# Oversized Load Corridor

## Shipping Route Study

MIG Engineering (2011) Ltd.
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# Executive Summary

Introduction and Background

World class industrial fabrication companies located in the Sarnia Lambton area have been fabricating oversized industrial process equipment and equipment modules for many years. Equipment has been built to meet the demanding standards of large industry located in the area. The supply of equipment in large modular form has become an international standard. Highly skilled engineering support for the industry is also located in the local cluster as well as many specialized support trades. They all participate and benefit from this work.

In recent years, fabricators have been pursuing contracts to build and export similar equipment, to markets in other regions of Canada and internationally. They have a competitive advantage gained from the many years of local experience as well as the complete supply chain already in place. Due to the inefficiency and associated costs of local transportation logistics for oversized loads within Sarnia Lambton the fabricators lose their competitive advantage when bidding on many of these export contracts. Existing infrastructure, including overhead utility lines along local roads makes movement of large loads difficult and costly to temporarily change. Existing dock sites were not designed or constructed to accommodate the loading and unloading of large equipment. This requires temporary accommodations and limits the type and number of pieces that can be handled in each load.

In addition to the opportunity to export oversized equipment, local large industries (and potential new ones), often require the supply of specialized large equipment from outside of the Sarnia Lambton area. This equipment is used to expand or improve their facilities and operations. It ensures their long term viability. This, in turn, leads to job retention and job creation both directly and indirectly through the local supply chain that installs and maintains the equipment. These companies face the same hurdles and expenses with transportation logistics as the local fabricators do for export. In some cases, the cost of delivery from the water to the industry site will impact whether or not the project occurs.

The Sarnia-Lambton Economic Partnership has been successfully promoting growth of the industrial sector in Sarnia Lambton. They, along with their industry partners, have identified an opportunity for increased exporting and importing of oversized equipment through creation of a designated Oversized Load Corridor to/from the Port of Sarnia.

Study Purpose and Objective

The overall purpose of the study is to provide a dedicated corridor for oversized loads in Sarnia-Lambton to accommodate shipments to local industries and the export of equipment to similar industries outside of Sarnia-Lambton. In general, the shipments will be fabricated structures, modules and large equipment and will not contain hazardous materials. The purpose of the dedicated oversized load corridor is to identify conditions that restrict transportation of an oversize load. The study also recommends the infrastructure upgrades and related improvements to eliminate or mitigate restrictions related to temporary removal costs, individual route evaluations, traffic control, property damage, power disruptions and safe and efficient transportation of an oversized load.

The objective of the study is to provide a report that can be implemented into detailed engineering design and provide a detailed cost analysis in order to proceed with project funding. In addition, the report can be used as a basis for public notifications and a future platform to evaluate public response to the proposed route.

In addition to the Oversize Load Corridor, a business case study will be completed separate from this study. The business case will provide an economic analysis and evaluate the socio-economic impacts of the proposed route and project.

Proposed Route

The preferred Oversized Load Corridor route was identified through a preliminary study of various dock sites and routes completed in Dec. 2012. The chosen route provides improved access to the Port of Sarnia to all major fabricators and industrial facilities. Our report also identifies and recommends improvements to the Port site itself to better accommodate these shipments. Once improvements are completed, it will reduce, or eliminate completely, temporary improvement costs which are currently repeated with each large load moved. It will also minimize traffic disruptions and road closures and decreases the chance of costly accidental damage to existing infrastructure.

Route Design Basis

The engineering assessment of the Oversized Load Corridor is based on an overall transporter size of 30 feet wide x 30 feet high x 150 feet long (9m W x 9m H x 45.7m L), including the transport vehicle. The height overall is from grade. This equates to a module or equipment size of 30 feet wide x 26 feet high x 100 feet long (9m W x 8m H x 30m L). The transporter vehicle recommended for the proposed shipping size and arrangement would consist of a tractor unit pulling two, six axle (self-steering) transporters. The quantity of axles is to ensure the load is distributed to keep tire loads below the maximum allowable as defined by the Highway Traffic Act.

Cost Summary

The study provides a detailed cost estimate to complete the improvements based on the engineering assessment of the required changes and upgrades. The cost estimate also includes a cost for the reconstruction and resurfacing of Blackwell Side Road.

The cost is a total installed cost that includes the applicable allowances and contingencies and is summarized below:

| Description | Sub-Total Cost |
|---|---|
| Port of Sarnia Harbour | $3,959,063 |
| Road Infrastructure (Civil, Structural and Misc.) | $2,472,782 |
| Road Infrastructure (Electrical) | $2,360,794 |

| | |
|---|---|
| Sub-Total | $8,792,639 |

| | |
|---|---|
| Contingency (20%) | $1,758,528 |
| Escalation (10%) | $879,264 |

| | |
|---|---|
| Total Cost | $11,430,431 |

Conclusion and Recommendations

This report provides the Sarnia-Lambton Economic Partnership, and their partners, a detailed list of recommended improvements for the proposed route and Port of Sarnia Harbour to achieve their goals.

The report provides a summary of the project risks and outstanding items that will require further investigation during detailed design and they are summarized below:

- Proceed with a public open house or announcement to evaluate input from private, commercial and industrial sectors.
- Further investigation is required to evaluate underground infrastructure at proposed bore locations, including sewer systems and utilities.
- The permit applications for Lambton County require oversize loads to be transported during daylight hours only. Further investigation is recommended to revise the existing permit application to allow non-daylight hour transportation to limit traffic disruptions.
- Further investigation is required to determine the impact of the oversize load corridor at the Highway 402 off ramp exiting onto Exmouth Street at Indian Road. The traffic disruptions could cause traffic to back into the eastbound lanes of Highway 402.
- An engineering assessment is required for the existing structures for each individual oversized load as defined by CSA S6-06 and the Ministry of Transportation Ontario.
- Further investigation is required at the Port of Sarnia Harbour based on the loading and unloading strategy for each individual oversized load.
- Approval of the Operational Procedure, Polices and Permits, including recommendations, will be required prior to implementation of the Oversize Load Corridor.

It also provides a detailed cost estimate to complete these improvements based on an engineering assessment of the required changes and upgrades. The cost estimate also includes a cost for the reconstruction and resurfacing of Blackwell Side Road.

The total project cost to complete the recommended improvements to an accuracy of +/- 20% is projected as $11,430,431, excluding HST.

The study includes an assessment for a large percentage of the types and size of loads to be shipped, but additional study work will be required for sizes outside of this boundary and this could lead to further impact of existing infrastructure. A preliminary investigation of each oversize load is recommended to ensure it meets the criteria of the Oversized Load Corridor.

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| REVISION REGISTER | | | | | |
|---|---|---|---|---|---|
| Rev. No. | Rev. Section No. | Description | Rev. Date | Prepared By | Approved By |
| A | All | Issued for Review | May 10 , 2016 | D. Johnson | M. Bosher |
| B | All | Incorporate Stakeholder Comments. Issued for Approval. | Aug. 04, 2016 | D. Johnson | M. Bosher |
| | | | | | |

# 1. Acknowledgements and Involvement

The following is a summary of the parties involved in the Oversized Load Corridor and the support they provided in the Shipping Route Study.

Major Stakeholders

- Sarnia-Lambton Economic Partnership (SLEP)
- Sarnia-Lambton Industrial Alliance (SLIA)
- The Corporation of the City of Sarnia

Stakeholders

- The Corporation of the County of Lambton
- The Corporation of the Township of St. Clair

Engineering Support

- MIG Engineering (2011) Ltd.: Engineering Lead
- Associated Engineering (Ont.) Ltd.: Sub-Consultant (Swept-Path Analysis)
- Riggs Engineering Ltd.: Sub-Consultant (Port of Sarnia Harbour)

Utility Support

- Bell Canada
- Bluewater Power Distribution Corporation
- Cogeco Cable Canada
- Hydro One Inc.
- Lambton Area Water Supply System (LAWSS)

Financial Support

- Sarnia- Lambton Industrial Alliance (SLIA)
- Toolrite Engineering
- LamSar Inc.
- Alliance Fabricating Ltd.

- Anderson-Webb Ltd.
- ANJ Industrial Fabricating Ltd.
- Canadian Structural and Mechanical Ltd.
- Central Machine and Marine Inc.
- John Duff Ltd.
- Kel-Gor Ltd.
- Lambton Metal Service
- Sandarin Services Inc.
- Sarnia Wolverine Manufacturing Ltd.
- St. Clair Mechanical Inc.

Interested Parties

- Chemfab Industries Inc.
- Great Lakes Fabricating Ltd.
- Promart Industrial Products Ltd.
- Shelly Machine & Marine
- Specialty Machine & Fabrication

Regulatory

- Ministry of Natural Resources and Forestry (MNRF)
- Ministry of the Environment and Climate Change (MOECC)
- Ministry of Transportation Ontario (MTO)
- St. Clair Region Conservation Authority (SCRCA)
- Transport Canada (TC)

Miscellaneous Support

- Mammoet Canada Eastern Ltd.
- Canadian National Railway Company (CN)

## 2. Project Objective and Background

The objective of this project is for MIG Engineering (2011) Ltd. (MIG) to provide a detailed scope of upgrades that will be required to implement an Oversized Load Corridor in Sarnia-Lambton. In addition to the report, a detailed total installed cost (TIC) estimate has been provided for the recommended upgrades.

For many generations, manufacturing companies located in the Sarnia-Lambton area have been fabricating oversized steel modules and equipment for the many international petroleum and petro-chemical industries. These companies are very well equipped and experienced to service this sector. A complete supply chain is in place to support this activity including machine shops, engineering firms and environmental service firms. This sector includes over 5,000 highly skilled unionized workers registered with the Sarnia Construction Association and many non-unionized skilled trades and specialized professionals that service the industry.

Sarnia-Lambton Economic Partnership (SLEP) has been successfully promoting growth of the area in both the traditional oil and petro-chemical sectors as well as building a new bio-hybrid chemical cluster that has the potential for significant growth. The supply chain that is in place is a major reason for the growth of the area.

The area manufacturers and fabricators have also been actively looking for new opportunities to export their specialized products and services to other Canadian and International markets. The Alberta Oil Sands and oil fields of Saskatchewan have been identified as a domestic area of rapid growth and demand that far outstrip the supply capability of local companies. A recent dramatic decrease in the price of oil has caused many exploration and new oil production projects in Canada, and around the world, to be deferred. These are expected to resume in the future. There remains an ongoing worldwide demand for equipment to maintain existing operations. There is also an increased demand for more efficient equipment and processes to be implemented due to the downturn. Increasing environmental vigilance and regulations require the latest specialized equipment to be utilized to adapt and improve processes. The current low oil price climate has also forced oil companies to reassess their supply chain procedures to seek out more efficient and cost effective high quality suppliers. This situation is applicable in Canada, the USA and around the world.

It is acknowledged that the shipping route from Thunder Bay to approximately Winnipeg is too restrictive to allow full Alberta sized equipment modules to be shipped by road or rail. This limits local area manufacturers and fabricators in their ability to fully supply this market.

It has also been determined that large modular steel fabrication has become an international standard in building for many industries. It is understood that the demands of such projects as the Hibernia and Hebron Oil developments will have similar large needs. Many other industries such as natural gas, petro-chemical plants, water and waste-water treatment and food processing with locations in Canada, the USA and Internationally also have the potential to be served by the local Sarnia-Lambton fabricators.

Due to the close proximity of local manufacturers and fabricators to end users in the Sarnia-Lambton area, there was rarely the need to ship oversized, heavy product over long distances. In many cases, much of the fabrication work occurred on-site. In the case of units fabricated for export from the local area, barriers to easy shipment have been identified. Local roads are not all adequate to handle the size and weight requirements to transport finished products to the City of Sarnia owned port facility, or other docks located along the St. Clair River. The Port facility itself, although usable in its current form, was not built with the necessary infrastructure to store, handle and load these very large units.

Large International industries in the Sarnia-Lambton area periodically need to import oversized equipment to expand, improve or retrofit their operations. New industry considering the area as a potential building site will also have the need to import certain large specialized equipment pieces. Although much of this equipment can be supplied locally, some items need to be sourced from international suppliers where patents are in place, or if pricing dictates a foreign supplier. These companies face the same hurdles and expenses shipping in large items as do local fabricators for outbound shipments. In some cases, the cost of the inbound shipment of necessary equipment may prohibit an expansion taking place at an existing site, or deter prospective industries.

A preliminary assessment of road routes from the area fabrication shops to various potential dock sites was completed in December 2012. This report included a rough estimate of costs required to make improvements to establish a dedicated “Oversize Load Corridor”. After analysis of the report and review by the various parties involved, it was determined that the most feasible dock site is the existing Port of Sarnia.

## 3. Oversized Load Corridor (Route Selection)

The selected oversized load corridor is based on the original Phase 1 study prepared by MIG in 2012. The Phase 1 study evaluated various routes, including docking options and evaluation of module sizes. The selected route is represented on the key plan in Appendix A, drawing P-10563-01, Sht. 1 of 2. Additional routing options were not evaluated as part of this study. The selected route was determined based on the following factors:

- Providing heavy shipping access to all major facility owners and fabrication stakeholders.
- Minimizing required upgrades and repair costs.
- Minimizing traffic disturbances and road closures.

## 4. Load (Module) Size Evaluation

The shipment size criteria was defined in the SLEP Request for Proposal (RFP), 2015-003. The criteria for the overall dimensions are defined in the RFP as 30 feet wide x 30 feet high x 150 feet long (9m W x 9m H x 45.7m L), including the transport vehicle. The 30 foot height is the overall height from grade.

In order to evaluate the shipment size and the restrictions associated with oversized loads, MIG contacted Mammoet Canada Eastern Ltd. (Mammoet). Mammoet was very supportive and a valuable resource to the study team. Mammoet provided various transport arrangements from actual shipments to determine the module size restrictions and the overall transporter dimensions for the turn analysis.

The overall transporter dimensions provided by Mammoet meet the requirements of the SLEP RFP 2015-003 for height, width and length, which equates to a module or equipment size of approximately 30 feet wide x 26 feet high x 100 feet long (9m W x 8m H x 30m L). The Mammoet template was the basis for the turn analysis and has been prepared in Appendix B for Associated Engineering (Ont.) Ltd. (AE)'s Transporter Vehicle Template, drawing No. 20155932-SK4. Also refer to the transporter vehicle dimensions provided in the AE report in Appendix C.

The transport vehicle recommended for the proposed shipping arrangement consists of a tractor unit pulling two, six axle (self-steering) transporters. The quantity of axles is to ensure the load is distributed and to maintain ground loadings that meet the maximum allowable gross vehicle weights as defined by the Highway Traffic Act, Ontario Regulation 413/05. In addition, the axles can be individually adjusted vertically to accommodate grade changes across intersections, rail crossings, curbs, bridges, etc.

## 5. Associated Engineering (Ont.) Ltd.: Swept-Path Analysis

AE was involved in the study to evaluate the swept-path of the load and the wheel base configuration of the transport vehicle at the associated intersections only. AE's analysis includes a summary of the recommended changes, based on a geometric assessment, and includes conceptual sketches of the proposed improvement. The swept-path analysis was completed for inbound and outbound shipments. Refer to Appendix C for the Study Report completed by AE.

It should be noted that the swept-path analysis is based on the assumption that the vehicle will travel at 5km/h and the transport vehicle operator will undertake each movement at a low speed in accordance with the MTO Long Combination Vehicle (LCV) Program.

The recommended changes were incorporated into the detailed cost estimate prepared by MIG and included in Appendix I. The changes include road widening at intersections, curb and gutter modifications and miscellaneous items such as street signs that are impacted at the intersections.

## 6. Structural and Civil Scope of Work

The structural and civil scope of work consists of an evaluation of the existing bridges and various types of culverts. Each structural item was reviewed based on the transportation vehicle provided in Appendix B. The following is a summary of the evaluations and the necessary or recommended improvements.

## 6.1 Bridges

Bear Creek Bridge

The proposed route along Courtright Line will cross the Bear Creek Bridge (B1): (Refer to Appendix A, drawing P-10563-02, Sht. 26 of 31).

MIG obtained drawings of the bridge, which were used to determine the capacity of key bridge components. The Bear Creek Bridge was analyzed based on the transportation vehicle provided in Appendix B, and a number of other wheel configurations. Based on this analysis, the existing deck and girders would not be sufficient to support the loads imposed by the selected shipping arrangement. However, the bridge was sufficient under a variety of other shipping configurations.

It is important to note that each shipping arrangement is custom designed to accommodate a module over the traveled route. Whereas loading impacts on small structures can be generalized for a range of different shipping arrangements, this is not the case for large structures like the Bear Creek Bridge.

Because of its span, many variables impact the stresses experienced by the bridge, such as module size and weight distribution, the width and length of the truck bed, the number and the configuration of axles, the number of tires per axle, etc. Due to the variables involved, an overall weight limit, for instance, cannot be generalized from analyzing the selected transport arrangement.

As such, our analysis of the bridge was performed as a guideline only, and each oversized load crossing of the bridge must be reviewed and approved by a Professional Engineer in accordance with MTO's operational policies and procedures.

In order to help streamline the review process and allow movers to select an acceptable transport arrangement at the outset, we suggest the following weight guidelines (based on bending moment envelopes for a variety of moving load configurations). In order to represent a wide range of different shipping arrangments, these guidelines are necessarily conservative, and should not be considered strict limits. For axle groups spaced relatively far apart, we suggest that the maximum load per 65' span be limited to 125,000lbs for single wide trailers and 300,000lbs for double wide trailers. For closely spaced axles evenly distributed across the span, we suggest a uniform load per 65' span of 3,500lbs/ft for single wide trailers, and 8000lbs/ft for double wide trailers.

The cost estimate is based on the assumption that bridge upgrades will not be necessary for the Bear Creek Bridge. Increasing the capacity of the bridge would require costly structural modifications to the main girders, the deck and possibly the piers. At a minimum, this would involve installing hanging scaffolding from the bridge to weld flange plates along the length of the beam, and reinforcing the deck slab. Retrofits of this extent are not a cost-effective means of shipping modules. Rather, a proper transporter arrangement should be selected to suit the bridge in its current form.

We believe this is the best approach, but want to address a potential impact: certain modules may require a double wide trailer in order to space heavy loads across two lanes and utilize the capacity of all

five bridge girders. As the scope of this study has not included turn analysis for a double wide trailer, this could result in interferences at various intersections that have not yet been accounted for.

However, based on correspondace with heavy moving companies, there are other unrelated reasons a double wide trailer may be required (e.g. lighter, taller, unblanced modules with high centers of gravity). In these cases, even extensive bridge upgrades would not eliminate this need. As such, we feel that the costs of upgrading the bridge outweigh the potential benefits of reducing the unkown impacts associated with a small percentage of potential moves.

MIG has conisidered a hypothetical “worst case” in which a module must be shipped in one piece across Bear Creek Bridge using a certain transport arrangent that cannot be maneuvered within the boundaries of each intersection. In this case, a two stage shipping process would be required: after shipping across the bridge, a module would be craned onto a new transport arrangement to maneuver the intersections and be transported the rest of the way to the dock.

Operational considerations to note:

- The transporter will need to drive along the middle of the bridge, taking up both lanes. All traffic will need to be restricted for the duration of the move.
- Due to the width of potential loads, there will be limited clearance on either side of the bridge—in some cases as little as 1’ to the inside face of the existing barriers. Movers should be made aware of this constraint and any operational difficulties that this may entail.

## 6.2 Culverts

As part of the project scope, MIG performed a field survey to identify the culverts along the proposed route. The field survey included location, diameter, length and depth. In addition, a visual inspection identified the type and existing condition of each culvert. The survey data of the culverts is provided in the Culvert Report in Appendix D. The culvert locations are specified on drawings P-10563-02, Sht. 1 to 31 based on the item description from the Culvert Report. If one end of a culvert was not accessible (e.g. buried or located in a catch basin) this was noted in the report. The report also references the municipal drains that are associated with each culvert, if applicable.

The visual inspection included an evaluation of each culvert based on the following definitions, and in certain cases a combination was specified (i.e. Good to Fair, Fair to Poor). For reference, photos of the culverts are included in Appendix D (Photos are not available for S7 and S68).

- Poor: Extensive corrosion, spalling or deterioration; deformation or mechanical damage.
- Fair: Some corrosion or spalling; localized deformation or mechanical damage.
- Good: No major defects; minimal corrosion or spalling; no deformation.

The culverts that were defined as 'Poor', 'Fair to Poor' or 'Fair' are included in the total installed cost estimate for replacement in-kind. The associated removal and road repair costs are included for each replacement. The existing designs and materials were assumed to be adequate for drainage purposes, and no new culvert designs or materials were evaluated for any of the culverts to be replaced.

The evaluation also included a review of the existing depth of cover. This was evaluated based on the requirements for culvert design defined by the Ministry of Transportation Ontario (MTO).

It was determined that there was adequate existing cover above all the culverts to be replaced. Due to the adequate level of cover, replacement in kind was determined to be sufficient and no other remedial measures were deemed necessary (e.g. increased cover, protective slabs or upgrading to thicker wall culverts). The depth of cover for culverts that could not be verified were assumed to be acceptable.

In general, since only the exposed portions of the culverts could be assessed, the condition of the entire culvert can only be approximated. The cost estimate is conservative insofar as it accounts for the replacement of all damaged or corroded culverts. In practice, even damaged culverts can withstand traffic loads, provided that they have adequate cover, and that the surrounding road-bed is in good condition.

When route development planning is underway, we recommend working with the associated municipality to determine a culvert replacement schedule using a priority based system (i.e. those to be replaced immediately, those to be replaced in the next 5 years, etc.) and to coordinate replacements with road upgrades or other improvements in order to minimize costs and traffic disturbances.

Culverts Spanning Over 3m

CSA S6-06, Canadian Highway Bridge Design code defines a bridge as being a structure with a span greater than 3m and the MTO requires any bridge structure to be inspected and evaluated structurally before any heavy shipment crosses. The following culverts were identified with a span over 3m:

- S7- Porter Creek Culvert: 4.2m Span. (Refer to Appendix A, drawing P-10563-02, Sht. 8 of 31)
- S38- Wray Drain Culvert: 6.1m Span. (Refer to Appendix A, drawing P-10563-02, Sht. 17 of 31)
- S48- Burton Creek Culvert: 3.7m Span. (Refer to Appendix A, drawing P-10563-02, Sht. 20 of 31)
- S77-Wellington Drain: 3.7m Span. (Refer to Appendix A, drawing P-10563-02, Sht. 29 of 31)

MIG inspected the above structures, took measurements and pictures, and identified key features. They were assumed to be in good condition, and do not require repairs or replacement at this time.

Drawings were obtained for Wray Drain and Burton Creek Culverts, verified with field measurements, and used to evaluate the capacities of the structures.

Drawings were unavailable for Porter Creek and Wellington Drain Culverts. However, these structures are typical to standard MTO rigid frame, open footed culverts. MIG reviewed the MTO Concrete Culvert

Design and Detailing Manual, and was able to select structures with the appropriate forms and dimensions to match our field measurements. Rebar details were determined from the appropriate tables in the manual, and used to evaluate the capacity of the structure.

The four structures were modelled as rigid frames under the loading pattern generated by the transport vehicle shown in Appendix B, as well as other wheel configurations. It was determined that the Porter Creek (S7), Burton Creek (S48), and Wellington Drain (S77) culverts were acceptable under the given load conditions. Wray Drain (S38) had insufficient capacity, and was found to be unacceptable under the given loading conditions.

Different modules and transport arrangements will produce different loading patterns. Therefore, as part of the permitting process, the above structures must be analyzed before each heavy move takes place.

Based on our analysis we have determined that some or all of the above structures will be undersized for a portion of the heavy moves. However, we have not included costs to replace any of these structures in our estimate. Instead we have assumed that temporary "jumper bridges" can be used to cross the structures when necessary. This option is common practice for other heavy shipments of this nature. A pre-shipping structural study will determine the required type of jumper bridge to be used in each case.

If the number of heavy shipments across these structure greatly increases, or if the existing structures deteriorate to a point that justifies replacement, the option of upgrading the existing designs to withstand heavier loads should be considered.

Operational considerations to note:

- A set of hazard markers on the guiderail system of the Porter Creek Culvert will need to be removed during transportation. The transport load would be above the guiderail system, but would come in contact with the hazard marks.
- Temporary Jumper bridges are usually made available by the transport company involved with the move. The setting up and operation of any temporary bridges must be coordinated before the move takes place.

<u>Assumptions</u>

The following assumptions were used to determine replacement costs:

- Culvert S-22: 450mm diameter culvert with 1200mm cover assumed.
- Assume the culvert can be replaced in a single lift (this may require the roadway to be blocked and/or detour).

Replacement Scope of Work

The following is the recommended scope of work for the culvert replacement and the basis for the cost estimate. The cost estimate also includes cost associated with traffic control and detour plans for construction.

- Excavation
    - The existing asphalt shall be cut neatly and fully stripped away above the area to be excavated.
    - Stripped asphalt shall not remain on the road, but be stockpiled on grade.
    - The roadbed shall be excavated at a 1:2 slope or shallower to expose the culvert.
    - No more than 50'(15m) of length shall be excavated at a time.
    - Excavated fill shall be piled for removal or re-use as applicable.
- Culvert Removal
    - Culverts shall be removed according to OPSS 510.
    - Culverts shall be removed so that no damaged portions remain in place.
    - Removed culverts shall be set aside for salvage, as required.
- Culvert Installation
    - New corrugated steel pipe shall be to OPSS 1801.
    - Steel culverts may be assembled beside the excavation or in the trench.
    - Where applicable, steel culvert sections shall be lapped and joined by means of steel couplers.
    - The pipe shall normally be joined with external screw-on couplers or split couplers.
- Road Bed Repair
    - Bedding and cover shall be placed and compacted in layers not exceeding 200mm thickness.
    - Backfilling and bedding shall be placed according to OPSS 401.
    - Compacting of bedding and cover shall be according to OPSS 501.
- Roadway Restoration

- The sub-base course shall be 12”(300mm) of Granular B.
- The base course shall be 6” (150mm) of Granular A.
- The roadway shall be 6” (150mm) of asphalt.
- Granular sub-base and base courses shall be placed according to OPSS 314.
- Hot Mix Asphalt shall be according to OPSS 1151.

In addition to the culverts, a construction cost was also included for upgrades to the Murphy Road catch basin leaders and storm sewer connection.

## 6.3 Road Upgrades

As part of the study, it was recommended that full depth reconstruction of Blackwell Side Road is required. The cost estimate and the detailed cost breakdown is included in Appendix J and includes 2,100m of roadway, 6.5m asphalt with 1m shoulders.

The road reconstruction scope of work will generally follow that specified under section 5.2 culverts (P.8) with a finished asphalt width of 6.5m and 1.0m wide gravel shoulders.

The road upgrades also include any impacts determined from the swept-path analysis. This includes any changes or upgrades to curbs, gutters, shoulders, asphalt and truck aprons as provided in the AE report in Appendix C.

# 7. Electrical Scope of Work

The electrical scope of work focused on the electrical and utility interferences along the proposed route. The electrical scope includes existing infrastructure owned by Bluewater Power Distribution Corporation (Bluewater Power), Hydro One Corporation (Hydro One) and low voltage cables for internet and cable (Cogeco and Bell). The general concept of the electrical scope is to ensure any wires, cables, poles, transformers, traffic signals and lights are relocated to allow uninterrupted passage of the oversized load and transport vehicle.

A field survey was completed by MIG to evaluate each of the electrical crossings along the proposed route. The field survey also included Bluewater Power and Hydro One to support the proposed solutions and provide input related to cost estimating.

The location of the Bluewater Power crossings are provided in Appendix E, B-447, Sht. 1 to 16. The reference drawings were provided by Bluewater Power and are labeled to coincide with the item numbers provided on the Electrical Report in Appendix F. Any items indicated with ‘N/C’ require no changes or upgrades to the crossing.

The location of the Hydro One crossings are provided in Appendix A, on drawings P-01563-02, Sht. 16-31 as separate Hydro One drawings were not available. Similar to Bluewater Power, the Hydro One labels also coincide with the item numbers provided on the Electrical Report in Appendix F.

The required transport vehicle clearance above the top of the travelling load is defined as 3 feet for low voltage, insulated lines (data or power) and 6 feet minimum to the neutral of a high voltage line over 600V. This criteria was determined based on the minimum vertical clearance above finished grade of 5.1m (17ft) as defined by MTO Provincial Standards. The proposed solutions for the interferences and the associated costs, are provided in the Electrical Report, in Appendix F.

The costs provided include temporary supports, equipment, material and labour. The cost was determined with input from Bluewater Power, but Hydro One was not included in the review, and costs for Hydro One will be estimated as the same as Bluewater Power.

The following is a detailed description of the proposed changes as outlined in the Electrical Report in Appendix F.

## 7.1 Road Bores

For the proposed road bores, a boring company will excavate to the required depth and bore a duct under the roadway. The duct should extend between the pole (or service) on each side of the road. The road bore will use a 4" duct for each high voltage line (H), a 2" duct for each commercial (C) or residential (R) line, and 1" duct for each low voltage line (T). In addition, every bore will include a 2" spare duct. The spare will be turned up at the pole base on both sides or terminate in a PVC surface junction box with a removable pedestrian cover. All ducts, including the spare, will be identified clearly with a unique matching label on both sides of the road. It is assumed that the existing poles will remain installed and the removal cost is not included in the estimate.

Verification of existing underground infrastructure will be required prior to road bore designs and cost has been included for locating and daylighting any utilities at the proposed locations. This is in addition to the Ontario One Call requirements.

## 7.2 New or Replacement Power Poles

Line on new poles will be raised, including all lines crossing the road(s), to provide a minimum clear height of 33 feet (10m) from the highest point in the road surface to the lowest point of sag, at 28 degrees centigrade.

Each new pole is to be a regulation 55-foot (16.8m) wood pole or higher, installed in a seven-foot-deep hole filled with compacted sand in layers. The holes will be excavated using Hydro-vacuuming methods to ensure that no underground infrastructure is damaged. The cost for Hydro-vacuuming the poles is

included in the electrical cost as part of the $8000 pole replacement. All poles must be provided with the necessary wood arms and insulators.

Each pole that replaces an existing pole will use the same number as the existing pole. Additional poles will be numbered by the utility using the pole.

In areas where an overhead system is required to be installed, the existing pole will remain installed. A cost for pole removal is not required.

## 7.3 Guy Wires (G)

Guy wires will normally be elevated so there is at least 33 feet (10m) clearance from highest point in the road surface to the lowest point of sag, at 28 degrees centigrade. Where the guy wire cannot be raised on an existing pole, a new pole will be provided. In some cases, it may be possible to rework the crossing in order to eliminate the need of the guy wire. Rigid pole bracing was reviewed, but is not an acceptable practice by the utility companies.

## 7.4 Residential (R) and Commercial (C) Feeder Lines

All residential and commercial feeders shall meet the requirements of the installing utility and the requirements provided in this study. All underground feeders are to be individual insulated copper wires with a bare ground wire. Colour coding shall be white for a neutral, black & red for single-phase services and black, red and blue for three phase services.

## 7.5 Low Voltage Lines (T): Telephone, Internet, Fibre Optic

Low voltage supplies will be relocated and/or replaced by the company that owns the cabling. Notify Cogeco, Bell Canada or other supplier before starting any work that has a low voltage line as outlined in the Electrical Report. Clearly direct the low voltage supplier as to how the new feeder system will be replaced.

Bell Canada was contacted and they advised us that there are no aerial services along the proposed route.

## 7.6 High Voltage Lines (H1 and H3)

The high voltage lines that are recommended to be relocated on existing or new poles shall meet the installation requirements of the utility in all regards. High voltage wires installed underground shall be single shielded insulated copper wires rated for the utility voltage. Neutrals may be bare copper and must be grounded at each point that the wire emerges from the ground. Where the new duct runs up

the height of the pole, the neutral is to be connected to the ground wire at the first point that it is exposed to air. No exceptions are permitted.

### 7.7 Traffic Signals

Traffic signals that interfere with the proposed route are to be fitted with a hinged or sliding device at the supporting pole which, by the removal of a pin locking device, can be rotated or slid and temporarily be held out of the path of the transport vehicle. The traffic signal may move in any direction to suit the particular location (up, down or horizontal). The internal wires will have to be fitted with a flexible metal conduit to protect the wires from damage and the weather.

### 7.8 Street Lighting

Similar to traffic signals, street lights that interfere with the proposed route are to be fitted with a hinged or sliding device at the supporting pole and by the removal of a pin locking device, can be rotated or slid and temporarily held out of the path of the transport vehicle. The street light may move in any direction to suit the particular location (up, down or horizontal). The internal wires will have to be fitted with a flexible metal conduit to protect the wires from damage and the weather.

## 8. Miscellaneous Scope of Work

The street signs that are impacted by the proposed route are provided in the AE Study Report and are included in the cost estimate.

There are no fire hydrants that are impacted by the proposed route.

There are no bus stops or other structures that are impacted by the proposed route.

## 9. Port of Sarnia Harbour and Dock Scope of Work

Riggs Engineering Ltd. (Riggs) provided the study for the changes associated with the Sarnia Harbour for loading and unloading shipping loads and modules. The analysis, including associated cost estimates is provided in Appendix G.

The evaluation of the harbor area is based on three potential loading/unloading methods which will be specific to the oversized load being transported. The study is based on direct access to Exmouth Street and a swept-path analysis was not completed at the harbor. Further investigation will be required to evaluate the loading or unloading with one (or two) shore cranes.

# 10. Communication: Approvals and Notifications

The study included communication with various corporations, agencies, stakeholders and municipalities to review the proposed route and gather feedback related to their experience and the current requirements and restrictions for oversized load shipments. The following is a summary of the communication and the information provided that is not referenced previously in the report. Refer to Appendix K for details of the permit requirements and the operational procedures and policies.

## 10.1 Lambton Area Water Supply System (LAWSS)

MIG discussed the route with Susan MacFarlane, Ph.D., P.Eng., General Manager of LAWSS, and she provided us with locations of their existing chambers along the route. For reference, the chamber locations along the route have been identified and highlighted on the drawings provided in Appendix H. She mentioned that the existing chambers would require an internal inspection by a structural engineer to verify the integrity. The inspection will need to be part of LAWSS preventative maintenance program, as the proposed loads that would be applied to the existing chambers would not exceed the current load restrictions.

## 10.2 Ministry of Transportation Ontario (MTO)

The MTO was contacted as the route requires access to two portions of Ontario Highway 40, which is a Provincial Highway maintained by the MTO. One portion of the Highway is known as Churchill Line and the other is Confederation. The MTO will need to be contacted for each oversized shipment along the route and the MTO will require permits on an individual shipment basis.

## 10.3 Ministry of the Environment and Climate Change (MOECC)

The MOECC will review any proposed dock construction plans with particular interest in any impact of the work on adjacent land. MOECC will evaluate impacts related to erosion, silt control and bank stability in the dock area.

## 10.4 Ministry of Natural Resources and Forestry (MNRF)

The MNRF will review any proposed dock construction plans, including water lot legal plans. The MNRF will issue a work permit for the construction. The MNRF will also assess the potential for impact to existing species as identified under the Ontario Endangered Species Act.

## 10.5 Transport Canada

The proposed dock enhancements and construction will require approval from Transport Canada to ensure the proposed work meets the requirements of the Navigation Protection Act.

## 10.6 St. Clair Region Conservation Authority (SCRCA)

In addition to the requirements of the MOECC, the proposed dock construction plans will need to be submitted to the SCRCA, who represent the work on behalf of the Department of Fisheries and Oceans (DFO). Prior to submission of a work permit, they will evaluate river and shoreline habitat protection and approve mitigation procedures. The work permit will provide construction restrictions for in-water work and may require water quality monitoring.

## 10.7 Canadian National Railway Company (CN)

MIG contacted CN as the proposed route crosses an existing CN railway along Blackwell Side Road. Refer to Appendix A, drawing P-10563-02, Sht. 8 of 31 for location. MIG requested a review from CN (Eastern Canada Division of Engineering) for the transport vehicle over the railway and any restrictions or permits that may be required for the railway crossing. All shipping information outlined on the permit application shall be provided to CN 2-3 weeks prior to crossing. CN will provide a letter of approval and Track Supervisor contact information to ensure flagging is set up during crossing. The CN Track Supervisor who is responsible for this crossing is Derek Basso (Ph. 905-669-3184, derek.basso@cn.ca). CN may also provide an option to set up a yearly permit to include multiple crossings. Refer to Appendix K for permit details.

# 11. Total Installed Cost Estimate

The summary of the total installed cost estimate is provided in Appendix I based on the subtotal costs. It should be noted that the costs are not separated per municipal jurisdiction. Appendix I includes three sections of the estimate: 1. Overall Summary, 2. Discipline Cost Summary and 3. Road and Intersection Cost Summary. The overall summary includes all applicable costs, including indirect costs. The discipline cost summary provides sub-total costs for each discipline and the road and intersection cost summary provides sub-total costs for each road based on discipline. The cost breakdown of the roads follows the flow of the route from the harbor as represented on the key plan in Appendix A.

The estimate details that can be used for further cost breakdown are provided in Appendix J for infrastructure upgrades and road reconstruction. The detailed electrical costs are included in the Electrical Report in Appendix F.

The following is a summary of the estimate basis for the costs that have been provided.

## 11.1 Estimate Allowances and Indirect Costs

The following is a summary of the allowances and contingencies that are included in the total installed cost estimate:

- Engineering: 15% of discipline sub-total. The engineering fee is included for each discipline sub-total to account for detailed engineering of the proposed changes, including design drawings, material selection and tender documents.
- Project and Construction Management: 10% of discipline sub-total. The Project Management is related to the management of the detailed engineering noted above. This may be represented through SLEP or the engineering consultant, but the responsibility is to manage deliverables, schedule of work areas, prioritizing projects, etc. The Construction Management has similar responsibilities, but this is directly related to construction including management of construction contractors (including Bluewater Power and Hydro One) and scheduling to ensure progress of the work related to project budgets.
- Contingency: 20% of total cost. The contingency was included to account for the overall accuracy of the estimate based on the estimate basis, assumptions and project risks.
- Escalation: 10% of total cost. Escalation was included to account for price increases related to inflation of material and construction costs based on the assumption that the work will occur over the next five years.

## 11.2 Estimate Assumptions and Exclusions

The following is a summary of the assumptions and exclusions applicable to the total installed cost estimate:

- Existing infrastructure is assumed to be designed to meet the requirements of the Ontario Highway Traffic Act for load distribution.
- The estimate does not include any Owner or stakeholder related costs.
- The estimate does not include costs associated with a public open houses or public advertisements.
- The cost for Bluewater Power to move hinged lights during a move is not included in the estimate.
- Costs have not been included for temporary bridge support or jumper bridge designs.
- It is assumed that there are no impacts related to the Municipal Drainage Act.
- Existing sewer systems were not evaluated as part of this study.

- It is assumed that there are no underground interferences with the proposed road bores. The estimate includes locate services and daylighting for underground infrastructure prior to bores.
- The assessment does not include an evaluation of obstructions at the fabricator facilities. The study is based on the fabricators accessing the proposed route.

## 12. Operational Procedures, Policies and Permits

A separate report was completed for the operational procedures, policies and permits and is included in Appendix K. The report provides a summary of the permit requirements for the Oversized Load Corridor and a recommended system for the coordination of the local permits. The report also includes potential responsibilities and a summary of the recommended changes that would be required to support the implementation of the proposed procedure.

In addition, the report also provides a summary of the current 'High Load Corridor' that is implemented in Alberta for reference.

## 13. Risks and Outstanding Items

The following are the risks associated with the Study and any outstanding items that require further study and investigation during detailed engineering:

- Detailed structural studies will be required based on individual shipping arrangements prior to each move.
- Evaluate the hinged traffic light design to ensure they are acceptable for installation on an existing wood pole. Also review interferences with the swing path of the hinged traffic light if moved in the vertical or horizontal positions.
- Proceed with public notifications and/or public open house of proposed route. May lead to potential project risk based on feedback from affected property owners.
- Evaluate underground infrastructure for proposed road bores.
- Kimball Road south of Petrolia Line is currently signed as having spring load restrictions and/or truck restrictions (with the exception of local deliveries). Include with Operating Procedure and permits.
- It is recommended that the Highway 402 Off-Ramp (W-E/W Ramp) exiting onto Exmouth Street at Indian Road be reviewed to verify that the queuing generated while access to Exmouth Street is blocked, does not spill back into the eastbound lanes of Highway 402 during the period on time envisioned.

- Recommend providing parts of this report as part of a ‘Notification of Potential Use’, including proposed routing, to notify adjacent landowners and affected private, commercial and industrial sectors (may become part of the public notification also).
- It should be noted that the existing fire hydrant at the intersection of Confederation Line and Blackwell Side Road. The fire hydrant is outside of the swept path of the transport vehicle but is in close proximity.
- Review alternative design options and materials for culvert replacements during detailed engineering.
- Further investigation is required to evaluate the loading and unloading of oversize loads at the harbour using one or two shore cranes and determine the impacts or interferences.