefolium	yarrow	native	forb	1
Agalinis purpurea	purple false foxglove	native	forb	7
Agrostis gigantea	redtop	non-native	grass	0
Anemone canadensis	canada anemone	native	forb	4
Anemone virginiana	thimbleweed	native	forb	3
Anticlea elegans	white camas	native	forb	10
Aquilegia canadensis	wild columbine	native	forb	5
Arctostaphylos uva-ursi	bearberry	native	shrub	8
Betula papyrifera	paper birch	native	tree	2
Campanula rotundifolia	harebell	native	forb	6
Carex capillaris	sedge	native	sedge	9
Carex castanea	sedge	native	sedge	6
Carex eburnea	sedge	native	sedge	7
Castilleja coccinea	indian paintbrush	native	forb	8
Centaurea stoebe	spotted knapweed	non-native	forb	0
Centaurium pulchellum	branching centaury	non-native	forb	0
Chelone glabra	turtlehead	native	forb	7
Comandra umbellata	bastard-toadflax	native	forb	5
Coreopsis lanceolata	sand coreopsis	native	forb	8
Cornus sericea	red-osier	native	shrub	2
Cypripedium parviflorum	yellow lady-slipper	native	forb	5
Danthonia spicata	poverty grass; oatgrass	native	grass	4
Dasiphora fruticosa	shrubby cinquefoil	native	shrub	8
Daucus carota	queen-annes-lace	non-native	forb	0
Diervilla lonicera	bush-honeysuckle	native	shrub	4
Euphrasia stricta	european eyebright	non-native	forb	0
Eurybia macrophylla	big-leaved aster	native	forb	4
Euthamia graminifolia	grass-leaved goldenrod	native	forb	3
Eutrochium maculatum	joe-pye-weed	native	forb	4
Fragaria virginiana	wild strawberry	native	forb	2
Fraxinus pennsylvanica	red ash	native	tree	2
Hypericum kalmianum	kalms st. johns-wort	native	shrub	10
Iris lacustris	dwarf lake iris	native	forb	9
Juncus balticus	rush	native	rush	4
Juniperus communis	common or ground juniper	native	shrub	4
Juniperus horizontalis	creeping juniper	native	shrub	10
Larix laricina	tamarack	native	tree	5
Leucanthemum vulgare	ox-eye daisy	non-native	forb	0
Lilium philadelphicum	wood lily	native	forb	7
Lobelia kalmii	bog lobelia	native	forb	10
Lotus corniculatus	birdfoot trefoil	non-native	forb	0
Maianthemum stellatum	starry false solomon-seal	native	forb	5
Melilotus albus	white sweet-clover	non-native	forb	0
Monarda fistulosa	wild-bergamot	native	forb	2
Oryzopsis asperifolia	rough-leaved rice-grass	native	grass	6
Packera paupercula	balsam ragwort	native	forb	3
Picea glauca	white spruce	native	tree	3
Pimpinella saxifraga	burnet-saxifrage	non-native	forb	0
Plantago lanceolata	english plantain	non-native	forb	0
Populus balsamifera	balsam poplar	native	tree	2
Populus tremuloides	quaking aspen	native	tree	1
Prunus pumila	sand cherry	native	shrub	8
Prunus virginiana	choke cherry	native	shrub	2
Rubus parviflorus	thimbleberry	native	shrub	6
Rudbeckia hirta	black-eyed susan	native	forb	1
Rumex acetosella	sheep sorrel	non-native	forb	0
Salix bebbiana	bebbs willow	native	shrub	1
Salix cordata	sand-dune willow	native	shrub	10
Salix myricoides	blueleaf willow	native	shrub	9
Schizachyrium scoparium	little bluestem	native	grass	5

Meander Species List - Limestone Bedrock Glade

Scientific Name	Common Name	Native	Physiognomy	Coefficient of Conservatism
Shepherdia canadensis	soapberry	native	shrub	7
Solidago canadensis	canada goldenrod	native	forb	1
Solidago hispida	hairy goldenrod	native	forb	3
Solidago houghtonii	houghtons goldenrod	native	forb	10
Solidago nemoralis	old-field goldenrod	native	forb	2
Solidago ohioensis	ohio goldenrod	native	forb	8
Solidago rugosa	rough-leaved goldenrod	native	forb	3
Symphyotrichum boreale	northern bog aster	native	forb	9
Symphyotrichum cordifolium	heart-leaved aster	native	forb	4
Tanacetum vulgare	garden tansy	non-native	forb	0
Thuja occidentalis	arbor vitae	native	tree	4
Triantha glutinosa	false asphodel	native	forb	10
Trifolium pratense	red clover	non-native	forb	0

FQA Metrics	Species Richness	Mean C Value	FQI
Native	60	5.3	41.1
All Species	73	4.4	37.6

Meander Species List - Limestone Cobble Shore

Scientific Name	Common Name	Native	Physiognomy	Coefficient of Conservatism
Agalinis purpurea	purple false foxglove	native	forb	7
Anemone virginiana	thimbleweed	native	forb	3
Anticlea elegans	white camas	native	forb	10
Arctostaphylos uva-ursi	bearberry	native	shrub	8
Betula papyrifera	paper birch	native	tree	2
Campanula rotundifolia	harebell	native	forb	6
Centaurea stoebe	spotted knapweed	non-native	forb	0
Chelone glabra	turtlehead	native	forb	7
Comandra umbellata	bastard-toadflax	native	forb	5
Coreopsis lanceolata	sand coreopsis	native	forb	8
Cornus sericea	red-osier	native	shrub	2
Cypripedium parviflorum	yellow lady-slipper	native	forb	5
Dasiphora fruticosa	shrubby cinquefoil	native	shrub	8
Daucus carota	queen-annes-lace	non-native	forb	0
Eutrochium maculatum	joe-pye-weed	native	forb	4
Iris lacustris	dwarf lake iris	native	forb	9
Juncus balticus	rush	native	rush	4
Juniperus communis	common or ground juniper	native	shrub	4
Lobelia kalmii	bog lobelia	native	forb	10
Lotus corniculatus	birdfoot trefoil	non-native	forb	0
Maianthemum stellatum	starry false solomon-seal	native	forb	5
Melilotus albus	white sweet-clover	non-native	forb	0
Picea glauca	white spruce	native	tree	3
Rubus parviflorus	thimbleberry	native	shrub	6
Rudbeckia hirta	black-eyed susan	native	forb	1
Salix bebbiana	bebbs willow	native	shrub	1
Salix cordata	sand-dune willow	native	shrub	10
Salix lucida	shining willow	native	shrub	3
Shepherdia canadensis	soapberry	native	shrub	7
Solidago canadensis	canada goldenrod	native	forb	1
Solidago houghtonii	houghtons goldenrod	native	forb	10
Solidago ohioensis	ohio goldenrod	native	forb	8
Symphyotrichum boreale	northern bog aster	native	forb	9
Symphyotrichum lanceolatum	panicled aster	native	forb	2
Tanacetum vulgare	garden tansy	non-native	forb	0
Thuja occidentalis	arbor vitae	native	tree	4
Trifolium pratense	red clover	non-native	forb	0
Typha x glauca	hybrid cat-tail	non-native	forb	0

FQA Metrics	Species Richness	Mean C Value	FQI
Native	31	5.5	30.6
All Species	38	4.5	27.7

Meander Species List - Mesic Northern Forest

Scientific Name	Common Name	Native	Physiognomy	Coefficient of Conservatism
Abies balsamea	balsam fir	native	tree	3
Acer saccharum	sugar maple	native	tree	5
Actaea pachypoda	dolls-eyes	native	forb	7
Actaea rubra	red baneberry	native	forb	7
Allium tricoccum	wild leek	native	forb	5
Anemone virginiana	thimbleweed	native	forb	3
Betula papyrifera	paper birch	native	tree	2
Carex arctata	sedge	native	sedge	3
Carex deweyana	sedge	native	sedge	3
Carex eburnea	sedge	native	sedge	7
Caulophyllum thalictroides	blue cohosh	native	forb	5
Clinopodium vulgare	wild-basil	native	forb	3
Comandra umbellata	bastard-toadflax	native	forb	5
Cornus rugosa	round-leaved dogwood	native	shrub	6
Corylus cornuta	beaked hazelnut	native	shrub	5
Cypripedium parviflorum	yellow lady-slipper	native	forb	5
Epipactis helleborine	helleborine	non-native	forb	0
Erythronium americanum	yellow trout lily	native	forb	5
Eurybia macrophylla	big-leaved aster	native	forb	4
Fagus grandifolia	american beech	native	tree	6
Fraxinus americana	white ash	native	tree	5
Fraxinus pennsylvanica	red ash	native	tree	2
Lithospermum officinale	gromwell	non-native	forb	0
Maianthemum canadense	canada mayflower	native	forb	4
Maianthemum racemosum	false spikenard	native	forb	5
Maianthemum stellatum	starry false solomon-seal	native	forb	5
Mycelis muralis	wall lettuce	non-native	forb	0
Myosotis sylvatica	garden forget-me-not	non-native	forb	0
Origanum vulgare	wild-marjoram	non-native	forb	0
Oryzopsis asperifolia	rough-leaved rice-grass	native	grass	6
Ostrya virginiana	ironwood; hop-hornbeam	native	tree	5
Picea glauca	white spruce	native	tree	3
Pinus strobus	white pine	native	tree	3
Poa compressa	canada bluegrass	non-native	grass	0
Populus balsamifera	balsam poplar	native	tree	2
Populus grandidentata	big-tooth aspen	native	tree	4
Populus tremuloides	quaking aspen	native	tree	1
Prunus virginiana	choke cherry	native	shrub	2
Ranunculus acris	tall or common buttercup	non-native	forb	0
Symphyotrichum ciliolatum	northern heart-leaved aster	native	forb	4
Taraxacum officinale	common dandelion	non-native	forb	0
Thuja occidentalis	arbor vitae	native	tree	4
Tilia americana	basswood	native	tree	5
Toxicodendron rydbergii	poison-ivy	native	shrub	3
Trientalis borealis	star-flower	native	forb	5
Trillium grandiflorum	common trillium	native	forb	5
Tsuga canadensis	hemlock	native	tree	5
Viola pubescens	yellow violet	native	forb	4

FQA Metrics	Species Richness	Mean C Value	FQI
Native	40	4.3	27.2
All Species	48	3.6	24.9

Meander Species List - Northern Shrub Thicket

Scientific Name	Common Name	Native	Physiognomy	Coefficient of Conservatism
Alnus incana	speckled alder	native	shrub	5
Anemone canadensis	canada anemone	native	forb	4
Caltha palustris	marsh-marigold	native	forb	6
Carex stricta	sedge	native	sedge	4
Cornus sericea	red-osier	native	shrub	2
Epilobium leptophyllum	fen willow-herb	native	forb	6
Equisetum fluviatile	water horsetail	native	fern	7
Eupatorium perfoliatum	boneset	native	forb	4
Eutrochium maculatum	joe-pye-weed	native	forb	4
Frangula alnus	glossy buckthorn	non-native	shrub	0
Fraxinus nigra	black ash	native	tree	6
Fraxinus pennsylvanica	red ash	native	tree	2
Gentianopsis virgata	small fringed gentian	native	forb	8
Geum rivale	purple avens	native	forb	7
Glyceria striata	fowl manna grass	native	grass	4
Larix laricina	tamarack	native	tree	5
Lysimachia thyrsiflora	tufted loosestrife	native	forb	6
Maianthemum stellatum	starry false solomon-seal	native	forb	5
Mentha canadensis	wild mint	native	forb	3
Onoclea sensibilis	sensitive fern	native	fern	2
Rubus pubescens	dwarf raspberry	native	shrub	4
Rumex orbiculatus	great water dock	native	forb	9
Salix discolor	pussy willow	native	shrub	1
Scirpus cyperinus	wool-grass	native	sedge	5
Scutellaria galericulata	marsh skullcap	native	forb	5
Sium suave	water-parsnip	native	forb	5
Symphyotrichum lateriflorum	calico aster	native	forb	2
Symphyotrichum puniceum	swamp aster	native	forb	5
Typha angustifolia	narrow-leaved cat-tail	non-native	forb	0
Typha x glauca	hybrid cat-tail	non-native	forb	0

FQA Metrics	Species Richness	Mean C Value	FQI
Native	27	4.7	24.4
All Species	30	4.2	23.0

Meander Species List - Northern Wet Meadow

Scientific Name	Common Name	Native	Physiognomy	Coefficient of Conservatism
Alnus incana	speckled alder	native	shrub	5
Anemone canadensis	canada anemone	native	forb	4
Bromus ciliatus	fringed brome	native	grass	6
Calamagrostis canadensis	blue-joint	native	grass	3
Caltha palustris	marsh-marigold	native	forb	6
Campanula aparinoides	marsh bellflower	native	forb	7
Carex cryptolepis	sedge	native	sedge	8
Carex hystericina	sedge	native	sedge	2
Carex lasiocarpa	sedge	native	sedge	8
Cirsium arvense	canada thistle	non-native	forb	0
Cirsium muticum	swamp thistle	native	forb	6
Comarum palustre	marsh cinquefoil	native	forb	7
Cornus sericea	red-osier	native	shrub	2
Crataegus phaenopyrum	washington thorn	non-native	tree	0
Dasiphora fruticosa	shrubby cinquefoil	native	shrub	8
Eupatorium perfoliatum	boneset	native	forb	4
Euthamia graminifolia	grass-leaved goldenrod	native	forb	3
Eutrochium maculatum	joe-pye-weed	native	forb	4
Fragaria virginiana	wild strawberry	native	forb	2
Geum rivale	purple avens	native	forb	7
Iris versicolor	wild blue flag	native	forb	5
Juncus articulatus	jointed rush	native	rush	3
Juncus balticus	rush	native	rush	4
Larix laricina	tamarack	native	tree	5
Lathyrus palustris	marsh pea	native	vine	7
Lilium philadelphicum	wood lily	native	forb	7
Liparis loeselii	loesels twayblade	native	forb	5
Lobelia kalmii	bog lobelia	native	forb	10
Lysimachia thyrsiflora	tufted loosestrife	native	forb	6
Parnassia glauca	grass-of-parnassus	native	forb	8
Persicaria amphibia	water smartweed	native	forb	6
Phalaris arundinacea	reed canary grass	native	grass	0
Phragmites australis var. americanus	reed	native	grass	5
Populus balsamifera	balsam poplar	native	tree	2
Potentilla anserina	silverweed	native	forb	5
Prunella vulgaris	self-heal	native	forb	0
Rhododendron groenlandicum	labrador-tea	native	shrub	8
Salix bebbiana	bebbs willow	native	shrub	1
Salix candida	hoary willow	native	shrub	9
Salix lucida	shining willow	native	shrub	3
Sanicula marilandica	black snakeroot	native	forb	4
Schoenoplectus acutus	hardstem bulrush	native	sedge	5
Schoenoplectus pungens	threesquare	native	sedge	5
Scirpus atrovirens	bulrush	native	sedge	3
Scirpus cyperinus	wool-grass	native	sedge	5
Shepherdia canadensis	soapberry	native	shrub	7
Sium suave	water-parsnip	native	forb	5
Solanum dulcamara	bittersweet nightshade	non-native	vine	0
Solidago canadensis	canada goldenrod	native	forb	1
Solidago ohioensis	ohio goldenrod	native	forb	8
Solidago rugosa	rough-leaved goldenrod	native	forb	3
Solidago uliginosa	bog goldenrod	native	forb	4
Symphyotrichum puniceum	swamp aster	native	forb	5
Thelypteris palustris	marsh fern	native	fern	2
Thuja occidentalis	arbor vitae	native	tree	4
Triantha glutinosa	false asphodel	native	forb	10
Typha x glauca	hybrid cat-tail	non-native	forb	0

FQA Metrics	Species Richness	Mean C Value	FQI
Native	53	4.9	35.7
All Species	57	4.6	34.7

Meander Species List - Rich Conifer Swamp (including swale component of Wooded Dune & Swale)

Scientific Name	Common Name	Native	Physiognomy	Coefficient of Conservatism	Cover Class
Abies balsamea	balsam fir	native	tree	3	1
Acer pensylvanicum	striped maple	native	tree	5	1
Acer rubrum	red maple	native	tree	1	1
Acer spicatum	mountain maple	native	tree	5	1
Alnus incana	speckled alder	native	shrub	5	2
Anemone canadensis	canada anemone	native	forb	4	1
Aralia nudicaulis	wild sarsaparilla	native	forb	5	3
Arisaema triphyllum	jack-in-the-pulpit	native	forb	5	1
Athyrium filix-femina	lady fern	native	fern	4	1
Betula papyrifera	paper birch	native	tree	2	1
Bidens cernua	nodding beggar-ticks	native	forb	3	1
Bromus ciliatus	fringed brome	native	grass	6	1
Caltha palustris	marsh-marigold	native	forb	6	1
Cardamine pensylvanica	pennsylvania bitter cress	native	forb	1	1
Carex aurea	sedge	native	sedge	3	1
Carex buxbaumii	sedge	native	sedge	10	1
Carex disperma	sedge	native	sedge	10	1
Carex intumescens	sedge	native	sedge	3	1
Cicuta bulbifera	water hemlock	native	forb	5	1
Cinna latifolia	wood reedgrass	native	grass	5	1
Clintonia borealis	bluebead-lily; corn-lily	native	forb	5	1
Cornus canadensis	bunchberry	native	shrub	6	1
Cornus rugosa	round-leaved dogwood	native	shrub	6	1
Cornus sericea	red-osier	native	shrub	2	2
Cystopteris bulbifera	bulblet fern	native	fern	5	2
Dryopteris carthusiana	spinulose woodfern	native	fern	5	2
Dryopteris intermedia	evergreen woodfern	native	fern	5	1
Epilobium ciliatum	willow-herb	native	forb	3	1
Epilobium leptophyllum	fen willow-herb	native	forb	6	1
Epipactis helleborine	helleborine	non-native	forb	0	1
Equisetum arvense	common horsetail	native	fern	0	2
Equisetum fluviatile	water horsetail	native	fern	7	1
Equisetum palustre	marsh horsetail	native	fern	8	1
Eupatorium perfoliatum	boneset	native	forb	4	1
Eutrochium maculatum	joe-pye-weed	native	forb	4	3
Fragaria virginiana	wild strawberry	native	forb	2	1
Frangula alnus	glossy buckthorn	non-native	shrub	0	1
Fraxinus nigra	black ash	native	tree	6	1
Fraxinus pennsylvanica	red ash	native	tree	2	1
Galium trifidum	small bedstraw	native	forb	6	1
Gaultheria hispidula	creeping-snowberry	native	shrub	8	1
Geum rivale	purple avens	native	forb	7	1
Glyceria striata	fowl manna grass	native	grass	4	2
Gymnocarpium dryopteris	oak fern	native	fern	5	1
Hierochloe hirta	sweet grass	native	grass	9	1
Impatiens capensis	spotted touch-me-not	native	forb	2	1
Larix laricina	tamarack	native	tree	5	1
Linnaea borealis	twinflower	native	forb	6	3
Lycopus uniflorus	northern bugle weed	native	forb	2	1
Maianthemum stellatum	starry false solomon-seal	native	forb	5	1
Maianthemum trifolium	false mayflower	native	forb	10	1
Matteuccia struthiopteris	ostrich fern	native	fern	3	1
Mentha canadensis	wild mint	native	forb	3	1
Mitella nuda	naked miterwort	native	forb	8	1
Monotropa uniflora	indian-pipe	native	forb	5	2
Mycelis muralis	wall lettuce	non-native	forb	0	1
Orthilia secunda	one-sided pyrola	native	forb	7	1
Petasites frigidus	sweet-coltsfoot	native	forb	10	1
Picea glauca	white spruce	native	tree	3	1
Picea mariana	black spruce	native	tree	6	1

Meander Species List - Rich Conifer Swamp (including swale component of Wooded Dune & Swale)

Scientific Name	Common Name	Native	Physiognomy	Coefficient of Conservatism	Cover Class
Populus balsamifera	balsam poplar	native	tree	2	1
Ranunculus recurvatus	hooked crowfoot	native	forb	5	1
Rhododendron groenlandicum	labrador-tea	native	shrub	8	1
Ribes hirtellum	swamp gooseberry	native	shrub	6	1
Ribes triste	swamp red currant	native	shrub	6	1
Rubus pubescens	dwarf raspberry	native	shrub	4	1
Salix bebbiana	bebbs willow	native	shrub	1	1
Scutellaria galericulata	marsh skullcap	native	forb	5	1
Scutellaria lateriflora	mad-dog skullcap	native	forb	5	1
Solanum dulcamara	bittersweet nightshade	non-native	vine	0	2
Solidago rugosa	rough-leaved goldenrod	native	forb	3	1
Symphyotrichum lanceolatum	panicled aster	native	forb	2	1
Symphyotrichum lateriflorum	calico aster	native	forb	2	1
Taxus canadensis	yew	native	shrub	5	1
Thalictrum dasycarpum	purple meadow-rue	native	forb	3	1
Thelypteris palustris	marsh fern	native	fern	2	1
Thuja occidentalis	arbor vitae	native	tree	4	2
Trientalis borealis	star-flower	native	forb	5	1
Veronica beccabunga var. americana	american brooklime	native	forb	10	1
Veronica officinalis	common speedwell	non-native	forb	0	1

FQA Metrics	Species Richness	Mean C Value	FQI
Native	75	4.8	46.5
All Species	80	4.5	41.6

Meander Species List - Sand and Gravel Beach

Scientific Name	Common Name	Native	Physiognomy	Coefficient of Conservatism
Ammophila breviligulata	marram grass	native	grass	10
Arabidopsis lyrata	sand cress	native	forb	7
Arctostaphylos uva-ursi	bearberry	native	shrub	8
Artemisia campestris	wormwood	native	forb	5
Asclepias syriaca	common milkweed	native	forb	1
Centaurea stoebe	spotted knapweed	non-native	forb	0
Comandra umbellata	bastard-toadflax	native	forb	5
Coreopsis lanceolata	sand coreopsis	native	forb	8
Elymus lanceolatus	wheat grass	native	grass	10
Equisetum arvense	common horsetail	native	fern	0
Equisetum variegatum	variegated scouring rush	native	fern	6
Fragaria virginiana	wild strawberry	native	forb	2
Juniperus horizontalis	creeping juniper	native	shrub	10
Lathyrus japonicus	beach pea	native	vine	10
Maianthemum stellatum	starry false solomon-seal	native	forb	5
Picea glauca	white spruce	native	tree	3
Pinus strobus	white pine	native	tree	3
Poa compressa	canada bluegrass	non-native	grass	0
Prunus pumila	sand cherry	native	shrub	8
Rudbeckia hirta	black-eyed susan	native	forb	1
Schizachyrium scoparium	little bluestem	native	grass	5
Shepherdia canadensis	soapberry	native	shrub	7
Silene vulgaris	bladder campion	non-native	forb	0
Solidago houghtonii	houghtons goldenrod	native	forb	10
Solidago ohioensis	ohio goldenrod	native	forb	8
Solidago simplex	gillmans goldenrod	native	forb	10

FQA Metrics	Species Richness	Mean C Value	FQI
Native	23	6.2	29.7
All Species	26	5.5	28.0

Meander Species List - Upland Meadow

Scientific Name	Common Name	Native	Physiognomy	Coefficient of Conservatism
Achillea millefolium	yarrow	native	forb	1
Agrostis gigantea	redtop	non-native	grass	0
Anaphalis margaritacea	pearly everlasting	native	forb	3
Anemone cylindrica	thimbleweed	native	forb	6
Arctostaphylos uva-ursi	bearberry	native	shrub	8
Bromus inermis	smooth brome	non-native	grass	0
Centaurea cyanus	bachelors-button	non-native	forb	0
Centaurea stoebe	spotted knapweed	non-native	forb	0
Clinopodium vulgare	wild-basil	native	forb	3
Comandra umbellata	bastard-toadflax	native	forb	5
Coreopsis lanceolata	sand coreopsis	native	forb	8
Dactylis glomerata	orchard grass	non-native	grass	0
Danthonia spicata	poverty grass; oatgrass	native	grass	4
Daucus carota	queen-annes-lace	non-native	forb	0
Fragaria virginiana	wild strawberry	native	forb	2
Hypericum perforatum	common st. johns-wort	non-native	forb	0
Juniperus communis	common or ground juniper	native	shrub	4
Juniperus horizontalis	creeping juniper	native	shrub	10
Lotus corniculatus	birdfoot trefoil	non-native	forb	0
Monarda fistulosa	wild-bergamot	native	forb	2
Origanum vulgare	wild-marjoram	non-native	forb	0
Pastinaca sativa	wild parsnip	non-native	forb	0
Poa pratensis	kentucky bluegrass	non-native	grass	0
Populus alba	white poplar	non-native	tree	0
Poterium sanguisorba	garden or salad burnet	non-native	forb	0
Prunella vulgaris	self-heal	native	forb	0
Prunus virginiana	choke cherry	native	shrub	2
Rudbeckia hirta	black-eyed susan	native	forb	1
Securigera varia	crown-vetch	non-native	forb	0
Shepherdia canadensis	soapberry	native	shrub	7
Solidago canadensis	canada goldenrod	native	forb	1
Solidago nemoralis	old-field goldenrod	native	forb	2
Symphyotrichum lanceolatum	panicled aster	native	forb	2
Symphyotrichum oolentangiense	prairie heart-leaved aster	native	forb	4
Taenidia integerrima	yellow-pimpernel	native	forb	8
Thuja occidentalis	arbor vitae	native	tree	4
Toxicodendron rydbergii	poison-ivy	native	shrub	3

FQA Metrics	Species Richness	Mean C Value	FQI
Native	23	3.9	18.7
All Species	37	2.4	14.6

Meander Species List - Upland Meadow - degraded

Scientific Name	Common Name	Native	Physiognomy	Coefficient of Conservatism
Achillea millefolium	yarrow	native	forb	1
Agrostis gigantea	redtop	non-native	grass	0
Asclepias syriaca	common milkweed	native	forb	1
Berteroa incana	hoary alyssum	non-native	forb	0
Bromus inermis	smooth brome	non-native	grass	0
Centaurea stoebe	spotted knapweed	non-native	forb	0
Datura stramonium	jimson-weed	non-native	forb	0
Daucus carota	queen-annes-lace	non-native	forb	0
Fragaria virginiana	wild strawberry	native	forb	2
Hypericum perforatum	common st. johns-wort	non-native	forb	0
Origanum vulgare	wild-marjoram	non-native	forb	0
Pastinaca sativa	wild parsnip	non-native	forb	0
Phleum pratense	timothy	non-native	grass	0
Prunella vulgaris	self-heal	native	forb	0
Scleranthus annuus	knawel	non-native	forb	0
Silene vulgaris	bladder campion	non-native	forb	0
Symphyotrichum ciliolatum	northern heart-leaved aster	native	forb	4
Symphyotrichum lanceolatum	panicled aster	native	forb	2
Taraxacum officinale	common dandelion	non-native	forb	0
Trifolium pratense	red clover	non-native	forb	0

FQA Metrics	Species Richness	Mean C Value	FQI
Native	6	1.7	4.2
All Species	20	0.5	2.2

Appendix B NATURAL COMMUNITY PHOTOS

Photo 1. Boreal Forest, North AOI

Photo 2. Boreal Forest (degraded), South AOI

Photo 3. Coastal Fen

Photo 4. Limestone Bedrock Glade

Photo 5. Limestone Cobble Shore

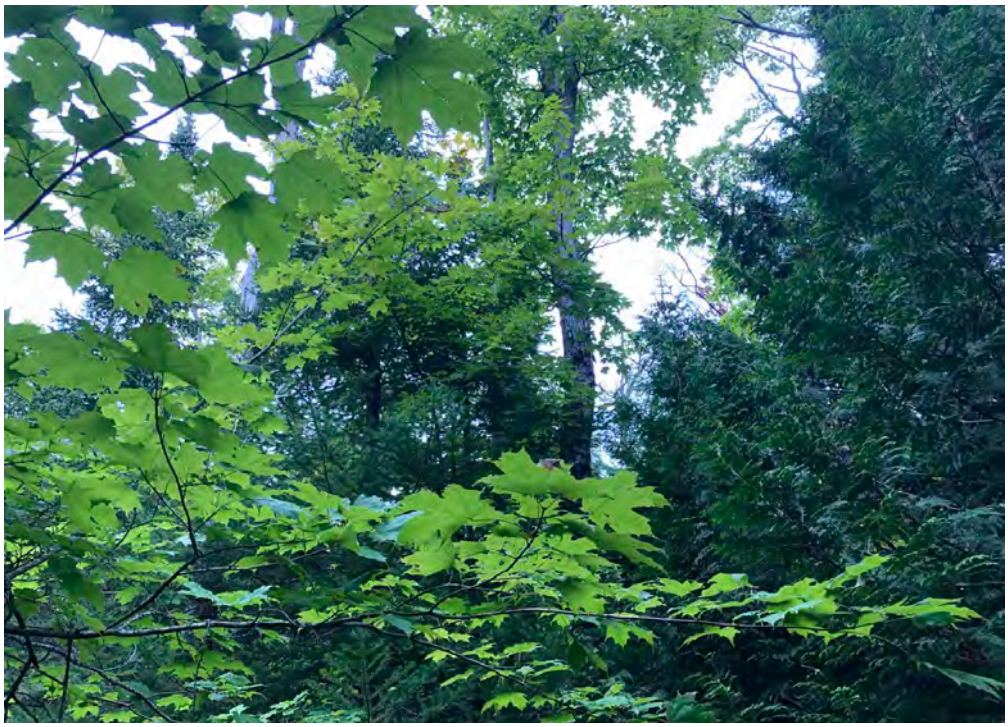

Photo 6. Mesic Northern Forest

Photo 7. Mesic Northern Forest (degraded)

Photo 8. Northern Shrub Thicket

Photo 9. Northern Wet Meadow

Photo 10. Rich Conifer Swamp

Photo 11. Sand and Gravel Beach

Photo 12. Wooded Dune and Swale Complex

Photo 13. Upland Meadow

Photo 14. Upland Meadow (degraded)

Appendix C RARE PLANT SPECIES PHOTOS

Photo 1. Dwarf lake iris, flower, June 18, 2019

Photo 2. Dwarf lake iris, leaves yellow-green, Aug. 28, 2019

Photo 3. Houghton's goldenrod, Aug. 28, 2019

Photo 4. Houghton's goldenrod, closeup, Aug. 27, 2019

Stantec Consulting Services Inc.
209 Commerce Parkway, PO Box 128, Cottage Grove WI 53527-8955

June 15, 2020
File: 193705885

Attention: Paul Turner
Enbridge Energy, Limited Partnership
26 East Superior Street, Suite 309
Duluth, MN 55802

Reference: Enbridge Great Lakes Tunnel Project, Rare Plants and Natural Communities Report, 2020 Survey Area

Mr. Turner,

Stantec Consulting Services Inc. (Stantec) conducted a rare plant survey, assessed habitat suitability for state- and federally-listed species, and characterized and mapped natural community types within an approximately 6.3-acre site (the "2020 Survey Area") on behalf of Enbridge Energy, Limited Partnership (Enbridge). The 2020 Survey Area consists of seven polygons in the vicinity of Enbridge's Mackinaw Station, south of the Straits of Mackinac, in Wawatam Township, Emmet County, Michigan (Attachment A—Figure 1). The field investigation was conducted by Larissa Mottl of Stantec, on May 27, 2020. This field investigation was performed in order to identify occurrences of, and characterize potential habitats for, state- and federally-listed plant species within portions of the Limits of Disturbance of the Great Lakes Tunnel Project that were not included in the previous survey area for rare plants and natural communities conducted by Stantec. This letter report comprises an addendum to Stantec's "Rare Plants and Natural Communities Report – Line 5 Replacement and Tunnel Project," dated October 22, 2019.

There were no state- or federally-listed plant species identified within the 2020 Survey Area. A summary of the methods and results of the field investigation are provided below.

Methods

Natural communities were identified and characterized using a pedestrian meander survey methodology. Communities were classified according to the Michigan Natural Features Inventory (MNFI) classification system, using the characteristics described in *A Field Guide to the Natural Communities of Michigan* (Cohen et al. 2015). The distribution and approximate extent of natural communities within the 2020 Survey Area were sketched onto maps in the field and were later digitized in Geographical Information System (GIS) software. The natural community types were mapped based on the plant composition and community structure observed in the field at the time of the survey. Species lists for each natural community were compiled and Floristic Quality Index was computed using the Michigan Floristic Quality Assessment (FQA) Database (Reznicek et al. 2014). The structure and composition of some communities within the survey area have been substantially altered from their natural condition. These areas have been modified by clearing of woody canopy species, soil disturbance, regular vegetation maintenance, ornamental plantings, and/or introduction and spread of weedy and non- native or invasive species. In these areas, vegetation structure and/or plant species composition have shifted away from natural community types recognized by MNFI and were therefore classified as degraded land cover types or developed areas.

Meander surveys for state- and federally-listed plant species were conducted throughout the 2020 Survey Area. If observed, occurrences of listed plant species were to be photographed, and the location and extent of listed plant populations recorded with a Global Positioning System (GPS) capable of sub-meter accuracy and mapped using GIS.

Results

The 2020 Survey Area is comprised of a mix of forested land cover, maintained transmission line corridors, and developed areas. Natural communities and other land cover types were identified, and their approximate extent was mapped within the 2020 Survey Area (Attachment A—Figure 2). Plant species lists recorded for each community during the 2020 field investigation are included in Attachment B. Representative photos of each community and land cover type are included in Attachment C.

No state- or federally-listed plant species were observed during the 2020 field investigation. Discussions of potential habitat suitability for listed plant species are included within the natural community descriptions below.

Natural Communities: Mesic Northern Forest

The predominant natural community type observed within the 2020 Survey Area is Mesic Northern Forest, which includes areas of degraded and modified early-successional forest, with a mix of native and non-native species, and boreal forest elements within steep, north-facing slopes over shallow dolomite. Mesic Northern Forest is a deciduous or mixed conifer-deciduous upland forest found across northern Michigan, with typical canopy dominants including sugar maple (Acer saccharum) and American beech (*Fagus grandifolia*) (Cohen et al. 2015). Overall, the Mesic Northern Forest communities within the 2020 Survey Area consist of small, fragmented woodlots, adjacent to residential lots with mowed turfgrass, maintained transmission line corridors, roads, and upland meadow areas. As a result of close proximity to these developed and modified areas, the Mesic Northern Forest community is subject to ongoing disturbance and degradation. Canopy species observed onsite include sugar maple, American beech, basswood (*Tilia americana*), paper birch (*Betula papyrifera*), balsam fir (*Abies balsamea*), and northern white-cedar (*Thuja occidentalis*). Groundlayer species included starry false Solomons seal (*Maianthemum stellatum*), Kentucky bluegrass (*Poa pratensis*), yellow trout lily (*Erythronium americanum*), large-flowered trillium (*Trillium grandiflorum*), and wild-basil (*Clinopodium vulgare*). The Mesic Northern Forest community type has been identified by MNFI as a potentially suitable habitat for dwarf lake iris, pine-drops, and hart's tongue fern; however, none of these listed species were identified during the 2020 field investigation, or during the 2019 survey of adjacent habitats with similar composition. Due to the degraded and fragmented character of the habitat, it is unlikely that any of these listed species are present within the Mesic Northern Forest identified within the 2020 Survey Area.

Other Land Cover Types: Upland Meadow, Developed Areas

Upland meadow areas occurring within the 2020 Survey Area consist of infrequently mowed/maintained electrical transmission line corridor, and a narrow strip adjacent to an electrical substation. These upland meadow areas are composed of a mix of native and non-native forbs and graminoids, with scattered shrub and tree saplings. Without ongoing maintenance these areas would likely succeed into forest.

While upland meadow is not recognized as a natural community type, this land cover type is widespread throughout northern Michigan and is found in maintained roadside, transmission line, and pipeline corridors, old fields, pastures, and other modified sites. As a result of ongoing disturbance and/or maintenance, and the degraded quality of the habitats, it is unlikely that any listed species are present within the upland meadow land cover type within the 2020 Survey Area.

Developed areas within the 2020 Survey Area consist of gravel and paved driveways and roads, mowed turfgrass, and residential lots. These areas are characterized by a lack of natural vegetation and are comprised of planted ornamental species and unvegetated areas. No state- or federally-listed plant species were observed within the upland meadow or developed portions of the 2020 Survey Area.

Based on the results of the 2020 field investigation, no state- or federally-listed plant species were observed within the 2020 Survey Area. Consistent with the findings of the 2019 investigation of adjacent areas, the natural communities and other land cover types present within the 2020 Survey Area have been subject to past and ongoing disturbance and fragmentation, and it appears unlikely that any Threatened or Endangered plant species occur within the 2020 Survey Area.

Regards,

Stantec Consulting Services Inc.

Joshua Sulman PWS
Environmental Scientist

Direct: 608 839-2003
Mobile: 608 469-8096
Joshua.Sulman@stantec.com

Stantec
209 Commerce Parkway, PO Box 128
Cottage Grove WI 53527-8955

Attachments: Attachment A – Figures 1-2
Attachment B – Plant Community Species Lists
Attachment C – Site Photographs

June 15, 2020

ATTACHMENT A - FIGURES

Figure No.
1

Title
2020 Survey Area
South Shore

Client/Project
Enbridge Great Lakes Tunnel Project
2020 Survey Area
Rare Plants & Natural Communities Report

Project Location
Emmet County, Michigan

193705885
Prepared by JM on 2020-06-11
Technical Review by SC on 2020-06-11
Independent Review by JS on 2020-06-12

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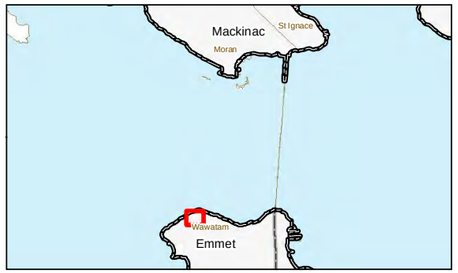
N

Legend
2020 Survey Area



Notes
1. Coordinate System: NAD 1983 UTM Zone 16N
2. Data Sources Include: Stantec, Enbridge, USGS, NADS
3. Orthophotography: 2018 NAIP

Stantec

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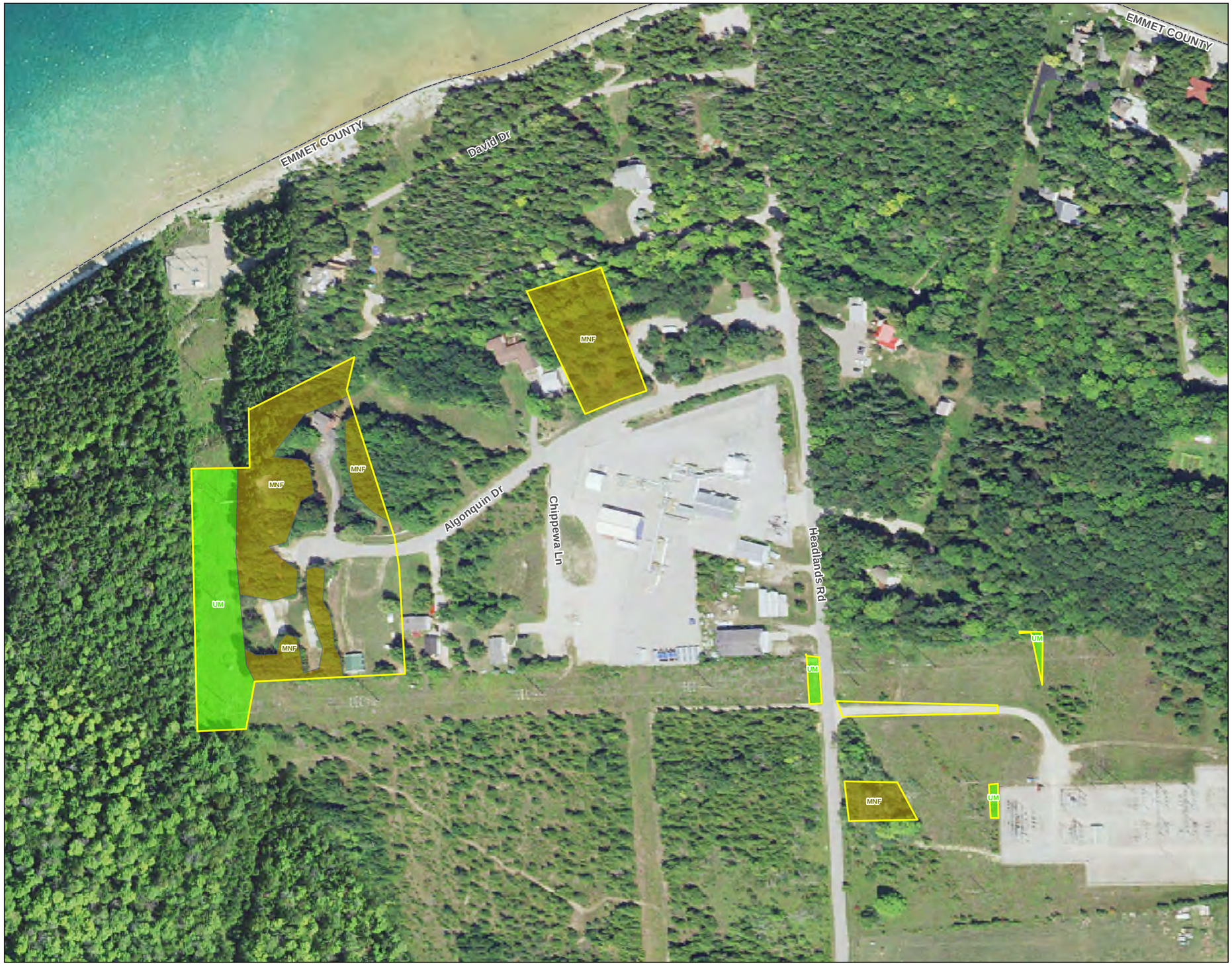

Figure No.
2

Title
Natural Communities
South Shore

Client/Project
Enbridge Great Lakes Tunnel Project
2020 Survey Area
Rare Plants & Natural Communities Report

Project Location
Emmet County, Michigan

193705885
Prepared by JM on 2020-06-11
Technical Review by SC on 2020-06-11
Independent Review by JS on 2020-06-12

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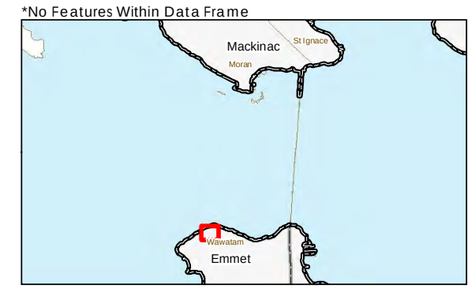
1:2,400 (At original document size of 11x17)

N

Legend
2020 Survey Area
Community Type
Mesic Northern Forest - MNF
Upland Meadow - UM

*All other areas in 2020 Survey Area: Developed

*No Features Within Data Frame



Notes
1. Coordinate System: NAD 1983 UTM Zone 16N
2. Data Sources Include: Stantec, Enbridge, USGS, NADS
3. Orthophotography: 2018 NAIP

Stantec

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June 15, 2020

ATTACHMENT B – PLANT COMMUNITY SPECIES LISTS

Great Lakes Tunnel Project - 2020 Survey Area
Rare Plants and Natural Communities Report

Meander Species List - Northern Mesic Forest

Scientific Name	Common Name	Native	Physiognomy	Coefficient of Conservatism
Abies balsamea	balsam fir	native	tree	3
Acer saccharum	sugar maple	native	tree	5
Achillea millefolium	yarrow	native	forb	1
Actaea rubra	red baneberry	native	forb	7
Allium tricoccum	wild leek	native	forb	5
Amelanchier interior	serviceberry	native	shrub	4
Anemone virginiana	thimbleweed	native	forb	3
Antennaria howellii	small pussytoes	native	forb	2
Aquilegia canadensis	wild columbine	native	forb	5
Aralia nudicaulis	wild sarsaparilla	native	forb	5
Arctostaphylos uva-ursi	bearberry	native	shrub	8
Berberis thunbergii	japanese barberry	non-native	shrub	0
Betula papyrifera	paper birch	native	tree	2
Bromus inermis	smooth brome	non-native	grass	0
Cardamine diphylla; dentaria d.	two-leaved toothwort	native	forb	5
Carex eburnea	sedge	native	sedge	7
Carpinus caroliniana	blue-beech	native	tree	6
Clinopodium vulgare	wild-basil	native	forb	3
Comandra umbellata	bastard-toadflax	native	forb	5
Convallaria majalis	lily-of-the-valley	non-native	forb	0
Cornus sericea; c. stolonifera	red-osier	native	shrub	2
Corylus cornuta	beaked hazelnut	native	shrub	5
Cypripedium parviflorum; c. calceolus	yellow lady-slipper	native	forb	5
Dactylis glomerata	orchard grass	non-native	grass	0
Dirca palustris	leatherwood	native	shrub	8
Erythronium americanum	yellow trout lily	native	forb	5
Fagus grandifolia	american beech	native	tree	6
Fragaria virginiana	wild strawberry	native	forb	2
Fraxinus pennsylvanica	red ash	native	tree	2
Hepatica acutiloba	sharp-lobed hepatica	native	forb	8
Hypericum perforatum	common st. johns-wort	non-native	forb	0
Juniperus communis	common or ground juniper	native	shrub	4
Juniperus horizontalis	creeping juniper	native	shrub	10
Linaria vulgaris	butter-and-eggs	non-native	forb	0
Maianthemum canadense	canada mayflower	native	forb	4
Maianthemum racemosum; smilacina r	false spikenard	native	forb	5
Maianthemum stellatum; smilacina s.	starry false solomon-seal	native	forb	5
Myosotis stricta	small-flowered forget-me-not	non-native	forb	0
Ostrya virginiana	ironwood; hop-hornbeam	native	tree	5
Pastinaca sativa	wild parsnip	non-native	forb	0
Phalaris arundinacea	reed canary grass	native	grass	0
Picea glauca	white spruce	native	tree	3
Picea pungens	blue spruce	non-native	tree	0
Pinus resinosa	red pine	native	tree	6
Pinus strobus	white pine	native	tree	3
Poa pratensis	kentucky bluegrass	non-native	grass	0
Polygonatum pubescens	downy solomon seal	native	forb	5
Populus alba	white poplar	non-native	tree	0
Populus grandidentata	big-tooth aspen	native	tree	4
Prunus virginiana	choke cherry	native	shrub	2
Ranunculus recurvatus	hooked crowfoot	native	forb	5
Rubus strigosus	wild red raspberry	native	shrub	2
Rudbeckia hirta	black-eyed susan	native	forb	1
Scrophularia lanceolata	early figwort	native	forb	5
Shepherdia canadensis	soapberry	native	shrub	7
Silene csereii	glaucous campion	non-native	forb	0
Solidago canadensis	canada goldenrod	native	forb	1
Symphyotrichum urophyllum; aster sag	arrow-leaved aster	native	forb	2
Taraxacum officinale	common dandelion	non-native	forb	0

Meander Species List - Northern Mesic Forest

Scientific Name	Common Name	Native	Physiognomy	Coefficient of Conservatism
Taxus canadensis	yew	native	shrub	5
Thuja occidentalis	arbor vitae	native	tree	4
Tilia americana	basswood	native	tree	5
Toxicodendron radicans	poison-ivy	native	vine	2
Trientalis borealis	star-flower	native	forb	5
Trillium grandiflorum	common trillium	native	forb	5
Viburnum trilobum; v. opulus	american highbush-cranberry	native	shrub	5
Viola pubescens	yellow violet	native	forb	4

FQA Metrics	Species Richness	Mean C Value	FQI
Native	54	4.3	31.6
All Species	67	3.5	28.6

Meander Species List - Upland Meadow

Scientific Name	Common Name	Native	Physiognomy	Coefficient of Conservatism
Abies balsamea	balsam fir	native	tree	3
Acer saccharum	sugar maple	native	tree	5
Achillea millefolium	yarrow	native	forb	1
Allium tricoccum	wild leek	native	forb	5
Amelanchier interior	serviceberry	native	shrub	4
Anemone virginiana	thimbleweed	native	forb	3
Aquilegia canadensis	wild columbine	native	forb	5
Aralia nudicaulis	wild sarsaparilla	native	forb	5
Berberis vulgaris	common barberry	non-native	shrub	0
Bromus inermis	smooth brome	non-native	grass	0
Carex eburnea	sedge	native	sedge	7
Carex umbellata	sedge	native	sedge	5
Centaurea stoebe	spotted knapweed	non-native	forb	0
Cerastium fontanum	mouse-ear chickweed	non-native	forb	0
Cichorium intybus	chicory	non-native	forb	0
Clinopodium vulgare	wild-basil	native	forb	3
Comandra umbellata	bastard-toadflax	native	forb	5
Cornus sericea	red-osier	native	shrub	2
Cypripedium parviflorum	yellow lady-slipper	native	forb	5
Dactylis glomerata	orchard grass	non-native	grass	0
Erigeron annuus	daisy fleabane	native	forb	0
Eurybia macrophylla	big-leaved aster	native	forb	4
Fragaria virginiana	wild strawberry	native	forb	2
Hypericum punctatum	spotted st. johns-wort	native	forb	4
Juniperus communis	common or ground juniper	native	shrub	4
Leucanthemum vulgare	ox-eye daisy	non-native	forb	0
Lilium philadelphicum	wood lily	native	forb	7
Lithospermum officinale	gromwell	non-native	forb	0
Maianthemum racemosum	false spikenard	native	forb	5
Maianthemum stellatum	starry false solomon-seal	native	forb	5
Medicago sativa	alfalfa	non-native	forb	0
Pastinaca sativa	wild parsnip	non-native	forb	0
Picea glauca	white spruce	native	tree	3
Plantago lanceolata	english plantain	non-native	forb	0
Poa pratensis	kentucky bluegrass	non-native	grass	0
Poterium sanguisorba	garden or salad burnet	non-native	forb	0
Prunus virginiana	choke cherry	native	shrub	2
Rosa acicularis	wild rose	native	shrub	4
Rubus strigosus	wild red raspberry	native	shrub	2
Rudbeckia hirta	black-eyed susan	native	forb	1
Sceptridium rugulosum	ternate grape-fern	native	fern	6
Silene csereii	glaucous campion	non-native	forb	0
Solidago canadensis	canada goldenrod	native	forb	1
Symphyotrichum urophyllum	arrow-leaved aster	native	forb	2
Taenidia integerrima	yellow-pimpernel	native	forb	8
Taraxacum officinale	common dandelion	non-native	forb	0
Thuja occidentalis	arbor vitae	native	tree	4
Toxicodendron radicans	poison-ivy	native	vine	2
Trifolium pratense	red clover	non-native	forb	0

FQA Metrics	Species Richness	Mean C Value	FQI
Native	33	3.8	21.8
All Species	49	2.5	17.5

June 15, 2020

ATTACHMENT C – SITE PHOTOGRAPHS

Photo 1. Upland Meadow in powerline corridor, starry false Solomons seal dominant.

Photo 2. Upland Meadow, common juniper and smooth brome dominant.

Photo 3. Mesic Northern Forest, northern white-cedar canopy.

Photo 4. Mesic Northern Forest, sugar maple canopy.

Photo 5. Mesic Northern Forest on steep, north-facing slope, balsam fir canopy.

Photo 6. Early-successional Mesic Northern Forest, mixed hardwoods and conifers.

Photo 7. Developed residential property, with ornamentals and mowed turfgrass.

Photo 8. Developed gravel access road and mowed/maintained shoulder.

APPENDIX F

Plant Mitigation Plan

Revised Plant Mitigation Plan

Great Lakes Tunnel Project

July 2021

Table of Contents

LIST OF TABLES

FIGURES

ACRYONYMS

ATV	All-terrain vehicle
BA	Biological Assessment
DLI	Dwarf lake iris
EGLE	Michigan Department of Environment, Great Lakes, and Energy
GIS	Geographic Information System
GPS	Global Positioning System
HG	Houghton's goldenrod
LOD	Limits of disturbance
MDNR	Michigan Department of Natural Resources-Wildlife Division
MDOT	Michigan Department of Transportation
MNFI	Michigan Natural Features Inventory
ROW	Right-of-way
USACE	U.S. Army Corps of Engineers
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service

1.0 INTRODUCTION AND PROJECT PURPOSE

This Revised Plant Mitigation Plan has been prepared by Enbridge Energy, Limited Partnership (Enbridge) to address comments received from the U.S. Army Corps of Engineers (USACE) dated August 19, 2020 and USACE and the U.S. Fish and Wildlife Service (USFWS) on January 26, 2021 concerning anticipated impacts to two state- and federally listed threatened plant species, dwarf lake iris (*Iris lacustris*) (DLI) and Houghton's goldenrod (*Solidago houghtonii*) (HG), during construction of the Great Lakes Tunnel Project (the Project) at Enbridge's North Straits Facility. The facility is located in Township 40N, Range 4W, Section 24, Mackinac County, Michigan, near the north shore of the Straits of Mackinac, at Point La Barbe (Figure 1).

The proposed Project involves replacing Enbridge's existing Line 5 dual 20-inch-diameter pipelines (Dual Pipelines) that cross the Straits of Mackinac (Straits) with a single, 30-inch-diameter pipeline. The replacement pipeline would be installed and located entirely underground in a tunnel beneath the lakebed of the Straits. The replacement pipeline would be connected to the existing 30-inch pipeline on both sides of the Straits.

Through project design considerations, impacts to rare species and other regulated and protected resources have been avoided and minimized to the extent practicable. However, impacts to DLI and HG are anticipated to result from construction activities within the limits of disturbance (LOD). The construction and ongoing operation of the Project will require vegetation removal within the Project's north side LOD. Access to the north side LOD will utilize Boulevard Drive (Figure 1). Segments of the unpaved portions of Boulevard Drive will need to be improved or widened to accommodate construction traffic. To minimize potential impacts to the shoreline of Lake Michigan, widening/improvements will take place on the landward side (north and west) of the road.

To minimize the extent of impacts to natural resources, Enbridge has sited the LOD directly adjacent to the existing North Straits Station. Enbridge has located the north side LOD at least 50 feet from the shoreline of Lake Michigan, with the exceptions of vehicle entranceways off the existing Boulevard Drive and two water discharge structures (Figure 1).

2.0 BACKGROUND INFORMATION

A plant mitigation plan was developed to mitigate for temporary effects to DLI and HG within the north side LOD and submitted as part of the draft Biological Assessment (BA) on July 2, 2020. Enbridge proposed to relocate approximately 50 percent of the surveyed stems of each species identified within the north side LOD at the time of the 2019 rare plants and natural community surveys. In addition, DLI and HG were to be relocated within upland areas of a proposed protected species Enhancement Area on Enbridge property northwest of the LOD consisting of approximately 5.4 acres. Following completion of construction,

approximately 6.2 acres of the LOD was proposed as a Re-Vegetation Area to allow native species to naturally re-establish.

Comments received from the USACE dated August 19, 2020 requested that consideration be given to additional mitigation measures to attempt to replace the existing plant stems to the extent possible, such as consideration of additional locations that may be available to accept transplants. Additionally, USACE asked about the feasibility of using seeds and/or individual plants from nearby areas to facilitate the reestablishment of DLI and HG within suitable parts of the LOD after construction. Comments also addressed the need for specific mitigation goals, discussion narrative on the overall benefits to DLI and HG within the Enhancement Areas, recommendations for baseline conditions and/or a reference site, stem count data, transplant procedures, and the request for a monitoring plan. Additionally, comments received by the USACE and USFWS on January 21, 2021 requested additional information regarding the timeline of activities, baseline conditions, and stockpile management as well as clarification on performance standards, monitoring quadrat locations, reference sites, and adaptive and long-term management strategies. On June 10, 2021, USACE and USFWS requested clarification on site preparation, how reference sites will be used, the number of quadrats to be surveyed, and statistical methodologies for analyzing the data, in addition to revisions to success criteria.

To address USACE and USFWS comments, this Revised Plant Mitigation Plan provides additional information in Sections 3.0 through 5.0 below.

2.1 STATE THREATENED/ENDANGERED SPECIES PERMIT

The Michigan Department of Natural Resources - Wildlife Division (MDNR) regulates state-designated threatened and endangered plants on private and public lands under Part 365, Endangered Species Protection, of the Natural Resource and Environmental Protection Act 451 of 1994. A Threatened/Endangered Species Permit is required when a project will study, collect, or relocate species. As part of this Revised Plant Mitigation Plan, DLI and HG will be collected and relocated from the Project's north side LOD prior to construction site preparation. Enbridge proposes to transplant the species into appropriate habitat within proposed Protected Species Enhancement Areas (Enhancement Areas) on Enbridge property (Figure 2). Enbridge will secure a Threatened/Endangered Species Permit prior to relocating threatened plant species.

2.2 RARE PLANTS AND NATURAL COMMUNITIES SURVEY

Surveys for DLI and HG were completed by qualified Stantec botanists in June and August of 2019 and the report, Rare Plants and Natural Communities Report - Line 5 Replacement and Tunnel Project, was submitted to the Michigan Department of Environment, Great Lakes, and Energy (EGLE) on October 22, 2019 (Stantec 2019). In May of 2020, additional surveys were conducted in the vicinity of Enbridge's Mackinaw Station, south of the Straits, and the report, Enbridge Great Lakes Tunnel Project, Rare Plants and Natural Communities Report, 2020 Survey Area, was submitted as Appendix B in the draft BA on July 2, 2020 (Stantec 2020).

The surveys were conducted using a pedestrian meander survey methodology and natural communities were identified and characterized using meander field observations according to the characteristics described in *A Field Guide to the Natural Communities of Michigan* (Cohen et al. 2015). An approximate 108.8-acre area (Study Area), located in Mackinac County north of the Straits, was surveyed for DLI and HG. The Study Area included Enbridge property and pipeline right-of-way (ROW), an adjacent property to the west, and a road corridor along Boulevard Drive from Densmore Road on the east to the first residence west of Point La Barbe. The north side Study Area extent is depicted in Figure 3. DLI and HG were not identified in the vicinity of Enbridge's Mackinaw Station south of the Straits (Stantec 2020).

2.2.1 Dwarf Lake Iris

DLI has a range restricted to the northern Lake Michigan and Lake Huron shorelines of Michigan, Wisconsin, and Ontario (Voss and Reznicek 2012). DLI is widespread and locally abundant in the vicinity of the north side LOD (Figure 2). This species is found most frequently within the Limestone Bedrock Glade, Coastal Fen, and Limestone Cobble Shore communities, especially within areas of low vegetation and open canopy, or under partial shade of northern white cedar (*Thuja occidentalis*). DLI spreads by rhizomes and can form large colonies covering extensive areas within suitable habitats.

Survey Results

During the meander surveys, DLI was found in the coastal fen, limestone bedrock glade, and limestone cobble shore natural communities (Stantec 2019). DLI was also found within cleared portions of the existing pipeline and transmission line corridors, at the margins of Rich Conifer Swamp and Wooded Dune and Swale, and along the edges of roadways and developed areas, on suitable calcareous substrates. A visual estimation of the number of stems (i.e., individual plants) at each location was made. Within the north side LOD, some groups of this species were estimated to have greater than 1,000 individual plant stems (Stantec 2019). Each group was mapped in the field using a Global Positioning System (GPS) unit and the estimated number of stems was recorded at each location. Following the fieldwork, the results were tallied using Geographic Information System (GIS) attribute data to determine an approximate number of stems of DLI within the Study Area and north side LOD. Based on these methods, approximately 27,075 DLI stems were located within the Study Area. Within the north side LOD, 5,067 stems were observed, and an additional 2,690 stems were observed within the Boulevard Drive Improvements LOD (Table 1).

2.2.2 Houghton's Goldenrod

HG is found only along the northern shorelines of Lakes Michigan and Huron and is almost entirely restricted to Michigan (Voss and Reznicek 2012). It is widespread and fairly abundant within the vicinity of the north side LOD (Figure 2). This species is found most frequently within the Limestone Bedrock Glade, Coastal Fen, and Limestone Cobble Shore communities, especially within open areas of low vegetation and no tree canopy (Stantec 2019).

Survey Results

During the meander surveys, HG was found in the coastal fen, limestone bedrock glade, and limestone cobble shore natural communities (Stantec 2019). It was also found within the existing cleared pipeline and transmission line corridors. A visual estimation of the number of stems (i.e., individual plants) at each location was made. Each group was mapped in the field and the estimated number of stems was recorded at each location. Following the fieldwork, the results were tallied using GIS attribute data to determine an approximate number of stems of HG within the Study Area and north side LOD. Based on these methods, approximately 16,405 HG stems were located within the Study Area. Within the north side LOD, 3,336 stems were observed, and an additional 441 stems were observed within the Boulevard Drive Improvements LOD (Table 1).

Table 1. 2019 Stem Count Estimates

Species	Common Name	Stem Count within 108.8-Acre North Study Area	Stem Count within North Side Project LOD	Stem Count within Boulevard Dr. Improvements LOD	Stem Count within LOD (Total)	Percentage of Surveyed Stems Within the LOD
Iris lacustris	Dwarf lake iris (DLI)	27,075	5,067	2,690	7,757	29%
Solidago houghtonii	Houghton's goldenrod (HG)	16,405	3,336	441	3,777	23%

3.0 PLANT MITIGATION PLAN

The purpose of the Plant Mitigation Plan is to mitigate for potential impacts to DLI and HG within the north side LOD and Boulevard Drive Improvements LOD. Approximately 71 percent of DLI and 77 percent of HG stems in the Study Area will remain undisturbed. Impacts to the remaining 29 percent and 23 percent of DLI and HG respectively, will be addressed through relocation of plants from the LOD to Enhancement Areas and re-vegetation of suitable portions of the LOD, post-construction. Existing DLI and HG outside of the LOD will benefit from habitat improvement activities in the Enhancement Areas proposed in the mitigation plan. Additionally, barriers will be installed along routes into the Enhancement Areas to prevent vehicle and pedestrian trespass that has degraded the habitat in recent years.

3.1 ENHANCEMENT AREAS BASELINE CONDITIONS

Enbridge is proposing to transplant DLI and HG from the LOD to proposed protected species Enhancement Areas prior to construction of the GLTP. Enbridge has identified areas on Enbridge property that are likely suitable habitat for DLI and HG transplants for a total of approximately 5.2 acres (Enhancement Areas)

(Figure 2). All Enhancement Areas are sited in portions of the property where Enbridge has no plans for development or facility upgrades.

Based on the 2019 botanical surveys, proposed Enhancement Areas are comprised of several community types including degraded boreal forest, limestone bedrock glade, degraded upland meadow, wet meadow, and wooded dune/swale complex (Figure 4). Portions of boreal forest and upland meadow have been degraded by household waste and debris and earth disturbance from unauthorized vehicle access and all-terrain vehicle (ATV) use. Natural community types within the Enhancement Areas are known to support both DLI and HG. The majority of the DLI within the Enhancement Areas are located in limestone bedrock glade, degraded boreal forest and wooded dune/swale complex. HG within the Enhancement Areas were more restricted to the limestone bedrock glade community and wooded dune/swale complex. Further details on stem counts per species in each natural community type within the Enhancement Areas are shown in Table 2.

Table 2. 2019 Stem Count Estimates by Natural Community Type within Proposed Enhancement Areas

Species	Common Name	Boreal Forest (Degraded)	Limestone Bedrock Glade	Upland Meadow (Degraded)	Wet Meadow	Wooded Dune/ Swale Complex
Iris lacustris	Dwarf lake iris (DLI)	400	2,780	10	10	300
Solidago houghtonii	Houghton's goldenrod (HG)	22	285	0	2	17
	Total	**422**	**3,065**	**10**	**12**	**317**

During meander surveys, approximately 10% cover of invasive species was observed within the Enhancement Areas and included spotted knapweed (*Centaurea stoebe*). This is based on visual estimates. Invasive species observed within the 2019 Study Area included garlic mustard (*Alliaria petiolata),* Japanese barberry (*Berberis thunbergii),* spotted knapweed, Canada thistle (*Cirsium arvense),* European swamp thistle (*Cirsium palustre),* leafy spurge (*Euphorbia esula)*, glossy buckthorn (*Frangula alnus),* Tartarian honeysuckle (*Lonicera tatarica),* wild parsnip (*Pastinaca sativa),* reed canary grass (*Phalaris arundinacea),* common reed (*Phragmites australis* subsp. *australis),* common buckthorn (*Rhamnus cathartica),* crown vetch (*Securigera varia),* garden tansy (*Tanacetum vulgare),* narrow-leaf cattail (*Typha angustifolia),* and hybrid cattail (*Typha* X *glauca).*

Surveys will be performed in the summer of 2021 to establish baseline conditions of stem counts of DLI and HG, and percent cover of invasive species within the Enhancement Areas. Details on the methods of the baseline surveys are included in Section 5.

3.1.1 Limestone Bedrock Glade Baseline Assessment

Limestone bedrock glade is generally a savanna or open woodland with scattered trees and shrubs formed on flat expanses of calcareous bedrock near the shores of the Great Lakes (Cohen et al. 2015). Limestone

bedrock glade in the Study Area has a species composition and structure characteristic for this community. Dominant species observed within the community included stunted northern white cedar, little bluestem (*Schizachyrium scoparium*), bearberry (*Arctostaphylos uva-ursi),* and junipers (*Juniperus communis, J. horizontalis*). Other frequent species included white camas (*Anticlea elegans),* bastard toadflax (*Comandra umbellata),* yellow lady-slipper (*Cypripedium parviflorum),* and ebony sedge (*Carex eburnea)* (Stantec 2019). Limestone Bedrock Glade is identified by Michigan Natural Features Inventory (MNFI) as potentially suitable habitat for DLI (MNFI 2020).

3.1.2 Wooded Dune and Swale Complex Baseline Assessment

Wooded dune and swale complex is a community comprised of alternating bands of wetland and upland forest that have established on a series of parallel ridges and swales formed by receding lake levels over time (Cohen et al. 2015). This community is a unique feature of Great Lakes shorelines. Rather than the sand dune ridges that are typical of the community, as described by MNFI, the ridges of this complex within the Study Area appear to be largely composed of dolomite cobbles. Wooded dune and swale complex is identified by MNFI as potentially suitable habitat for both DLI and HG (MNFI 2020). Within the Study Area, DLI and HG were observed to occur locally within canopy openings, or at the edges of this community (Stantec 2019).

3.1.3 Boreal Forest Baseline Assessment

Boreal forest is a coniferous or mixed conifer-deciduous forest characteristic of northern Michigan, especially along Great Lakes shorelines, and may occur on wetland and upland sites (Cohen et al. 2015). boreal forest comprises the dune/ridge community component of the wooded dune and swale complex, and also occurs as a contiguous community within portions of the Study Area. Typical canopy dominants observed within the boreal forest in the Study Area include northern white cedar, balsam fir (*Abies balsamea*), and white spruce (*Picea glauca*). Typical understory and shrub species include striped maple (*Acer pensylvanicum),* mountain maple (*A. spicatum),* Canadian fly honeysuckle (*Lonicera canadensis),* and Canada yew (*Taxus canadensis).* Herbaceous species include starflower (*Trientalis borealis),* wild basil (*Clinopodium vulgare),* and sweet coltsfoot (*Petasites frigidus)* (Stantec 2019). This community is identified by MNFI as potentially suitable habitat for DLI (MNFI 2020).

3.1.4 Habitat Suitability and Site Selection

Areas of boreal forest and wooded dune/swale complex will be modified to enhance habitat for suitable placement of DLI and HG on Enbridge property. Proposed activities will include site preparation with a combination of selective thinning of woody vegetation, removing garbage and debris, and invasive species removal to create more suitable habitat similar to the limestone bedrock glade community and open areas within the wooded dune/swale complex.

Qualified botanists will further evaluate Enhancement Areas to identify specific, appropriate site preparation measures and collect detailed invasive species baseline data prior to DLI and HG relocation. Further details are described in Section 4.1.1 Enhancement Area Site Preparation, and Section 5.2 Enhancement Area Monitoring.

3.2 RE-VEGETATION AREAS BASELINE CONDITIONS

Additional plant mitigation areas have been identified as Re-Vegetation Areas within the north side LOD and total approximately 4.5 acres (Figure 2). No hard scape or permanent structures have been planned for these areas.

These areas currently consist of limestone bedrock glade and wooded dune and swale complex habitat types (Figure 4). During meander surveys, approximately 10% cover of invasive species was observed within the Re-Vegetation Areas and included spotted knapweed and garden tansy. This is based on visual estimates. Surveys will be performed in the summer of 2021 to establish baseline conditions of stem counts of DLI and HG, as well as percent cover of invasive species within the Re-Vegetation Areas. Details on the methods of the baseline surveys are included in Section 5.

While approximately 80 percent of DLI and HG will be transplanted from the LOD, the remaining seed bank likely contains DLI, HG, and other compatible native species. Stockpiling the top four to six inches of native topsoil, thereby preserving the existing seed bank, will likely increase the rate in which the Re-Vegetation Areas can return to natural conditions. Further details on topsoil stockpiling and redistribution are provided in Section 4.0.

3.3 REFERENCE SITES

Selection of a reference site in the vicinity of the Project provides the opportunity to compare conditions and vitality of local DLI and HG with the plants within the mitigation areas. A publicly accessible reference site documented to have DLI and HG in the vicinity of the Project are owned by the United States Forest Service (USFS). Hiawatha National Forest - St. Ignace District is located approximately two miles northwest of the Project location (Figure 4). The Eastern Upper Peninsula Cooperative Weed Management Area facilitated a non-native invasive plant program on the St. Ignace District within 15 acres of habitat containing HG (USFS 2012). Additionally, MNFI prepared a Surveys and Monitoring for the Hiawatha National Forest: FY 2012 Progress Report (Cuthrell, Penskar, and Gehring 2012) documenting the presence of DLI and HG within the forest. Enbridge will work with the St. Ignace Ranger District botanist to identify locations available for reference site monitoring. Additionally, Enbridge will monitor a 0.11-acre reference site on its property located on Point LaBarbe. The site is outside of the LOD and proposed Enhancement Areas and was observed to have DLI and HG (Figure 5). Data from both reference sites will be included as part of the annual monitoring reporting outlined in Section 6.0. Reference site observations are not intended to inform the success criteria, rather they are intended to assess the seasonal health and viability of the species in a location that is relatively close to the mitigation area. This information is important to botanists prior to conducting the annual surveys to assess if species reproductive status and/or vegetative health is particularly high or low for a given growing season.

3.4 PLANT MITIGATION PLAN GOALS

The proposed plant mitigation plan will comprise a two-part approach for DLI and HG before and after construction. Mitigation measures will be coordinated with EGLE, MDNR, and USFWS prior to implementation.

Part 1. Enhancement Areas. Up to 80 percent of DLI and HG recorded within the Project LOD and Boulevard Drive Improvement LOD will be transplanted to carefully selected Enhancement Areas on Enbridge property before construction site preparations begin (Figure 6). Additionally, an increase in numbers of stems of both species by natural recruitment from existing DLI and HG is anticipated from habitat management actions proposed within Enhancement Areas.

Part 2. Re-Vegetation Areas. The remaining 20 percent of DLI and HG stems **not** transplanted before construction activities will be mitigated by the redistribution of the existing seed bank from stockpiled topsoil within designated Re-Vegetation Areas in the Project LOD after construction is complete (Figure 7).

The overall goal of the mitigation activities in the Enhancement and Re-Vegetation Areas is no net loss of stems of DLI or HG resulting from the Project.

3.4.1 Plant Mitigation Success Criteria

Measurable success criteria will be used to evaluate whether the proposed Enhancement and Re-Vegetation Areas have met the goal of mitigating for impacts to DLI and HG. The Plant Mitigation Plan will implement the following success criteria:

Enhancement Areas:

1. A number equivalent to 100 percent of the transplanted stems of DLI to the Enhancement Areas will be present as live stems at the end of Year 5, in excess of the baseline DLI stem count in the Enhancement Areas. This includes transplanted stems within the Enhancement Areas and natural recruits within the Enhancement Areas resulting from habitat enhancement activities.
    a. Interim success criteria: At Year 3, the stem count will be equivalent to 75 percent of the transplanted number of stems of DLI.
2. A number equivalent to 100 percent of the transplanted stems of HG to the Enhancement Areas will be present as live stems at the end of Year 5, in excess of the baseline HG stem count in the Enhancement Areas. This includes transplanted stems within the Enhancement Areas and natural recruits within the Enhancement Areas resulting from habitat enhancement activities.
    a. Interim success criteria: At Year 3, the stem count will be equivalent to 75 percent of the transplanted number of stems of HG.

3. Combined areal coverage by target invasive species will not exceed 10 percent across the combined Enhancement Areas in Year 1 through Year 5.

4. Habitat disturbance caused by trash disposal, ATVs, and other unauthorized use will be reduced by installing barriers, blockades, and/or other means to help limit unauthorized access within the Enhancement Areas. During construction, the Environmental Inspector will monitor the Enhancement Areas for signs of unauthorized activity. Once construction is complete, Enbridge operations personnel will continue to monitor the Enhancement Areas for signs of unauthorized activity and maintain the barriers/blockades as necessary.

    a. Interim Success Criteria: Disturbance to DLI, HG, and natural communities within the Enhancement Areas will be minimized, and any observed damage to barriers or natural communities within Enhancement Areas resulting from unauthorized access will be documented and repaired.

Re-Vegetation Areas:

5. A number equivalent to 20 percent of the baseline number of stems of DLI in the LOD will be present as live stems at the end of Year 5.

    a. Interim success criteria: At Year 3, the stem count will be equivalent to 15 percent of the baseline number of stems of DLI in the LOD.

6. A number equivalent to 20 percent of the baseline number of stems of HG in the LOD will be present as live stems at the end of Year 5.

    a. Interim success criteria: At Year 3, the stem count will be equivalent to 15 percent of the baseline number of stems of HG in the LOD.

7. Combined areal coverage by target invasive species will not exceed 10 percent across the combined Re-Vegetation Areas in Year 1 through Year 5.

Alternative Success Criteria:

8. At Year 5 of the Re-Vegetation monitoring period, the total number of stems of DLI across the Enhancement Areas and Re-Vegetation Areas (in excess of the baseline number of stems of DLI within the Enhancement Areas) combined will meet or exceed the baseline number of stems of DLI within the LOD.

9. At Year 5 of the Re-Vegetation monitoring period, the total number of stems of HG across the Enhancement Areas and Re-Vegetation Areas (in excess of the baseline number of stems of HG within the Enhancement Areas) combined will meet or exceed the baseline number of stems of HG within the LOD.

10. If Alternative Success Criteria 8 and 9 are both met along with Re-Vegetation Area Criteria 7, then the overall project goal of no net loss of stems of DLI and HG will have been met.

Based on the plant mitigation goals, performance standards, and success criteria, approximately 100 percent of impacts to DLI and HG will be mitigated by a combination of transplants in the Enhancement Areas, natural recruitment from the native seed bank in the Enhancement Areas through habitat improvements, and recruitment from the native seed bank within topsoil redistributed in the Re-Vegetation Areas (Table 3).

Table 3. Plant Mitigation Success Criteria Compared to Approximate Total Stem Counts of Impacts within the LODs

Stem Counts	Dwarf Lake Iris	Houghton's Goldenrod
Impacts within LOD*	7,757	3,777
Total stem count in Enhancement Areas at Year 5**	6,210	3,020
Total Stem count in Re-Vegetation Areas at Year 5	1,550	760
Anticipated Stem Counts: Mitigation Total**	7,760	3,780

*Estimated based on 2019 visual surveys. Actual impacts will be updated based on 2021 baseline surveys.
**In excess of baseline stem counts in the Enhancement Areas.

4.0 PLANT MITIGATION METHODS

Enbridge has sited the LOD to avoid wetlands and protected species to the greatest extent practicable, while allowing adequate space for a technically feasible and safe construction area. In addition to mitigation activities, Enbridge will implement measures to avoid and minimize impacts to DLI and HG outside of the LOD. Measures will include the installation of berms and silt fence along the LOD boundary and silt fence along the improvements to Boulevard Drive. Enbridge will also install exclusionary signage at two-track roads to the northwest of the LOD and exclusionary fence along the western edge of the LOD to discourage unauthorized pedestrian and vehicle access to areas with existing DLI and HG present.

Construction is expected to require removal of all existing vegetation within the LOD. Prior to construction, DLI and HG will be transplanted to the Enhancement Areas. Following transplantation, the top four to six inches of topsoil within the LOD will be scraped and stockpiled to preserve the existing seed bank. Following construction, the topsoil will be redistributed within the Re-Vegetation Areas to encourage the re-establishment of the native seed bank of DLI and HG.

Enbridge anticipates GLTP construction will begin in 2022 and is anticipated to last 38 to 47 months. An overview of the GLTP construction and plant mitigation schedule is provided below.

- Summer 2021 – Baseline plant surveys

- May to September 2022 – Enhancement Areas site preparation and habitat enhancement, and plant relocation
- Fall 2022 – Site grading within the LOD and stockpile of topsoil (3 months)
- 2022 to 2025 – Project construction (36 to 40 months)
- 2025/2026 – Final site cleanup and redistribution of topsoil in the Re-Vegetation Areas (6 months)

4.1 ENHANCEMENT AREAS

4.1.1 Site Preparation and Habitat Enhancement

Prior to site preparation of transplant recipient locations within the Enhancement Areas, botanists will conduct a meander survey to identify optimal transplant locations, and to identify, GPS, and/or flag in situ DLI and HG to be avoided during habitat enhancement and transplanting efforts. Several factors will be used to select transplant locations including, but not limited to, soil, aspect, slope, microtopography, plant community, woody and herbaceous cover, invasive species, and presence of preexisting DLI and HG. Botanists will conduct quadrat sampling to determine accurate baseline stem counts of DLI and HG within the Enhancement Areas (see Section 5.1). Existing wetlands adjacent to the Enhancement Areas will be flagged to avoid disturbance. Habitat enhancement activities will be implemented, and transplant recipient sites will be selected based on past experience and success relocating these species and best professional judgment. Acreage within these areas will be mapped and specific habitat modifications will be documented. It is anticipated that site preparation activities will occur in the fall of 2022. Habitat enhancement activities will include, but are not limited to, selective thinning of woody vegetation, removing garbage and debris, and invasive species treatments using targeted applications of selective herbicides. Selective thinning of woody canopy will include thinning dense white cedar stands to increase illumination of the ground layer, where shading is currently too dense for DLI and HG to thrive. Canopy thinning will target smaller size classes of densely crowded white cedars and will focus on the edges of existing DLI and HG. Dense branches and woody material may be dispersed or removed from the Enhancement Areas. Garbage and debris within the Enhancement Areas, including tires, household waste, and other debris, will be collected and hauled to an appropriate offsite disposal facility.

Invasive species treatments will also occur at this time and will be performed in a manner to minimize damage to non-target species. Woody invasive species may be cut and hauled offsite, and stumps may be treated with herbicide. Broadleaf herbaceous invasive species may be treated with a foliar application of broadleaf-specific herbicide or may be hand pulled as needed if foliar treatment may affect DLI or HG in the area. Other treatment methods, including wicking, may be utilized. Specific application methods will be evaluated based on site-specific conditions, and to avoid impacts to DLI and HG.

Unauthorized access and ATV use has been an ongoing issue within the proposed Enhancement Areas. To minimize disturbance to the relocated plants, Enbridge will install gates, blockades, barriers, fencing, and/or other means to deter unauthorized access to the Enhancement Areas (Figure 6). Enbridge will also

install exclusionary signage at the two-track roads to the northwest of the LOD to discourage pedestrian, ATV, and vehicle access.

These activities will improve habitat and protect transplants of DLI and HG, as well as existing DLI and HG within the Enhancement Areas.

4.1.2 Transplant Methods

Up to 80 percent of existing stems of DLI and HG within the LOD will be transplanted to the Enhancement Areas (Figure 6). Transplanting is expected to occur during spring or early fall of 2022, during seasonal windows when relocation is expected to maximize transplant survival (Barr 2011, Vande Water 2011 and Dave Schuen, personal communication, September 10, 2020). Identification of DLI and HG within the LOD will be documented with photographs depicting the field marks used to identify the species. Other species of goldenrod are present in the LOD and may not be distinguishable from HG in April and May. For a comprehensive transplantation, all plants will be moved that are, or could possibly be, HG. While transplanting stems to the enhancement areas, a count of stems of both species will be collected and used for evaluation of success criteria.

There are no plans to collect voucher specimens of DLI and HG for the purposes of documentation. If voucher collections are required, specimens may be deposited at the University of Michigan Herbarium, Ann Arbor, Michigan.

Specific methods for transplanting will be coordinated with EGLE, MDNR, and USFWS. Initial proposed methods, however, for DLI and HG transplants are based on similar methods proposed in the Barr Engineering Protected Species Relocation and Monitoring Plan (Barr 2011) and North Straits Valve Site Project DLI and HG 2011 Transplant and Monitoring Report (Vande Water 2011):

<u>DLI Methods</u>

1. Individual plants or sod in the LOD will be dug in a minimum 12-inch squares to a minimum depth of three inches, depending on the size of the group of stems.

2. Larger groups of stems, connected by rhizomes, will be kept intact to the extent practicable.

3. Groups of stems may be dug by hand or by small mechanical means such as a sod cutter, which will preserve the soil rhizosphere and minimize disturbance to the DLI rhizomes.

4. Root zones will be wrapped to provide protection from sun exposure and desiccation. Roots will be kept moist until the plants are installed.

5. The number of transplants will be quantified by determining the average number of stems per square foot, then extrapolating the stem density to the transplanted area to estimate total transplanted stems. Due to the rhizomatous nature of DLI, counting each individual stem is not considered practical, and may cause damage to individual plants if stems are separated for counting.

HG Methods

1. Individual plants or sod within the LOD will be dug in approximate six-inch squares to a minimum depth of six inches.
2. For larger groups of stems, sub-dividing may be necessary to move individual plants.
3. Root zones will be wrapped or potted with similar material used to wrap DLI .
4. The number of transplants will be quantified using individual stem count estimates.

Recipient sites within the Enhancement Areas will be pre-dug to the appropriate depth of the hand-dug or sod transplants (as appropriate) before relocation to minimize root zone exposure. To the extent practicable, plants will be transplanted within four hours of initial removal. Following transplant installation within the Enhancement Areas, the actual location and extent of transplanted DLI and HG will be recorded with GPS and documented with photographs. Additional measures such as partial shade fabric and wind fencing may be utilized during transplant activities, if needed. An on-site Enbridge environmental inspector will manage water transport to the area and will ensure plants are watered shortly following transplanting. The environmental inspector will remain onsite throughout construction activities and will periodically monitor plant viability and drought conditions during the growing season, and water as needed. The environmental inspector will notify Enbridge and Stantec of issues that would threaten plant survival or transplant success.

4.2 RE-VEGETATION AREAS

Construction duration within the LOD is expected to last approximately three to four years, with estimated completion planned in 2025 or 2026. Although there will be permanent operational facilities established within the LOD, following completion of construction, approximately 4.5 acres of the north side LOD have been designated as Re-Vegetation Areas (Figure 7).

4.2.1 Site Preparation

Proposed re-vegetation methods for DLI and HG are based on similar methods utilized by the Michigan Department of Transportation (Dave Schuen, personal communication, September 10, 2020). Prior to construction, the top four to six inches of soil from the LOD will be scraped and stockpiled to preserve the existing seed bank. The topsoil will be stockpiled in a specified location within the LOD and covered per sediment and erosion control permitting requirements. Covering will limit the growth of invasive species or DLI and HG from the stockpile. Additionally, the stockpile will be fenced, and sufficient signage will be placed in the vicinity designating the area as protected. The soil will be stockpiled for three to four years during construction. MDOT has demonstrated success with utilizing stockpiled soil for up to three years for both species (Dave Schuen, personal communication, September 10, 2020). Seed viability could decrease if the soil is stockpiled more than three years. The interim success criteria for the Re-Vegetation Areas (#5a and #6a) will be used to determine if seed viability of the stockpile decreased. If so, adaptive management measures will be implemented (Section 7.0).

The subsoil in the Re-Vegetation Areas will be covered with geotextile fabric prior to placement of an aggregate layer and will remain in place for the duration of construction. Geotextile fabrics will provide a barrier between the aggregate and existing subsoil.

If any of the proposed Re-Vegetation Areas are not cleared or otherwise impacted by construction activities, these areas will remain in their current state and will not be considered when evaluating success criteria.

Enbridge will install gates, blockades, barriers, fencing, and/or other means to deter unauthorized access to the Re-Vegetation Areas (Figure 6).

4.2.2 Re-Vegetation Methods

Following construction, aggregate and geotextile fabric within the Re-Vegetation Areas will be removed. The stockpiled topsoil will be redistributed over the Re-Vegetation Areas to encourage the re-establishment of the native seed bank of DLI and HG. Within 72 hours of topsoil placement, the areas will be seeded with a native seed mix of species native to Mackinac County, Michigan, and covered with certified weed-free mulch to preserve moisture and prevent soil erosion. The seed mix will be sourced from regional native plant nurseries. Species included in the mix may include, but are not limited to, species identified in natural communities within the Study Area, such as: little bluestem (*Schizachyrium scoparium)*, black-eyed susan (*Rudbeckia hirta)*, common milkweed (*Asclepias syriaca)*, wild columbine (*Aquilegia canadensis),* and wild bergamot (*Monarda fistulosa*). An Enbridge environmental inspector will monitor the redistribution of the topsoil, seeding, and mulching. Additionally, the inspector will monitor for watering as needed during the topsoil application and throughout the growing season for supplemental watering.

If expression from the seed bank is insufficient to achieve Alternative Success Criteria #8 and #9, Enbridge may supplement DLI and HG stems in the Re-Vegetation Areas with live plugs. Enbridge would work with a nursery certified by the Michigan Department of Agriculture and Rural Development for the growing of live plugs and would work with regulatory agencies to ensure that live plugs meet standards to be certified as free of pests and invasive species. If it is not possible to meet these criteria, live plugs will not be used.

5.0 MONITORING PLAN

5.1 BASELINE SURVEYS

Quantitative sampling of DLI and HG within the LOD and Enhancement Areas will be conducted in the summer of 2021 to determine baseline density estimates for DLI and HG, which will be used to extrapolate total stem counts for each area. Botanists, using GPS units capable of submeter accuracy, will sample 160 randomly spaced 0.25 m^2 quadrats (50 cm x 50 cm) distributed across the extent of the currently undeveloped portion of the LOD, with an additional 10 quadrats within the undeveloped portion of the Boulevard Drive Improvements LOD. Additionally, 85 randomly spaced 0.25 m^2 quadrats will be established and sampled across the extent of the Enhancement Areas. The locations of the quadrats will be determined using a random point generator in GIS. Quadrats will be located in the field using a GPS with sub-meter accuracy. Within the Enhancement Areas, a metal rod or PVC pipe will placed in a pre-defined corner of

each quadrat to assist with future relocation and positioning of the quadrat during the Enhancement Areas Monitoring period (see Section 5.2).

The number of quadrats (16 quadrats per acre) is proposed such that of each of these survey areas (LOD, Boulevard Drive Improvements LOD, and Enhancement Areas) are sampled to provide good spatial coverage and reduce uncertainty associated with density estimates and associated stem counts for each area. Within each quadrat, the number of DLI and HG live stems will be counted, noting presence of any flowering individuals. Individual stems of DLI arising from a common lateral rhizome will be counted as an individual plant. Where clumps of stems make individual stem counts challenging, the botanist will estimate the number of individual stems using their best professional judgement. Any small non-flowering plants of HG that cannot be reliability identified will not be included in the stem count. The data collected from the quadrats will be used to calculate stem density for DLI and HG within the LOD and Enhancement Areas and extrapolated to the total area to estimate the baseline stem counts, using a 95% confidence interval to estimate the margin of error for the estimates. Within the Enhancement Areas, acreage of baseline suitable habitat for HG and DLI will be determined in order to calculate stem density for DLI and HG within suitable habitat within the Enhancement Areas. The number of quadrats proposed is anticipated to be adequate for calculating stem density and the 95% confidence interval and will be evaluated in the field as baseline surveys are conducted. Additional quadrats may be added if deemed necessary. DLI's distinctive rhizomes and leaf pattern will allow for identification throughout the growing season. The optimal period for positive identification of HG is typically in August and September (MNFI 2020).

Additionally, during baseline surveys, meander surveys of the LOD and Enhancement Areas will be conducted for invasive species. Data to be collected will include areal coverage of each species, including notes on the presence and distribution of invasive species for follow-up management or treatment. The location of target invasive species within the Enhancement Areas for follow-up treatment will collected with GPS units.

5.2 ENHANCEMENT AREAS

Enbridge proposes quantitative vegetation plot monitoring and a meander survey of the Enhancement Areas to be conducted during the growing season, to be performed twice (one quadrat survey and two meander surveys) during the growing season in Year 1 following transplantation, and once during the growing season annually from Year 2 through Year 5 (comprising the five-year Enhancement Areas monitoring period, 2023-2027). Quadrat locations in the Enhancement Areas for the baseline surveys and Enhancement Areas monitoring period are included in Figure 8.

The following activities will be conducted during the monitoring events in the Enhancement Areas:

1. Conduct vegetation sampling of the 85 randomly spaced 0.25-m^2 quadrats (50 cm x 50 cm) established in the Enhancement Areas during baseline surveys. The locations of the quadrats will be located visually by the presence of the previously placed metal or PVC rod or by using a GPS with sub-meter accuracy if the rod is absent.

2. Quantify the number of DLI and HG live stems within each quadrat, noting presence of any flowering individuals. Previously existing, transplanted or recruited stems of each species will not be distinguished. The total number of stems of each species present in the Enhancement Areas will constitute the quantitative success criteria.

3. Visually assess the percent of woody canopy cover in each quadrat.

4. List all vascular plant species observed while conducting a pedestrian meander survey of the Enhancement Area, inclusive of their areal coverage. Record notes on presence and distribution of invasive species for follow-up management or treatment.

5. Note general conditions of plants and surrounding areas including signs of site damage, condition of installed barriers, unauthorized access, vandalism, herbivory, plant desiccation, or significant plant mortality.

6. Establish a minimum of eight photo documentation points to be used repeatedly to document site conditions of the Enhancement Areas.

7. Document antecedent precipitation conditions and long-term averages using data from the Cross Village weather station in Emmet County, Michigan, leading up to the monitoring events, and note areas of inundation and deviations from typical weather conditions observed during monitoring.

8. Note the presence of target invasive species within the Enhancement Areas, and GPS the locations for follow-up treatment.

9. Assess and document general population health through observation of rhizome production (DLI), flower density, comparison of the health of the reference site, and general physiological conditions.

5.3 RE-VEGETATION AREAS

Enbridge proposes both quantitative and qualitative monitoring of the Re-Vegetation Areas. Year 1 monitoring will take place after the redistributed topsoil has been in place for one full growing season. One quadrat survey and two meander surveys will be conducted in Year 1, and one quadrat survey will be conducted annually during the growing season of Years 2 through Year 5 (comprising the five-year Re-Vegetation Areas monitoring period). Quadrat locations in the Re-Vegetation Areas for the Re-Vegetation Areas monitoring period are included in Figure 8.

The following activities will be conducted during the monitoring events in the Re-Vegetation Areas:

1. Establish and conduct vegetation sampling of 75 randomly spaced 0.25-m^2 quadrats (50 cm x 50 cm) distributed across the Re-Vegetation Areas. The locations of the quadrats will be determined using a random number generator. Quadrats will be located in the field using a GPS with sub-meter accuracy. A metal rod or PVC pipe will placed in a pre-defined corner of each quadrat to assist with future relocation and positioning of the quadrat.

2. Quantify the number of DLI and HG live stems within each quadrat, noting presence of any flowering individuals.
3. Visually assess the percent of canopy cover in each quadrat.
4. List all vascular plant species observed while conducting a pedestrian meander survey of the Re-Vegetation Areas, inclusive of their areal coverage. Record notes on presence and distribution of invasive species for follow-up management or treatment.
5. Note general conditions of plant viability and plant mortality.
6. Establish a minimum of four photo documentation points to be used repeatedly to document site conditions of the Re-Vegetation Areas.
7. Document antecedent precipitation conditions and long-term averages leading up to the monitoring events and note areas of inundation during monitoring observations.
8. Note the presence of target invasive species within the Re-Vegetation Areas and GPS the locations for follow-up treatment.
9. Assess and document general population health through observation of rhizome production (DLI), flower density, comparison of the health of the reference site, and general physiological conditions.

6.0 ANNUAL REPORTING

Annual monitoring reports will be submitted to USACE, USFWS, MDNR, and EGLE by December 31 of each calendar year summarizing the findings of baseline data collection and subsequent monitoring events, and documenting progress towards goals, status of performance standards, and achievement of applicable interim and final success criteria. Reports will include annual density estimates and extrapolated stem counts with associated 95% confidence intervals for DLI and HG in the Enhancement and Re-Vegetation Areas. Stem counts and associated 95% confidence intervals estimated for the Enhancement Areas at the end of the monitoring period will be compared to baseline estimates to calculate the increase due to mitigation activities for DLI and HG. Similarly, the density estimates in the Re-Vegetation Areas would also represent additions due to mitigation activities. Raw vegetation data will be available upon request.

Suitable habitat for baseline stem density calculations will be quantified and mapped in the baseline report. Post-enhancement activities will increase the area of suitable habitat in the Enhancement Areas and will be documented in the monitoring reports. The initial report in Year 1 of the Enhancement Areas monitoring period will summarize the transplantation and habitat enhancement activities completed, in addition to the results of annual monitoring. The report in Year 1 of the Re-Vegetation Areas monitoring period will summarize the soil distribution and seeding activities completed, in addition to summarizing the results of annual monitoring. If adaptive management actions are needed, an adaptive management plan will be developed and discussed within the annual monitoring report.

7.0 ADAPTIVE MANAGEMENT

In the event the approved mitigation plan, one or more mitigation activities, or one or more areas of the mitigation site fails to achieve the interim or final success criteria specified in the mitigation plan, Enbridge will notify the USACE. Adaptive management activities may consist of corrective actions and additional monitoring. Corrective actions may include barrier repair, invasive species treatment, seeding with DLI and HG, the planting of live plugs, and/or additional thinning of woody vegetation.

8.0 LONG-TERM MANAGEMENT

8.1.1 Ownership of the Site and Identity of Long-Term Steward

The mitigation activities are located on a single parcel owned by Enbridge. All Enhancement and Re-Vegetation Areas are sited in portions of the property where Enbridge has no plans for development or facility upgrades. Enbridge will be responsible for long-term management activities on the property.

8.1.2 Identification of Long-Term Management Activities

Long-term management activities will include monitoring and repair of barriers installed on the site and monitoring and treatment of invasive species.

9.0 REFERENCES

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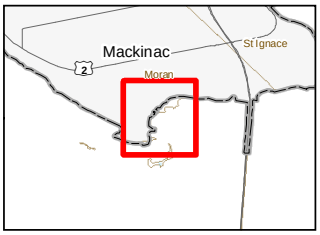

Legend

- North Side Limits of Disturbance
- Boulevard Drive Improvements

Notes
1. Coordinate System: NAD 1983 UTM Zone 16N
2. Data Sources Include: Stantec, Enbridge, NADS, USGS
3. Orthophotography: 2018 NAIP

Figure No.
1

Title
Limits of Disturbance - North Side

Client/Project
Enbridge Great Lakes Tunnel Project
Plant Mitigation Plan

Project Location
Mackinac County, Michigan

193705885
Prepared by JM on 2020-08-28
Technical Review by MZ on 2020-08-31
Independent Review by KW on 2021-02-24

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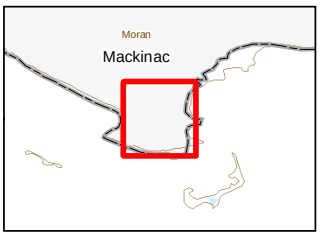
Stantec



Notes
1. Coordinate System: NAD 1983 UTM Zone 16N
2. Data Sources Include: Stantec, Enbridge, NADS, USGS
3. Orthophotography: 2018 NAIP

Legend

- North Side Limits of Disturbance
- Boulevard Drive Improvements

Protected Species Mitigation Areas

- Potential Protected Species Re-Vegetation Area (4.52 Acres)
- Enhancement Area (5.15 Acres)

Community Type

- Boreal Forest (Degraded) - BFd
- Coastal Fen - CF
- Limestone Bedrock Glade - LBG
- Limestone Cobble Shore - LCS
- Mesic Northern Forest - MNF
- Mesic Northern Forest (Degraded) - MNFd
- Northern Shrub Thicket - NST
- Rich Conifer Swamp - RCS
- Sand & Gravel Beach - SGB
- Upland Meadow - UM
- Upland Meadow (Degraded) - UMd
- Wet Meadow - WM
- Wet Meadow/Northern Shrub Thicket - WM/NST
- Wooded Dune & Swale Complex - WDSC

Figure No.
4

Title
Natural Communities

Client/Project
Enbridge Great Lakes Tunnel Project
Plant Mitigation Plan

Project Location
Mackinac County, Michigan

193705885
Prepared by JM on 2020-08-28
Technical Review by MZ on 2020-08-31
Independent Review by KW on 2021-02-24

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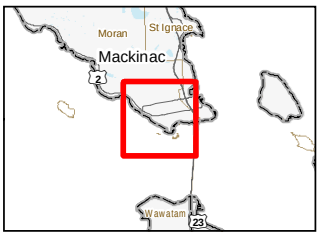

Notes
1. Coordinate System: NAD 1983 UTM Zone 16N
2. Data Sources Include: Stantec, Enbridge, NADS, USGS
3. Orthophotography: 2018 NAIP

Legend

- North Side Limits of Disturbance
- Boulevard Drive Improvements
- Enbridge Civil Survey Property Boundary
- Reference Site
- On-Site Reference Site

Figure No.
5

Title
Reference Site

Client/Project
Enbridge Great Lakes Tunnel Project
Plant Mitigation Plan

Project Location
Mackinac County, Michigan

193705885
Prepared by JM on 2020-08-31
Technical Review by MZ on 2020-08-31
Independent Review by KW on 2021-02-24

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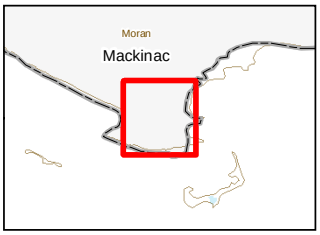

Legend

- North Side Limits of Disturbance
- Boulevard Drive Improvements
- Potential Protected Species Re-Vegetation Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 16N
2. Data Sources Include: Stantec, Enbridge, NADS, USGS
3. Orthophotography: 2018 NAIP

Figure No.
7

Title
Protected Species Re-Vegetation Plan

Client/Project
Enbridge Great Lakes Tunnel Project
Plant Mitigation Plan

Project Location
Mackinac County, Michigan

193705885
Prepared by JM on 2020-08-28
Technical Review by MZ on 2020-08-31
Independent Review by KW on 2021-02-24

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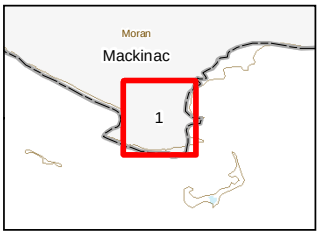

Notes
1. Coordinate System: NAD 1983 UTM Zone 16N
2. Data Sources Include: Stantec, Enbridge, NADS, USGS
3. Orthophotography: 2018 NAIP

Legend

- North Side Limits of Disturbance
- Boulevard Drive Improvements
- Protected Species Enhancement Area
- Potential Protected Species Re-Vegetation Area
- 0.25m² Quadrat Location (Mitigation Area Monitoring)

Figure No.
8

Title
Plant Mitigation Monitoring Plan

Client/Project
Enbridge Great Lakes Tunnel Project
Plant Mitigation Plan

Project Location
Mackinac County, Michigan

193705885
Prepared by JM on 2021-02-24
Technical Review by JH on 2021-02-24
Independent Review by XX on 2021-XX-XX

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Stantec

Technical Memorandum

Sample Size Analysis of Dwarf Lake Iris Quadrats

Quantitative sampling of Dwarf Lake Iris (DLI) occurred within two study areas of the Great Lakes Tunnel Project—Limits of Disturbance (LOD) and Enhancement Areas (EA)—in early June 2021. Botanists initially sampled 160 randomly spaced 0.25 m^2 quadrats (50 cm ×50 cm) distributed across the extent of the undeveloped portion of the LOD, and 85 randomly spaced 0.25 m^2 quadrats in the EA. The number of quadrats (16 quadrats per acre) was deemed suitable to provide good spatial coverage, based on results from prior qualitative visual surveys of DLI abundance in different habitat types (Stantec 2019). However, following the initial surveys in LOD and EA, the botanists noted DLI plants were spatially clumped, with 75 and 77 percent of the quadrats containing no DLI stems, respectively.

This observation raised the question whether the 160 and 85 quadrats would be sufficient to estimate the mean DLI density that could be used to extrapolate, with 95% confidence, to the true population density for each area. Secondarily, if deemed not sufficient, then how many quadrats would need to be sampled to improve the confidence in the extrapolation? Based on analysis of stem counts and associated standard error during the initial field survey, an additional 80 quadrats were sampled in the LOD, increasing the sample size to 240 quadrats. Two quadrats within the LOD were excluded, one of which was located in a trash pile where no vegetation was present, and the other had missing/null data. The 85 randomly located quadrats initially placed within the EA were similarly increased to a total of 215 quadrats sampled, of which two quadrats were excluded due to missing/null data.

To evaluate the first question of whether the initial number of quadrats would be sufficient, routine exploratory data analyses (mean, standard deviation, frequencies, and percentiles, etc.) were performed on the LOD and EA data sets (Table 1 and Table 2). The stem count data were also sequentially ordered based on the quadrat identification number (low to high) and a series of sample means, standard deviations, and standard errors were calculated for different sample sizes that incrementally increased by 10 quadrats. For the LOD area, this empirical data analysis approach resulted in a mean stem count–sample size relationship that was used to evaluate the effect of sample size on the mean.

Based on the 238 quadrats ultimately sampled in the LOD area, the original sample size of 160 quadrats was insufficient to adequately estimate a sample mean because the mean stem count continued to increase with sample size (Figure 1). The mean stem count and sample size relationship begins to flatten from approximately 190 to 238 samples, indicating that the sample mean may stabilize (~7.8 stems per quadrat). However, there is uncertainty of the relationship past 238 samples. In the context of a baseline field assessment, it is desirable to

identify the portion of a relationship where both the mean and standard error stabilize to determine whether the sample size is sufficient to meet project goals. In this case, 238 samples remained questionable in terms of achieving the desired goal of using the sample mean to estimate a true population mean. Therefore, a bootstrap resampling approach was used to evaluate a potential relationship beyond the 238 samples collected from LOD.

Using the raw data collected at LOD, a randomized sample with replacement routine was used to generate a data set that contained stem count results for 500 quadrats. The sample means, standard deviations, and standard errors were calculated for sample sizes ranging from 10 to 500, in increments of 10. This analysis resulted in a similar mean stem count–sample size relationship (Figure 2) which provided insight into the number of quadrats needed to stabilize the mean and standard error. The bootstrapped relationship shows that the mean stem count (6.8 stems/quadrat) begins to stabilize at 230 samples and consistently remains near the 7.0 stems/quadrat level through 500 samples. Similarly, the standard error is 1.4 at 230 samples and approaches 1.0 at 500 samples. Based on this relationship, a sample size of approximately 260 quadrats samples would achieve a desired 95% confidence level that the sample mean approximates the population mean. At 260 samples, the bootstrapped mean stem count was 6.9 with a 95% margin of error of 2.6 (i.e., 6.9 ± 2.6). In comparison, the original 238 samples resulted in a mean stem count and margin of error of 7.6 ± 2.8. The minor difference between the raw and bootstrapped mean values, combined with the overlapping 95% confidence intervals, indicates that the 238 samples are sufficient to estimate a true population mean for the LOD area approximately 95% of the time. At 238, the number of quadrats within the undeveloped portion of the LOD is approximately 26 quadrats per acre.

The same approach was applied to the EA data, and the original sample size of 85 was deemed insufficient to adequately estimate a sample mean. The sample size of 213 quadrats within the EA appeared to be adequate as the mean began to stabilize around 180 samples (Figure 3). The mean stem count decreased from 8.4 to 4.9 over the range of sample sizes. The bootstrap resampling approach was used to evaluate the sample mean-sample size relationship beyond 213 samples and again stem counts for 500 quadrats were generated using the raw EA data. The bootstrapped relationship shows that the mean stem count (3.7 stems/quadrat) begins to stabilize at 200 samples and consistently remains near the 3.7 stems/quadrat level through 500 samples (3.5 ± 1.2). Similarly, the standard error is 1.0 at 200 samples and approaches 0.6 at 500 samples. Based on this relationship, a sample size of approximately 230 quadrats would achieve a desired 95% confidence level that the sample mean approximates the true population mean. At 230 samples, the bootstrapped mean stem count and 95% margin of error was 3.6 ± 1.8. In comparison, the 213 samples resulted in a mean stem count and margin of error of 4.9 ± 2.4. While the mean stem counts slightly differs between the bootstrapped and raw data, the overlapping confidence intervals indicate the difference is not significant. Therefore, a sample size of 213 quadrats will be sufficient to

estimate a true population mean for the EA approximately 95% of the time. At 213, the number of quadrats within the EA is approximately 41 quadrats per acre.

References

Stantec. 2019. Rare Plants and Natural Communities Report – Line 5 Replacement and Tunnel Project. Submitted to EGLE, October 22, 2019.

Table 1: Summary statistics for the raw stem count data collected at the Limit of Disturbance and Enhancement Area, and for the simulated data sets using a bootstrap resampling with replacement routine.

Study Area / Simulated	N	Mean	Standard Deviation	Standard Error	95% Confidence Interval for Mean		Skewness	Kurtosis
					Lower Bound	Upper Bound		
LOD	238	7.64	21.90	1.42	4.85	10.44	3.72	14.84
Bootstrap LOD	260	6.92	21.69	1.35	4.27	9.56	4.43	21.29
EA	213	4.91	17.32	1.19	2.57	7.25	4.94	26.94
Bootstrap EA	230	3.61	14.20	0.94	1.76	5.45	5.21	28.40

Table 2: Frequency and percentile analysis of the raw stem count data collected at the Limits of Disturbance and Enhancement Area.

Limits of Disturbance Area				Enhancement Area			
Stem Count per Quadrat	Frequency of Occurrence	Percent	Cumulative Percent	Stem Count per Quadrat	Frequency of Occurrence	Percent	Cumulative Percent
0	181	75.4	76.1	0	166	77.2	77.9
1	2	.8	76.9	1	6	2.8	80.8
2	5	2.1	79.0	2	6	2.8	83.6
3	2	.8	79.8	3	3	1.4	85
4	6	2.5	82.4	4	3	1.4	86.4
5	1	.4	82.8	6	3	1.4	87.8
6	2	.8	83.6	7	2	0.9	88.7
7	2	.8	84.5	8	1	0.5	89.2
9	2	.8	85.3	9	1	0.5	89.7
10	2	.8	86.1	11	2	0.9	90.6
14	2	.8	87.0	12	2	0.9	91.5
16	1	.4	87.4	14	1	0.5	92
17	1	.4	87.8	15	1	0.5	92.5
19	1	.4	88.2	16	2	0.9	93.4
20	1	.4	88.7	24	1	0.5	93.9
23	1	.4	89.1	31	1	0.5	94.4
25	1	.4	89.5	32	1	0.5	94.8
27	1	.4	89.9	33	1	0.5	95.3
29	1	.4	90.3	36	1	0.5	95.8
30	1	.4	90.8	37	1	0.5	96.2
33	2	.8	91.6	48	1	0.5	96.7

Limits of Disturbance Area			
Stem Count per Quadrat	Frequency of Occurrence	Percent	Cumulative Percent
36	1	.4	92.0
37	1	.4	92.4
38	1	.4	92.9
39	1	.4	93.3
41	1	.4	93.7
43	2	.8	94.5
44	1	.4	95.0
50	1	.4	95.4
53	1	.4	95.8
78	2	.8	96.6
81	1	.4	97.1
87	1	.4	97.5
91	2	.8	98.3
99	1	.4	98.7
116	1	.4	99.2
117	1	.4	99.6
146	1	.4	100.0
Total	238	99.2	
Missing	2	.8	
Total	240	100.0	

Enhancement Area			
Stem Count per Quadrat	Frequency of Occurrence	Percent	Cumulative Percent
55	1	0.5	97.2
60	1	0.5	97.7
61	1	0.5	98.1
90	1	0.5	98.6
102	1	0.5	99.1
108	1	0.5	99.5
133	1	0.5	100.0
Total	213	99.1	
Missing	2	.9	
Total	215	100.0	

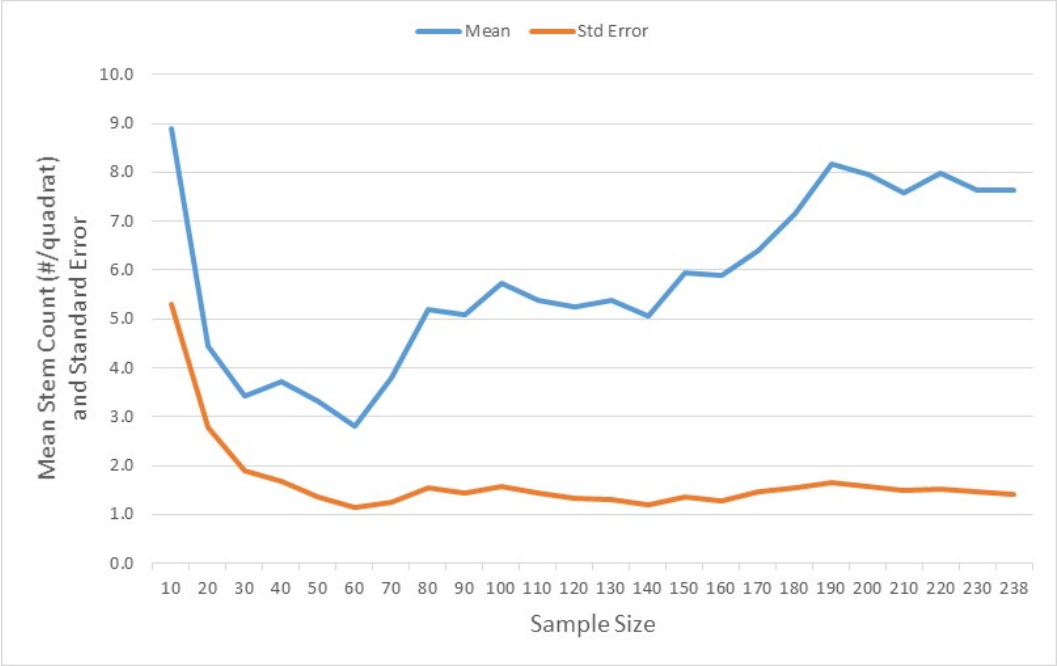

Figure 1: Mean stem density and sample size relationship for raw data collected at LOD.

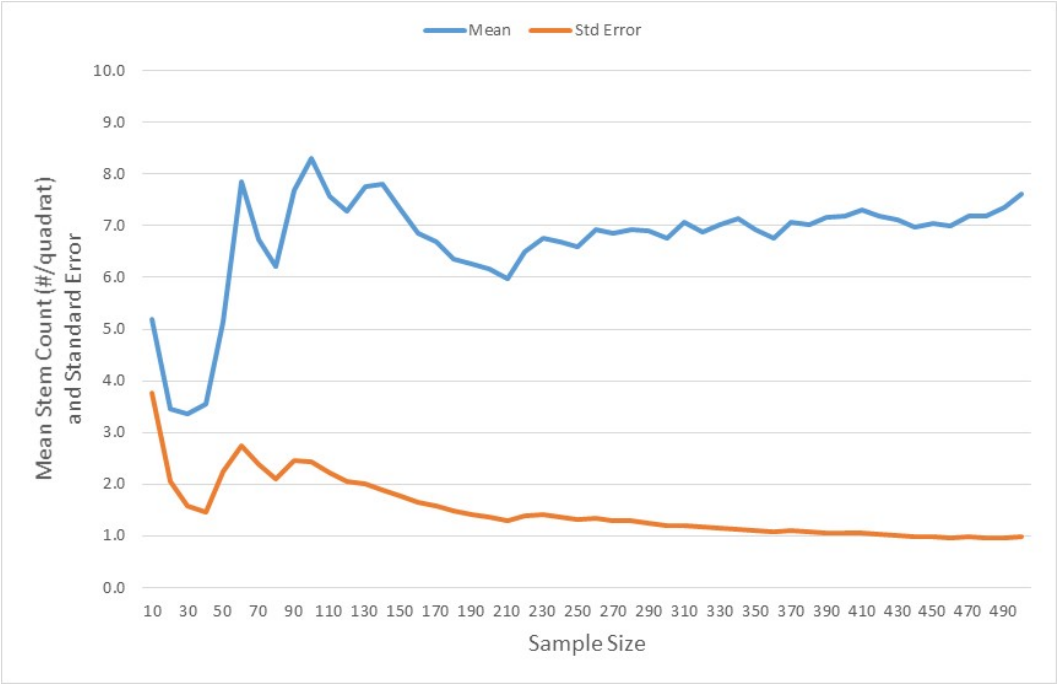

Figure 2: Bootstrapped mean stem density and sample size relationship using LOD raw data.

Figure 3: Mean stem density and sample size relationship for raw data collected at EA.

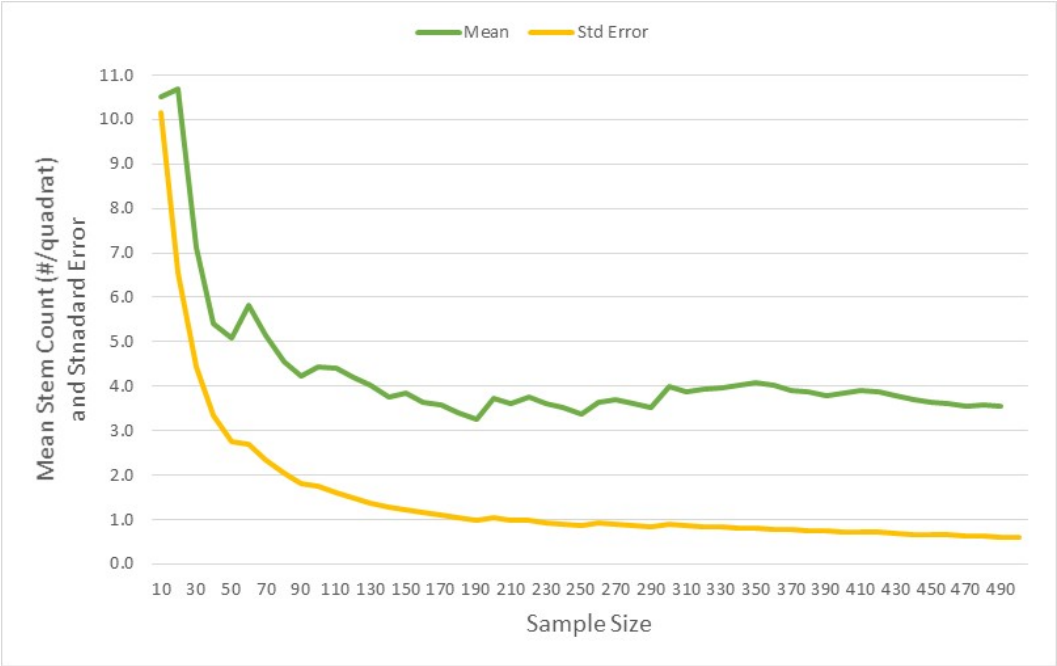

Figure 4: Bootstrapped mean stem density and sample size relationship using EA raw data.