

# 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.

# 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 18-21 feet finished inside diameter, or other appropriate diameter determined through final design. The tunnel will accommodate the replacement of that portion of Enbridge’s Line 5 pipeline<sup>1</sup> (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.

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<sup>1</sup> 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 Background

The Tunnel Agreement, and the commitment to construct the tunnel, resulted from years of study and negotiation between Enbridge and the State. On November 27, 2017, Enbridge entered into what is referred to as the “First Agreement” with the State concerning Line 5 Dual Pipelines’ crossing of the Straits. As relevant here, Stipulation F of the First Agreement required Enbridge to prepare a report assessing the replacement of the Line 5 Dual Pipelines across the Straits.

In accordance with that requirement, on June 15, 2018, Enbridge submitted a report to the State, *Alternatives for Replacing Enbridge’s Dual Line 5 Pipelines Crossing the Straits of Mackinac* (Alternatives Report).<sup>2</sup> That Alternatives Report considered installing a replacement segment across the Straits utilizing horizontal directional drilling (HDD) methods or by placing a pipe inside a larger, secondary containment pipe, which would be buried in a trench near the shore and laid on the remaining lakebed covered with rock. The HDD method was rejected in the Alternatives Report because it was not technically feasible. The latter method was rejected because the potential environmental impacts during construction would be much greater than replacing the Dual Pipelines with a pipeline replacement segment within a tunnel.

On October 4, 2018, Enbridge and the State entered into what is referred to as the “Second Agreement.” That Second Agreement 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 pipeline, is a feasible alternative for replacing the Dual Pipelines, and that alternative would virtually eliminate the risk of a potential release into the Straits. Under the Second Agreement, Enbridge and the State agreed to negotiate further agreements to construct a tunnel beneath the Straits.

In December 2018, and following the enactment of Public Act 359, Enbridge and the Authority entered into the Tunnel Agreement. That Agreement sets forth the process by which Enbridge will construct and provide to the Authority a tunnel so as to allow for the discontinuation of service on the existing Line 5 Dual Pipelines’ crossing of the Straits upon the replacement segment being placed into service within the tunnel. The tunnel will also allow for the possibility of other third-party companies to locate utilities within the tunnel. Also pursuant to the Tunnel Agreement in December 2018, the Michigan Department of Natural Resources (the agency responsible for administering the State of Michigan’s subsurface land rights) issued an easement (MDNR Easement) to the Authority, authorizing the Authority to access, occupy, and use such subsurface lands for purposes of constructing, operating, and maintaining the tunnel. The Authority subsequently assigned certain rights under that MDNR Easement to Enbridge to allow Enbridge to access, occupy, and use such subsurface lands for purposes of constructing, operating, and maintaining the tunnel.

## 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

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<sup>2</sup> Available at

[https://www.enbridge.com/~media/Enb/Documents/Projects/line5/ENB\\_Line5\\_AltEvaluation\\_Report\\_June15.pdf](https://www.enbridge.com/~media/Enb/Documents/Projects/line5/ENB_Line5_AltEvaluation_Report_June15.pdf).

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 and the Authority 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.