

Construction Sequence, Methods, Timing and Equipment

Great Lakes Tunnel Project

The Great Lakes Tunnel Project (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. 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. The LODs will be cleared, graded, and covered with three to six inches of crushed aggregate in preparation for construction activities. Access road improvements will occur during the site preparation period.

An 18- to 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 areas for a portal, slurry and water treatment system including sediment and infiltration basins, and a variety of necessary construction equipment, vehicles, storage areas and trailers. The start date of construction will depend on a number of factors, including receipt of all regulatory approvals.

Approximate Construction Sequence

1. Development of the south side laydown areas, which will include ground clearing, grading and fencing.
2. Excavation and ground support for the south portal entrance. This will involve ground excavation, limited blasting, grouting/ground improvement and shoring, and installation of related infrastructure (sediment and infiltration ponds, etc.).
3. Delivery, assembly and commissioning of the TBM, slurry treatment plant, and ancillary plant and equipment.
4. Delivery and storage of segmental precast concrete tunnel lining. Delivery and storage will continue throughout the tunnel excavation period (i.e., TBM launching to TBM arrival).
5. TBM tunnel excavation, precast tunnel lining installation, tunnel spoil disposal.
6. Land clearing, grading, and fencing on the north side.
7. Excavation and ground support for the north shaft TBM retrieval. This will involve ground excavation, limited blasting, grouting/ground improvement and shoring, and installation of related infrastructure (sediment and infiltration ponds, etc.).
8. Receiving and assembly of pipeline material. This will involve spooling (welding) activities approximately two months prior to tunnel completion. At this time, it is proposed that only the south side be used for this purpose as a means of minimizing disruption on the north side.
9. TBM breakthrough on the north side, disassembly, and removal from site.
10. Pipeline installation, tie-ins to existing lines, and pressure hydrotesting of the pipeline.
11. Permanent systems installation (ventilation, lighting, etc.).
12. Site cleanup of tunnel LOD areas including the areas surrounding the portal, shaft, and laydown areas.

The proposed Project activity durations are estimated as follows:

- Vegetation clearing, grading, and fencing of LODs (access roads will not be fenced) – three months
- Portal excavation, TBM assembly, and other preparations for construction – six months
- Tunnel construction, equipment and temporary utility removal, and cleanup – two years
- Pipeline installation in tunnel and tie-into existing system – eight months
- Backfill portal, construct above ground facilities, finalize site cleanup – six months

NOTE: Some activities will take place concurrently. The pipeline can be put into service while the site cleanup and completion of above ground facilities are ongoing.

The construction activities will occur within the LODs. Once tunnel construction begins, construction activities are expected to occur 24 hours per day and six days per week on the south side for an estimated two years, or until the TBM boring is complete. Under some circumstances and for limited duration, construction activities may occur seven days per week. Construction activities on the north side are expected 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.

Tunnel Alignment

The tunnel alignment will be located within the shaded zones shown on Figure 3. When determining the precise placement of the tunnel below the lake bottom, Enbridge will consider the following alignment aspects:

1. Tunnel Plan – the plan describes the horizontal alignment, which defines a line that runs along the center of the tunnel. It would be how the tunnel would look if viewed from directly above it.
 - In plan, the tunnel alignment will be located on Enbridge-owned property at the tunnel entry and exit points, and within the existing 1200-foot wide easement beneath the lake. Within those limits, the exact location of the tunnel alignment will be defined by:
 - The endpoints as established by tunnel construction site layouts at the north and south ends.
 - Maintaining a relatively straight alignment and avoiding sharp horizontal curves.
 - Maintaining appropriate distance from the geotechnical investigation borehole locations.
2. Tunnel Profile – the profile describes the vertical alignment, which defines the changes in the elevation of the tunnel as it crosses beneath the lakebed of the Straits.
 - In profile, the tunnel alignment will be located between an upper bound defined by depth of cover requirements and a lower bound defined by anticipated subsurface conditions, with consideration of tunnel/pipeline geometry requirements. The width of the tunnel profile band, as shown in Figure 3, ranges between 90 to 305 feet.
 - The profile will be based on the following considerations:
 - The minimum depth of cover over the tunnel will be at least ten feet below top of rock as the tunnel approaches the entry and exit points and at approximately 60 feet below the lake bottom in the deeper-water sections of the lake (greater than 80 feet of water depth).
 - The maximum depth of cover over the tunnel will be established through further analysis of the geotechnical data and a maximum practical operational slope at the entry and exit points in the range of seven to eight percent.

Ground Conditions

The majority of the length of the tunnel will be in rock. In the deep channel of the Straits of Mackinac (Straits) the tunnel may be mined in soil (glacial deposits). For tunnel sections in soil (referred to as soft-ground tunneling), or partially in soil (referred to as mixed face tunneling) the top of the tunnel will be at approximately 60 feet beneath the lakebed. This is equivalent to approximately 2.5 excavated tunnel diameters of cover above the outside of the top of the tunnel, which is considered conservative for modern pressurized face tunneling. With pressurized face tunneling, as will be used for the Project, Enbridge does not anticipate any impact to the lake bottom or the existing pipeline from settlement caused by tunnel construction.

The tunnel alignment, both horizontal and vertical, will be finalized based on:

- Subsurface conditions anticipated based on the geotechnical data.
- TBM design features to address the anticipated ground and groundwater conditions.

- Tunnel/pipeline geometry considerations.

Tunnel Portal Structure-South Side

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 serves as a gradual transition from the surface to the entrance to the tunnel. After the tunnel is completed, a cut-and-cover tunnel structure will be constructed within the portal to extend from the tunnel to the ground surface. 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.

Tunnel Shaft Structure-North Side

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 150 feet. Around the shaft will be the necessary construction support equipment such as a crane, electrical building, parking, office space, and a sediment and infiltration basin.

Potential Blasting

To construct the portal on the south side and the shaft on the north side mechanical excavation is required. Ideally this is done using a piece of equipment called an excavator/dozer ripper, which is designed to break up rock. This is the methodology the project plans to use to construct the tunnel entry and exits points; however, should the Project encounter high strength rock that cannot be excavated mechanically, rock excavation would be performed by a controlled drilling and blasting method.

Excavation done by controlled drilling and blasting, is achieved by breaking up the rock to fragments. The type of blasting that would be used on the Project includes the following four steps: (1) drilling holes; (2) placing explosives and detonator (and stemming) in each hole, (3) detonating the charge, and (4) removing the broken material. The type of explosives used and the placement within the drilled holes ensures that the rock is merely fragmented so it can be removed from the site, while limiting ground vibrations and air overpressure. Specification limits for maximum vibrations and air overpressure at adjacent facilities and structures will be developed by the Engineer during final design, and will be based on regulatory requirements, identification of the types of and distances to adjacent facilities and structures, and published research.

Spoil Handling and Disposal

The Project will generate both surface and tunnel muck of soil and broken rock, respectively. Regarding surface muck, reusable topsoil will be stockpiled locally and returned during site cleanup. Any topsoil and overburden not suitable for reuse will be stockpiled separately and removed for disposal.

Regarding tunnel muck, rock cuttings from the tunnel may be of good quality and have use as a structural fill on-site. Any cuttings not suitable for reuse will be stockpiled separately and removed for disposal.

Bentonite slurry used by the TBM will be removed from the tunnel via a slurry pipeline and processed at the surface to separate the bentonite from the excavated material, which will be stockpiled on site. Cleaned bentonite slurry is returned to the TBM's cutting chamber for reuse.

There are several potential muck disposal sites with capacity and reasonable haul distances from the Project construction site.

Other Construction Activities

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

- Muck handling system and slurry dewatering plant
- Temporary storage of muck, dewatering, and other materials
- Power substation
- Mechanics' shop and utility storage
- Precast tunnel 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

Within each LOD there will be a sediment basin and infiltration basin to collect and treat storm water and water generated during tunnel construction. Enbridge will secure all necessary regulatory approvals for the basins. Enbridge has applied separately for an NPDES permit for discharges of treated tunnel water.

Industry typical storm water best management practices (BMPs) will be used along the perimeter and within the LODs as needed and/or required by applicable permits. These may include silt fencing, perimeter soil berms, straw bales, and other erosion control devices. Enbridge's Environmental Protection Plan (attached) will be maintained during construction.

Access Roads

The north side LOD will be accessed via Boulevard Drive. Segments of the unpaved portions of Boulevard Drive may need to be improved or widened. From the North Straits Facility to the paved portion of Boulevard Drive to the east, the road will be improved to a total width of up to 14 feet to accommodate one-way construction traffic. Around the facility, Boulevard Drive will be widened up to a total of 20 feet wide to accommodate two-way construction traffic (Figure 2). 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 public roads and no improvements to them are anticipated.

The access roads will accommodate large equipment and provide access for equipment, personnel, and vehicles to the tunnel construction sites. The access roads will carry traffic required to develop the construction site area and will deliver the TBM and supporting components and materials 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 LODs and hauling excavated material from the construction of the tunnel portal and shaft. During tunneling by the TBM, the access roads will be used to remove tunnel muck from tunnel construction from the site for offsite disposal, as well as for general access to the site for delivery of materials and for other construction activities to build and support the tunnel.

Pipeline Installation, Decommissioning, and Tie-Ins

Once the tunnel has been constructed, installation of the 30-inch pipeline will be done by welding of pipe joints at the south side portal via production line means, and incremental pushing/pulling of the pipeline through the tunnel.

Once the new segment of pipeline across the Straits is put into service, the existing dual pipelines across the Straits will be decommissioned in accordance with federal, state and local regulations, as well as provisions in Article 7 of the Third Agreement between the State of Michigan and Enbridge.

The pipelines from the tunnel entrances will be “tied-in” to the existing 30-inch pipelines on both the north and south sides. Tie-ins may be performed via traditional open trench or trenchless methods (e.g. HDD). All tie-in ground disturbing activities will take place within the established LODs. If the north side tie-in is completed via a trenchless technique, it may extend outside the LOD, under Wetland 3 (Figure 8). There will be no ground disturbance to Wetland 3 if this option is employed.

Restoration

Once the tunnel has been constructed, pipeline installed and all operational structures in place, Enbridge will determine areas within LODs that may be restored. Until the permanent operational footprint of all structures and facilities are determined, a site specific restoration plan cannot be developed. At a minimum, all areas will be stabilized through the use of grading, seeding, graveling or other means. Permanent storm water management facilities will be established under a separate NPDES permit.

The crossing of Wetland 3 will be restored to original contours, seeded with an emergent wetland seed mix, and is expected over time to return to its natural state. Enbridge will monitor disturbed areas for invasive species.

Areas that may not be graveled during construction will be allowed to revegetate naturally. Enbridge is willing to consider mitigation measures, within and/or outside of the LOD, to help compensate for effects to protected plant species within the LOD. For example, it may be practical to relocate some plant populations to off-site areas nearby to enhance existing populations or establish new ones.



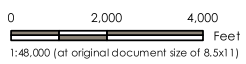
Legend
 Limits of Disturbance
 - - - - Existing Line 5

Figure No.
1

Title
Vicinity Map

Client/Project
Enbridge Great Lakes Tunnel Project
Joint Permit Application

Project Location
Emmet County & Mackinac County, MI
 Prepared by JM on 2019-12-19
 Technical Review by JH on 2019-12-20
 Independent Review by KW on 2020-03-31



- Notes**
1. Coordinate System: NAD 1983 UTM Zone 16N
 2. Data Sources Include: Stantec, Enbridge, NADS, USGS
 3. Background: USGS 7.5' Topographic Quadrangles

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- Legend**
- Workspace
 - Access Road
 - Potential Trenchless Tie-in Centerline
 - Existing Pipeline

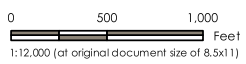
- Notes**
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 2. Data Sources Include: Stantec, Enbridge, NADS, USGS
 3. Orthophotography: 2018 NAIP

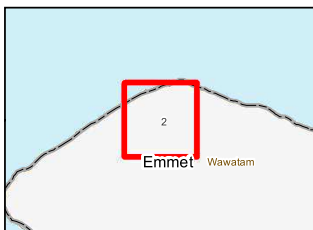
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Figure No. **2A**
 Title **Project Overview Map**

Client/Project
 Enbridge Great Lakes Tunnel Project
 Joint Permit Application

Project Location Mackinac County, Michigan
 Prepared by JM on 2019-12-19
 Technical Review by JH on 2019-12-20
 Independent Review by KW on 2020-03-31





Legend

- Workspace
- Access Road
- Potential Tie-in Centerline
- Existing Pipeline

Notes

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

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

Figure No.

2B

Title

Project Overview Map

Client/Project

Enbridge Great Lakes Tunnel Project
Joint Permit Application

Project Location

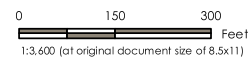
Emmet County, Michigan

193705885

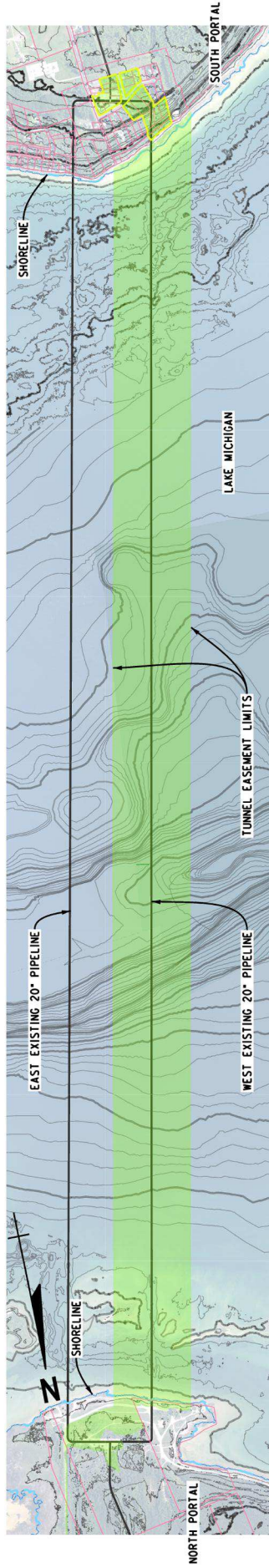
Prepared by JM on 2019-12-19

Technical Review by JH on 2019-12-20

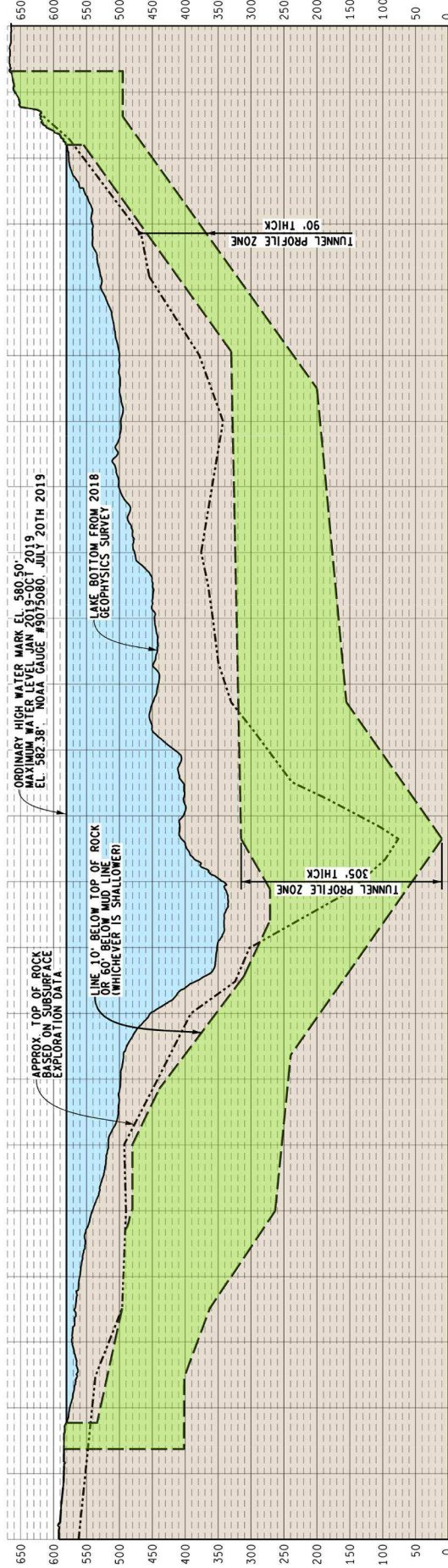
Independent Review by KW on 2020-03-31



PLAN



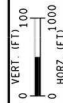
PROFILE



NOTES:

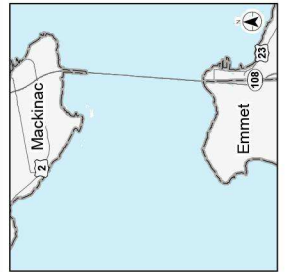
1. MINIMUM DEPTH OF LIMITS OF TUNNEL IN PROFILE HAVE BEEN ESTABLISHED TO MAINTAIN THE TUNNEL CROWN (EXTRADOS) AT LEAST 10 FT BELOW TOP OF ROCK OR 60 FT BELOW MUDLINE, WHICHEVER IS SHALLOWER, AND TO MAINTAIN A CONTINUOUS DOWNWARD GRADE TOWARDS THE DEEPEST PORTION OF THE TUNNEL.
2. MINIMUM DEPTH LIMITS HAVE BEEN FURTHER ADJUSTED IN CONSIDERATION OF AVAILABLE DATA FROM THE SUBSURFACE EXPLORATION PROGRAM.
3. MAXIMUM DEPTH OF LIMITS OF TUNNEL IN PROFILE HAVE BEEN ESTABLISHED BASED ON AVAILABLE DATA FROM THE SUBSURFACE EXPLORATION PROGRAM AND A MAXIMUM PRACTICAL OPERATIONAL SLOPE IN THE RANGE OF 7 TO 8 PERCENT.

LIMITS OF TUNNEL IN PLAN AND PROFILE. TUNNEL WILL BE DESIGNED AND CONSTRUCTED SUCH THAT IT IS WITHIN THE LIMITS SHOWN.



DATE: 3/22/2020
DRAWN BY: K. MANNING
APPROVED BY: E. DWYRE

GREAT LAKES TUNNEL PROJECT		DRAWING SHEET
STRAITS OF MACKINAC, MICHIGAN		
LIMITS OF TUNNEL PLAN AND PROFILE		002



Legend
— Existing Pipeline

*Figures not to scale.

Data Sources: Stantec, Enbridge, WSP, NADS, USGS

Figure No. 3

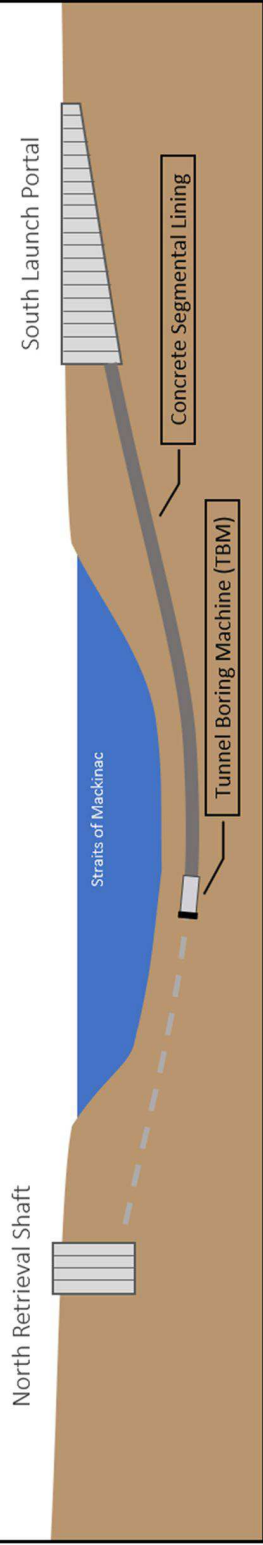
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Tunnel Profile

Client/Project
Enbridge Great Lakes Tunnel Project
Joint Permit Application

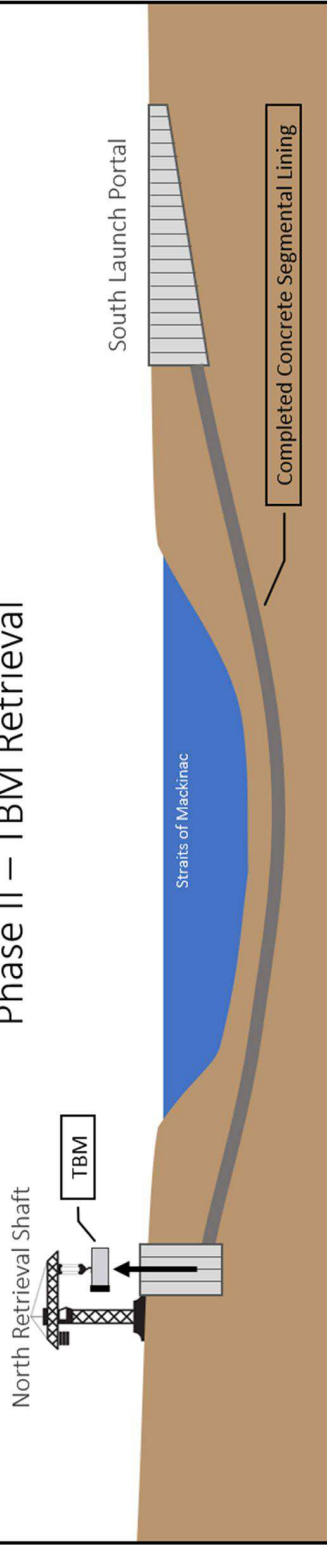
Project Location
Mackinac & Emmet County, Michigan



Phase I - Tunnel Construction



Phase II - TBM Retrieval



Phase III - Pipeline Installation

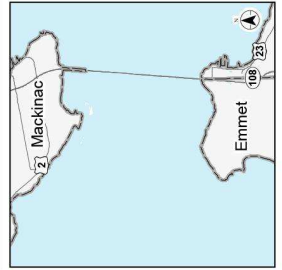
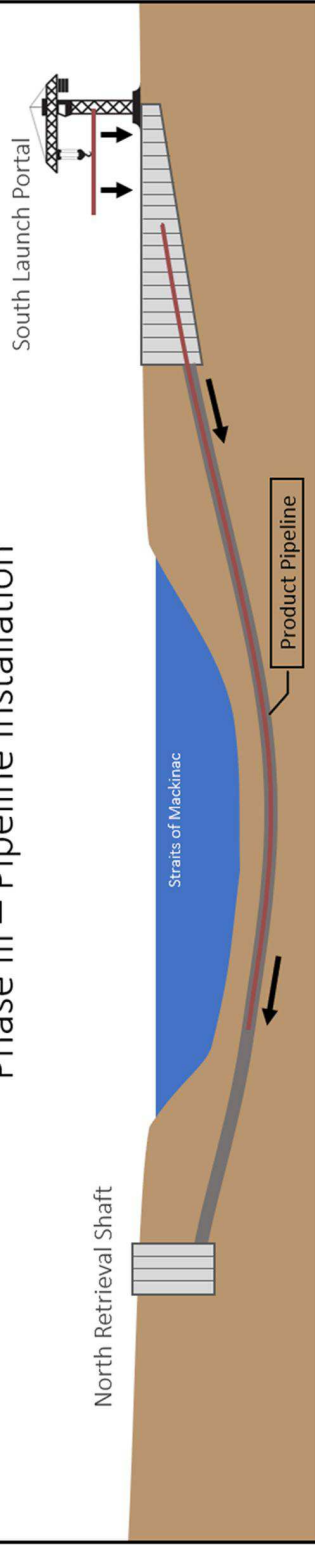


Figure No. 4

Tunnel Configuration

Client/Project
Enbridge Great Lakes Tunnel Project
Joint Permit Application

Project Location
Mackinac & Emmet County, Michigan



NO.	DATE	AUTH	DESCRIPTION

FINAL PLAN REVISIONS (SUBMITTAL DATE:)

NO. DATE AUTH DESCRIPTION

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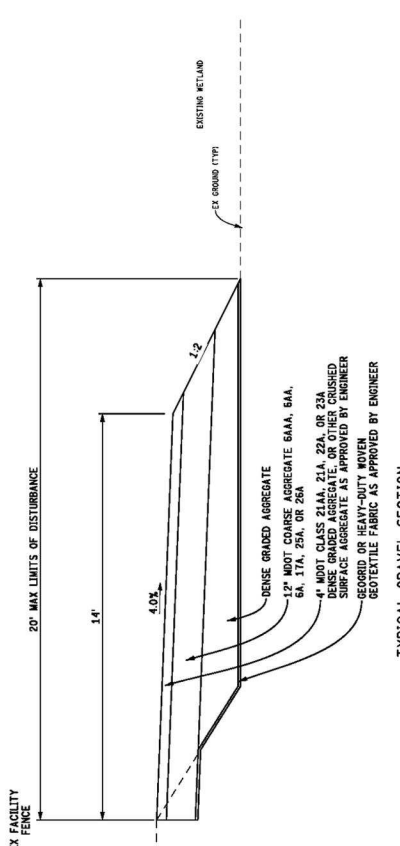
0 0 HORIZ. (FT) 4

DATE: 01/21/2020
 DRAWN BY: A. SCHIMBERG
 APPROVED BY: E. DMYRE

GREAT LAKES TUNNEL PROJECT
 STRAITS OF MACKINAC, MICHIGAN
 TYPICAL SECTION GRAVEL

BRADING SHEET
 014

FILE: 31402075.000



TYPICAL GRAVEL SECTION

NO.	DATE	AUTH	DESCRIPTION

FINAL PLAN REVISIONS (SUBMITTAL DATE:)

NO. DATE AUTH DESCRIPTION

3 0 VERT. (FT) 4

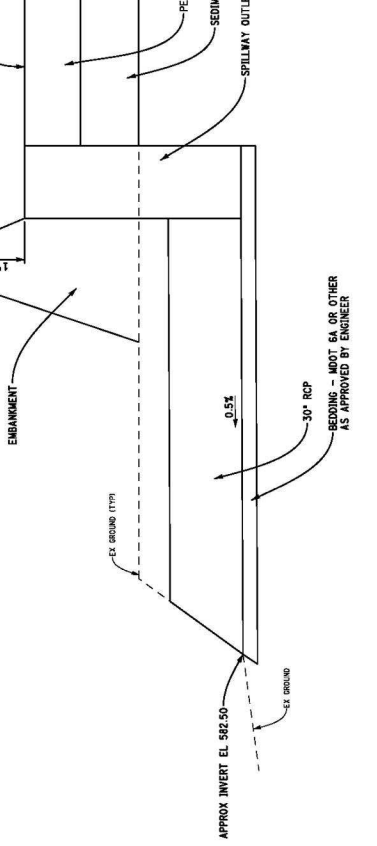
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DATE: 07/28/2020
 DRAWN BY: A. SCHIMBERG
 APPROVED BY: E. DMYRE

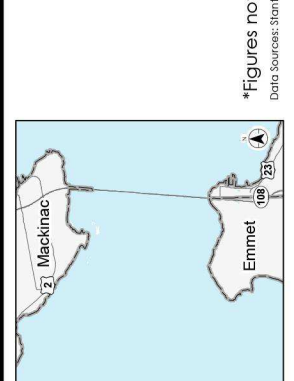
GREAT LAKES TUNNEL PROJECT
 STRAITS OF MACKINAC, MICHIGAN
 TYPICAL SECTION CULVERT

BRADING SHEET
 015

FILE: 31402075.000



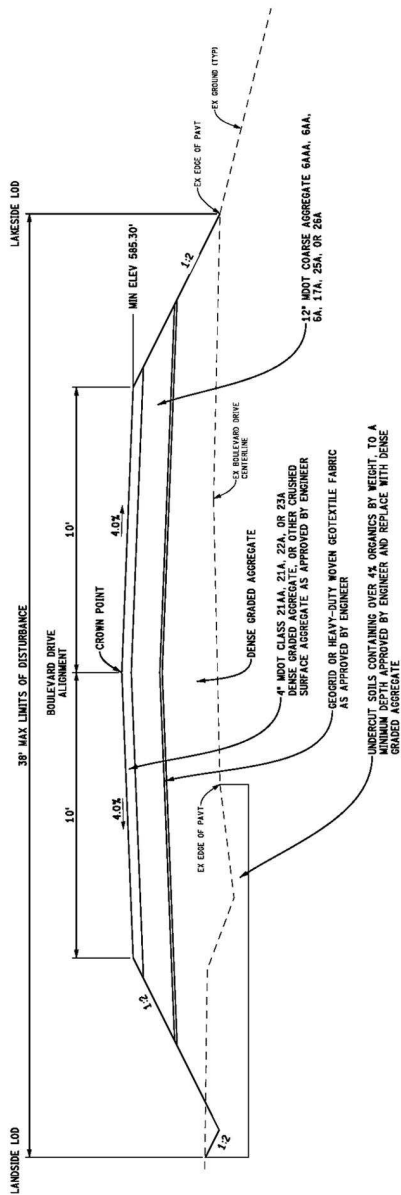
TYPICAL SECTION POND OUTLET CULVERT



*Figures not to scale.
 Data Sources: Stantec, Enbridge, WSP, NADS, USGS

Figure No. **5**
 Title
North Shore LOD Wetland Impact Cross-Sections
 Client/Project
 Enbridge Great Lakes Tunnel Project
 Joint Permit Application
 Project Location
 Mackinac & Emmet County, Michigan





TYPICAL SECTION
 PROPOSED BOULEVARD DRIVE - SOUTH AND EAST OF
 FACILITY ACCESS (TWO-WAY TRAFFIC)
 FACING EAST

FINAL PLAN REVISIONS	3	DATE	DESCRIPTION	DATE	DESCRIPTION	DATE	DESCRIPTION
NO.	DATE	AUTH					
VERT. (FT)				HORIZ. (FT)			
0 4				0 4			
GREAT LAKES TUNNEL PROJECT				DRAWING SHEET			
STRAITS OF MACKINAC, MICHIGAN				003			
TYPICAL SECTION BOULEVARD DRIVE							
DATE: 01/31/2020				DRAWN BY: A. SCHIMBERG			
				APPROVED BY: E. D'INTRE			

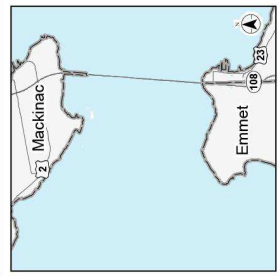
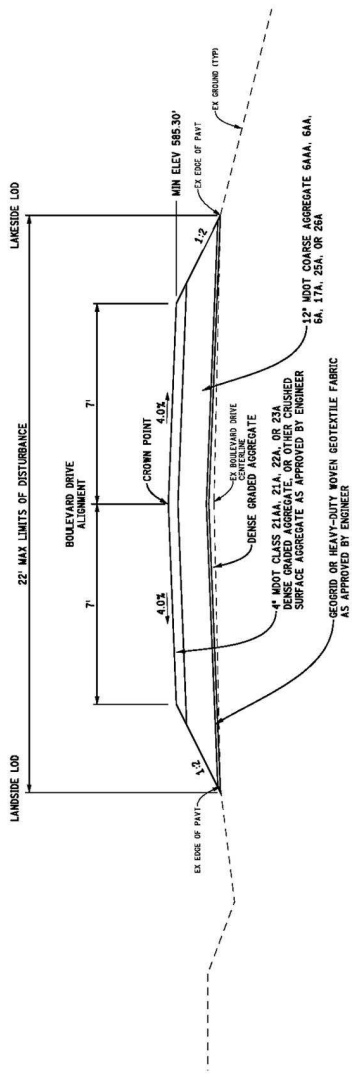


Figure No. **6A**
 Title **Access Road Typical**
 Client/Project Enbridge Great Lakes Tunnel Project
 Joint Permit Application
 Project Location Mackinac & Emmet County, Michigan





TYPICAL SECTION
 PROPOSED BOULEVARD DRIVE - NORTH OF FACILITY
 FACING NORTH

FINAL PLAN REVISIONS	NO.	DATE	AUTH	DESCRIPTION	DATE	BY	APPROVED BY	DATE	BY	APPROVED BY	PROJECT	SHEET
	1				01/31/2020	A. SCHIMBERG	E. DWYRE	01/31/2020	A. SCHIMBERG	E. DWYRE	GREAT LAKES TUNNEL PROJECT STRAITS OF MACKINAC, MICHIGAN	004

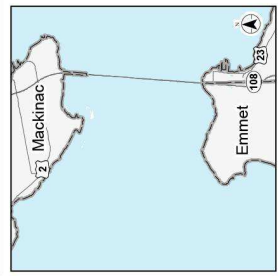
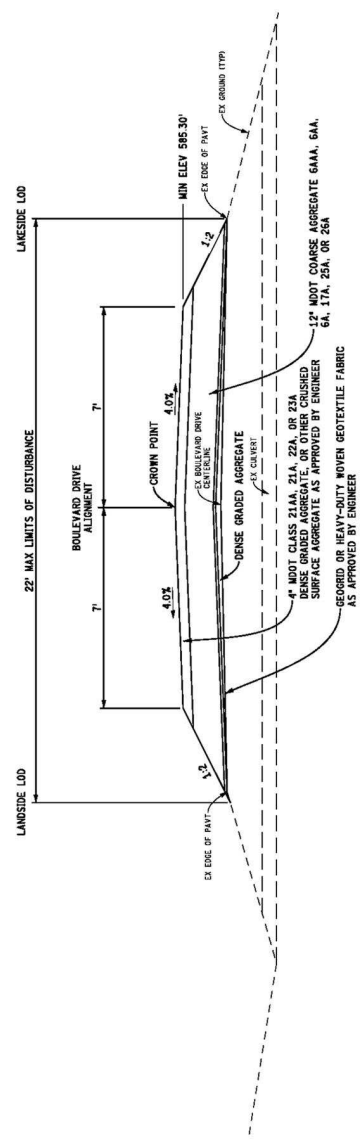


Figure No. **6B**
 Title **Access Road Typical**
 Client/Project Enbridge Great Lakes Tunnel Project
 Joint Permit Application
 Project Location Mackinac & Emmet County, Michigan





TYPICAL SECTION
 PROPOSED BOULEVARD DRIVE - NORTH OF FACILITY
 ACCESS (ONE-WAY TRAFFIC)
 FACING NORTH

NO.	DATE	AUTH.	DESCRIPTION	3	DESCRIPTION	VERT. (FT)	HORZ. (FT)	DATE	BY	APPROVED BY	PROJECT	SHEET
						0	0	01/31/2020	A. SCHIMBERG	J. FOX	GREAT LAKES TUNNEL PROJECT STRAITS OF MACKINAC, MICHIGAN	005
						4	4				TYPICAL SECTION BOULEVARD DRIVE - CULVERT	

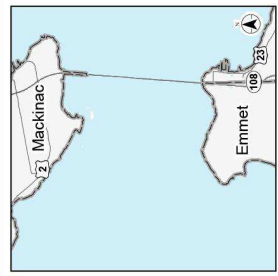


Figure No. **6C**
 Title **Access Road Typical**
 Client/Project Enbridge Great Lakes Tunnel Project
 Joint Permit Application
 Project Location Mackinac & Emmet County, Michigan



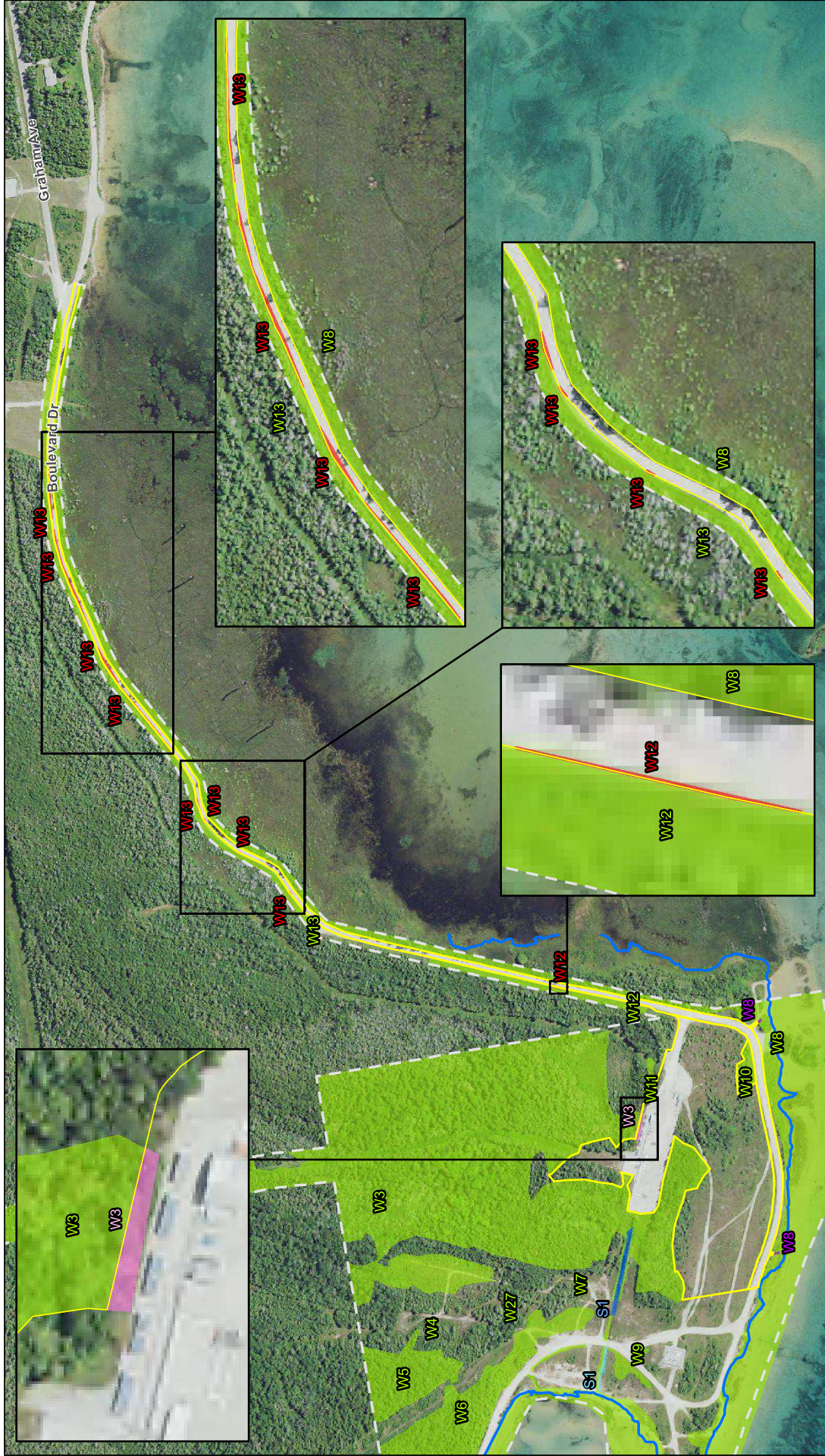


Figure No.
7A

Title
**Wetlands and Waterbodies
within the LOD**

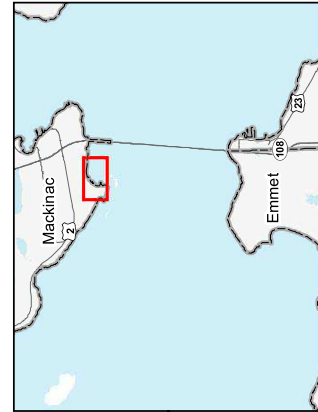
Client/Project
Enbridge Great Lakes Tunnel Project
Joint Permit Application

Project Location

Prepared by: JM on 2019/12/19
Technical Review by: JH on 2019/12/20
Independent Review by: KW on 2020/03/31



- Legend**
- Limits of Disturbance
 - Survey Area
 - Approximate OHWM
 - Stream 1 - EGLE Part 301 Regulated
 - Stream 1 - USACE Section 404 Regulated
- Field Delineated Wetlands - By Type**
- PFO
 - PEM/PUB
 - PEM/PFO
 - Wetland Outside LOD



Data Sources: Stanlec, Enbridge, NAD83, USGS



Figure No.
7B

Title
**Wetlands and Waterbodies
within the LOD**

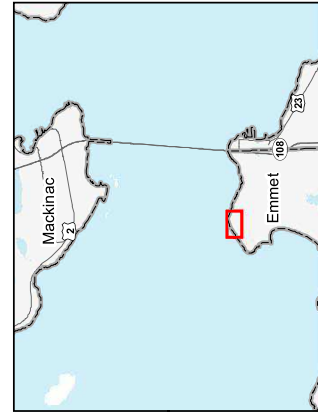
Client/Project
Enbridge Great Lakes Tunnel Project
Joint Permit Application

Project Location
Emmet Co., MI
Prepared by JM on 2019/12/19
Technical Review by JH on 2019/12/20
Independent Review by KW on 2020/03/31



Legend

- Limits of Disturbance
 - Survey Area
 - Approximate OHWM
 - Stream 1 - EGLE Part 301 Regulated
 - Stream 1 - USACE Section 404 Regulated
-
- PFO
 - PEM/PUB
 - PEM/PFO
 - Wetland Outside LOD



Data Sources: Stanlec, Enbridge, NAD83, USGS

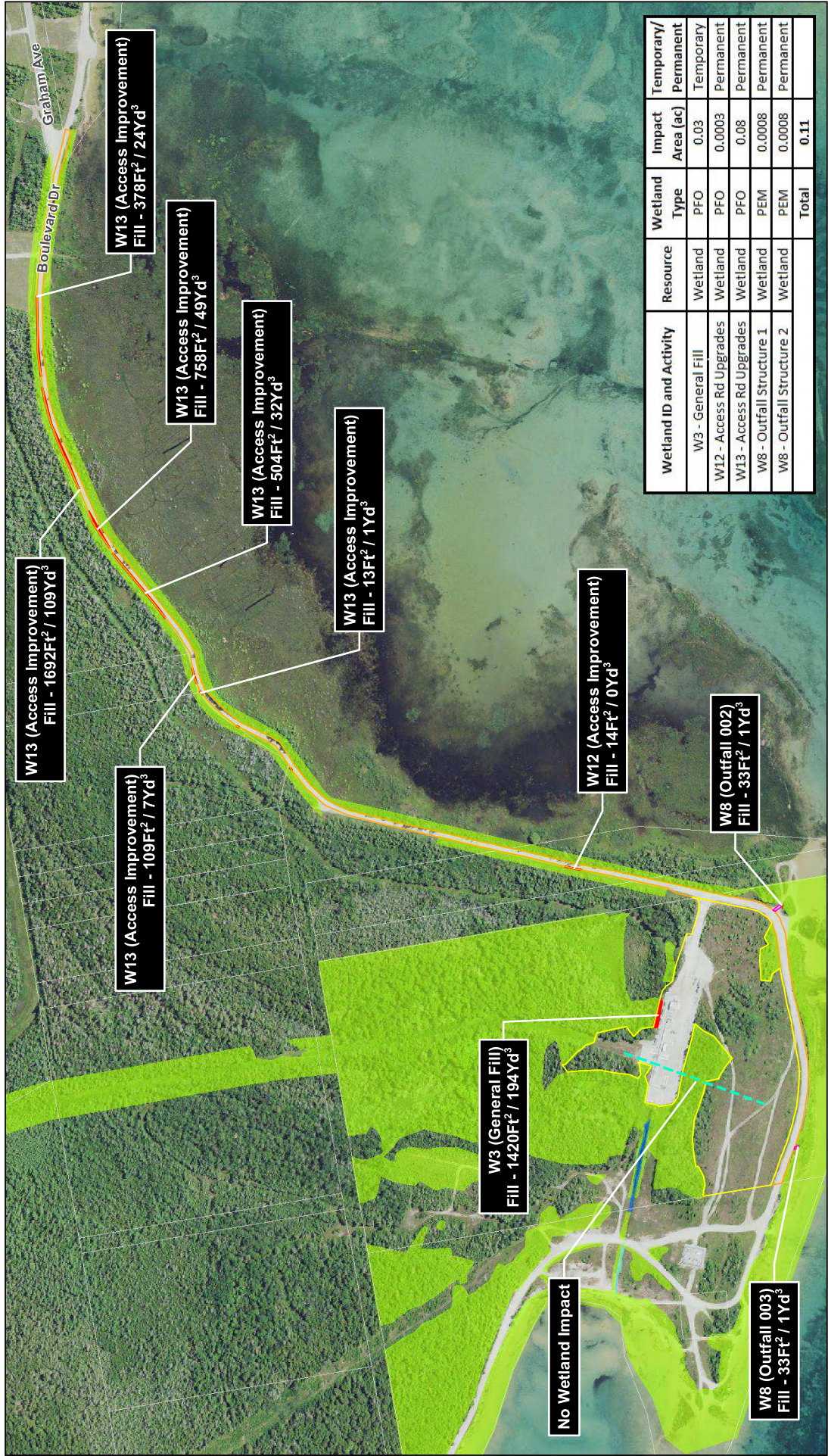


Figure No. 8A

Wetland and Waterbody Impacts

Client/Project: Enbridge Great Lakes Tunnel Project
 Joint Permit Application

Project Location: Mackinac Co., MI

Prepared by: JH on 2019/12/19
 Technical Review by: JH on 2019/12/20
 Independent Review by: KW on 2020/03/31

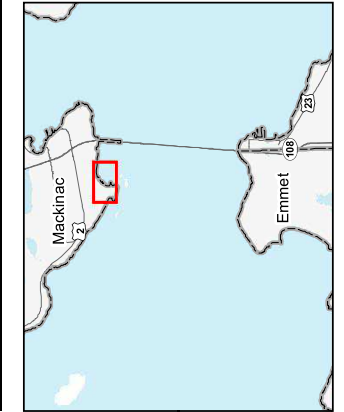
Scale: 0, 300, 600 Feet

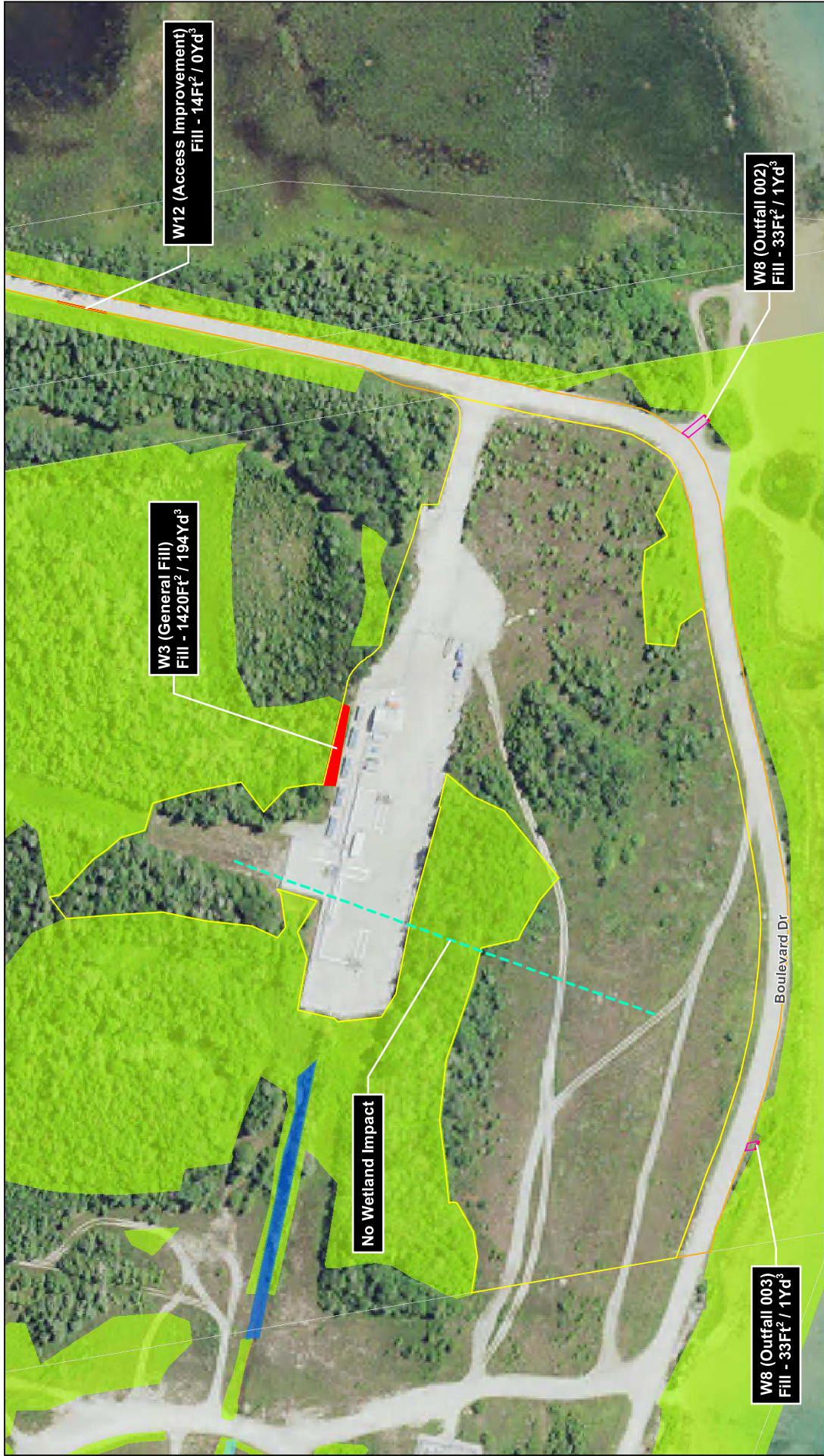
North Arrow

Legend

- Parcel Boundary
- Potential Trenchless Tie-in Centerline
- Stream 1 - EGLE Part 301 Regulated
- Stream 1 - USACE Section 404 Regulated
- Field Delineated Wetland
- Impact Area
- Access Improvement
- General Fill
- Outfall Structure
- No Wetland Impact

Data Sources: Stanlec, Enbridge, NAD83, USGS





W12 (Access Improvement)
Fill - 14Ft² / 0Yd³

W3 (General Fill)
Fill - 1420Ft² / 194Yd³

No Wetland Impact

W8 (Outfall 002)
Fill - 33Ft² / 1Yd³

W8 (Outfall 003)
Fill - 33Ft² / 1Yd³

Figure No. **8B**

Wetland and Waterbody Impacts

Client/Project
Enbridge Great Lakes Tunnel Project
Joint Permit Application

Project Location
Mackinac Co., MI
Prepared by JW on 2019.12.19
Technical Review by JH on 2019.12.20
Independent Review by KW on 2020.03.31

- Stream 1 - EGLE Part 301 Regulated
- Stream 1 - USACE Section 404 Regulated
- Field Delineated Wetland
- Impact Area

- Parcel Boundary
- Potential Trenchless Tie-in Centerline
- Impact Activity
- Access Improvement
- General Fill
- Outfall Structure

Data Sources: Stantec; Enbridge; NAD83; USGS



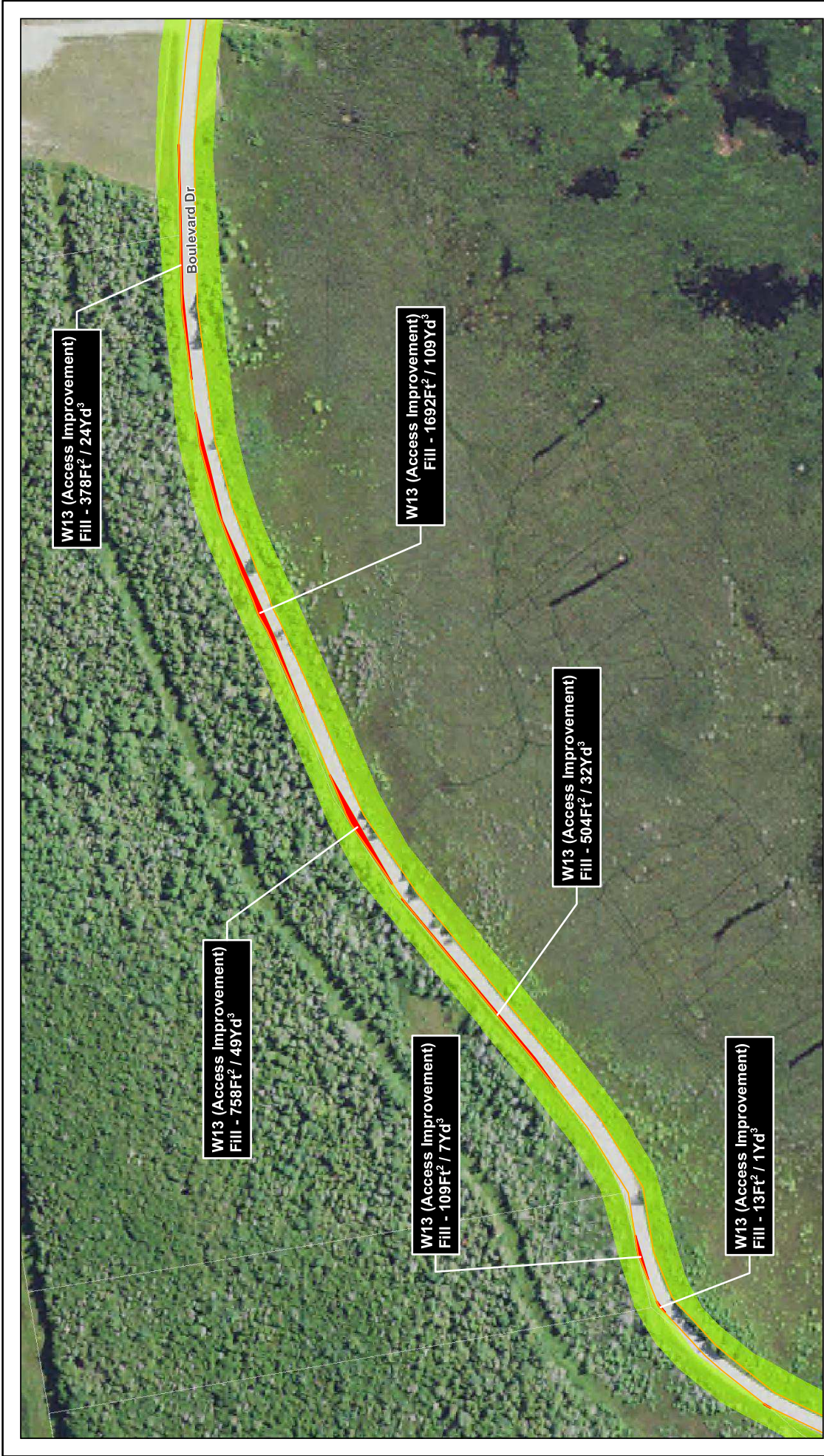
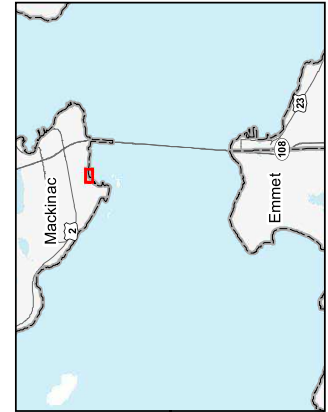
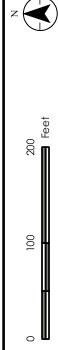


Figure No.
8C

Title
Wetland and Waterbody Impacts

Client/Project
Enbridge Great Lakes Tunnel Project
Joint Permit Application

Project Location
Mackinac Co., MI
Prepared by: JN on 2019/12/19
Technical Review by: JH on 2019/12/20
Independent Review by: KW on 2020/03/31



Data Sources: Stantec, Enbridge, NAD83, USGS

June 8, 2020

Joseph Haas
 Michigan Department of Environment, Great Lakes, and Energy
 Gaylord District Office
 Water Resources Division
 Submission No. HNY-NHX4-FS42Q

Dear Mr. Haas,

In response to the correction request received from your office on May 4, 2020, we are pleased to submit additional information for the Great Lakes Tunnel Project (GLTP) Joint Permit Application (JPA) (Submission No. HNY-NHX4-FS42Q) regarding additional mitigation measures to help offset proposed impacts to the wetlands.

A summary of wetland impacts is presented in Table 1 below. Proposed impacts include 0.03 acre of temporary impacts and 0.1 acre of permanent impacts, for a total of 0.13 acres of wetland impact.

Table 1. Wetland Impacts

Wetland ID and Activity	Resource	Wetland Type	Impact Area (ac)	Temporary/Permanent
W3 - General Fill	Wetland	PFO	0.03	Temporary
W12 - Access Rd Upgrades	Wetland	PFO	0.0003	Permanent
W13 - Access Rd Upgrades	Wetland	PFO	0.08	Permanent
W8 - Outfall Structure 002	Wetland	PEM	0.01	Permanent
W8 - Outfall Structure 003	Wetland	PEM	0.01	Permanent
		Total	0.13	

The majority of wetland impacts (wetland W13) are of low quality and much of the impacted areas are low lying areas within, and along the shoulder of, Boulevard Drive. Wetland mitigation options in the eastern Upper Peninsula are limited as no banks exist and there are very few prior converted wetlands near Point La Barbe that would make suitable mitigation sites.

Enbridge is proposing to enhance an on-site wetland that contains invasive *Phragmites australis* (see attached Figure 1). Enbridge will remove this species from the wetland using mechanical means and/or herbicide applications and plant a native wetland seed mix. Enbridge will evaluate the area periodically and remove *Phragmites* that may continue to grow until native wetland plant species are established.

Enbridge is also proposing out-of-kind mitigation by installing barriers along portions of their property line to help prevent unauthorized vehicle traffic (both on and off road). There is evidence of damage to wetlands, plants and soil along much of the western and southern property boundaries from unauthorized vehicles. There is also household debris in these areas, likely from unauthorized vehicles.

Enbridge is proposing to relocate some protected plant species to the northwestern portion of their property and barriers will help prevent damage to these relocated plants, existing protected plant species, wetlands and upland communities.

The southern portion of the property has evidence of significant unauthorized vehicle activity. This area will contain workspace for the tunnel construction. Portions of this area will be fenced after tunnel construction. Enbridge will work with Moran Township and the adjacent property owner to the west (Cloverland Electric) to develop an overall plan the help prevent unauthorized vehicle activity in this area.

The approximate areas where barriers would be installed are shown on the attached Figure 1. Areas with large trees would not have barriers installed. Barriers may include fencing, boulders, J barriers, posts or other means. Portions along Boulevard Drive may have guard rail installed.

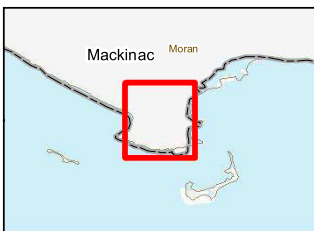
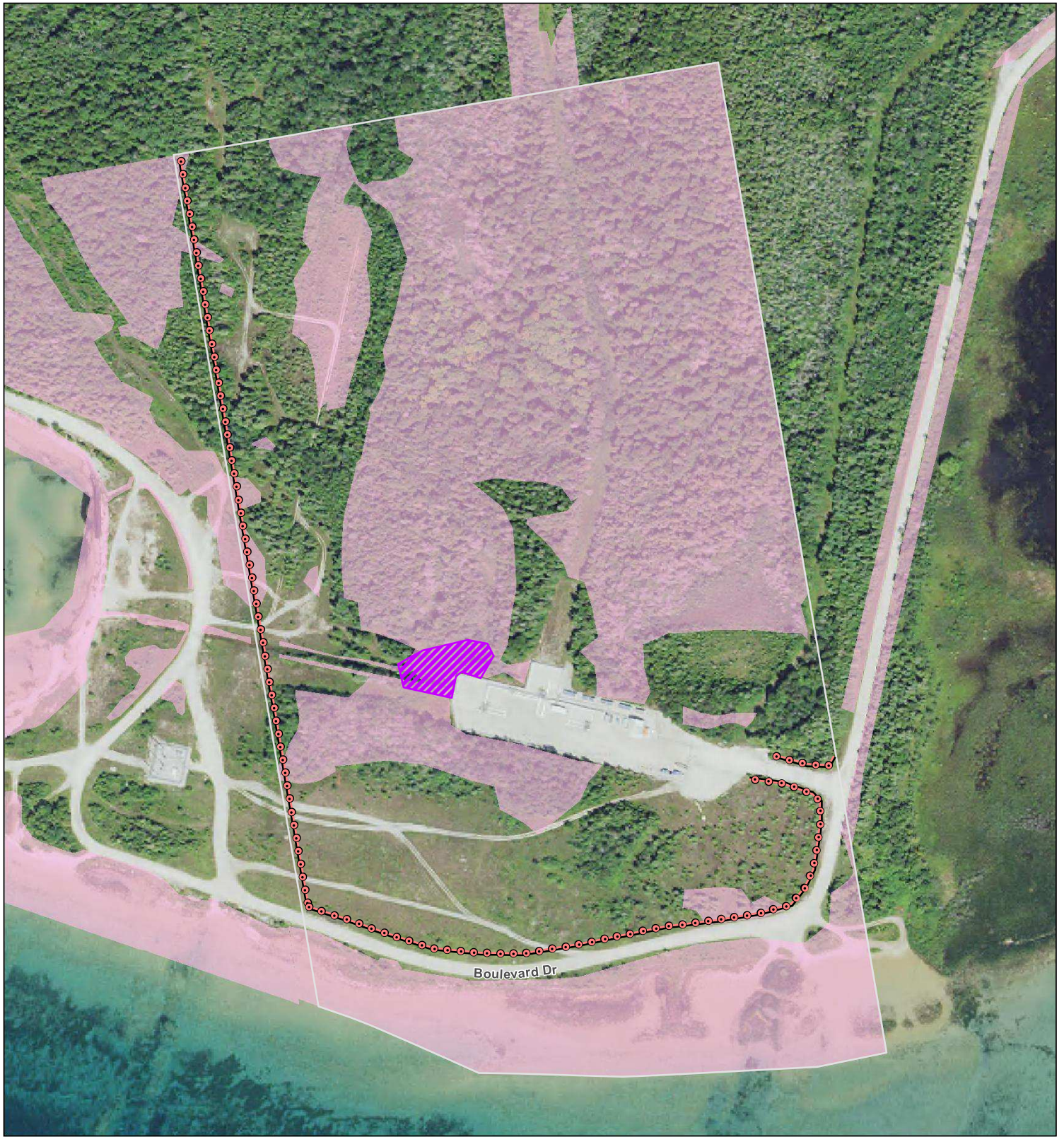
Enbridge will periodically evaluate the effectiveness of the barriers and maintain, improve or add additional barriers as needed.

If you have questions or comments on the information provided, please feel free to contact me at the phone number or email address in the signature below. You may also contact Jeff Benefiel at Stantec (jeff.benefiel@stantec.com or 980-213-7730).

Sincerely,

A handwritten signature in blue ink, appearing to read "Paul Turner", is written over a horizontal line.

Paul Turner
Environmental Specialist, US Projects
paul.turner@enbridge.com
(218) 269-0560



Legend

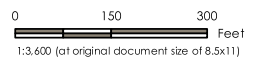
- Enbridge Property Boundary
- Approximate Barrier Installation Location*
- Pragnites australis Population
- Surveyed Wetland

- Notes**
1. Coordinate System: NAD 1983 UTM Zone 18N
 2. Data Sources Include: Stantec, Enbridge, NADS, USGS
 3. Orthophotography: 2018 NAIP

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

*Mature trees will not be removed for the placement of barriers. Barrier locations shown and extent are approximate.

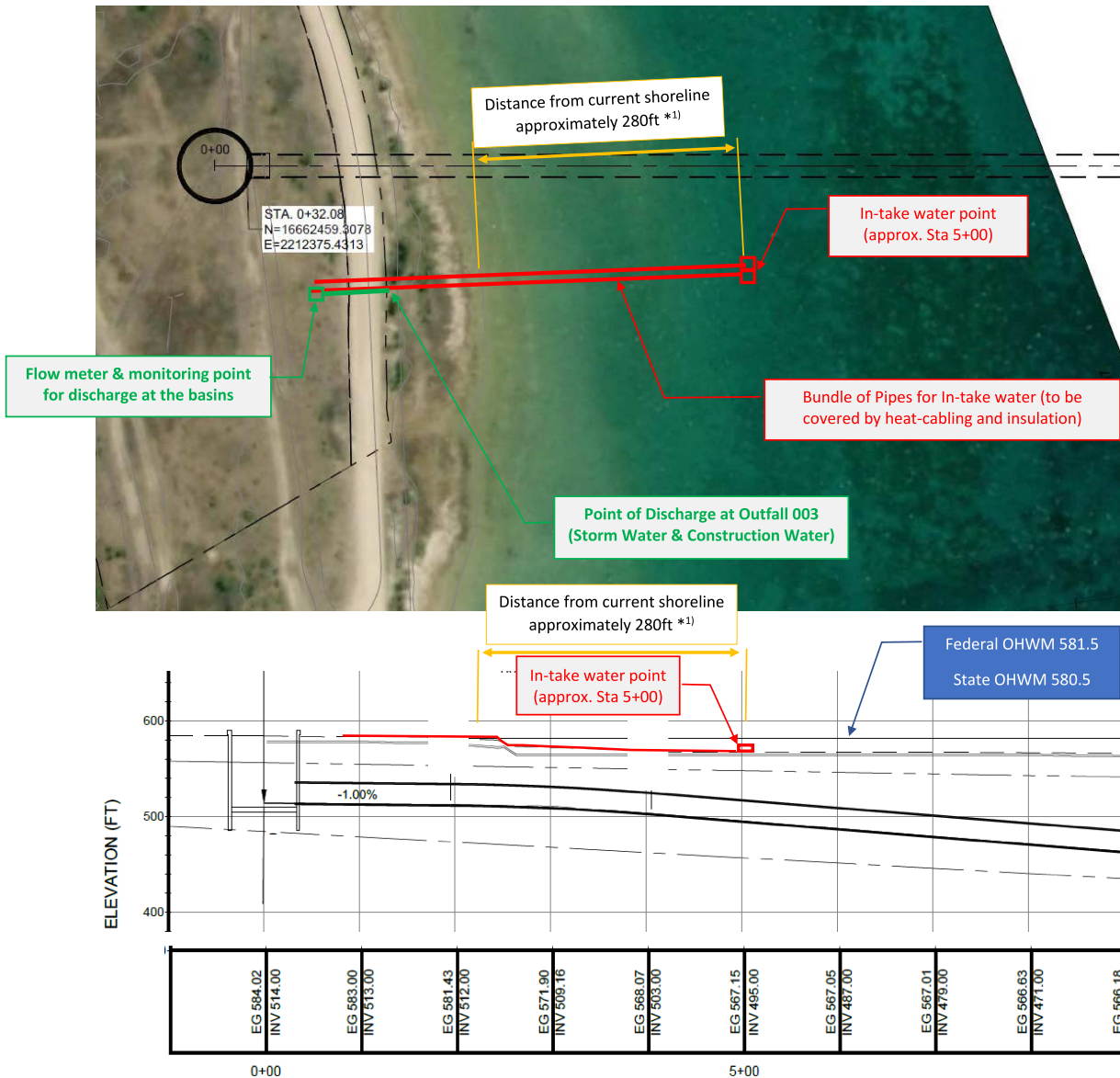
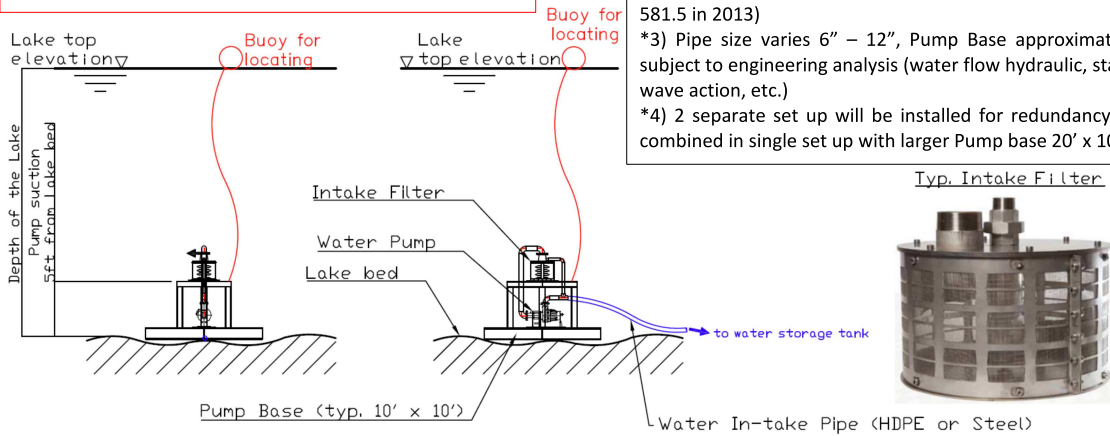
Figure No. **1**
 Title **Wetland Mitigation Plan Map**
 Client/Project **Enbridge Great Lakes Tunnel Project Wetland Mitigation Plan**
 Project Location **Mackinac County, Michigan** Prepared by JM on 2020-06-03
 Technical Review by SC on 2020-06-03
 Independent Review by KW on 2020-06-03



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' +



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 -

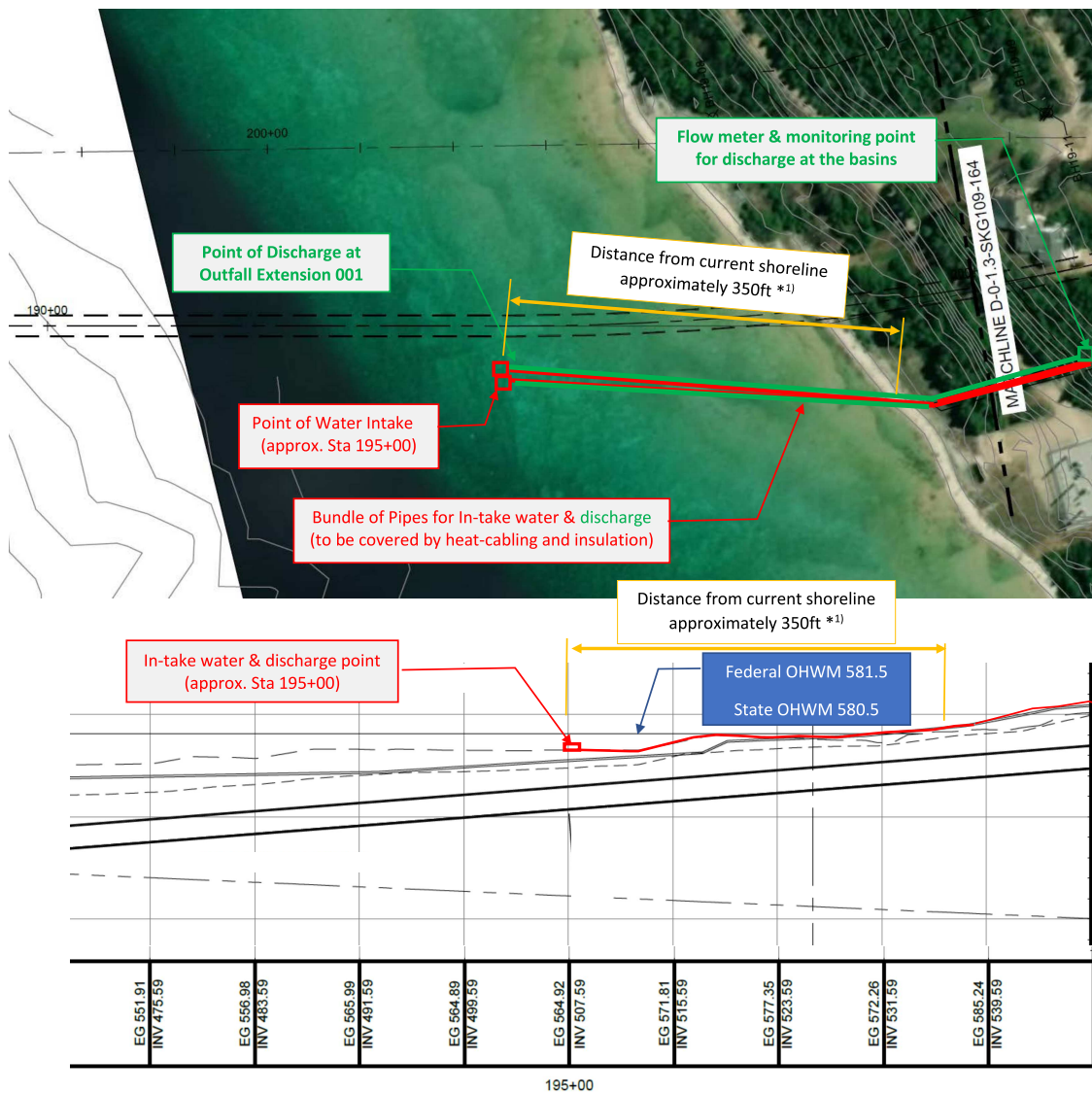
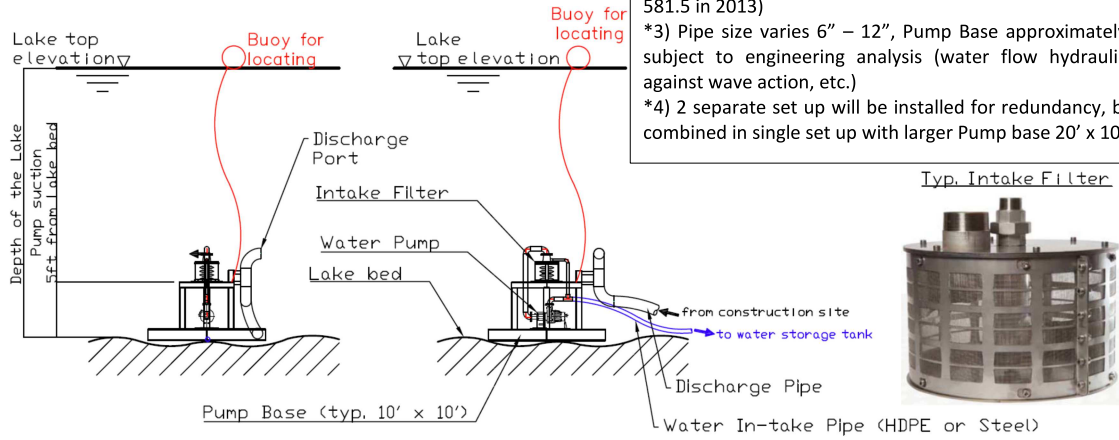
*1) The current intake location is based on an approximate 17ft water depth, as shown in the profile below. The location is subject to adjustment based on the actual contour of lake bed.

*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' +



Great Lakes Tunnel Project

Alternative Analysis and Minimization of Impacts Report

The Great Lakes Tunnel Project (Project) is an underground tunnel that will be constructed and operated by Enbridge Energy, Limited Partnership (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 (State) 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 tunnel will 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 North Straits Facility located on the north side of the Straits to an opening point as near as practicable to Enbridge’s existing Line 5 Mackinaw Station located on the south side of the Straits.

Except for the entrance points on either side of the Straits, the tunnel will be constructed entirely underground, approximately 60 feet beneath the lakebed of the Straits. The tunnel will be approximately 21 feet finished inside diameter. The tunnel will accommodate the replacement of that portion of Enbridge’s Line 5 pipeline¹ (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 utilities into the lakebed or the Straits.

Additional background information is provided below regarding the actions and assessment that led to the Tunnel Agreement. Alternatives, including a no-action alternative and tunnel alignment alternatives, are also described below.

¹ Line 5, in operation since 1953, transports light crude oil, light synthetic crude oil, light sweet crude oil, and natural gas liquids (NGLs). It provides the feedstock for refineries throughout the region that produce petroleum products such as gasoline, propane, diesel and jet fuel used by consumers across Michigan and surrounding regions.

In Michigan, Line 5 crosses the Straits, an approximately 4-mile long span of water that connects Lake Michigan and Lake Huron. At the point of and for the duration of that crossing, Line 5 consists of two 20-inch diameter pipes that rest on or are anchored to the submerged lands located below the Straits (referred to as the “Line 5 Dual Pipelines” or “Dual Pipelines”).

Tunnel Agreement and Alternatives Report Background

A complete alternatives analysis for the proposed tunnel project was completed by Enbridge on June 15, 2018, titled *Alternatives for Replacing Enbridge's Dual Line 5 Pipelines Crossing the Straits of Mackinac* (Alternatives Report). The Alternatives Report was provided to the State and can be located at:

<https://mipetroleumpipelines.com/document/alternatives-replacing-enbridges-dual-line-5-pipelines-crossing-straits-mackinac>

The Alternatives Report was completed to satisfy Enbridge's obligation under the "First Agreement"² that Enbridge entered with the State on November 27, 2017, which required Enbridge to prepare a report assessing the replacement alternatives for the Line 5 Dual Pipelines across the Straits. In accordance with that obligation, the Alternatives Report assessed the following three alternatives to replace the Line 5 Dual Pipelines' crossing of the Straits with a new pipeline:

1. Constructing an underground tunnel beneath the lakebed of the Straits in which a new pipeline would be constructed, operated, and maintained (referred to as "Tunnel Alternative");
2. Installing a new pipeline across the Straits using an open-cut method that includes secondary containment (referred to as "Open-Cut Alternative"); or
3. Installing a new pipe below the Straits using the horizontal directional drilling method (referred to as "HDD Alternative").

The Alternatives Report assessed the costs and engineering requirements for the construction of each alternative identified above. The Alternatives Report also identified the approvals and authorizations necessary to construct, operate, and maintain each of the alternatives, as well as assessed each alternative's potential environmental impacts.

The Alternatives Report concluded that the HDD Alternative was not technically feasible due to: the pipe diameter required for the replacement (30-inch); the characteristics of the hard subsurface rock (dolomite and limestone); and the approximate four-mile length of the drill required.

The Alternatives Report concluded that both the Tunnel Alternative and Open-Cut Alternative were technically feasible replacements to the Line 5 Dual Pipelines. While the Tunnel Alternative was determined to have a greater cost (\$350-500 million), the Alternatives Report concluded that a tunnel would virtually eliminate the potential for any release into the Straits, and would have no impacts to the navigable waters in the Straits or the lakebed in contact with the water of the Straits during construction or after its built. The Open-Cut Alternative was identified as having a lower cost (\$250-300 million) but having only the potential to reduce the probability of a release into the Straits. Also, the Open-Cut Alternative would result in direct and indirect environmental impacts to the navigable waters, lakebed, and shorelines of the Straits during construction.

Following the issuance of the Alternatives Report, the Tunnel Alternative was agreed upon by the State and Enbridge as the preferred feasible alternative for the replacement of the Line 5 Dual Pipelines. Specifically, on October 3, 2018, Enbridge and the State entered into what is referred to as the "Second

² Available at <https://mipetroleumpipelines.com/document/agreement-between-state-michigan-and-enbridge-energy-line-5-michigan>.

Agreement,”³ which recognized that construction of a tunnel beneath the lakebed of the Straits connecting the upper and lower peninsulas of Michigan, and the placement in the tunnel of a new oil pipeline, is a feasible and prudent alternative for replacing the Line 5 Dual Pipelines. A tunnel would essentially eliminate the risk of adverse impacts that may result from a potential oil spill in the Straits and eliminate the possibility of an anchor strike to the pipeline. Under the Second Agreement, Enbridge and the State agreed to negotiate additional agreements in furtherance of the Tunnel Alternative.

In connection with the State’s commitment to negotiate further agreements concerning the construction of the Tunnel Alternative, the Michigan Legislature enacted Public Act 359 in December 2019. That statute created the Authority and provided that agency with authority to enter agreements to construct, own, operate, and lease a utility tunnel beneath the Straits. Following the enactment of Public Act 359, the Authority and Enbridge executed the “Tunnel Agreement,”⁴ which sets forth the process by which Enbridge will construct a tunnel under the oversight of the Authority and provides for the Authority’s ownership of the tunnel upon its completion. The Tunnel Agreement further provides that, upon completion of the tunnel, the Authority will lease the tunnel to Enbridge for purposes of operating and maintaining a replacement to the Line 5 Dual Pipelines to be located in the tunnel. The tunnel also will provide the potential to accommodate other third-party utilities, such as electric transmission, broadband, and telecommunication lines. To facilitate the construction of the tunnel, the Authority, in accordance with its obligations under the Tunnel Agreement, obtained from the Michigan Department of Natural Resources (MDNR) an easement to allow the Authority to access, occupy, and use the subsurface lands of the Straits for the tunnel.⁵ The Authority subsequently assigned certain rights under that MDNR Easement to Enbridge to access, occupy, and use such subsurface lands for purposes of constructing, operating, and maintaining the tunnel.⁶ Enbridge separately entered into the “Third Agreement”⁷ with the State, which further acknowledges the Tunnel Alternative as a feasible alternative to replace the Line 5 Dual Pipelines.

Consistent with Enbridge’s obligations under the Agreements identified above and related legislation, Enbridge is pursuing, the Tunnel Alternative. The range of project alternatives to the Tunnel Alternative are: (1) a no-action alternative, under which a tunnel is not pursued; or (2) an action alternative, under which EGLE considers and identifies a preferred alternative for the location of the tunnel entrances on the north and south sides of the Straits. These project alternatives are discussed in more detail in the sections that follow.

³ Available at <https://mipetroleumpipelines.com/document/second-agreement-between-state-michigan-and-enbridge-energy-line-5-michigan>.

⁴ Available at <https://mipetroleumpipelines.com/document/tunnel-agreement-between-msca-and-enbridge-energy>.

⁵ Available at <https://mipetroleumpipelines.com/document/easement-underground-utility-tunnel-straits-mackinac>.

⁶ Available at <https://mipetroleumpipelines.com/document/assignment-easement-rights-msca-enbridge-energy>.

⁷ Available at <https://mipetroleumpipelines.com/document/3rd-agreement-between-state-michigan-and-enbridge-energy>.

No Action Alternative

Under the no action alternative, the tunnel would not be constructed, operated, and maintained in accordance with the Tunnel Agreement to accommodate the replacement of that portion of Enbridge's Line 5 or other utilities. Enbridge's Line 5 Dual Pipelines would continue to be operated and maintained on the lakebed of the Straits. Utilities, such as electric and broadband cables, would also continue to be located on the lakebed of the Straits or on the Mackinac Bridge.

Tunnel Alignment Alternatives

Line 5 currently crosses the Straits from Point La Barbe in Michigan's Upper Peninsula to McGulpin Point in Michigan's Lower Peninsula (Figure 1). The distance between these two land points is approximately 3.58 miles and is the shortest distance between the upper and lower peninsulas.

Currently a single, 30-inch-diameter pipeline crosses Michigan's Upper Peninsula, enters Enbridge's North Straits Facility on Point La Barbe and splits into two, 20-inch-diameter pipelines. These two pipelines run south across the Straits and enter Enbridge's Mackinaw Station on Point McGulpin. A single, 30-inch-diameter pipeline exits the Mackinaw Station to the south (Figure 1).

Minimizing the length of tunnel by utilizing the shortest crossing distance between the upper and lower peninsulas is preferred as it helps reduce construction, operation and future maintenance costs of the tunnel. A shorter tunnel also requires less handling and transporting of the sediment and rock removed (known as muck) as the tunnel is built and shortens the construction duration. Locating the tunnel entrances as close as practical to the existing stations minimizes the need for constructing additional pipeline (known as a tie-in) to connect the replacement segment within the tunnel to the existing Enbridge facilities. Therefore, Enbridge focused on the areas of Point La Barbe and McGulpin Point as the preferred locations for the tunnel entrances. This alignment, given its length, is the least impactful feasible and prudent alternative for the Tunnel alignment. Other alignments would be longer in length, thereby leading to increased construction impacts and costs.

Tunnel Entrance Location Alternatives

North Side

Enbridge considered multiple locations for siting of the north side tunnel entrance. Locating the tunnel entrance to the northwest of the North Straits Facility would not be preferred as there are residential homes, a county road and overhead electrical infrastructure in this area (Figure 2). Also, U.S. Highway 2 approaches the shoreline of Lake Michigan in this area, limiting the area available for construction activities. There are also significant topographic features in this area that would require substantial grading to produce the needed, relatively level construction area (Figure 3).

Locating the tunnel entrance to the north or northeast of the North Straits Facility is also not preferred. Significant wetland and hydric soil features are present in these areas (Figure 3). There also is an existing below ground natural gas pipeline in the area, limiting the area available for construction activities.

Locating the tunnel entrance east toward the Mackinac Bridge is also not preferred as this area has significant infrastructure including residences, commercial buildings, and areas used for tourism.

Given these constraints and the desire to minimize potential impacts to the human and natural

environments, Enbridge selected the area adjacent to the existing North Straits Facility as the preferred location for the north side tunnel entrance. This location will minimize impacts to residential and commercial areas. In addition, Enbridge owns approximately 61 acres of land around the station, eliminating the need to acquire land from private landowners.

South Side

Enbridge considered multiple locations for siting of the south side tunnel entrance. There are significant constraints locating a tunnel entrance on the south side. Many residential homes, the historic McGulpin Point Lighthouse, Headlands International Dark Sky Park and multiple overhead electric transmission corridors and facilities are present in the vicinity of the existing Mackinaw Station (Figure 4).

Similar to the north side, a pipeline tie-in will be required from the tunnel entrance to Enbridge's existing Mackinaw Station. Minimizing the length of this tie-in helps reduce additional potential impacts to the human and natural environments.

Locating the tunnel entrance south or west of the existing station would place it within Headland International Dark Sky Park. This is not preferred as above ground operational facilities are required which could impact the benefits that portion of the park provides the public and natural communities.

Locating the tunnel entrance to the east of the existing station is not preferred as there are multiple residential homes and associated infrastructure as well as the McGulpin Point Lighthouse in this area. In addition, there is not sufficient area available to safely conduct construction activities in this area without disturbing some of these features.

There are relatively level open spaces with few existing homes southeast of the existing station. However, there is overhead electric transmission and underground natural gas infrastructure along the boundaries of the open areas (Figure 4). Additionally, there is an electric transmission substation to the north of these open areas. While there is sufficient space for construction in this location, the tunnel alignment would need to be located under the existing homes to the north. This area would also require an approximate one-half mile tie-in back to the substation and an associated new right-of-way (ROW) on private property and/or within a portion of the Headlands International Dark Sky Park. Therefore, Enbridge determined this area was not preferred for locating the tunnel entrance.

Given these constraints and the desire to minimize potential impacts to the human and natural environments, Enbridge selected the area adjacent to the existing Mackinaw Station as the preferred location for the south side tunnel entrance. In addition, Enbridge owns approximately 17 acres of land around the station, minimizing the amount of land which would need to be acquired from private landowners.

Construction Methods Alternatives

The proposed tunnel would be excavated with a Tunnel Boring Machine (TBM). TBMs are technically sophisticated pieces of equipment used to excavate tunnels in all types of ground conditions. TBMs can be configured so that they are suited to conditions with high groundwater pressure.

Constructing a tunnel using a TBM has two general approaches: launching the TBM from a portal entry or a shaft entry. A portal entry is a sloping "ramp" design starting at ground level and progressing to a point below ground that the TBM will initiate or complete boring (Figure 5). The side walls of the portal entry are typically supported using sheet piles. A shaft entry is a vertical excavation down to a depth

below ground that the TBM will initiate or complete boring (Figure 6). Based on preliminary design, Enbridge proposes boring the tunnel from the south side using a portal to launch the TBM. The north side would have a TBM receiving shaft.

Construction Workspace Alternatives

Tunnel construction techniques and sequencing are well established, worldwide. Generally, a portal or shaft is constructed from the surface to the tunnel entrance, the TBM is assembled at the entrance and it moves forward, boring the tunnel using cutting tools on its front. Rock cut (muck) by the TBM is conveyed to the back of the TBM and transported out of the tunnel. As the TBM advances, a pre-cast concrete lining is installed around the inside of the tunnel and the annulus (the space outside the concrete lining) would be filled with cement grout to help support it and reduce water inflows. Ventilation and lighting are placed in the tunnel. After the tunnel is constructed, the Line 5 pipeline replacement segment will be installed within the tunnel.

At the surface, support equipment and facilities are needed to manage the tunnel boring process. Areas for the lining segments, muck storage, operating crane, power station, mechanical buildings, water management, and other needs surround the portal or shaft. Enbridge has designated the total area required for construction on each side within a defined limits of disturbance (LOD). All the required surface equipment and facilities will be contained within the LOD.

Typically, utilities to be placed in a tunnel would be assembled at the surface in a long corridor and then pulled or pushed into the tunnel. To help reduce the amount of area needed for construction and the associated potential impacts to environmental features, Enbridge has committed to segmentally assembling the pipeline within the south side LOD, and then pushing or pulling the pipeline into the tunnel. Enbridge will also utilize off-site, existing commercial or industrial locations for some required construction activities, such as pipe storage, materials fabrication, and management offices to minimize the size of the LODs and the associated potential impacts to environmental features.

Limits of Disturbance (LOD) Siting and Configuration

Enbridge conducted environmental and cultural surveys in the areas surrounding both the North Straits Facility and Mackinaw Station to help site and configure the LODs in ways to avoid and minimize potential impacts to sensitive features while still allowing safe and efficient construction of the tunnel.

North Side LOD

Surveys identified multiple types of wetlands around the North Straits Facility and the existing Line 5 ROW to the north of the Facility (Figure 7). To help minimize the extent of impacts to natural resources, Enbridge has sited the north side LOD in primarily upland areas (Figure 7). The total size of the LOD is approximately 16 acres. Forested wetlands to the north of the LOD will be avoided. Wetlands within the LOD consist of medium quality forested and emergent vegetation. Other than vehicle entranceways off the existing Boulevard Drive, Enbridge has located the LOD at least 50 feet from the shoreline of Lake Michigan (Figure 7). The LOD utilizes upland areas, previously disturbed areas, and the existing station to the extent practical. No significant cultural resources exist within the LOD.

The LOD generally slopes downward to the west. This area will have perimeter berms installed to help prevent stormwater runoff. A water management system will be located in the LOD as well to help

manage stormwater and water generated from the tunnel. The system will include an oil-water separator, a sediment basin, and an infiltration basin.

Access to the LOD will utilize Boulevard Drive south and east of the North Straits Facility. Segments of the unpaved portions of Boulevard Drive may need to be improved or widened to accommodate construction traffic. To help minimize potential impacts to the shoreline of Lake Michigan, widening/improvements would take place on landward side (north and west) of the road.

Houghton's goldenrod and dwarf lake iris, both federally listed Threatened species, are present on the north side (Figure 8). The greatest concentrations of these species are in upland areas that do not contain woody vegetation. This coincides generally with the area within several hundred feet of the Lake Michigan shoreline. Enbridge is willing to consider potential mitigation measures, within and/or outside of the LOD, to help compensate for effects to protected plant species within the LOD. It may be practical to relocate some plant populations to off-site areas nearby to enhance existing populations or establish new ones.

South Side LOD

Enbridge has designed the LOD to avoid private residential properties, Headlands International Dark Sky Park and McGulpin Point Lighthouse (Figure 9). The LOD includes areas adjacent and within Enbridge's existing Mackinaw Station and one area southeast of the Station. The total size of the LOD is approximately 25 acres. There are no wetlands, protected species or significant cultural resources within the LOD. Enbridge will maintain a 115-foot buffer from the shoreline of Lake Michigan with the exception of a water discharge structure. Access to the LOD will utilize existing public roads and no improvements to them are anticipated.

The LOD generally slopes downward to the northwest corner. This area will have perimeter berms installed to help prevent stormwater runoff. A water management system will be located in the LOD as well to help manage stormwater and water generated from the tunnel. The system will contain an oil-water separator, a sediment and infiltration basin.

Summary

The tunnel is being pursued by Enbridge in accordance with the Tunnel Agreement and related legislation. The tunnel will accommodate the replacement of a portion of Enbridge's Line 5 and will also provide the potential to accommodate use by other utilities. Placing Line 5 into the underground tunnel will virtually eliminate the risk of a potential release from Line 5 into the Straits. Various alternatives were identified and considered for the alignment of the tunnel across the Straits, including alternative tunnel entrances on either side of the Straits and LOD configurations around the entrances. The preferred tunnel alignment identified above will minimize potential effects to the human and natural environments while allowing for the safe construction, operation, and maintenance of the tunnel in accordance with the Tunnel Agreement.

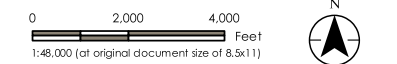


Legend
 — Existing Line 5

Figure No. **1**
 Title **Existing Enbridge Line 5**

Client/Project
 Enbridge Great Lakes Tunnel Project
 Alternative Analysis and
 Minimization of Impact Report

Project Location
 Emmet County & Mackinac County, MI
 Prepared by JM on 2019-11-08
 Technical Review by JD on 2019-11-13
 Independent Review by KW on 2020-02-24



- Notes**
1. Coordinate System: NAD 1983 UTM Zone 14N
 2. Data Sources include: Stantec, Enbridge, NADS, USGS
 3. Background: USGS 7.5 Topographic Quadrangles

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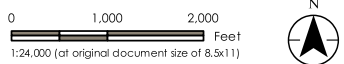


- Legend**
- Existing Line 5
 - Natural Gas Line (Non-Enbridge Line)
 - Overhead Electric Line
 - Facility Boundary
 - National Wetlands Inventory Feature

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

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Figure No. **2**
 Title **North Side National Wetlands Inventory Features**
 Client/Project **Enbridge Great Lakes Tunnel Project Alternative Analysis and Minimization of Impact Report**
 Project Location **Mackinac County, Michigan** Prepared by JM on 2019-11-08
 Technical Review by DG on 2019-11-13
 Independent Review by KW on 2020-02-26





Legend

- Existing Line 5
- Natural Gas Line (Non-Enbridge Line)
- Overhead Electric Line
- Facility Boundary
- National Wetlands Inventory Feature
- NRCS Soil Survey Data
- Hydric Ratings**
- Predominantly Hydric Soil
- Partially Hydric Soil
- Non-Hydric Soil

National Hydrography Data

- ~ Perennial Stream
- - - Intermittent Stream
- ~ Waterbody

Figure No. **3**
 Title **North Side Topographic Features**

Client/Project
 Enbridge Great Lakes Tunnel Project
 Alternative Analysis and
 Minimization of Impact Report

Project Location
 Mackinac County, Michigan

193705885
 Prepared by JM on 2019-11-08
 Technical Review by JD on 2019-11-13
 Independent Review by KW on 2020-02-24

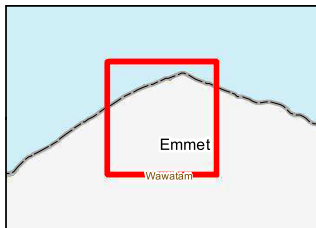
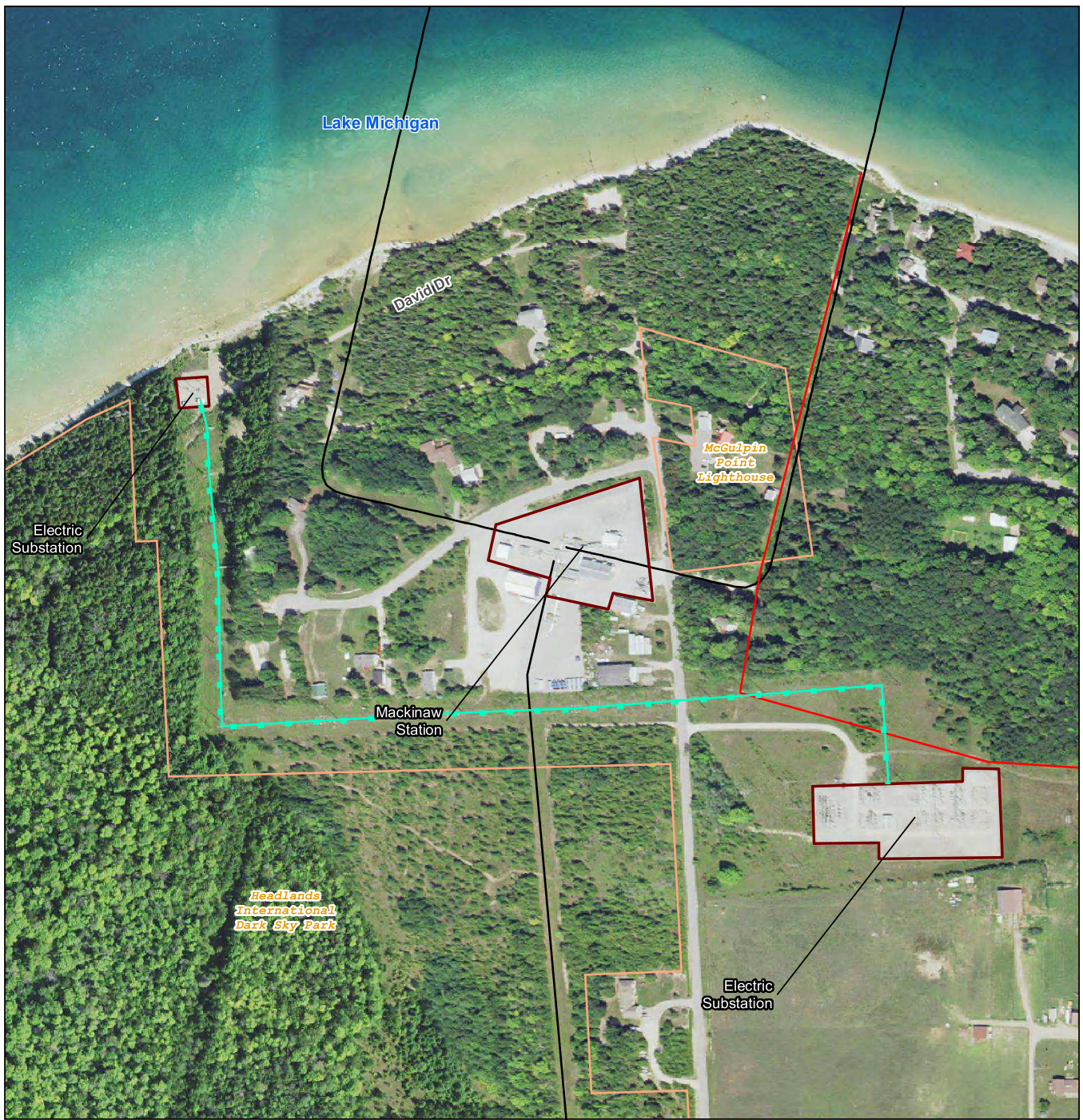
Notes

1. Coordinate System: NAD 1983 UTM Zone 16N
2. Data Sources include: Stantec, Enbridge, NADS, USGS, USFWS, NRCS
3. Background: USGS 7.5' Topographic Quadrangles

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0 1,000 2,000 Feet
 1:24,000 (at original document size of 8.5x11)

Stantec



- Legend**
- Existing Line 5
 - Natural Gas Line (Non-Enbridge Line)
 - Overhead Electric Line
 - Station Boundary
 - Local Area of Interest
- National Hydrography Data
- ~ Perennial Stream
 - - - Intermittent Stream
 - ☪ Waterbody

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

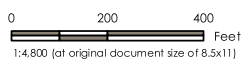
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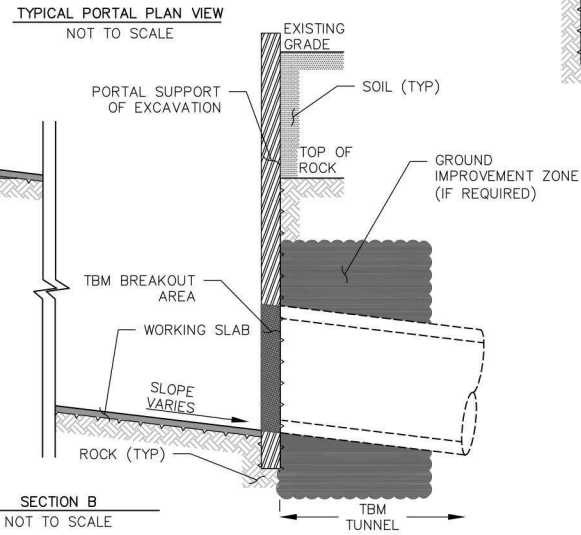
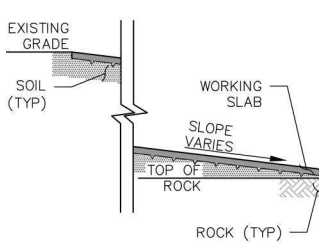
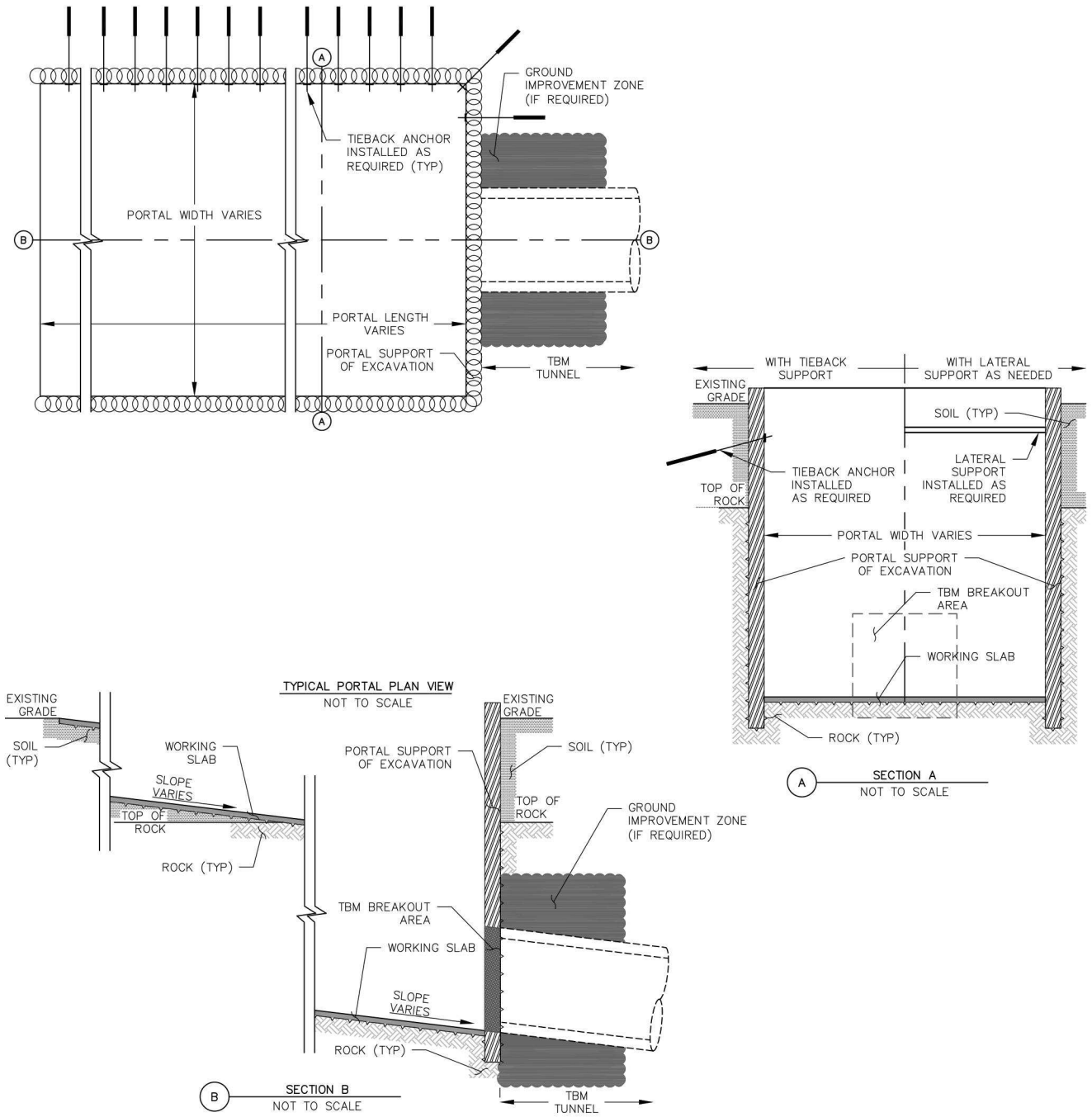
Figure No. **4**
 Title **South Side Features**

Client/Project
 Enbridge Great Lakes Tunnel Project
 Alternative Analysis and
 Minimization of Impact Report

Project Location
 Emmet County, Michigan

193705885
 Prepared by JM on 2019-11-08
 Technical Review by JD on 2019-11-13
 Independent Review by KW on 2020-02-24





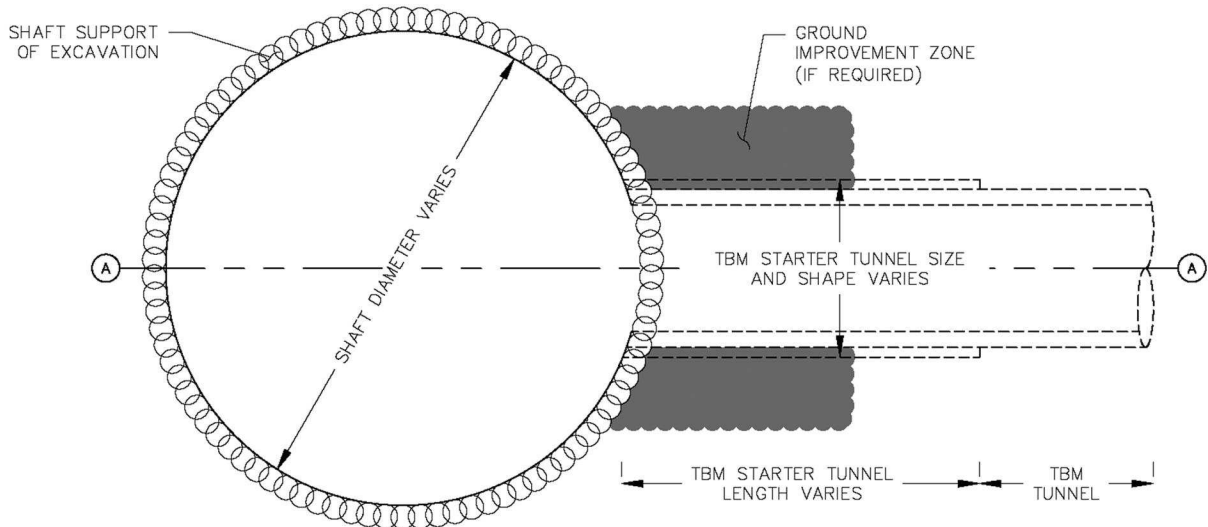
- Notes**
1. Coordinate System: NAD 1983 UTM Zone 14N
 2. Data Sources include: Stantec, Enbridge, NADS, USGS
 3. Background: USGS 7.5' Topographic Quadrangles

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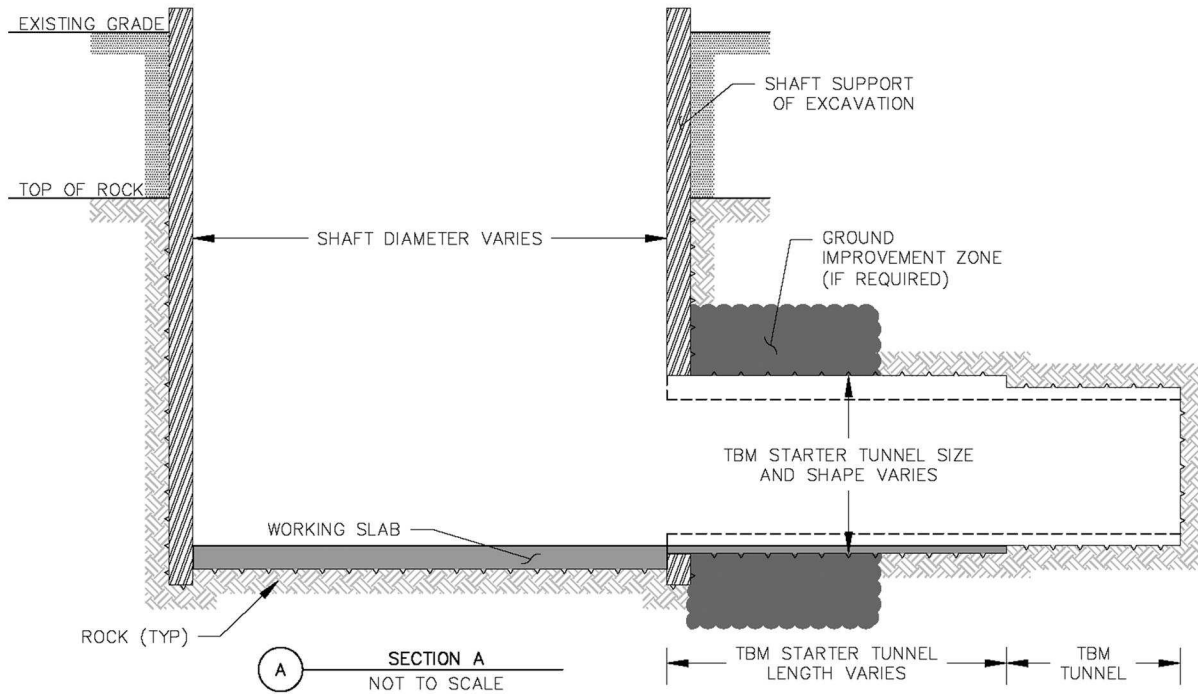
*Figures not to scale.

Figure No.	5
Title	Typical Tunnel Portal Design
Client/Project	Enbridge Line 5 Great Lakes Tunnel Project Alternative Analysis and Minimization of Impact Report
Project Location	Emmet County & Mackinac County, MI
Prepared by	JM on 2019-11-08
Technical Review by	JD on 2019-11-13
Independent Review by	KW on 2020-02-26





TYPICAL SHAFT PLAN VIEW
NOT TO SCALE



SECTION A
NOT TO SCALE



- Notes**
1. Coordinate System: NAD 1983 UTM Zone 14N
 2. Data Sources include: Stantec, Enbridge, NADS, USGS
 3. Background: USGS 7.5' Topographic Quadrangles

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*Figures not to scale.

Figure No.

6

Title

Typical Tunnel Shaft Design

Client/Project

Enbridge Line 5 Great Lakes Tunnel Project
Alternative Analysis and
Minimization of Impact Report

Project Location

Emmet County &
Mackinac County, MI

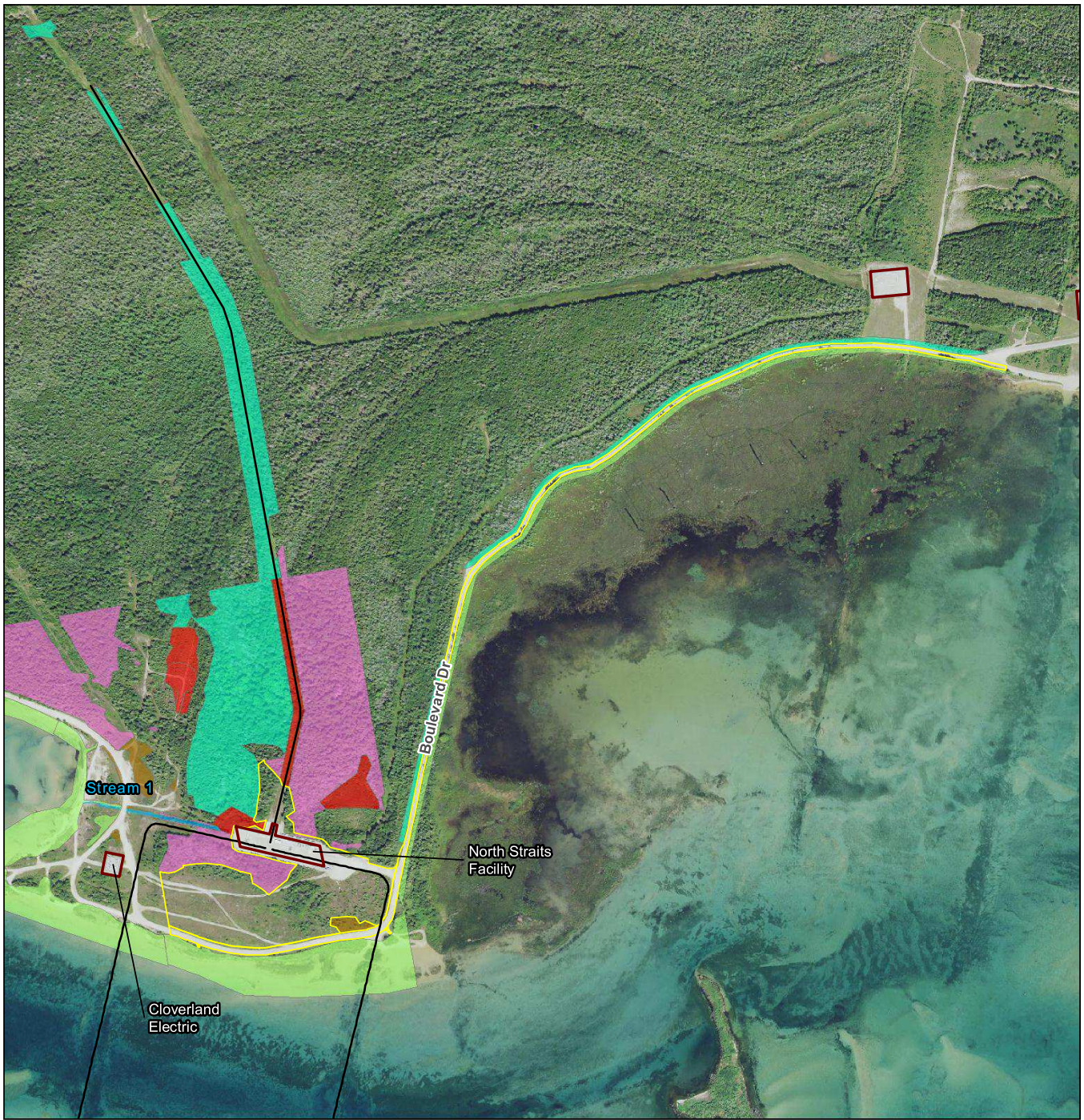
193705885

Prepared by JM on 2019-11-08

Technical Review by JD on 2019-11-13

Independent Review by KW on 2020-02-26





Legend

- Limits of Disturbance
 - Existing Line 5
 - Station Boundary
 - ~ Field Delineated Stream
-
- Wetland Type**
- PEM
 - PFO
 - PEM/PFO
 - PEM/PSS
 - PEM/PUB

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

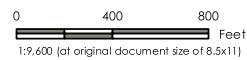
Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

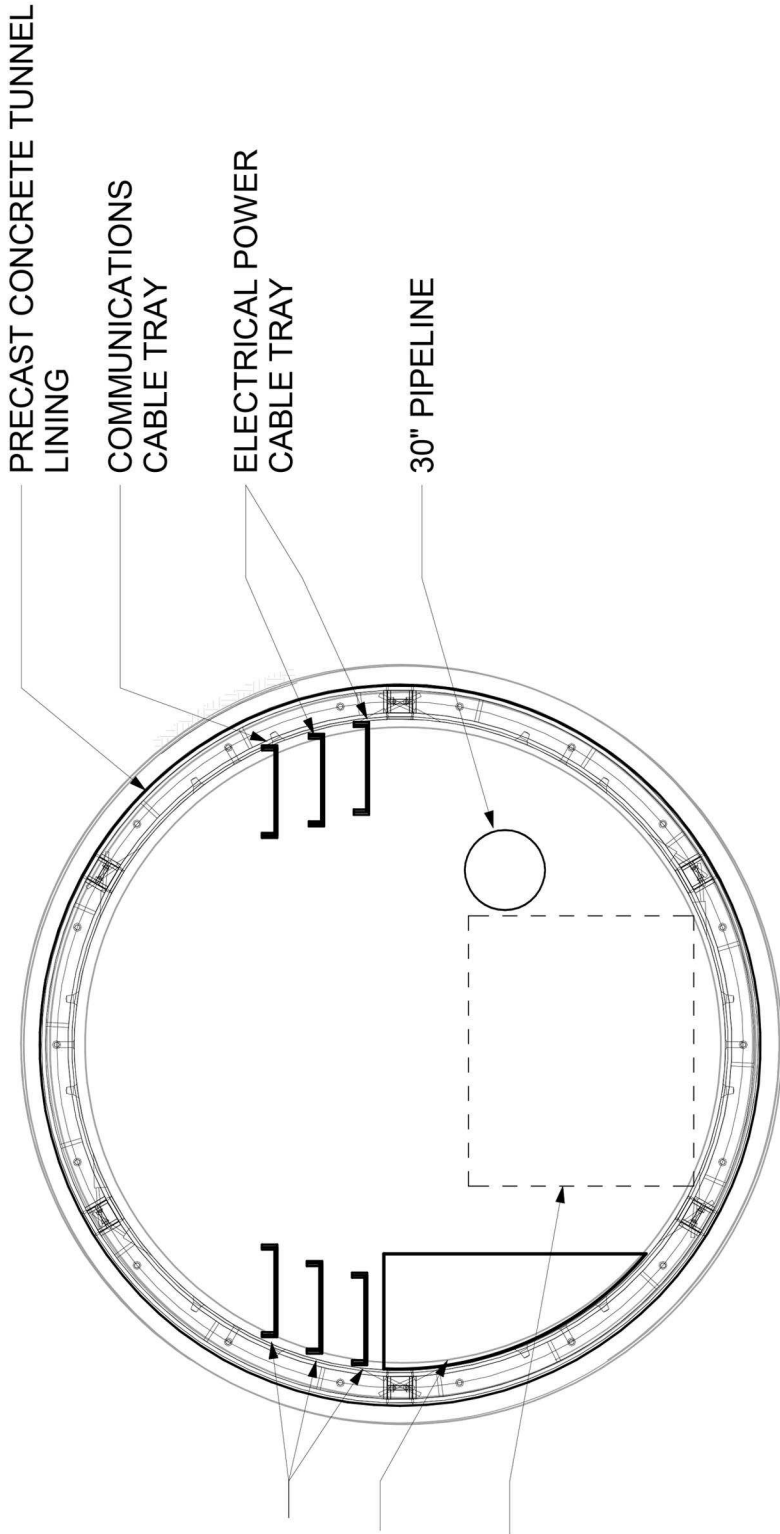
Figure No.
7

North Side LOD

Client/Project
Enbridge Great Lakes Tunnel Project
Alternative Analysis and
Minimization of Impact Report

Project Location
Mackinac County, Michigan
193705885
Prepared by JM on 2019-11-08
Technical Review by JD on 2019-11-13
Independent Review by KW on 2020-02-26





ELECTRICAL POWER CABLE TRAY
 SPACE FOR FUTURE 3RD PARTY UTILITIES
 TUNNEL MAINTENANCE VEHICLE ACCESS 7'-6" x 9'-0"
 30" PIPELINE

1 TYPICAL TUNNEL SECTION

GLTP - MEP Systems

ARUP
 Arup USA Inc
 10370 Richmond Avenue, Suite 475 Houston TX 77042 USA
 T +1-713-783-2787

TUNNEL SECTION VIEW

ARUP	Date	04/24/20
Job No	273207-00	Dwg No
		SKM0XX-XXX

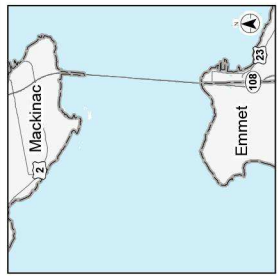


Figure No.

8

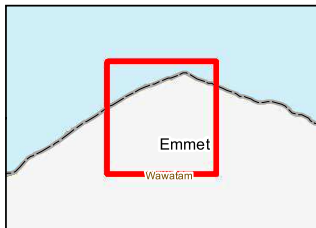
Title
Tunnel Cross-Section

Client/Project
 Enbridge Great Lakes Tunnel Project
 JPA - USACE Information Request 1

Project Location
 Mackinac & Emmet County, Michigan



*Figures not to scale.
 Data Sources: Stantec, Enbridge, WSP, NADS, USGS



- Legend**
- Limits of Disturbance
 - Existing Line 5
 - Station Boundary
 - Wetland Type
 - PEM/PSS

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

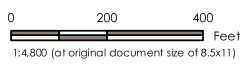
Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

Figure No. **9**
 Title
South Side LOD

Client/Project
 Enbridge Great Lakes Tunnel Project
 Alternative Analysis and
 Minimization of Impact Report

Project Location
 Emmet County, Michigan

193705885
 Prepared by JM on 2019-11-08
 Technical Review by JD on 2019-11-13
 Independent Review by KW on 2020-03-31



Plant Mitigation Plan
Great Lakes Tunnel Project

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Figure 2 – Protected Species Enhancement Area



PLANT MITIGATION PLAN

Introduction and Project Purpose

1.0 INTRODUCTION AND PROJECT PURPOSE

This Plant Mitigation Plan (Plan) has been prepared by Enbridge Energy, Limited Partnership (Enbridge) to address concerns related to anticipated impacts to two Federally 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 construction and ongoing operation of the Project will require removal of all vegetation within the Project's north side limits of disturbance (LOD) in Mackinac County (Figure 1). 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 LOD.

Enbridge proposes to relocate a portion of the population of each species (DLI and HG) from the Project's north side LOD prior to construction site preparation. Enbridge proposes to transplant the species into appropriate habitat within a proposed Protected Species Enhancement Area (Enhancement Area) on Enbridge property northwest of the LOD (Figure 2).

Additionally, although there will be permanent operation facilities established within the LOD (depicted as hardscape areas and permanent facility outlines in Figure 1), following completion of construction, portions of the LOD will be allowed to naturally re-vegetate (see Re-vegetated Areas in Figure 1). Enbridge will implement invasive species management in those areas to encourage the re-establishment of both DLI and HG.

2.0 TIME PERIOD PROPOSED FOR PLANT RELOCATION

Project construction is anticipated to occur begin after October 2021. Site preparation will require removal of all existing vegetation and some topsoil within the LOD and a layer of aggregate will be applied for the duration of construction.

Relocations of DLI and HG from the LOD are proposed to occur in August or September of 2021, prior to construction site preparation. This timing is expected to be beneficial for transplant survival as the plants are senescing, and HG are more readily differentiated from similar-looking goldenrods (such as Ohio goldenrod, *Solidago ohioensis*) at the Project site. As a contingency for DLI, transplanting may also occur in early spring 2021 prior to flowering. Spring transplanting is not proposed for HG due to the difficulty in identifying plants with confidence prior to flowering.

3.0 NUMBER OF PLANTS TO BE RELOCATED

Botanical surveys for DLI and HG were conducted throughout the LOD and vicinity in June and August 2019, respectively (Stantec 2019). Stem count estimates within the LOD and the number of plants proposed for relocating are provided in Table 1. Enbridge proposes to relocate approximately 50 percent of the plants of each species that occurred in the LOD at the time of the 2019 surveys. Approximately



PLANT MITIGATION PLAN

Proposed Relocation Methods

3,900 plants of DLI and 1,900 plants of HG are anticipated to be relocated based on the 2019 population estimates.

Table 1. 2019 Stem Count Estimates and Proposed Plant Numbers for Relocation

Species	Common Name	2019 Stem Estimates within the North Side LOD	Approximate Number of Plants Proposed for Relocation
<i>Iris lacustris</i>	Dwarf lake iris (DLI)	7,757	3,900
<i>Solidago houghtonii</i>	Houghton's goldenrod (HG)	3,777	1,900

4.0 PROPOSED RELOCATION METHODS

The LOD will be staked to identify the extent of impacted populations prior to construction site preparation. Botanists with experience identifying DLI and HG will flag colonies and individual plants to guide relocation efforts and track plant counts. DLI's distinctive rhizomes and leaf pattern will allow for identification and flagging throughout the growing season. Due to morphological similarities between HG and Ohio goldenrod, HG should be flowering when flagged. The optimal period for positive identification is typically in August and September (MNFI, 2020). If transplants of HG are expected to occur outside of the flowering period, plants will be pin-flagged while in flower to guide relocation efforts. Identification of DLI and HG within the LOD will be documented with photographs depicting the field marks used to identify the species.

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 (MICH), Ann Arbor, Michigan.

Figure 2 shows the proposed Enhancement Area where DLI and HG will be relocated. This area currently contains early-successional, degraded upland conifer forest; small trees and shrubs; household waste and debris; areas of degraded/disturbed upland meadow, and areas of forested, shrub-scrub, and herbaceous wetland. Based on the 2019 botanical surveys, the Enhancement Area is known to support small populations of both DLI and HG. Botanists will further evaluate the Enhancement Area to identify specific, appropriate recipient sites for relocating DLI and HG prior to relocation activities.

Some site preparation of proposed recipient sites within the Enhancement Area is anticipated and proposed for enhancing suitable habitat for DLI and HG. Recipient site preparations may include a combination of selectively thinning woody vegetation, controlling invasive species, use of targeted application of herbicides, removing garbage and debris, and enhancing local microtopography and soil conditions to create more suitable habitat. Individual plants or sod (for dense DLI colonies) in the LOD would then be relocated to enhance the existing populations and/or establish new ones within the Enhancement Area. Individual plants of DLI and HG, including stems, roots, rhizomes, and associated soil, will be relocated. Specific methods for removal and storage will be coordinated with Michigan Department of Environment, Great Lakes, and Energy (EGLE), Michigan Department of Natural Resources (MDNR), and U.S. Fish and Wildlife Service (USFWS).

Enbridge proposes qualitative monitoring of the Enhancement Area on a bi-monthly basis during the growing season (approximately 3 field observations per year) for two years after relocation (2022 and 2023), or as recommended by EGLE, MDNR, and USFWS. The purpose of the qualitative monitoring is to



PLANT MITIGATION PLAN

Summary of Methods to Mitigate Project Impacts

assess general growing conditions of relocated plants within the Enhancement Area relative to undisturbed populations in the vicinity and 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 Area. Actions will be determined based on the severity of observed issues, but may include weed and invasive species management, soil amendments, and supplemental watering.

Unauthorized access and ATV use has been an ongoing issue within the proposed Enhancement Area and vicinity. To minimize disturbance to the relocated plants, Enbridge will install gates, blockades, barriers, fencing, and/or other means to help limit unauthorized access to the Enhancement Area.

5.0 SUMMARY OF METHODS TO MITIGATE PROJECT IMPACTS

To the extent practicable, project work has been planned to avoid and minimize impacts to protected species. Plant mitigation measures will be coordinated with EGLE, MDNR, and USFWS. The proposed mitigation approach for DLI and HG includes transplanting approximately 50 percent of estimated populations recorded within the LOD during the 2019 surveys.

- Enbridge will evaluate specific habitat suitability within the proposed Enhancement Area for the potential to relocate DLI and HG species.
- Habitat enhancement and site preparation within the proposed Enhancement Area may include, but are not limited to, selective thinning of woody vegetation, controlling invasive species, use of targeted application of herbicides, removing garbage and debris, application of soil amendments potentially including surface materials, enhancing local microtopography through micro-grading techniques, and other strategies to enhance habitat suitability.
- To minimize disturbance to the relocated plants, Enbridge will install gates, blockades, barriers, fencing, and/or other means to help limit unauthorized access to the Enhancement Area.
- Following an adaptive management approach, Enbridge may apply management interventions to address issues identified in periodic monitoring observations of the Enhancement Area. Actions will be determined based on the severity of observed issues, but may include weed and invasive species management, soil amendments, and supplemental watering.
- Following completion of construction, portions of the LOD that will not be used for permanent operational facilities will be allowed to naturally re-vegetate. Enbridge will implement invasive species management in those areas to encourage the re-establishment of both DLI and HG.



PLANT MITIGATION PLAN

References

6.0 REFERENCES

Michigan Natural Features Inventory (MNFI). 2020. Michigan's Rare Plants and Animals [website].
<https://mnfi.anr.msu.edu/species/>

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





- Legend**
- Limits of Disturbance
 - Permanent Facilities (Locations may vary within Hardscape Areas)
 - Hardscape Areas
 - Re-Vegetated Areas

- Notes**
1. Coordinate System: NAD 1983 UTM Zone 14N
 2. Data Sources Include: Stantec, Enbridge, NADS, USGS
 3. Orthophotography: 2018 NAIP

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Figure No. **1**
 Title **Operations Site Plan - North Side**

Client/Project
 Enbridge Great Lakes Tunnel Project
 Plant Mitigation Plan

Project Location
 Mackinac County, Michigan

193705885
 Prepared by JM on 2020-05-18
 Technical Review by KW on 2020-05-18
 Independent Review by JB on 2020-05-18

