County of Simcoe

PRELIMINARY DESIGN REPORT

Old Fort Overhead Bridge Replacement Design

PROJECT NO. 20328

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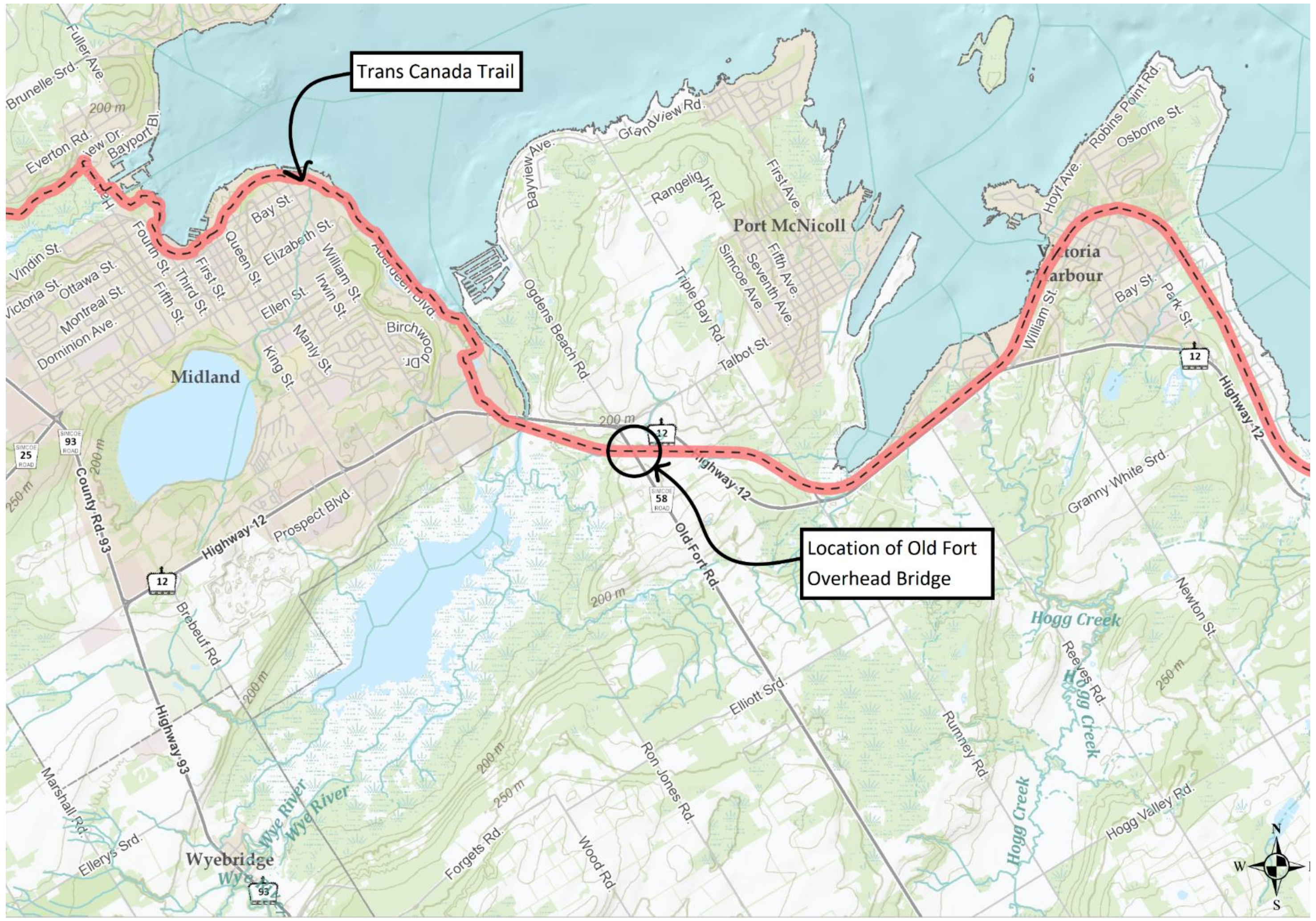


OLD FORT OVERHEAD BRIDGE

2 INTRODUCTION

2.1 LOCATION

Old Fort Overhead Bridge was originally built in 1978 and carries Old Fort Road (Simcoe County Road 58) over the abandoned CN Railway track approximately 300m south of Highway 12 in the Township of Tay, ON. The abandoned CN Railway track has been converted to the Trans Canada Trail (also known as the Tay Shore Trail at this location).

Old Fort Road runs in the north-south direction at the bridge location. The existing profile features local sag locations on either side of the bridge, while the bridge itself is on a slight crest.

2.2 PURPOSE AND JUSTIFICATION

LEA Consulting Ltd. (LEA) was retained by the County of Simcoe to provide engineering services for completing the preliminary and detail design for the replacement of the Old Fort Overhead Bridge. The purpose of this report is to generate and evaluate options for the replacement of the Old Fort Overhead Bridge and to develop preliminary design recommendations for the bridge replacement.

The existing structure comprises three-spans (13.6m – 13.7m – 12.1m) of concrete slab on prestressed voided slab girders with reinforced concrete piers and abutments. There are four (4)girders with corrugated steel decking on the reinforced concrete deck soffit between the girders. The distance between the inside face of the piers along the bridge is approximately 13.3m and the vertical clearance below the middle span of the bridge is 7.9m. The clear width of the bridge between barrier wall faces is 9.2m. The existing lane widths are 3.4m.

In general, the existing structure is nearing the end of its service life, with major components exhibiting signs of corrosion and deterioration as summarized in Section 2.3 below.

2.3 RATIONALE

The existing bridge exhibits deterioration of components such as the concrete girders, pier caps, expansion joints, handrails and barrier walls. Some of the observations made from LEA's site inspection in April 2020 as well as those reported in the Biennial Inspection Report conducted in 2016 by Engineered Management Systems are provided in Section 4.3 of this report.

These observations indicate severe structural deficiencies, especially the bearing cracks of the girders (see **Appendix A Photo 3** and **Photo 4**). Extensive rehabilitation to repair and strengthen the girders would be required, along with replacement of the north expansion joint and handrails, and local concrete repairs to the barrier walls and abutment. Given the large vertical clearance under the existing bridge is not needed after the conversion of the CN Railway track to the Trans Canada Trail, extensive rehabilitation and future maintenance costs for a structure of this size are unwarranted. Therefore, replacement with a smaller structure or an at-grade crossing to accommodate the smaller clearance required for the Trans Canada Trail and to provide lower life cycle costs is justified.

3 PROJECT APPROACH

3.1 ENVIRONMENTAL ASSESSMENT PROCESS

The Municipal Engineers Association (MEA) Municipal Class Environmental Assessment (MCEA) document (October 2000, as amended in 2007, 2011 and 2015) is an approved planning and design process under the provincial *Environmental Assessment Act* (EA Act). The MCEA document provides guidelines approved under the EA Act which protect the environment during project implementation. The undertakings are considered pre-approved provided adherence to the mandatory environmental planning process as set out in the MCEA document.

Key components of the Class EA planning process include: clear statement of the problem or opportunity, consultation with potentially affected parties early and throughout the study process, consideration of a reasonable range of alternative solutions, systematic evaluation of alternatives, clear and transparent documentation, and traceable decision-making. The MCEA document outlines a five (5) phase planning process approved under the EA Act to plan and undertake all municipal infrastructure projects in a manner that protects the environment.

- **Phase 1** (Problem or Opportunity): identify the problem (deficiency) or opportunity.
- **Phase 2** (Alternative Solutions): identify alternative solutions to address the problem or opportunity by taking into consideration the existing environment, and establish the preferred solution taking into account public and review agency input. Determine the appropriate Schedule for the undertaking and document decisions in a Project File for Schedule B projects or proceed through the following Phases for Schedule C projects.
- **Phase 3** (Alternative Designs): examine alternative methods of implementing the preferred solution, based upon the existing environment, public and review agency input, anticipated environmental effects and methods of minimizing negative effects and maximizing positive effects.
- **Phase 4** (Environmental Study Report (or equivalent)): document, provide a summary of the rationale, planning, design and consultation process of the project as established through the above Phases and make such documentation available for scrutiny by review agencies and the public for a minimum 30-day public review period.
- **Phase 5** (Implementation): can proceed following the end of the 30-day review period and the resolution of any Part II Order requests. Complete contract drawings and documents and proceed to construction and operation. Monitor construction for adherence to environmental provisions and commitments. Where special conditions dictate, also monitor the operation of the completed facilities.

3.1.1 Determining the Project Schedule

The MCEA document provides a framework by which projects are classified as Schedule A, A+, B, or C based on a variety of factors including the general complexity of the project, level of technical investigation required, and the potential impacts on the natural, social, cultural, and economic environments that may occur. Each schedule classification requires a different level of documentation and review to be compliant with the EA Act and satisfy the requirements of the MCEA process.

Appendix 1 of the MCEA document provides general guidance for determining the appropriate schedule for an undertaking. While some transportation-related undertakings are identified as particular schedules, others are classified based on the estimated cost of the undertaking and/or potential impacts to the environment. The identified cost thresholds are adjusted on an annual basis in accordance with the Ministry of Transportation's (MTO) tender price index.

3.1.2 Part II Order Process

If significant outstanding issues have not been addressed during the Class EA study process and could be better addressed through an Individual EA process, any member of the public can ask for a higher level of assessment. This is known as a Part II Order and anyone can make the request. A Part II Order request should not be submitted to delay or stop the planning and implementation of a Class EA project. A Part II Order request can be made within the specified review period as outlined in the Notice of Study Completion. A Part II Order request is submitted only when issues cannot be resolved through the Class EA process, discussions with the proponent or with mediation.

As of July 1, 2018, a Part II Order Request Form must be submitted to request a Part II Order at https://www.ontario.ca/page/class-environmental-assessments-part-ii-order. The completed form must include the following information: name and address, project name, proponent name, specific reasons why the request is being made, summary concerns and issues, why a higher level of environmental assessment would address your concerns, information about efforts to date to discuss and resolve concerns with the proponent, the outcome you are seeking from the minister, and other matters relevant to the request.

The request must focus on potential environmental effects of the project or the Class EA process; not focus on decisions outside the Class EA process (e.g., land-use planning decisions made under the *Planning Act* or issues related to municipal decision-making about the process); and not raise issues unrelated to the project. Unless stated otherwise in the request, any personal information provided will become part of the public record and will be released, if requested, to any person. The completed Part II Order Request Form must be submitted to the Minister of Environment, Conservation and Parks or delegate, with a copy of the form to the Director of Environmental Assessment and Permissions Branch and the proponent.

Minister's decisions on Part II Order requests are final. The minister has four (4) options for a decision on a Part II Order request:

1. Refer the matter to mediation before making a decision;
2. Deny the request and inform the proponent and requester;
3. Deny the request but impose conditions; or,
4. Require the proponent to comply with the Part II Order and prepare a terms of reference and individual environmental assessment.

If the request has been turned down, the proponent can implement the project subject to any conditions imposed. If the request has been granted, the proponent can begin preparing terms of reference for an Individual EA, if they still wish to move ahead with the project.

3.1.3 Municipal Class Environmental Assessment Schedule B Study

The project is being completed as a Schedule B study under the MCEA process. Schedule B projects have the potential for some adverse environmental and social impacts. As per the MCEA document, proponents are required to undertake a screening process involving mandatory contact with potentially affected members of the public, Indigenous communities, and relevant review agencies to ensure that they are aware of the project and that their concerns are addressed. Schedule B projects require the completion of Phases 1 and 2 of the MCEA planning process, which is documented within this Preliminary Design Report (PDR) and submitted for a mandatory 30-day review period. If concerns are raised that cannot be resolved, any member of the public may appeal to the Minister of the Environment, Conservation and Parks (MECP) to issue an order to comply with Part II of the EA Act, bumping up the status of the project.

The following outlines the five (5) phase planning process for this study:

- **Phase 1** (Problem or Opportunity): Extensive deterioration of the bridge and the large clearance provided by the existing bridge is not required after the conversion of the CN Railway track to the Trans Canada Trail.
- **Phase 2** (Alternative Solutions): Three (3) options were identified and considered for this study: 1) bridge replacement with similar type crossing structure; 2) tunnel crossing structure; and 3) at-grade crossing of the Trans Canada Trail with Old Fort Road.
- **Phase 3** (Alternative Designs): A project specific evaluation matrix was developed for this study. The evaluation matrix considered input from the County, correspondence/consultation received to date, environmental factors (socio-economic, archaeology, cultural heritage, terrestrial ecosystem and fisheries), highway engineering, traffic engineering, land use and property and cost (construction and future maintenance).
- **Phase 4** (Preliminary Design Report): This document will be made available for scrutiny by review agencies and the public for a minimum 30-day public review period. A Notice of Study Completion will be issued near the end of the study to provide notice of the 30-day review period.
- **Phase 5** (Implementation): Detail design to continue with the recommended design following the 30-day review period and the resolution of any concerns or issues and Part II Order requests (if applicable). During construction, monitoring will be undertaken to ensure construction adheres to environmental provisions and commitments made within the PDR and other technical reports as applicable.

3.2 EXTERNAL INVOLVEMENT / CONSULTATION

3.2.1 Study Notification

To date, consultation has included the issuance of a Notice of Study Commencement letter at the onset of the study. Letters were sent to agencies, businesses, emergency medical services, Indigenous communities, municipalities, stakeholders, transportation services and utility providers on March 11, 2020. The intent of the letter was to inform the contacts of the project and to solicit input as required. Future public consultation will include a newspaper advertisement notification and a Public Information Centre (PIC) in the fall of 2020. At the completion of the study, a Notice of Study Completion letter will be sent to project contacts to provide notice of the PDR 30-day review period.

3.2.2 External Agencies and Community Groups / Consultation Summary

To date, the following relevant comments have been received after the issuance of the Notice of Study Commencement letter. Consultation will be ongoing as the study progresses until the end of the 30-day review period:

- County of Simcoe – 911 & Emergency Planning – acknowledged receipt of the notice.
- Township of Tay – Parks, Recreation and Facilities – meeting held to discuss project.
- Township of Tay – Director of Public Works – meeting held to discuss project.
- Moose Deer Point First Nation – no issues with the project at this time.
- Ministry of Environment, Conservation and Parks – acknowledged receipt of the Project Information Form (PIF) and notice.
- Ministry of Tourism, Culture and Sport - acknowledged receipt of the notice.
- Ontario Ministry of Transportation – information was provided regarding project limits and proposed detour to ensure no conflicts with planned future work on Highway 12.
- Nottawasaga Valley Conservation Authority – provided notice that the project was not within their jurisdiction.
- Hydro One – meeting held on March 23, 2020 to discuss general project details and timing. Hydro One provided a point of contact for the project moving forward.
- Enbridge – confirmed that infrastructure was not present within the study area.
- Vianet – confirmed that facilities are not present within the study area.
- Ontario Provincial Police – Southern Georgian Bay (Midland Detachment) - acknowledged receipt of the notice.
- County of Simcoe Paramedic Services – requested information regarding road closures and detours.

3.3 PUBLIC CONSULTATION

A virtual PIC is planned for the fall of 2020. At this time, the date for the PIC is unknown. The intent of the PIC will be to inform the public of the MCEA study, present the evaluation process of the alternative solutions, summarize the selection of the recommended design and solicit further input. Details will also be provided regarding the location and timing of the temporary detour of Old Fort Road as well as the Trans Canada Trail during construction.

4 EXISTING CONDITIONS

4.1 TRANSPORTATION

4.1.1 Traffic

AADT for Old Fort Road is 2100 for the year 2019 per the data from the County of Simcoe website.

4.1.2 Horizontal Alignment

Old Fort Road is oriented in the north-south direction. The existing horizontal alignment within the project limits is tangential i.e. there are no horizontal curves. Old Fort Road crosses Trans Canada Trail approximately 300m south of Highway 12.

4.1.3 Vertical Profile

Based on a design speed of 50 km/h, the minimum K values for crest and sag vertical curves are 7 and 13 respectively as identified in Tables 3.3.2 and 3.3.4 of the Geometric Design Guide for Canadian Roads TAC. The assessment of existing vertical curves on Old Fort Road was based on these values.

There are three vertical curves located within the project limits. The following table summarizes the findings:

Table 1: Summary of Vertical Curve Review

Station VPI	Type of Vertical Curve	Approx. Length of Vertical Curve (m)	K-Value	Approx. Design Speed (km/h)	Meets or Exceeds Design Speed of 50km/h?
	Grade -0.17%				
10+499.53	Sag	56	±12	40 km/h*	No
	Grade 4.9%				
10+577.66	Crest (Bridge)	52	±18	>50 km/h	Yes
	Grade 1.0%				
10+660.15	Sag	48	±22	>50 km/h	Yes
	Grade 5.1%				

* The existing vertical curve located at station 10+499.53 will be retained as it is outside the bridge replacement limits and no related operational or safety issues have been identified. Bringing the vertical curve up to standard will have significant impacts on project cost, utilities and residential entrances within the curve limits.

4.1.4 Cross Section Geometry

The cross-sections were reviewed using the survey plan prepared for this project.

In general, the existing lane and shoulder widths are about ±3.40m and ±0.6m respectively at the bridge location with a fully paved shoulder, and about ±3.40m and ±1.5m respectively at the approaches with partially paved shoulder widths of ±0.5m.

4.1.5 Guide Rail

The guide rail conditions were reviewed and documented. The bridge approaches are protected by steel beam guide rails (SBGR) at each quadrant, which terminates at the parapet wall of the structure. The guide rail is mounted on wood posts with wood offset blocks. The southeast and northwest sections of the guide rails are terminated with buried end treatments while the southwest and northeast sections of the guide rail are terminated with upright "fishtail" end treatments. All guide rail sections are in fair condition. **Table 2** documents the guide rail details and conditions within the study limits.

Table 2: Existing Guide Rail

Station	Lt / Rt	Length (m)	Type of Guide Rail	End Treatment	Condition	Offset from CL of Old Fort Road (m)	Height from ground to center of rail (cm)
10+523 to 10+561	Lt.	38	SBGR	SBEAT	Fair	4.6 – 4.7	50
10+523 to 10+555	Rt.	32	SBGR	SBEAT	Fair	4.7 – 5.3	60
10+606 to 10+636	Lt.	30	SBGR	SBEAT	Fair	4.7	60
10+599 to 10+638	Rt.	39	SBGR	SBEAT	Fair	4.8-5.0	60

4.2 UTILITIES

Overhead and buried utilities were noted on both the east and west sides of Old Fort Road, including crossing perpendicular to the road just north and south of the bridge. The utility poles on the west side are much closer to the existing bridge structure compared to those of the east side (about 2m and 4m respectively). The utilities noted include:

- Bell overhead lines on the west side of the bridge parallel to the roadway;
- Hydro One overhead lines perpendicular to the roadway approximately 50m south of the bridge;
- Secondary hydro cables at poles along Old Fort Road on both east and west sides; and
- Buried Rogers cables at the Old Fort Road and Highway 12 intersection.

4.3 STRUCTURE AND APPROACHES

The existing structure was built in 1978. It has a three-span (13.6m – 13.7m – 12.1m) slab-girder superstructure supported by reinforced concrete piers and abutments. There are four (4) prestressed voided slab girders with corrugated steel decking on the reinforced concrete deck soffit between the girders. The distance between the inside face of the piers along the bridge is approximately 13.3m and the vertical clearance below the middle span of the bridge is 7.9m. The clear width of the bridge between barrier wall faces is 9.2m.

Observations from a visual inspection of the bridge carried out on April 7, 2020 and the 2016 Biennial Inspection Report are as follows:

- Wide bearing cracks and delamination of concrete girders at abutments and piers;
- Vertical stained cracks on the girder webs;
- Rusting of the north expansion joint armouring and signs of leaking;

- Localized areas of corrosion of the corrugated steel on the deck soffit between the girders at the north pier;
- Concrete spalling and bearing cracks at ends of diaphragms at the south end of the bridge;
- Vertical cracks and efflorescence on the cantilever portion of the pier caps and over the piers;
- Visible deflection of the handrails, likely due to impact, and severe cracking, areas of concrete delamination and spalling on the inside face of the barrier walls; and
- Concrete spalling of the south abutment on the west corner.

There are no drains on the bridge deck. Further, there is no record of previous rehabilitation for this structure.

A small creek flowing east to west runs alongside the Trans Canada Trail on the north side of the south pier. There are small drainage pipes / culverts that channel flow at specific locations along the trail near the bridge.

There is another creek on the north side of Old Fort Bridge with two CSP culverts carrying flow underneath Old Fort Road from east to west. The diameter of each culvert is approximately 750mm. The culverts are in poor condition as the inverts at the outlet end of the culverts have corroded away completely.

4.4 ENVIRONMENTAL

4.4.1 Archaeology

Stage 1 and 2 archaeological assessments were undertaken to support the MCEA study. The study area included a 500 m buffer around the bridge. The results of the Stage 1 study determined that the study area has archaeological potential for both historical and pre-contact archaeological sites given its proximity to known and documented archaeological sites. Based on the findings of the Stage 1 archaeological background assessment, it was determined that a Stage 2 archaeological survey was required. A Stage 2 archaeological survey was completed in the fall 2020. The results of test pit surveys determined that previous extensive land disturbance has removed a majority of the archaeological potential across the study area and as such, it was determined that the study area does not retain any Cultural Heritage Value or Interest. Both the Stage 1 and 2 reports have been submitted to the Ministry of Heritage, Sport, Tourism, Culture and Industry (MHSTCI) as required under the *Ontario Heritage Act*.

4.4.2 Cultural

A Cultural Heritage Evaluation Report (CHER) was prepared to support the MCEA study. The purpose of this assessment was to review relevant historical documents and evaluate the potential cultural heritage value or interest of the existing structure. To evaluate potential cultural heritage value or interest, the standards of the *Ontario Heritage Act* under Ontario Regulation (O. Reg.) 9/06 were applied. The results of the evaluation determined that the Old Fort Road Overhead Bridge (Simcoe Structure #058086) does not exhibit cultural heritage value or interest and as such no further cultural heritage assessments are recommended for this structure.

4.4.3 Fisheries

The study area is located within Severn Sound watershed with hydraulic connection to the Wye Marsh and Wye River. Watercourse thermal regimes throughout the Severn Sound watershed are generally considered to be cold to coolwater due to groundwater inputs. However, warmwater watercourses such as the North River have been identified. Within the study area, approximately 60 m north of the Trans Canada Trail, two (2) Corrugated Steel Pipe (CSP) culverts under Old Fort Road provide east to west flows for an Unnamed Tributary to the Wye River. The tributary is a permanent watercourse which outlets to the Wye Marsh approximately 700 m to the southwest. Two (2) surface water drainage feature runs the length of the Trans Canada Trail as lateral ditches within the study area. Both drainage features have direct hydraulic connectivity to the Unnamed Tributary to Wye River approximately 200m west of the bridge. Fish species were observed in both the Unnamed Tributary to the Wye River and the drainage features, with fish being directly observed under the bridge. Background information provided by the MNRF has designated the Unnamed Tributary to the Wye River as a coldwater thermal regime. It is inferred that the drainage features also have a coldwater thermal regime as they are continuously flowing and there was evidence of groundwater contributions (i.e. watercress, iron staining and seeps). Secondary source aquatic information for the study area is limited, review of the Land Information Ontario (LIO) database provides no fish community information for the Unnamed Tributary to Wye River. However, information for fish species within the Wye River noted recorded occurrences for Brown Bullhead (*Ameiurus nebulosus*), Brown Trout (*Salmo trutta*), Channel Catfish (*Ictalurus punctatus*), Common Carp (*Cyprinus carpio*), Largemouth Bass (*Micropterus salmoides*), Northern Pike (*Esox lucius*), Pumpkinseed *(Lepomis gibbosus*), Rainbow Trout (*Oncorhynchus mykiss*), Rock Bass (*Ambloplites rupestris*), White Sucker (*Catostomus commersonii*) and Yellow Perch (*Perca flavescens*). These species represent a diverse fish community, with species across many trophic levels and with varying habitat requirements. Available information as reviewed through the Department of Fisheries and Oceans (DFO) Species at Risk online mapping and public registry feature did not identify any Species at Risk (SAR) or critical habitat within the study area or the Wye River. No occurrence records were reported for provincially protected aquatic SAR in the Natural Heritage Information Centre (NHIC) database.

Fisheries sensitivities and constraints within the study area will be further refined following the completion of a summer field survey and following additional consultation with regulatory agencies.

4.4.4 Terrestrial

The study area is comprised of the following Ecological Land Classification (ELC) vegetation communities: FODM8-1 – Fresh Moist Poplar Deciduous Forest Type, FOM – Mixed Forest, MEM – Mixed Meadow, RES – Residential, THD – Deciduous Thicket, THDM2-1 – Sumac Deciduous Shrub Thicket Types, WOCM1-2 – Dry Fresh White Cedar Coniferous Woodland Type and WOM – Mixed Woodland. No rare vegetation, vegetative communities or botanical Species at Risk were observed within the study area. Bordering the west study area limits, the Wye Marsh is present. The Wye Marsh is designated a Provincially Significant Wetland (PSW) by the MNRF. The Wye Marsh includes cattail marshes, fens, coniferous swamps, upland forests and open water areas. The Wye Marsh is ecologically significant locally and provides habitat for a wide variety of avian and herpetofauna species.

Avian species observed within the study area include Black Capped Chickadee (*Poecile atricapillus*), Blue Jay (*Cyanocitta cristata*), Northern Cardinal (*Cardinalis cardinalis*), Gray Catbird (*Dumetella carolinensis*), Eastern Phoebe

(*Sayornis phoebe*), Hairy Woodpecker (*Leuconotopicus villosus*), Red Winged Blackbird (*Agelaius phoeniceus*) and Wild Turkey (*Meleagris gallopavo*). No avian species or nests were observed under the bridge. Wildlife observed within the study area included Eastern Chipmunk (*Tamias striatus*), Red Squirrel (*Tamiasciurus hudsonicus*), Eastern Gartersnake (*Thamnophis sirtalis sirtalis*) and Green Frog (*Rana clamitans*). There was also evidence of Beaver (*Castor canadensis*) activity on the west side of the study area. Several dens (species unknown) were also observed along the surface water drainage features parallel to the Trans Canada Trail. The observation of the Eastern Gartersnake was on March 31, 2020 which suggests the potential for hibernacula within the study area. Several suitable type areas with rock piles were observed within the study area; however, none were in close proximity to the bridge.

The field survey program also included a tree inventory 150 m west and east of the bridge. The results of the tree inventory note that Trembling Aspen (*Populus tremuloides*) and Eastern White Cedar (*Thuja occidentalis*) account for a large majority (44%) of the surveyed trees and that the most trees were considered to be in “Good” or “Fair” condition with only minor structural or health related defects.

Terrestrial sensitivities and constraints within the study area will be further refined following the completion of a summer field survey and following additional consultation with regulatory agencies.

4.5 LEGAL SURVEY

In order to complete an assessment of the impacts of each replacement option on properties and utilities, an accurate definition and layout of the County’s Right-Of-Way (ROW) within the project limits was required. Due to the lack of accuracy of the County’s related available GIS data and plans, conducting a legal (boundary fabric) survey was necessary.

This survey was completed by MRM Surveying Ltd. in November 2020 and can be used to define the County’s ROW in future references. Further, the impact on properties and utilities has been assessed based on the survey findings and detailed in Section 5.2.2.1 of this report.

5 OPTIONS AND EVALUATION

5.1 DESCRIPTION OF DESIGN OPTIONS

The following three replacement options were developed and evaluated:

- **Option 1:** Single-span bridge
- **Option 2:** Tunnel structure
- **Option 3:** At-grade crossing

All replacement options would be designed for 50km/hr design speed with a 3.5m lane and 1.5m shoulder in each direction, anticipating full closure of Old Fort Road during construction and detour along Rumney Road and Elliot Side Road (see **Appendix F**). All replacement options would maintain the existing horizontal alignment of Old Fort Road. Replacement options are shown in **Appendix C**.

The foundation system of the existing structure is unknown as the original drawings are not available. A Preliminary Foundation Investigation and Pavement Design Report has been completed for this site and indicates that both spread footings and pile foundations are feasible at this location. The subsurface stratigraphy encountered in the boreholes typically consisted of surficial pavement structure and associated fills over the native layered silts and sands underlain by non-plastic glacial till.

The options are further detailed in the following sections.

5.1.1 Option 1: Single-span bridge

This option would involve replacing the existing three-span bridge with a 30m single-span bridge with a concrete deck on steel girders and semi-integral abutments supported on spread footings. The 225mm reinforced concrete cast-in-place deck would be overlaid with 90mm of asphalt and waterproofing and would be continuous with the reinforced concrete approach slabs. The barrier system would comprise 0.3m concrete parapet walls with steel railings over the bridge superstructure. The total width of the proposed bridge is 10.6m. The substructure would also include reinforced concrete abutments and wingwalls.

A preliminary evaluation indicates that a 30m span, with the proposed abutments located at the middle of the approach spans of the existing bridge, minimizes the risk of conflict between the foundations system if either spread footings or pile system foundations are chosen.

5.1.1.1 Comparison of Semi-Integral and Integral Abutments

As long-term durability is a factor, consideration was given to utilizing either semi-integral or integral abutments since both spread footings and pile foundations are feasible at this site. This would eliminate the need for expansion joints on the bridge and accordingly avoid the regular maintenance and replacement of such joints as well as the exposure of abutments, deck and girders to de-icing salts. This exposure causes corrosion of their reinforcing steel bars and concrete spalling. Therefore, eliminating expansion joints avoids the repair and replacement of these structure components, reduces the bridge maintenance budget and enhances the long-term durability and overall performance of the structure.

Spread footings are suitable for semi-integral abutments while deep pile foundations are required for an integral abutment system. However, per the recent geotechnical investigation carried out by Thurber at this site, due to the existence of a very dense till strata, pre-augering to drive the piles to achieve a minimum 7m pile length would be required, which is not practical as it will incur additional cost and time to the installation of the pile foundations. Therefore, a semi-integral abutment system with spread footings is considered an optimum solution for the bridge option.

5.1.1.2 Comparison of Prefabricated Steel and NU Girders

Prefabricated and readily available girders for the bridge are preferred as these reduce construction budget and duration and, accordingly, the closure period of Old Fort Road and the trail. Preliminary analyses indicate that NU concrete girders or steel girders would need to be 1.2m deep. Four (4) girders would be required in either case. A comparison of the costs for each indicate that the steel girders system would be more economical with approximately $50k in savings. For this reason, a steel girder system was chosen for the evaluation of the bridge option.

5.1.2 Tunnel Structure

This option involves replacing the existing bridge with a concrete box structure along Tay Shore Trail and backfilling above the tunnel structure as well as the approaches. The clear span of the tunnel would be 6.7m and the vertical clearance 4.5m, similar to the existing tunnel structure to the east along Tay Shore Trail (see **Appendix A Photo 7**). Given the size of the structure, precast options are limited and so the structure would need to be cast-in-place.

To reduce the cost of this option, the length of the proposed tunnel was reduced by lowering the road profile to minimize the fill on top of the tunnel and the size of the embankments as well. Further, utilizing Retaining Soil System (RSS) walls at all four corners of the tunnel has been investigated and the length of the tunnel with and without the RSS walls would be 15m and 33m respectively. Given the much higher unit cost per meter for the tunnel structure compared to that of the RSS walls, using RSS walls is the optimal cost solution of this option. The total width of the roadway would be 12m which includes 1m of rounding for the steel beam guide rail on each side. The height of the RSS walls is approximately 7.5m at the corners of the tunnel structure and 12.6m in length on average.

Waterproofing will be provided over top of the structure. The cast-in-place concrete box structure would be founded on dense sandy silt to silty sand till layer with granular material required under the base of the box structure. There is low risk of conflict in terms of foundation of the existing structure and the proposed box structure. Illumination will be required inside the tunnel, potentially utilizing overhead illumination fixtures, and outside light poles at the entrances similar to the existing tunnel structure to the east along Tay Shore Trail.

5.1.3 At-Grade Crossing

The third option involves eliminating the need for any structure by raising the grade of the trail and lowering the profile of Old Fort Road to establish an at-grade-intersection. To achieve a maximum 4% slope of the trail, extensive grading of the trail will be required for approximately 370m. Further, significant lowering of Old Fort Road profile will be associated with major impacts on utilities, private properties and entrances. Stop signs at each side of the intersection of the trail would be required to alert pedestrians of the roadway. Warning signals would be needed for the pedestrian crossing.

5.2 EVALUATION OF DESIGN OPTIONS

The initial task in the evaluation was to develop a list of evaluation factors and sub-factors that could be used to discuss the design options and make comparisons between them. Factor areas selected for this project included:

- Highway Engineering: A primary objective for Simcoe County is to provide for the safe and efficient movement of goods and people on the road network. Compliance with standards for the final construction will help ensure the road meets a driver's expectations. Improving sightlines by improving the road profile, minimizing the impact on entrances and maintaining the functional use of the trail are key elements considered in the evaluation.
- Traffic Engineering: Short-term traffic safety is not a concern as the bridge will be replaced under a full road closure but for long-term traffic safety improving sight lines and eliminating accident risk are key considerations. Options where the trail remains completely independent of the road are considered favourable to avoid accidents where the trail and roadway will cross.
- Utility Needs and Relocation: Extent of utility impacts in constructing each option.
- Environmental (Natural, Heritage, Social and Cultural Environment): Impact to fish habitat and removal of trees are considered to be key elements to compare between options. Keeping the trail functional along with the road is key for all users to suit or improve the existing conditions so as to maintain the functional requirements for public use.
- Land Use and Property Impacts: Property impacts and the requirement to acquire property to suit the proposed design are evaluated based on areas beyond the right of way. Impacts to the land use are also considered.
- Structural Engineering and Constructability: Structure type and commitment to future maintenance is considered important in selecting the most efficient crossing, taking into consideration length of construction and impedances to the public during construction.
- Construction Cost: The capital value of the investment should be maximized and thus lower cost options are considered more favourable.

For each of these factors, sub-factors were developed to reflect the specific conditions and issues related to the project area. The selection of the sub-factors is important to the decision-making process because they should adequately describe the issue to be evaluated. During the evaluation, one or more potential sub-factors were screened out as it was determined that there was not a meaningful, measurable difference among the options being assessed for that proposed sub-factor.

The list of factors and sub-factors developed for the project, along with a description of the sub-factor, rationale / justification for its use and the relative weighting, is provided in **Appendix B**.

5.2.1 Evaluation Methods

There are various methods available for the assessment and evaluation of design options. The approach selected for this project is the use of both a qualitative or reasoned argument approach (to evaluate the sub-factors) and a quantitative or arithmetic approach (to compare the options to one another).

The qualitative (reasoned argument) approach focuses on the differences in impacts between the various options and, based on these differences, the advantages and disadvantages of each option are identified, rationalized and converted to a single arithmetic score for that sub-factor. The method by which an arithmetic score was established in this evaluation is the "Step" function, where a choice between good/fair/poor or major/moderate/minor/none is available. In this function a rating of "very poor" for a sub-factor equates to a score of zero, while "very good" scores 100%. Intermediate scores of poor, fair, and good score 25%, 50% and 75% of the sub-factor points respectively. With respect to cost evaluation, since there is some separation between the estimated costs for options for this assignment, the maximum score was assigned to the lowest cost option, with points pro-rated for other options based on the difference from the lowest cost option.

The assessed scores for the evaluated sub-factors are then added to arrive at the category factor and overall score for a particular design option. The totals for each option are then compared to determine the preferred option. The sum of all the percentage weights for all of the factor areas totals 100%.

The evaluation carried out for major factor areas is described in more detail below. The full table documenting the evaluation including weights and scores for each factor and sub-factor is shown in **Appendix B**.

5.2.2 Evaluation Factors

5.2.2.1 Horizontal Alignment - Highway and Traffic Engineering, Utilities and Property

All replacement options involve replacement of the existing two-lane structure with a new two-lane structure incorporating improved shoulder widths. On this basis, all options will provide some improvement in safety and snow storage capacity at the bridge crossing itself.

All options retain the existing horizontal alignment and design standards, maintain access to adjacent properties and improve sight distance by eliminating the existing crest at the bridge. There is decreased safety for Trans Canada Trail users with Option 3 as they will have to cross Old Fort Road, and the proposed 4% trail profile will decrease the comfort level of Trans Canada Trail users. No temporary traffic signals or illumination for construction purposes is required for any option. Permanent illumination will be required inside the tunnel for Option 2.

Based on the completed legal survey of the ROW, options 1 and 2 will require relocation of overhead Bell and secondary hydro cables and potentially Hydro One cables as well. Option 2 will have minor impact to the adjacent property entrances. Option 3 will have minor impact to utilities.

The detailed utility, property and drainage impacts for Option 1 (bridge) and Option 3 (at-grade crossing) are as follows:

- Four (4) utility poles will be impacted by grading over 140m. Two of these poles are undermined by an average of 0.25m. The poles might not need to be relocated if they are deep enough which will decrease the relocation limits to 50m (2 poles)
- No impact to driveways
- Minor to no impact on existing drainage
- For option 1 only, some property acquisition will be required from Canadian National Railway due to encroachment of abutment embankment beyond the County ROW
- For option 3 only, major property acquisition will be required from Canadian National Railway to realign the trail

The detailed utility, property and drainage impacts for Option 2 (tunnel) are as follows:

- Six (6) utility poles and seven (7) hydro poles will be impacted by grading over 230m
- Impact to four (4) driveways; driveways would require regrading to tie-in to the lowered road
- Major impact to existing drainage (deeper ditches are needed due to the greater profile lowering)
- Some property acquisition will be required from Canadian National Railway due to encroachment of the retaining walls beyond the County ROW

5.2.2.2 Vertical Alignment

For Option 1, the crest curve on the existing bridge would be eliminated to improve sight distance. The bridge would be located on a 2.59% grade. Adjacent entrances would not be affected by the profile change. Minor impacts to utilities are anticipated.

For Option 2, the road profile would be lowered by 1.9m at the bridge area to reduce the fill on top of the culvert to about 1m. Also, existing sag curves would be brought up to standard for design speed 50km/hr. The construction limits would increase by 90m more than Option 1, caused by the profile lowering. At the north and south approaches of the existing bridge, two and three entrances would need to be regraded respectively. Also, minor impacts to utilities are anticipated; yet, more than those of option 1.

5.2.2.3 Environmental

Archaeological potential and terrestrial impacts are expected to be low for all three options but is highest for Option 3 due to the increased construction footprint. Option 1 has no impact on the trail alignment, use and sightlines, while Options 2 and 3 will impact sightlines and usability of the trail. Options 1, 2 and 3 will require minimal, moderate and high tree clearing respectively. Option 1 will have minimal impact to the watercourse under bridge that runs parallel to trail. However, a culvert under the embankment will be required for Options 2 and 3. For Option 3, re-alignment of the watercourse will be required as well.

In-water work timing is estimated to be between July 1 to September 30.

5.2.2.4 Structure and Constructability

The feasibility of using prefabricated components for the superstructure can decrease construction time for Option 1, while for Option 2 only a cast-in-place approach is feasible. Option 3 scores highest in terms of structure and constructability as there is no structure and, accordingly, no long-term maintenance and durability issues of a structure. Option 1 has a higher maintenance cost due to decreased durability compared to Option 2. The bridge deck, girders and abutments will be exposed to de-icing salts which accelerate corrosion of the components, whereas the tunnel has additional protection due to the fill and waterproofing over the culvert. However, the use of a semi-integral abutment system improves durability by eliminating expansion joints. For the bridge, maintenance will involve replacing the asphalt and waterproofing, deck, barrier walls and substructure local concrete patch repairs along with replacing the bearings during the service life of the structure. For the tunnel, this will typically include local concrete patch and repairs. However, the tunnel structure will eventually require replacement of the culverts which will increase the required maintenance cost.

For both Options 1 and 2, there is minimal risk of conflict between foundations of the new and existing structures due to the shallow spread footings. RSS walls for Option 2 will be required to minimize the length of the tunnel and thus maximizing cost savings as detailed in Section 5.1.2.

For all options, as illustrated via the General Arrangement (GA) drawings in **Appendix C**, the permanent cross-section developed includes:

- 2 x 3.5m traffic lanes
- 2 x 1.5m shoulders

While 3.5m lane widths are not the 3.75m County of Simcoe standard, the existing lane widths on Old Fort Road are approximately 3.4m and there are no plans to increase the lane widths on this roadway based on the Transportation Master Plan. The proposed cross-section widens the shoulders to 1.5m from the existing 0.6m.

For Option 1, the structure cross-section also includes 0.3m on each side for a parapet wall with railing. For Option 2, this would be replaced with 1.0m rounding which would include the steel beam guide rails. Option 3 would have no such addition as there is no requirement for a parapet wall or steel beam guide rail.

For Options 1 and 2, various factors were considered in developing the structure options. This included consideration of schedule and cost benefits from incorporating more prefabricated components where feasible, such as steel or concrete NU girder units for Option 1, and RSS wall panels for Option 2 rather than cast-in-place concrete retaining walls.

5.2.2.5 Construction and Life Cycle Cost Estimation

The estimated capital costs of construction have been developed to a preliminary level and are summarized in the enclosed evaluation matrix **Appendix B**. **Appendix E** contains the estimated quantities and costs for the studied options. This estimate will be refined as the project progresses further in detailed design for the preferred option. The first stage cost evaluation incorporates major work items for the bridge structure and includes consideration for the length of roadway for grading.

For the highway component, cost estimates have been derived using the Ministry of Transportation 2016 Parametric Estimating Guide. The following assumptions have been made:

- The unit costs for structure items are based on Ministry of Transportation (MTO) Huntsville District. All costs were obtained from 2019 contracts and later, using unit costs for similar quantities of items where possible.
- The unit costs for grading are based on Provincial average base costs within the Parametric Estimating Guide.
- The costs have been factored from the 2016 base year to 2021. These 2021 costs were used to compare between options for evaluation purposes.
- A contingency allowance of 20% has been included for the structure and grading costs.
- Contract Administration costs are not included in the estimates.
- Cost of property acquisition was not included for cost comparison purposes.

The at-grade crossing option is estimated to be the lowest in terms of cost due to the elimination of any structure construction and maintenance. However, the capital construction costs for Options 1 and 2 are estimated to be within 25% of this cost. The costs for the structures in Options 1 and 2 are $2.73M and $2.45M respectively, however there are additional grading and utility relocation costs for Option 2 due to the lower profile and thus larger grading limits and impact to adjacent entrances and utilities. The removal of the existing bridge is estimated to be $325k for all options.

A 75-year life cycle cost (LCC) analysis was also carried out for each of the three options according to the MTO Structural Financial Analysis Manual, using a 6% discount rate as recommended in the manual. Rehabilitation and/or maintenance at various points over the life cycle was considered for each option. For the single-span bridge, the LCC includes:

- local concrete repairs to deck soffit, barriers, etc; replacement of asphalt and waterproofing; replacement of bearings; and traffic staging at both 25 and 50 years, and
- rehabilitation/re-surfacing of approaches at years 15 and 40.

For the tunnel structure, this includes:

- local concrete repairs to the tunnel structure at years 30 and 60;
- replacement of the culverts in the embankments at year 45, which will require excavation of fill and reinstating the retaining walls in the affected areas as well; and
- repaving of the road will also be required at years 15, 30 and 60.

For the at-grade crossing, maintenance includes:

- regrading and repaving at years 15, 30, 45 and 60, and
- replacement of the culvert in the embankment at year 45.

No residual value was considered in this analysis as it was assumed that each option will have a 75-year life cycle. A consideration of uncertainty in the cost estimates was also included. The net present value of each option was calculated and compared in the Evaluation Matrix. As the lowest cost option and requiring minimal maintenance, the at-grade crossing has the best net present value. The full life cycle cost analysis can be seen in **Appendix E**.

5.3 CONSTRUCTION AND METHODOLOGY

Each option will require road and trail closure at the beginning of the construction process for removal of the existing bridge.

Once the bridge is removed for Option 1, hoarding and a temporary covered walkway will be installed along the trail to maintain the trail open during construction. Temporary flagged trail closers will be required during girder erection and installation and removal of deck formwork. Construction of the bridge will proceed with the temporary covered walkway along the trail which then can be removed once the bridge parapet walls are in place and the deck formwork is removed. The final stages would involve waterproofing the deck, paving and lane markings before the road can be opened and traffic resumed on the new bridge.

After removal of the existing bridge, Option 2 will require excavation of the trail for the tunnel. The granular pad will then be placed. Formwork for the tunnel invert slab and placement of reinforcing steel bars would follow, followed by the same for the walls and the top slab in separate stages. Each stage will require about 7 days for the concrete to cure and to achieve the strength allowed for stripping formwork. During this time, the excavation and placement of the RSS wall footings can take place. The RSS panels can then be installed including tie-backs and backfilling under the roadway. Installation of culverts for the existing watercourses will be required prior to backfilling. The trail will remain closed until all grading and RSS wall work around the tunnel ends is completed. The final stage would involve paving of the road, installation of steel beam guide rails and lane markings before the road can be reopened.

For Option 3, after removal of the existing bridge, backfilling of the trail and under the roadway will take place to achieve the required 4% slope and intersection at the crossing. Installation of culverts for the existing watercourses will be required prior to backfilling. Once the grading is done, the roadway and trail paving can be completed, including installation of warning / stop signs and lane markings, before the roadway and trail can be reopened.

It should be noted that Option 1 requires the least trail and road closure duration compared to the other investigated options. As for Option 2, the construction of both the cast-in-place tunnel and the RSS walls will take longer and thus will extend the duration of road and trail closure. Construction schedules, assuming starting by the end of spring / beginning of summer, indicate that the total time for road and trail closure will be between 17-20 weeks and 22-25 weeks for the bridge and tunnel options respectively. The tunnel option is also affected by the in-water work restriction, which means the tunnel excavation and replacement cannot occur before July 1, pushing the construction into mid-to-late November where conditions may not be favourable for paving. Comparatively, construction of the bridge could be completed by the end of September. On the other hand, Option 3 will require the longest time for road and trail closure as neither can be re-opened until the entire construction is complete.

It is anticipated that each option can be completed within one construction season.

These constructability factors were considered in the points evaluation of each of the three design options.

5.4 SUMMARY OF OPTIONS

A matrix table is included in **Appendix B** that summarizes the options, their advantages and disadvantages, and the outcome of the evaluation. The evaluation indicates the following main points:

- Options 1 and 2 score comparably higher points for highway engineering and long-term traffic safety when compared to Option 3, which reduces safety and accessibility for pedestrians and traffic at this site.
- Option 3 has the least impact to utilities, while Option 2 has the most impact due to the larger grading limits and the need for illumination within the tunnel. The bridge option scores average in this regard.
- Option 1 is favoured from an environmental perspective with the least impact to the footprint of the structure, minimal alteration to the trail and sightlines, and minimal impact to the watercourse under the bridge. Both Options 2 and 3 will require construction of a culvert to accommodate the watercourse as it is used for fish passage and would be covered in fill. The two options also significantly alter the sightlines of the trail. In addition, usability of the trail is reduced due to the steep 4% slope in Option 3.
- Each option has minor to no impact to entrances and property and have therefore received the same score for this factor. Option 2 will have the most impact to entrances due to the relatively larger grading limits.
- In terms of structure, the at-grade option scores full points due to the elimination of any structure capital or long-term maintenance cost. In comparing the other two options, the tunnel is more favourable in terms of long-term durability due to the fill over the structure and reduced maintenance requirements of individual structural components. For the bridge, maintenance / rehabilitation will include replacement of bearings, deck, waterproofing, and local concrete patch and repairs. For the tunnel, this will only include local concrete patch and repairs. While low, the risk of conflict between the existing and proposed foundation systems for the bridge does exist. For these reasons, the bridge scores slightly lower than the tunnel option in terms of structural factors.
- Regarding constructability and impact on road and trail closure duration, the bridge option scores the highest points due to the estimated speed of construction and quicker re-opening of the trail and road. Construction schedules indicate that the total time for road closure will be between 17-20 weeks and 22-25 weeks for the bridge and tunnel options respectively.
- While the at-grade crossing is the lowest cost option, its low scores in the previous categories leaves it as the lowest-scoring option overall by a considerable margin. The structure cost for the bridge is the highest of the three options, while the tunnel option has more grading and entrance/utility impact costs.

The final scores for the options are 83 for the bridge (Option 1), 80 for the tunnel (Option 2), and 66 for the at-grade crossing (Option 3).

5.5 PREFERRED DESIGN OPTION

The bridge option achieves the highest scoring due to favourable impact in terms of environmental, highway, traffic safety, utility relocation, property, and constructability factors. While the tunnel option scores higher in terms of capital construction cost and structure durability (resulting in lower long-term maintenance costs as well), the bridge option scores more favourably overall, especially in environmental and constructability factors, impact to utilities / property, and road geometrics.

6 RECOMMENDED DESIGN

6.1 GENERAL

The new bridge will be a 30m single span semi-integral abutment structure on the existing alignment on Old Fort Road. This design option was selected because it minimizes environmental factors and constructability issues, has a relatively short construction period, and minimizes the potential for property / entrance impacts. A preliminary General Arrangement Drawing for the bridge replacement is included in **Appendix C**.

Old Fort Road will have a new vertical profile (grade lowering by 0.9m above the centreline of the Trans Canada Trail).

6.2 GEOMETRY

6.2.1 Horizontal Alignment

The new bridge will be constructed on the existing Old Fort Road alignment. This section of Old Fort Road has a design and posted speed of 50km/h.

6.2.2 Vertical Profile

The recommended vertical alignment consists of a 2.59% grade to the north. The preferred vertical alignment through the area of the bridge will result in about 0.9m grade lowering at the new structure. This grade lowering is a result of the elimination of the existing vertical crest curve.

6.2.3 Cross Section

As the average existing shoulder width is 1.5m within the surveyed limits and given the low design speed of 50 km/h, we recommend maintaining 1.5m fully paved shoulder within the project limits plus 0.5m rounding where SBGR is needed. Widening a small section of the road will not provide value and will incur additional property, drainage and utility impacts.

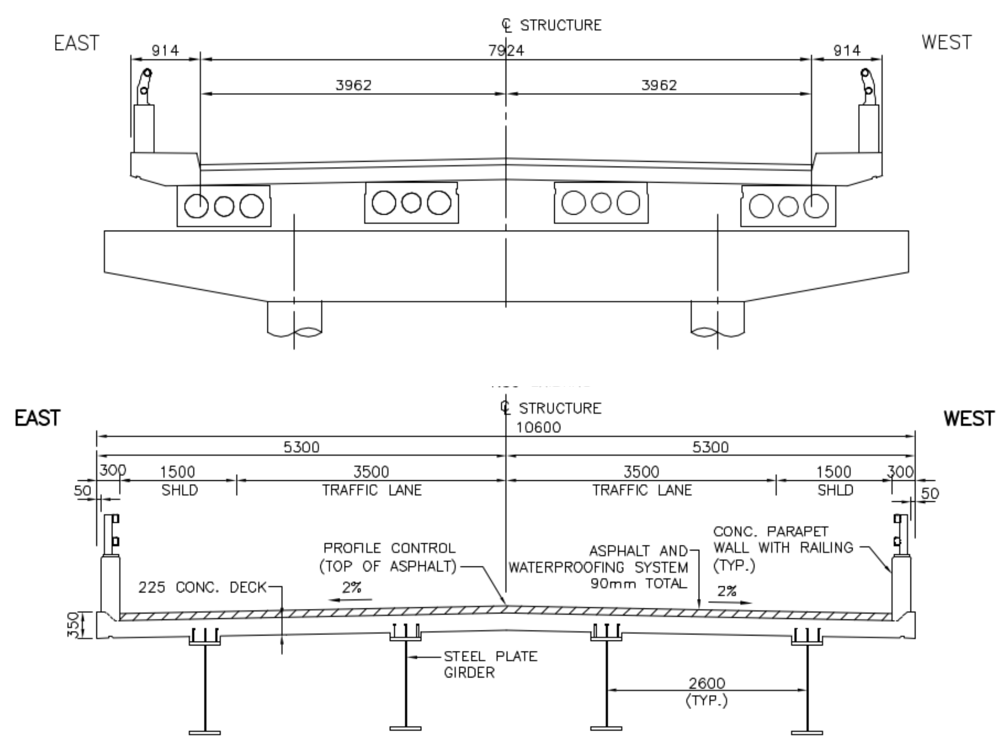
The proposed cross-sections of Old Fort Road are as follows:

Bridge

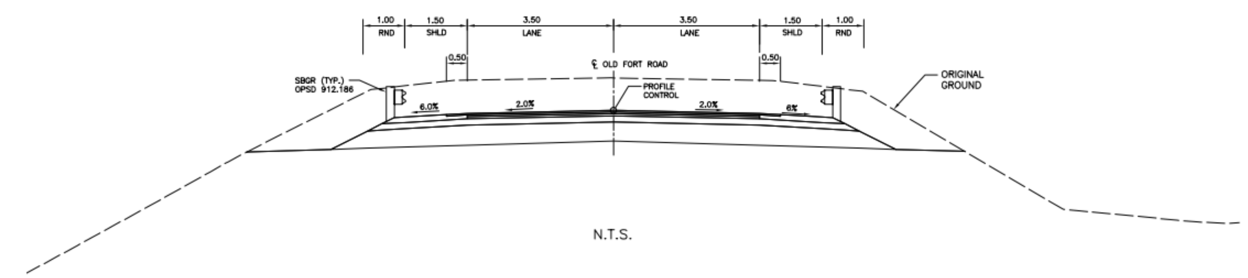
- Parapet Walls 0.3m
- Shoulders 2 x 1.5m
- Lane Widths 2 x 3.5m
- Crossfall 2% downslope in each direction with centreline of road coinciding with centreline of structure

Old Fort Road

- Shoulders 2 x 1.5m
- Lane Width 2 x 3.5m



Typical section at the bridge



Typical section at approaches

6.2.4 Entrances

Within the project limits, no entrances will be re-graded as a result of the profile lowering.

6.2.5 Roadside Safety Improvements

The roadside safety improvements include:

- Eliminating the existing crest curve at the bridge location to improve sight distance; and
- Replacing the guide rail in all quadrants with new end treatments.

6.2.6 Pavement Structure

Geotechnical investigation and pavement analysis have been performed. Based on the borehole data, the anticipated traffic volumes, and assuming adequate subgrade drainage, the following preliminary pavement design is recommended for Old Fort Road:

- 40 mm Superpave 12.5 FC1, 90 mm Superpave SP 19, 150 mm of OPSS Granular A Base and 450 mm of OPSS Granular B Type II Subbase

Should the County consider not using Superpave asphalt mixes for this project the recommended Superpave 12.5 can be substituted with HL3 material, and the Superpave SP 19 can be replaced with HL8 asphalt material.

For the preliminary design of the trail pavement, the following is recommended:

- 40 mm Superpave 12.5, 50 mm Superpave SP 19, 300 mm of OPSS Granular A Base

6.3 STRUCTURE

6.3.1 Structure Description

The new structure will incorporate the following details:

- 30m single-span bridge, with 32° skew to the centreline of the Trans Canada Trail;
- Two 3.5m wide traffic lanes with 1.5m wide shoulders between inside faces of the parapet walls on the replacement bridge;
- 300mm wide parapet walls with steel railing on the outside of the shoulders;

- Superstructure consists of four lines of steel girders made composite with a 225mm thick cast-in-place reinforced concrete deck slab, and 90mm waterproofing and asphalt overlay;
- Semi-integral abutments at both abutments with 6000 mm long approach slabs;
- Each abutment will be supported on spread footings founded on the very dense shallow till layer;
- 5.5m and 6m long wingwalls slabs on the north and south approach respectively; and
- Embankment slopes will be constructed at 2:1 and covered with rip-rap under the bridge.

The preliminary General Arrangement Drawing is included in **Appendix C**. The cost estimate for the structure is provided in **Appendix E**.

6.3.2 Foundation and Embankments

Thurber Engineering Ltd., a sub-consultant to LEA Consulting Ltd., has completed a field investigation and provided recommendations for preliminary design of foundations for the new structure.

The subsurface stratigraphy encountered in the boreholes at the bridge structure generally consisted of surficial pavement structure and associated approach fills overlying a silty sand layer and major deposit of dense to very dense sandy silt to silty sand till.

Thurber's design recommendations for this site noted that shallow footings founded on the very dense sandy silt to silty sand till layer are feasible. As an option, driven H-piles with a tip elevation of 180.0m are also feasible for the abutments. However, pre-augering will be required to penetrate the very dense till and to provide a sufficient length of pile to achieve lateral fixity. Pre-augering is not practical at this site. As a result, a semi-integral abutment bridge is favourable at this site by utilizing spread footings close to grade, providing an economical solution for this substructure element into the very dense material at this location. The preliminary design for this structure was therefore carried out considering shallow foundations and the use of semi-integral abutment details.

6.3.3 Miscellaneous

6.3.3.1 Design Code

The bridge replacement design will be carried out in in accordance with CHBDC CAN/CSA S6-19. Design details will be in accordance with MTO Structural Manual.

6.3.3.2 Materials

Concrete bridge components such as footings, abutment walls, wingwalls, bridge deck, approach slabs, and parapet walls will be Class C1 per CSA A23.1 with compressive strength of 30 MPa at 28 days unless otherwise specified on the drawings.

The parapet walls will be detailed with stainless steel or Glass Fibre-Reinforced Polymers (GFRP) reinforcing bars as per MTO Structural Manual/Standard Drawings. All other components will be detailed with black steel.

Structure backfill will be limited to Granular 'A' or 'B- Type II'.

Transportation of 30 meter long steel girder sections will be required for this project. The appropriate special provisions that address this situation will be included with the specifications.

6.3.3.3 Steel Girders

Steel girders will be detailed using atmospheric corrosion resistant steel conforming to CSA standard G40.20/G40.21 grade 350AT or grade 350A. All steel surfaces except diaphragms will be coated from the end of the girders to 600m beyond the front face of the abutment.

6.3.3.4 Bearings

Elastomeric bearings will be designed for the girders at the abutments. Lateral restraint will be provided with steel dowels cast within the abutment bearing seat.

6.3.3.5 Parapet Walls

For combined vehicles and cyclists traffic a TL-4 barrier (SS110-82, 83 and 84) is specified as per as per MTO Structural Manual/Standard drawings. Reinforcing will be stainless steel or Glass Fibre-Reinforced Polymers (GFRP) reinforcing bars as per MTO Structural Manual/Standard drawings listed above.

6.3.3.6 Drainage

No deck drains will be provided on the bridge.

6.3.3.7 Approach Slabs

The approach slab will be detailed in accordance with MTO Structural Standard Drawing SS116-1.

6.3.3.8 Expansion Joints and Jointless Deck Details

The bridge will have semi-integral abutments. Movement at the abutments will be accommodated by rubberized asphalt joints at the approach slabs in accordance with MTO standard details for Semi-Integral Abutment Bridges.

6.3.3.9 Slopes

The forward slope under the bridge will be covered with rip-rap and the remaining embankment slopes will be restored with seed and mulch. Drainage to existing embankment ditches will be restored and lined with rip rap as required during detail design.

6.4 PROPERTY AND UTILITIES

Some property acquisition will be required from Canadian National Railway due to encroachment of the abutment embankment beyond the County ROW. Permanent property requirements will be finalized as this project progresses into detailed design.

Overhead Bell and secondary hydro cables on the west side will require relocation. Four utility poles will be impacted by grading over 140m. The number of poles impacted can potentially be reduced to two poles over 50m during the detailed design based on further communication with Bell and Hydro one.

6.5 ENVIRONMENTAL

6.5.1 Archaeology

No archaeological impacts are anticipated as the results of the Stage 2 archaeological assessment determined that the study area did not contain any Cultural Heritage Value or Interest.

6.5.2 Cultural

The existing bridge does not exhibit cultural heritage value or interest and as such no impacts are anticipated.

6.5.3 Fisheries

Impacts to fisheries are not anticipated as the surface water drainage features under the bridge will be maintained in their current state and condition. No in-water work is required for this project. Similarly, the Unnamed Tributary to Wye River and culverts under Old Fort Road will not require any modification and no in-water work is required.

Key project mitigation measures that will be incorporated into the detail design and implemented during construction to minimize impacts to fisheries resources include:

- Suitable protection systems will be designed and implemented to protect the surface water drainage features during removal of the existing bridge and construction of the new bridge. Watercourse protection will be undertaken in accordance with OPSS 182;
- Perimeter silt fence barrier will be implemented along the length of all watercourses within the project limits to minimize erosion and prevent sediment from entering the watercourses. Silt fence barrier will be installed and maintained in accordance with OPSS 805;
- All dewatering discharge, if required, shall be directed to a filter bag to remove sediments. The filter bag shall be located in an area that is at least 30 m from any watercourse, sufficiently vegetated, stable and does not display any evidence of erosion or instability. Dewatering set-up and treatment shall in accordance with OPSS 518;
- Immediately stabilize disturbed embankments to prevent erosion and/or sedimentation, preferably through re-vegetation with native species suitable for the site. Site restoration shall be undertaken in accordance with OPSS 804;
- Conduct equipment fuelling, maintenance and repair at least 30 m away from the watercourse; and,
- Prepare and implement a Spill Prevention/Response Plan.

6.5.4 Terrestrial

To accommodate the design as well as access/egress, local vegetation around the bridge may require select removal. Existing trees around the immediate areas of the bridge were limited. These trees were noted to provide limited value for wildlife, particularly avian species. No nesting was observed in trees within the immediate vicinity of the bridge. Similarly, no nesting by avian species was observed under the bridge. Wildlife habitat to be impacted around the bridge was not considered to be significant and was in part impacted by local users through the construction of an ad-hoc foot path and snowmobile trail and road snow clearing activities during the winter (including salt related impacts). There was limited evidence and potential for areas directly adjacent to the bridge to provide any value as wildlife habitat.

Key project mitigation measures that will be incorporated into detail design and implemented during construction to minimize impacts to terrestrial resources include:

- Removal of vegetation will occur outside of the migratory bird nesting period April 1st to August 31st and activities will occur in accordance with the Migratory Birds Convention Act (MBCA) and Migratory Bird Regulations;
- Specified work areas should be surrounded by exclusion fence to restrict wildlife access to the active construction area. Exclusion fencing to be installed and maintained during the active season of April 1st to September 30th. The exclusion fencing should be examined daily and repaired as needed to ensure it functions as intended;
- At the specified locations as presented on the contract drawing set, tree protection fencing shall be erected around the identified Tree Protection Zone (TPZ) for trees identified to be retained that are within proximity to the grading limits; and,
- Complete required site restoration following OPSS 804.

6.6 CONSTRUCTION METHODOLOGY AND STAGING

It is anticipated that the bridge will be replaced using the following sequence over one construction season. The girders will need to be fabricated beginning of June to be ready for delivery and installation on site by mid-July. This will require approval of shop drawings and material order starting in April. As a result, the contract will need to be awarded in March to accommodate the dates outlined in this Section.

- Old Fort Road will be closed to traffic in May followed by removal of the existing bridge. The schedule will not be affected by the in-water work restriction since there is no in-water work. However, the ditch / watercourses within the construction zone will need to be protected during bridge demolition and construction activities.
- The substructure including shoring, excavation, and construction of the spread footings, abutments and wingwalls will be completed mid-July.
- The girders will be installed once they are delivered on site and the construction of the cast-in-place concrete deck and approach slabs will be completed by mid-August.
- Parapet wall/railing system and waterproofing and paving of the bridge deck is anticipated to be completed by the end of August.
- This will be followed by completion of embankment grading and installation of guide rails and signage.
- The road can be opened to traffic on the new bridge mid-September. The construction schedule indicates that contractor should complete demobilization and clearing the site by the end of September.

A preliminary construction schedule is provided in **Appendix D**.

6.7 CONSTRUCTION COST ESTIMATE

The preliminary construction capital cost associated with the replacement of the Old Fort Overhead Bridge, including 20% contingency amounts, is estimated to be $2.73M (2020-2021 dollars). The breakdown of structure costs is provided in **Appendix E**.

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APPENDIX A

SITE PHOTOGRAPHS

Photo 1: Old Fort Overhead Bridge (elevation looking west from trail)

Photo 2: Old Fort Road, bridge north approach looking south

Photo 3: Bearing cracks at ends of girders
(Note: picture obtained from 2016 Biennial Inspection Report by Engineered Management Systems Inc.)

Photo 4: Bearing cracks of girders over piers
(Note: picture obtained from 2016 Biennial Inspection Report by Engineered Management Systems Inc.)

Photo 5: Creek underneath Old Fort Bridge

Photo 6: CSP culvert outlet on north west side of Old Fort Road

Photo 7: General view of the tunnel structure to the east of Old Fort Overhead Bridge

Photo 8: General view of at-grade crossing at Triple Bay Road and Trans Canada Trail

APPENDIX B

DESIGN OPTIONS

OLD FORT ROAD BRIDGE REPLACEMENT
SIMCOE COUNTY

LIST OF FACTORS AND SUB-FACTORS

FACTOR / SUB-FACTOR	DESCRIPTION	MEASURE	WEIGHT %	RATIONALE FOR SELECTION
HIGHWAY ENGINEERING			**Total Weighting = 20%**	
Roadway Geometrics	Compliance with Design Standards	Assessment of resultant road network (permanent) related to design speed, compliance with standards, etc.	20	A primary objective for Simcoe County is to provide for the safe and efficient movement of goods and people on the road network. Compliance with standards for the final construction will help ensure the road meets a driver's expectations.
TRAFFIC ENGINEERING			**Total Weighting = 10%**	
Traffic Safety Short-Term during Construction	Collision Risk	Comparison of expected accident risk between alternatives	0	An objective is to provide for the safe and efficient movement of goods and people on the roadway network during construction. Short-term traffic safety is not a concern as the bridge will be closed during construction and traffic detour around existing road network
Traffic Safety Long-Term	Collision Risk	Comparison of expected accident risk between alternatives	10	A primary objective is to provide for the safe and efficient movement of goods and people on the roadway network after construction.
UTILITY NEEDS AND RELOCATIONS			**Total Weighting = 10%**	
Relocate existing utilities / install new utilities	Relocation of existing plant that conflicts with permanent road construction	Extent of utility relocation required for an alternative	10	There is overhead hydro on the east side and overhead Bell/cable on west side of the roadway. LEA is undertaking utility circulation to confirm ownership, type, and location and any underground utility in the area
ENVIRONMENTAL (Natural, Heritage, Social and Cultural Environment)			**Total weighting = 15%**	
Trans Canada Trail (Tay Trail)	Function use of trail for both pedestrians and maintenance/emergency vehicles	Clear open spaces, flat grades, adequate clearances and maintenance requirements	7	The primary objective is to make the trail functional for all users to suit or improve the existing conditions so to maintain the functional requirements for public use.
Archaeology/Heritage	Potential of archeological artifacts being found	Stage 1 assessment identifying the potential of archeological artifacts	2	Stage 1 archeological assessment to be completed. The age of the structure could trigger the MCTS, however Simcoe County has determined that this structure is of low heritage potential, thus specific mitigation measures will not be required for the removal of this resource.
Terrestrial Ecology	Impact on local vegetation and wildlife habitat	Area of local vegetation impacted	4	In keeping with the Environmental Protection Requirements for Transportation projects, it is desirable to minimize impacts on areas of significant local vegetation and on areas of wildlife habitat.
Fisheries and Aquatic Habitat	Impact on fish habitat	Impacts on creek north of bridge	2	In keeping with the Environmental Protection Requirements for Transportation projects, it is desirable to minimize impacts on areas of fish habitat and to reduce any harmful alteration, disruption or destruction of such. The creek north of the bridge has fish habitat. Profile lowering is not anticipated to impact the existing creek.
LAND USE AND PROPERTY			**Total Weighting = 5%**	
Land requirement	Any requirement for ROW expansion	Area of un-subdivided or privately owned land required	5	Expansion of the ROW, if required at this area, would require property acquisition.
STRUCTURAL ENGINEERING			**Total Weighting = 20%**	
Structural	Superstructure	Span configuration and superstructure type	7	Superstructure types can vary significantly in cost. Structure type will demand variable long-term maintenance requirements and reducing exposure to salt and vehicular use will improve durability.
	Substructure	Abutment requirements and future performance / maintenance requirements	7	The performance of deep foundations for larger loading carrying abutments will attract greater long-term maintenance requirements.
Constructability	Constructability of proposed alternatives and access to work areas and trail closures	Qualitative assessment based on staging and access requirements	6	The duration of trail closures and the use of precast elements to limit the trail closure are factors effecting the complexity of the bridge replacement. Construction staging complexity and length of construction impact degree of constructability.
COST			**Total Weighting = 20%**	
Capital construction cost	Capital construction cost	Relative construction cost, excluding property and engineering costs (dollars)	20	The value of the investment in the new structure should be maximized and will most readily be achieved in the life cycle by reducing the capital cost of construction.

OLD FORT OVERHEAD BRIDGE REPLACEMENT DESIGN - PRELIMINARY DESIGN
COUNTY OF SIMCOE

EVALUATION OF REPLACEMENT OPTIONS

FACTORS and SUB-FACTORS / OPTION	OPTION 1 (Single-span Bridge)	OPTION 2 (Tunnel Structure)	OPTION 3 (At-grade crossing)
Roadway Geometrics			
Design Speed	50 km/hr	50 km/hr	50 km/hr
Horizontal Curve Radius	N/A	N/A	N/A
Length of Road Construction	155 m	155 m	155 m Old Fort Road\370m Trans Canada Trail
HIGHWAY ENGINEERING			
ROADWAY GEOMETRICS (maximum 20)	• Retains existing road alignment. • Retains existing design standards / design speed on Old Fort Road. • Proposed profile will provide better sight distance for both northbound and southbound lanes by eliminating the existing crest curve at the bridge location. • Maintains access to adjacent properties. • No re-configuration of entrances required. • GOOD (20)	• Retains existing alignment. • Retains existing design standards / design speed on Old Fort Road. • Proposed profile will provide better sight distance for both northbound and southbound lanes by eliminating the existing crest curve at the bridge location. • Maintains access to adjacent properties. • Minor regrading to adjacent property entrances. • GOOD (19)	• Retains existing alignment. • Retains existing design standards / design speed on Old Fort Road. • Proposed profile will provide better sight distance for both northbound and southbound lanes by eliminating the existing crest curve at the bridge location. • Maintains access to adjacent properties. • No re-configuration of entrances required. • Re-grading of trail at 4% slope required at Old Fort Overhead bridge location. • FAIR (12)
WEIGHTED OPTION SCORE (maximum 20)	**20**	**19**	**12**
TRAFFIC ENGINEERING			
LONG-TERM SAFETY (maximum 10)	• Existing roadway alignment is retained. • Full road closure during construction. • Detour required during construction. • No temporary traffic signals or illumination required. • Proposed profile will provide better sight distance for both northbound and southbound lanes by eliminating the existing crest curve at the bridge location. • GOOD (10)	• Existing roadway alignment is retained. • Full road closure during construction. • Detour required during construction. • No temporary traffic signals or illumination required. • Proposed profile will provide better sight distance for both northbound and southbound lanes by eliminating the existing crest curve at the bridge location. • GOOD (10)	• Existing roadway alignment is retained. • Warning signals are needed for pedestrian crossing. • Full road closure during construction for Old Fort Road and Trans Canada Trail. • Decreased safety for Trans Canada Trail users as they will have to cross Old Fort Road. • Proposed steep 4% Trail profile will decrease the comfort level of Trans Canada Trail users. • Detour required during construction. • No temporary traffic signals or illumination required. • Proposed profile will provide better sight distance for both northbound and southbound lanes. • POOR (5)
WEIGHTED OPTION SCORE (maximum 10)	**10**	**10**	**5**

FACTORS and SUB-FACTORS / OPTION	OPTION 1 (Single-span Bridge)	OPTION 2 (Tunnel Structure)	OPTION 3 (At-grade crossing)
RELOCATE EXISTING UTILITIES / INSTALL NEW UTILITIES	• Utilities noted on site, including overhead Bell, Hydro One, and secondary hydro cables, and buried Rogers cables. • Overhead Bell and secondary hydro cables on the west side will require relocation of four utility poles. • FAIR (6)	• Utilities noted on site, including overhead Bell, Hydro One, and secondary hydro cables, and buried Rogers cables. • Overhead Bell and secondary hydro cables will require relocation of six utility poles. • Hydro One cables will require relocation of seven hydro poles. • Permanent illumination inside tunnel required. • POOR-FAIR (4)	• Utilities noted on site, including overhead Bell, Hydro One, and secondary hydro cables, and buried Rogers cables. • Overhead Bell and secondary hydro cables on the west side will require relocation of four utility poles. • FAIR (6)
WEIGHTED OPTION SCORE (maximum 10)	**6**	**4**	**6**
ENVIRONMENTAL (Natural, Archaeology, Built Heritage and Fisheries)			
TRANS CANADA TRAIL (TAY TRAIL) (maximum 7)	• Minimal alteration to trail alignment, use and sightlines. • GOOD (7)	• Tunnel structure may impact sightlines and usability. • FAIR (5)	• Significant alteration to trail profile. Users will have to cross an active roadway at grade with vehicles. • POOR (2)
ARCHAEOLOGY (maximum 2)	• Stage 2 AA is recommended based on proximity to known archaeological sites. • Archaeological potential expected to be low given limited structure footprint change; evaluation pending. • GOOD (2)	• Stage 2 AA is recommended based on proximity to known archaeological sites. • Tunnel structure and RSS walls to encroach minimally beyond footprint of existing bridge. • Archaeological potential expected to be low given location of footprint increase; evaluation pending. • GOOD (2)	• Stage 2 AA is recommended based on proximity to known archaeological sites. • Fill material for trail embankment to encroach moderately along trail and beyond footprint of existing bridge. • Archaeological potential expected to be low-moderate given location of footprint increase; evaluation pending. • FAIR (1)
TERRESTRIAL (maximum 4)	• Minimal clearing and grubbing of trees and shrubs required. • GOOD (3)	• Some clearing and grubbing of trees and shrubs required. • FAIR (2)	• More clearing and grubbing of trees and shrubs required. • POOR (1)
FISHERIES (maximum 2)	• New bridge abutments outside of watercourse under bridge that runs parallel to trail. • GOOD (2)	• Culvert under embankment next to tunnel structure required to convey watercourse flow. • FAIR (1)	• Fill material for trail embankment to alter a long stretch of watercourse under the bridge and parallel to the trail. • Re-alignment of watercourse will be required. • POOR (0)
WEIGHTED OPTION SCORE (maximum 15)	**14**	**10**	**4**
LAND USE AND PROPERTY			
LAND REQUIREMENT	• Entrances will not be affected by the construction. • Some property acquisition will be required from Canadian National Railway due to encroachment of embankment grading. • FAIR-GOOD (4)	• Entrances will be affected by the construction. • Some property acquisition will be required from Canadian National Railway due to the retaining walls beyond the County ROW. • FAIR-GOOD (4)	• Entrances will not be affected by the construction. • Major property acquisition will be required from Canadian National Railway to regrade Trans Canada Trail. • POOR (2)
WEIGHTED OPTION SCORE (maximum 5)	**4**	**4**	**2**

FACTORS and SUB-FACTORS / OPTION	**OPTION 1** **(Single-span Bridge)** Cross Section = 2*(0.3+1.5+3.5) = 10.6m	**OPTION 2** **(Tunnel Structure)**	**OPTION 3** **(At-grade crossing)**
SPAN CONFIGURATION & SUPERSTRUCTURE TYPE (maximum 7)	• Single span 30m long NU 1200x160 OR steel girders 1.2m depth with integral abutments; 4 girders with 2.6m spacing and 1.4m overhang • Even number of girders to simplify future replacement/rehabilitation staging design to maintain a lane of traffic during construction. • Prefabricated and easily produced/available girders can reduce fabrication and construction time. • Economical superstructure depth; clearance is not a concern. • Higher maintenance cost, medium long-term durability. • FAIR (3)	• Cast-in-place concrete box tunnel with 4.5m clearance and 6.7m span (similar to existing tunnel structure to east) located between the piers of the existing bridge. • Consider RSS walls or concrete retaining walls on trail to shorten length of tunnel and embankment width. • Relatively lower maintenance cost compared to bridge option, high long-term durability. • GOOD (5)	• No superstructure required. • Long-term maintenance eliminated. • GOOD (7)
SUBSTRUCTURE (maximum 7)	• Preliminary geotechnical findings indicate both spread footings and pile foundations are feasible. • Semi-integral abutment foundations reduce risk of conflict with existing foundations, pile foundations for integral abutments will require pre-augering which is not practical at this site. • GOOD (5)	• Box structure on granular bedding located within the piers of existing structure to avoid conflict with existing structure foundation. • GOOD (6)	• No substructure required. • Long-term maintenance eliminated. • GOOD (7)
WEIGHTED OPTION SCORE (maximum 14)	**8**	**11**	**14**
CONSTRUCTABILITY & DETOUR (maximum 6)	• Old Fort Road closed during construction, detour along Rumney Road and Elliot Side Road; duration of road closure 17-20 weeks • If using precast/prefabricated elements, superstructure erection can be accelerated. • Trail closure required for bridge removal and falsework for new bridge; minimal trail closure duration. • One construction season. • Low construction risk due to conflict with existing foundations if use pile foundation. • Minimal advanced tree clearing required (low footprint area). • GOOD (5)	• Old Fort Road closed during construction, detour along Rumney Road and Elliot Side Road; duration of road closure 22-25 weeks • Minimal risk of conflict with existing foundation. • Trail would need to be closed during construction for removal of bridge structure, excavation for tunnel, erection of tunnel, placement of embankment fill and construction of RSS walls, and roadwork up top; longest duration of trail closure. • One construction season. • Advanced tree clearing required over a larger footprint. • FAIR-GOOD (4)	• Old Fort Road closed during construction, detour along Rumney Road and Elliot Side Road • Grade raise requires trail and road closure for extended period of time. • One construction season. • Advanced tree clearing required over largest footprint. • FAIR (3)
WEIGHTED OPTION SCORE (maximum 6)	**5**	**4**	**3**

OPTION / FACTORS and SUB-FACTORS	OPTION 1 (Single-span Bridge)	OPTION 2 (Tunnel Structure)	OPTION 3 (At-grade crossing)
ROADWAY CONSTRUCTION COSTS	• $172,000	• $439,000	• $1,884,000
MISCELLANEOUS COSTS (ENTRANCES, AND RECONSTRUCTION)	• No impacts on existing entrances.	• Existing entrances will be impacted. • $15,000	• No impacts on existing entrances.
COST FOR NEW STRUCTURE	• Steel girder (1.2m depth) bridge $2,229,000	• Cast-in-place concrete box tunnel $1,682,000	• $0
DETOUR STRUCTURE COST	• Detour bridge and signals not needed	• Detour bridge and signals not needed	• Detour bridge and signals not needed
REMOVAL COST - OLD STRUCTURE	• Removal of existing bridge including cutting abutments down to grade $ 324,000	• Removal of existing bridge including cutting abutments down to grade $ 324,000	• Removal of existing bridge including cutting abutments down to grade $ 324,000
TOTAL INITIAL COST ESTIMATE	**$ 2,725,000**	**$ 2,445,000**	**$ 2,208,000**
NET PRESENT VALUE*	**$ 2,905,000**	**$ 2,633,000**	**$ 2,359,000**
WEIGHTED OPTION SCORE (maximum 20, minimum 10)	**16**	**18**	**20**
TOTAL OPTION SCORE (maximum 100)	***83***	***80***	***66***

* Considering life cycle costs, see Appendix E for full details

APPENDIX C

PRELIMINARY GENERAL ARRANGEMENT DRAWINGS

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No

SHEET —

OLD FORT OVERHEAD BRIDGE
GENERAL ARRANGEMENT
OPTION 1: SINGLE SPAN BRIDGE

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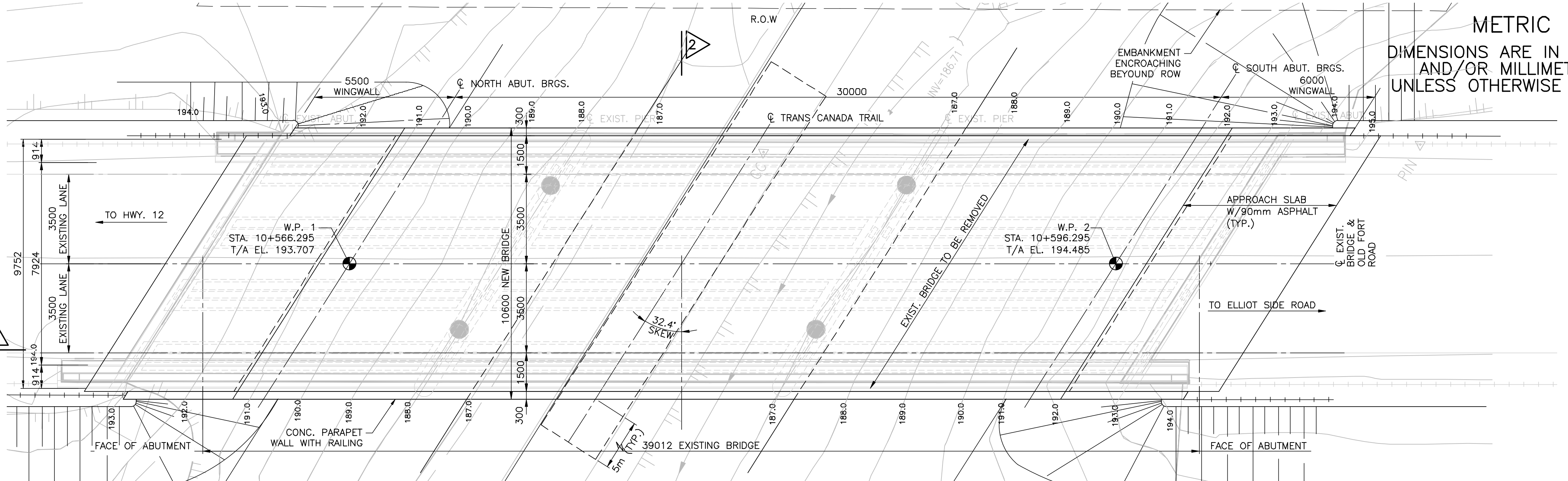

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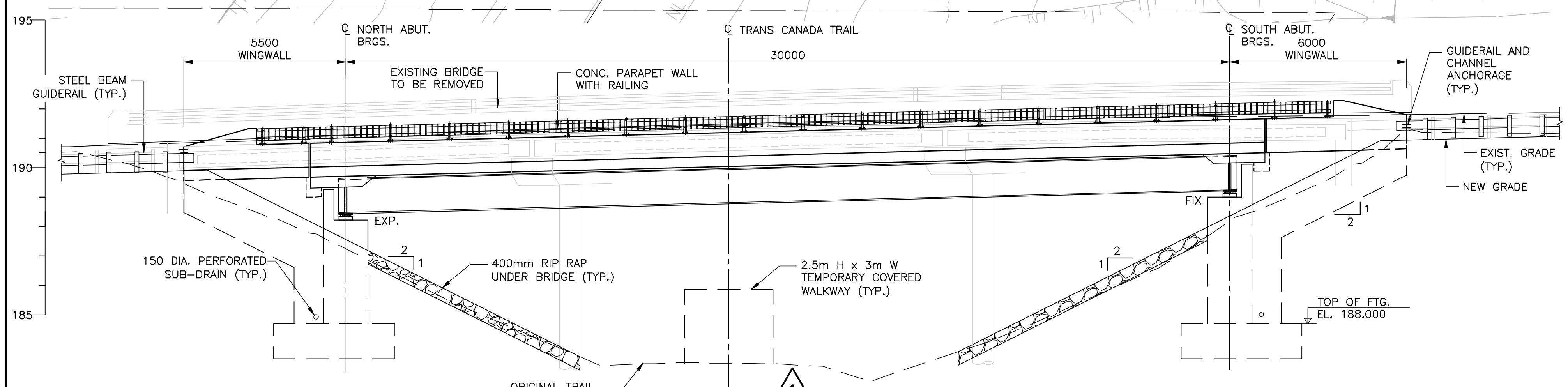

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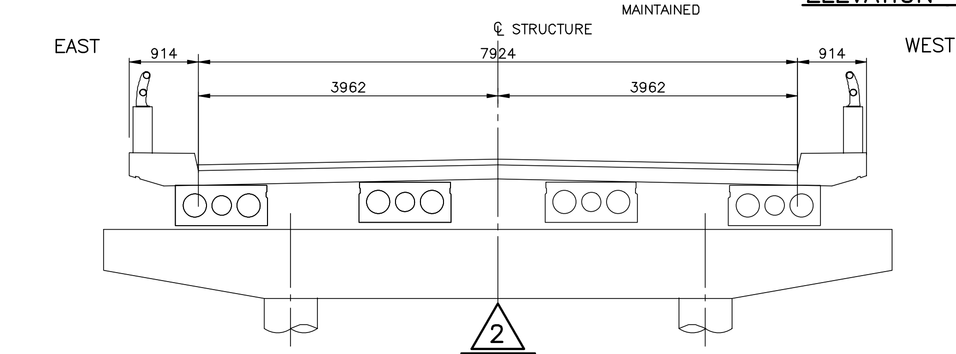

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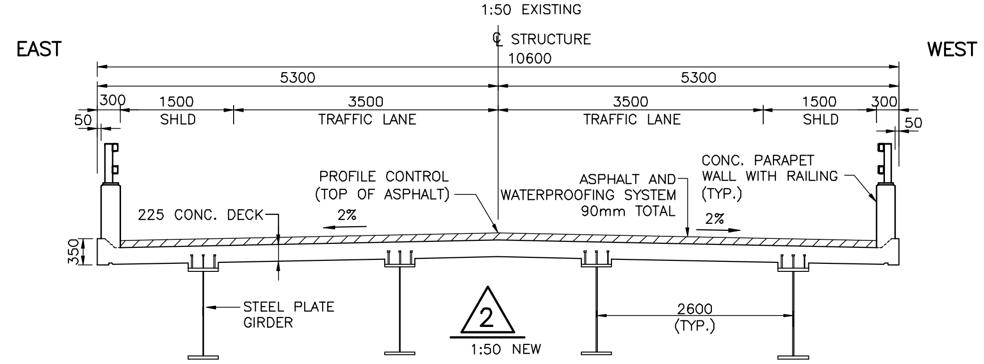

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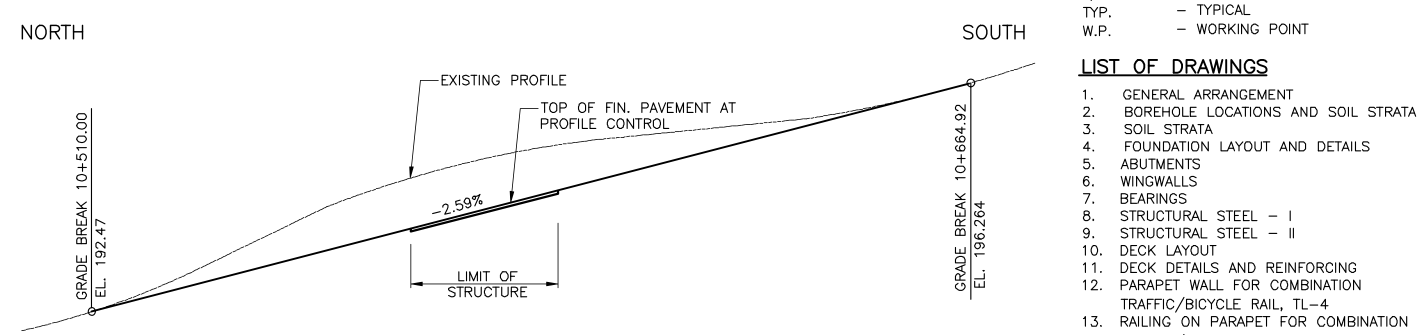

PROFILE OF OLD FORT ROAD
N.T.S.

WP #	STATION	NORTH COORDINATE	EAST COORDINATE
1	10+566.295	4953961.072	592507.091
2	10+596.295	4953935.874	592523.373

GENERAL NOTES:

CLASS OF CONCRETE..30 MPa

CLEAR COVER TO REINFORCING STEEL

FOOTING...100±25
DECK TOP...70±20
BOTTOM...40±10
REMAINDER (UNLESS NOTED OTHERWISE)...........70±20

REINFORCING STEEL

REINFORCING STEEL SHALL BE GRADE 400W UNLESS OTHERWISE SPECIFIED.

TENSION LAP LENGTHS NOT INDICATED ON THE CONTRACT DRAWINGS SHALL BE CLASS B.

BAR MARKS WITH PREFIX "S" DENOTE STAINLESS STEEL BARS. STAINLESS REINFORCING STEEL SHALL BE TYPE 316LN OR DUPLEX 2205 AND HAVE MINIMUM YIELD STRENGTH OF 500 MPA.

BAR HOOKS SHALL HAVE STANDARD HOOK DIMENSIONS USING MINIMUM BEND DIAMETERS. WHILE STIRRUPS AND TIES SHALL HAVE MINIMUM HOOK DIMENSIONS. ALL HOOKS SHALL BE IN ACCORDANCE WITH THE STRUCTURAL STANDARD DRAWING SS12-1, UNLESS INDICATED OTHERWISE.

GLASS FIBRE REINFORCED POLYMER REINFORCING BARS SHALL BE GRADE I, GRADE II OR GRADE III AS SPECIFIED IN THE CONTRACT DRAWINGS.

THE NOMINAL DIAMETER, TENSILE MODULUS OF ELASTICITY AND GUARANTEED MINIMUM TENSILE STRENGTH SHALL BE AS SPECIFIED IN THE CONTRACT DOCUMENTS.

BAR MARKS WITH THE PREFIX GI DENOTE GRADE I GLASS FIBRE REINFORCED POLYMER BARS.

BAR MARKS WITH THE PREFIX GII DENOTE GRADE II GLASS FIBRE REINFORCED POLYMER BARS.

BAR MARKS WITH THE PREFIX GIII DENOTE GRADE III GLASS FIBRE REINFORCED POLYMER BARS.

CONSTRUCTION

1. THE CONTRACTOR SHALL ESTABLISH THE BEARING SEAT ELEVATIONS BY DEDUCTING THE ACTUAL BEARING THICKNESSES FROM THE TOP OF BEARING ELEVATIONS. IF THE ACTUAL BEARING THICKNESSES ARE DIFFERENT FROM THOSE GIVEN WITH THE BEARING DESIGN DATA, THE CONTRACTOR SHALL ADJUST THE REINFORCING STEEL TO SUIT.
2. BACKFILL BEHIND ABUTMENTS SHALL NOT BE PLACED UNTIL CONC. IN THE ABUTMENT HAS REACHED A STRENGTH OF 25 MPa.
3. THE CONTRACTOR SHALL ESTABLISH THE BEARING SEAT ELEVATIONS BY DEDUCTING THE ACTUAL BEARING THICKNESSES FROM THE TOP OF BEARING ELEVATIONS. IF THE ACTUAL BEARING THICKNESSES ARE DIFFERENT FROM THOSE GIVEN WITH THE BEARING DESIGN DATA, THE CONTRACTOR SHALL ADJUST THE REINFORCING STEEL TO SUIT.

LIST OF ABBREVIATIONS:

ABUT.	– ABUTMENT
BRGS.	– BEARINGS
CONC.	– CONCRETE
℄	– CENTRELINE
DIA.	– DIAMETER
EL.	– ELEVATION
EXIST.	– EXISTING
FIN.	– FINISHED
FTG.	– FOOTING
HWY.	– HIGHWAY
N.T.S.	– NOT TO SCALE
SHLD.	– SHOULDER
STA.	– STATION
T/F	– TOP OF FOOTING
TYP.	– TYPICAL
W.P.	– WORKING POINT

LIST OF DRAWINGS

1. GENERAL ARRANGEMENT
2. BOREHOLE LOCATIONS AND SOIL STRATA
3. SOIL STRATA
4. FOUNDATION LAYOUT AND DETAILS
5. ABUTMENTS
6. WINGWALLS
7. BEARINGS
8. STRUCTURAL STEEL – I
9. STRUCTURAL STEEL – II
10. DECK LAYOUT
11. DECK DETAILS AND REINFORCING
12. PARAPET WALL FOR COMBINATION TRAFFIC/BICYCLE RAIL, TL-4
13. RAILING ON PARAPET FOR COMBINATION TRAFFIC/BICYCLE RAIL, TL-4
14. APPROACH SLAB
15. STANDARD DRAWING

APPLICABLE STANDARD DRAWINGS:

MTOD-912.450	GUIDE RAIL SYSTEM, STEEL BEAM STRUCTURE CONNECTION, TUBE RAILING INSTALLATION
OPSD-3101.150	WALLS, ABUTMENT, BACKFILL, MINIMUM GRANULAR REQUIREMENT
OPSD-3102.100	WALLS, ABUTMENT, BACKFILL DRAIN
OPSD-3370.100	DECK, WATERPROOFING HOT APPLIED ASPHALT MEMBRANE WITH PROTECTION BOARD
OPSD-3370.101	DECK, WATERPROOFING HOT APPLIED ASPHALT MEMBRANE AT ACTIVE CRACKS GREATER THAN 2mm WIDE AND CONSTRUCTION JOINTS

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION

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DRAWN DT	CHK MR	SITE	STRUCT	SCHEME	DWG 1

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CREATED:

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

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WP No .

OLD FORT OVERHEAD BRIDGE GENERAL ARRANGEMENT OPTION 2: TUNNEL STRUCTURE

SHEET
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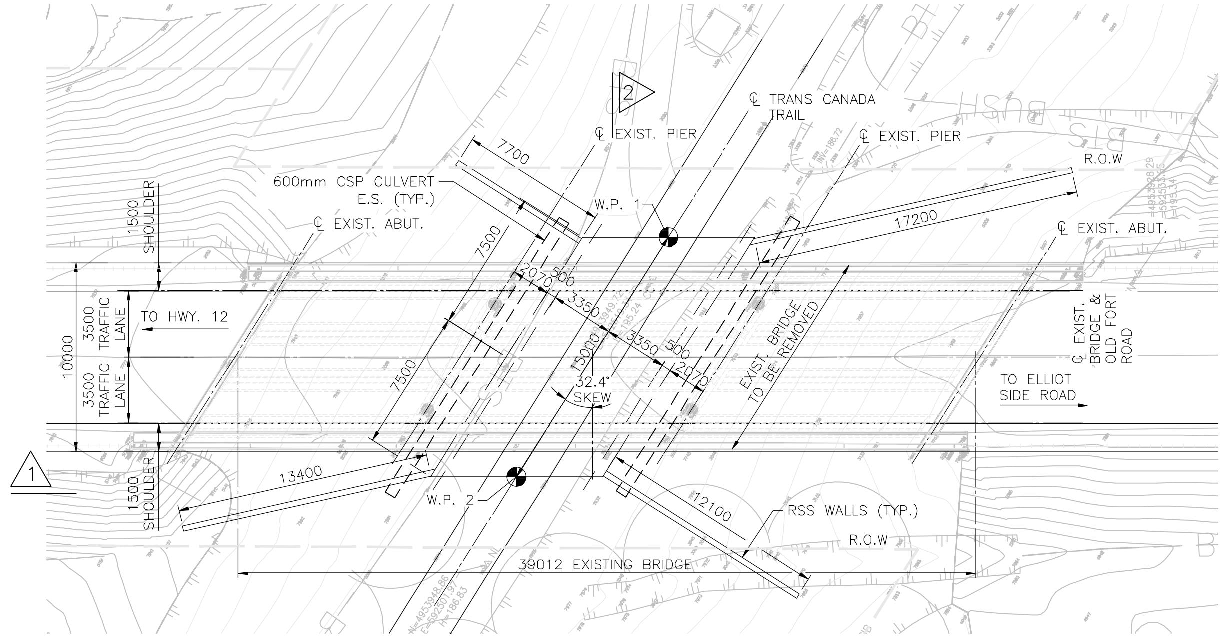

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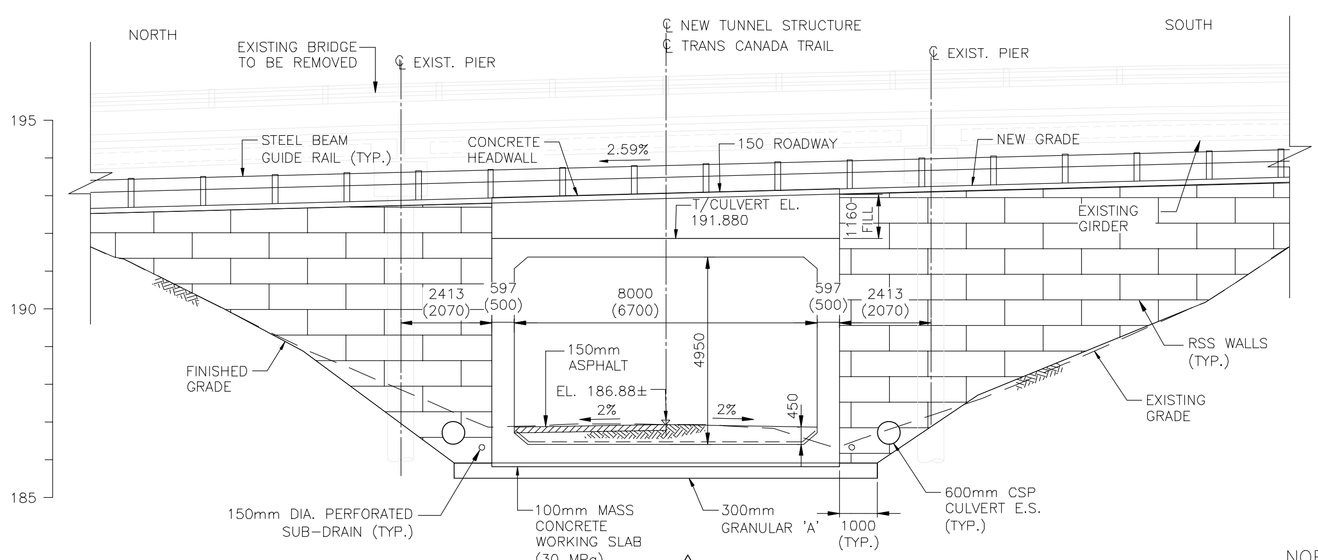

ELEVATION 1
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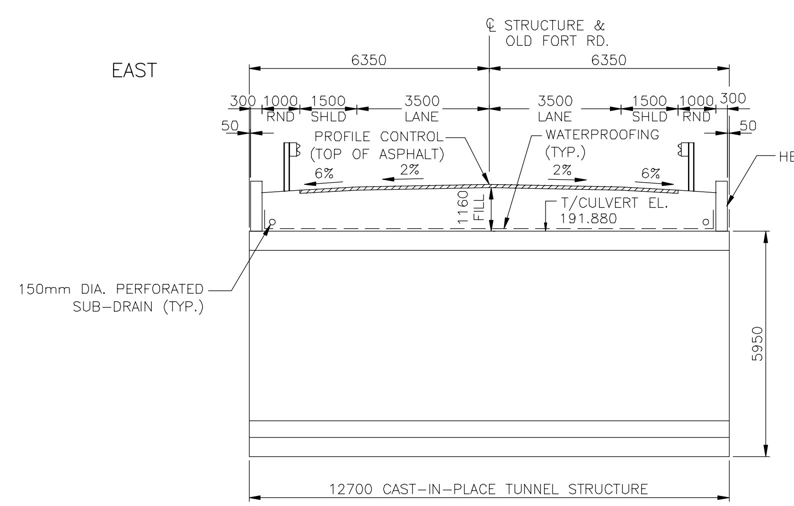
() DENOTES PERPENDICULAR DIMENSION



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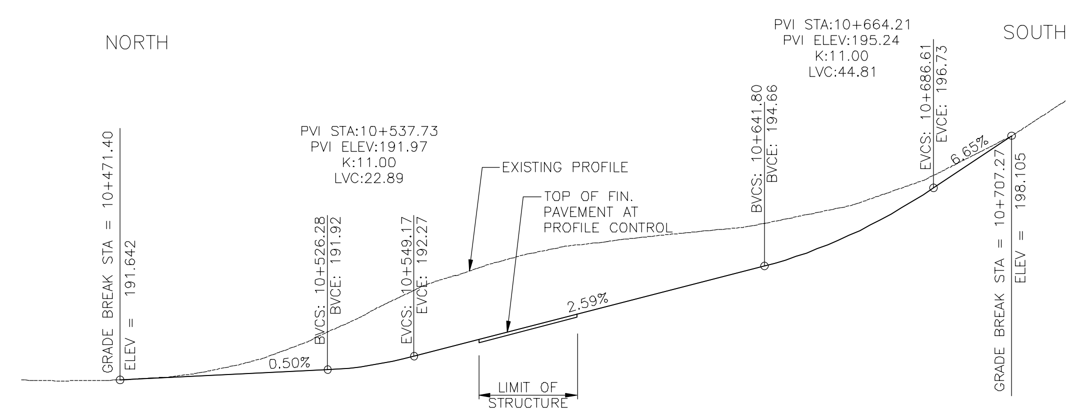

PROFILE OF OLD FORT ROAD
N.T.S.

GENERAL NOTES:

1. CLASS OF CONCRETE

FOOTINGS....30 MPa
PRECAST CULVERT, RETAINING WALLS AND FOOTING UNITS....35 MPa
REMAINDER (UNLESS NOTED OTHERWISE)....30 MPa

2. CLEAR COVER TO REINFORCING STEEL

FOOTINGS....100±25
CULVERT AND RETAINING WALLS: SEE PRECAST CULVERT AND WINGWALL DWGS.
REMAINDER (UNLESS NOTED OTHERWISE)....70±20

3. REINFORCING STEEL

REINFORCING STEEL SHALL BE GRADE 400W UNLESS OTHERWISE SPECIFIED.

TENSION LAP LENGTHS NOT INDICATED ON THE CONTRACT DRAWINGS SHALL BE CLASS B.

BAR HOOKS SHALL HAVE STANDARD HOOK DIMENSIONS USING MINIMUM BEND DIAMETERS, WHILE STIRRUPS AND TIES SHALL HAVE MINIMUM HOOK DIMENSIONS. ALL HOOKS SHALL BE IN SS12-1, UNLESS INDICATED OTHERWISE.

4. CONSTRUCTION

1. OLD FORT ROAD AND TRANS CANADA TRAIL SHALL BE CLOSED AND PROTECTION TO WATERCOURSES/DITCHES WITHIN DEMOLITION/CONSTRUCTION ZONE SHALL BE PROVIDED PRIOR TO DEMOLITION OF EXISTING BRIDGE AND DURING CONSTRUCTION.
2. BACKFILL SHALL BE PLACED SIMULTANEOUSLY BEHIND BOTH SIDES OF THE CULVERT KEEPING THE HEIGHT OF THE BACKFILL APPROXIMATELY THE SAME. AT NO TIME SHALL THE DIFFERENCE IN ELEVATION BE GREATER THAN 500mm.
3. WELDING OF REINFORCING STEEL SHALL NOT BE PERMITTED.

LIST OF DRAWINGS

1. GENERAL ARRANGEMENT
2. BOREHOLE LOCATIONS AND SOIL STRATA
3. SOIL STRATA
4. CONSTRUCTION STAGING & ROADWAY PROTECTION
5. RSS WALL LAYOUT AND DETAILS
6. STANDARD DETAILS

LIST OF ABBREVIATIONS:

ABUT.	ABUTMENT
℄	CENTRELINE
DIA.	DIAMETER
E.S.	EACH SIDE
EL.	ELEVATION
EXIST.	EXISTING
SHLD	SHOULDER
RD.	ROAD
RND	ROUNDING
TYP.	TYPICAL
T/CULVERT	TOP OF CULVERT

APPLICABLE STANDARD DRAWINGS:

OPSD-3101.1	WALLS-ABUTMENT, BACKFILL, MINIMUM GRANULAR
OPSD-3329.101	DECK, REINFORCEMENT - SUPPORTS FOR REINFORCING STEEL FOR SLAB DEPTHS GREATER THAN 300mm

COORDINATE TABLE

CONTROL	NORTHING	EASTING	ELEVATION	C.L. LANE OFFSET	STATION
W.P. 1	4953950.216	592521.646	–	6.35m	10+583.312
W.P. 2	4953950.089	592506.647	–	6.35m	10+575.278

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION

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MINISTRY OF TRANSPORTATION, ONTARIO PH-D-707 88-05

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

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OLD FORT OVERHEAD BRIDGE
GENERAL ARRANGEMENT
OPTION 3: AT GRADE CROSSING

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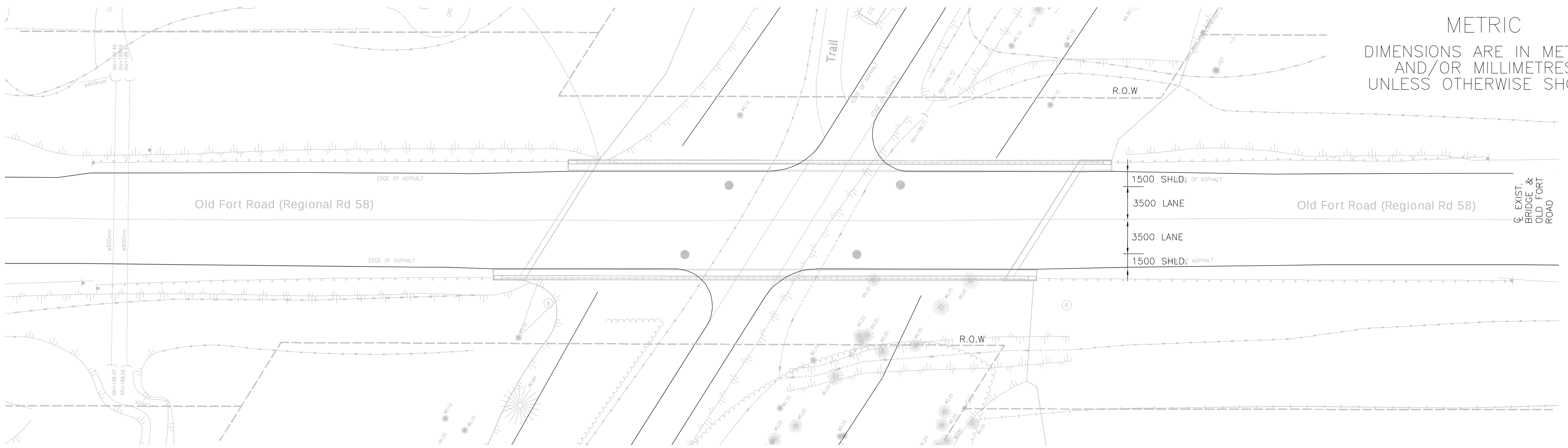

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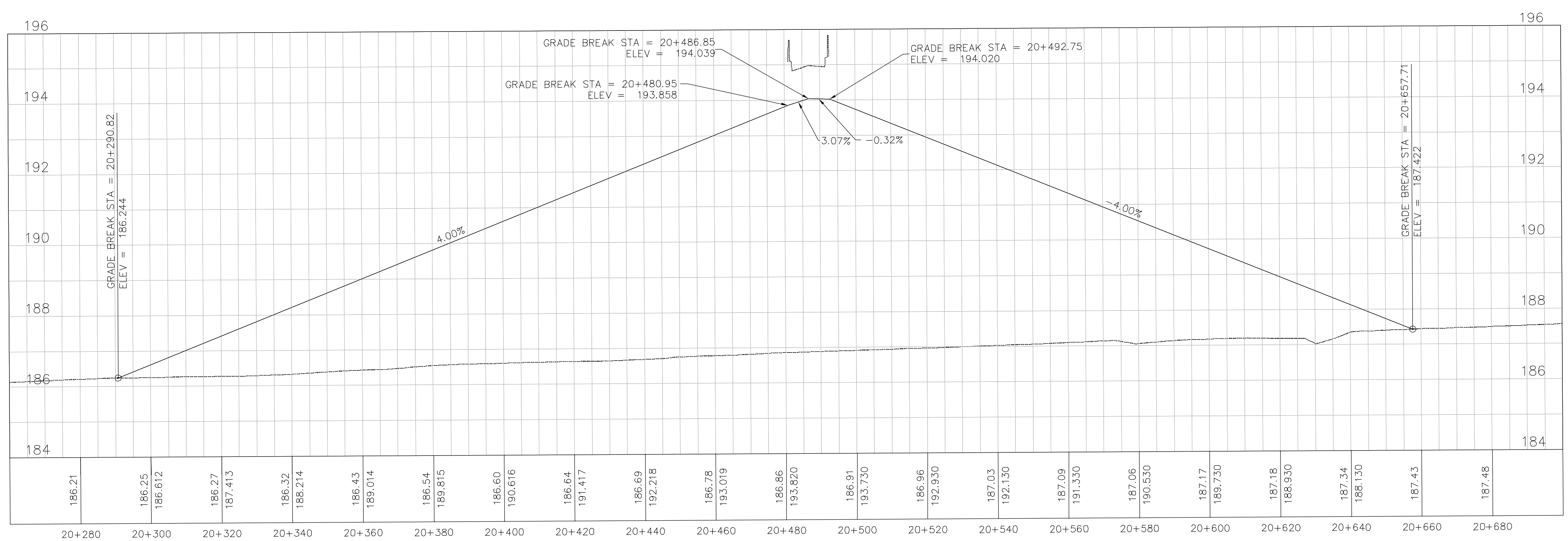

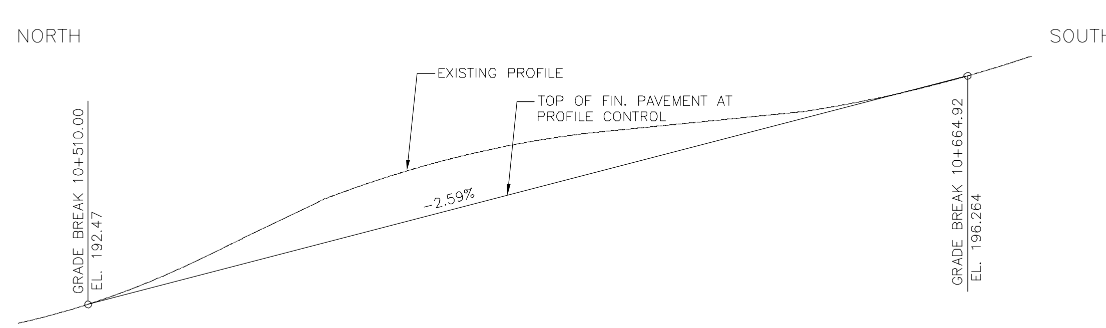

PROFILE OF OLD FORT ROAD
N.T.S.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS		
DATE	BY	DESCRIPTION

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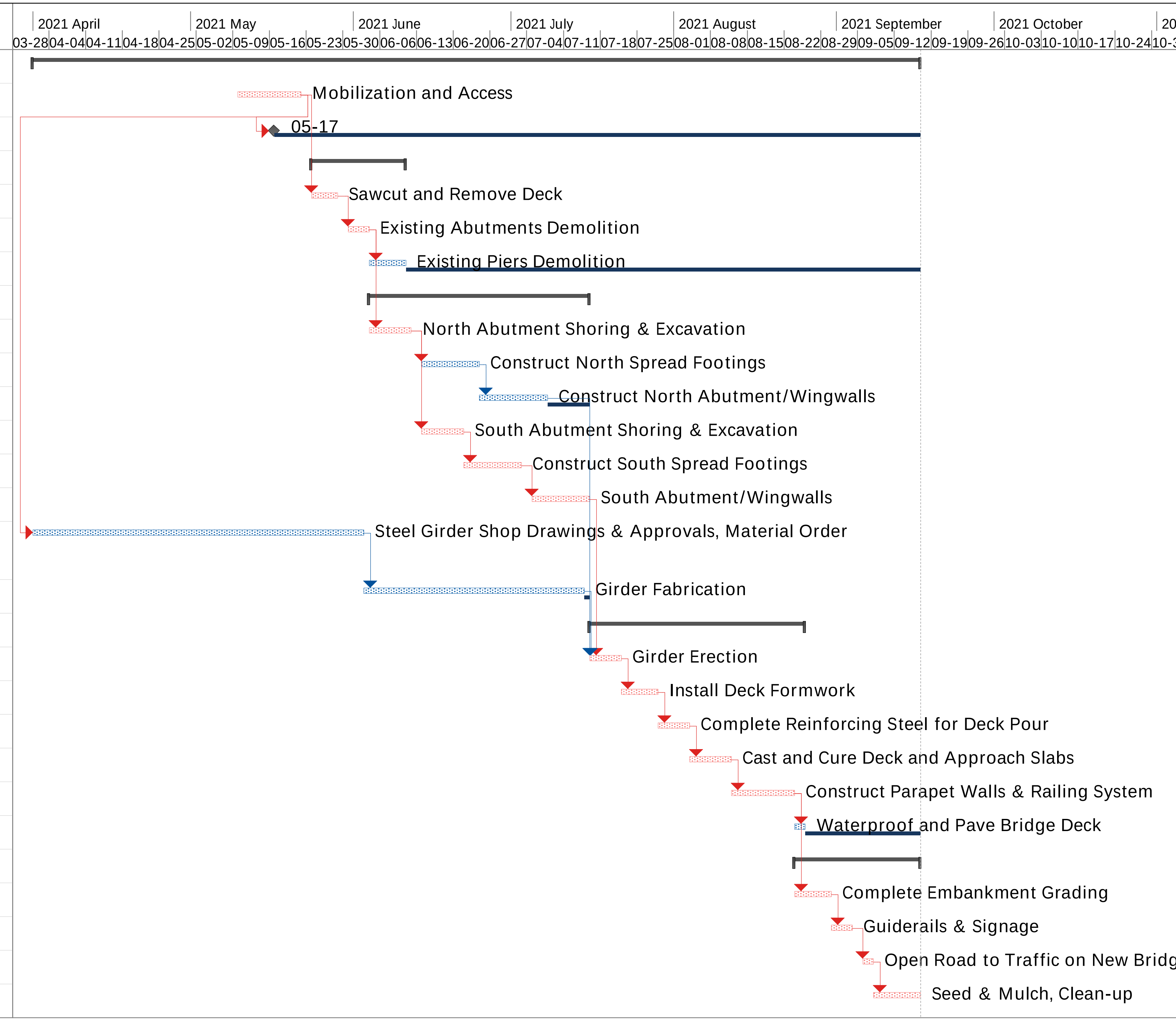
MINISTRY OF TRANSPORTATION, ONTARIO
PH-D-707
88-05

APPENDIX D

CONSTRUCTION SCHEDULES

Replacement of Old Fort Overhead Bridge - Option 1: Single-span Bridge

ID	Task Name	Duration	Start	Finish
1	Old Fort - Option 1: Single-span Bridge	121 days	Thu 21-04-01	Thu 21-09-16
2	Mobilization and Access	10 days	Mon 21-05-10	Fri 21-05-21
3	Road Closure	0 days	Mon 21-05-17	Mon 21-05-17
4	Existing Bridge Removal	14 days	Mon 21-05-24	Thu 21-06-10
5	Sawcut and Remove Deck	5 days	Mon 21-05-24	Fri 21-05-28
6	Existing Abutments Demolition	4 days	Mon 21-05-31	Thu 21-06-03
7	Existing Piers Demolition	5 days	Fri 21-06-04	Thu 21-06-10
8	Abutment Construction	30 days	Fri 21-06-04	Thu 21-07-15
9	North Abutment Shoring & Excavation	6 days	Fri 21-06-04	Fri 21-06-11
10	Construct North Spread Footings	9 days	Mon 21-06-14	Thu 21-06-24
11	Construct North Abutment/Wingwalls	9 days	Fri 21-06-25	Wed 21-07-07
12	South Abutment Shoring & Excavation	6 days	Mon 21-06-14	Mon 21-06-21
13	Construct South Spread Footings	9 days	Tue 21-06-22	Fri 21-07-02
14	South Abutment/Wingwalls	9 days	Mon 21-07-05	Thu 21-07-15
15	Steel Girder Shop Drawings & Approvals, Material Order	45 days	Thu 21-04-01	Wed 21-06-02
16	Girder Fabrication	30 days	Thu 21-06-03	Wed 21-07-14
17	Superstructure Construction	29 days	Fri 21-07-16	Wed 21-08-25
18	Girder Erection	4 days	Fri 21-07-16	Wed 21-07-21
19	Install Deck Formwork	5 days	Thu 21-07-22	Wed 21-07-28
20	Complete Reinforcing Steel for Deck Pour	4 days	Thu 21-07-29	Tue 21-08-03
21	Cast and Cure Deck and Approach Slabs	6 days	Wed 21-08-04	Wed 21-08-11
22	Construct Parapet Walls & Railing System	8 days	Thu 21-08-12	Mon 21-08-23
23	Waterproof and Pave Bridge Deck	2 days	Tue 21-08-24	Wed 21-08-25
24	Embankment Grading	18 days	Tue 21-08-24	Thu 21-09-16
25	Complete Embankment Grading	5 days	Tue 21-08-24	Mon 21-08-30
26	Guiderails & Signage	4 days	Tue 21-08-31	Fri 21-09-03
27	Open Road to Traffic on New Bridge	2 days	Mon 21-09-06	Tue 21-09-07
28	Seed & Mulch, Clean-up	7 days	Wed 21-09-08	Thu 21-09-16

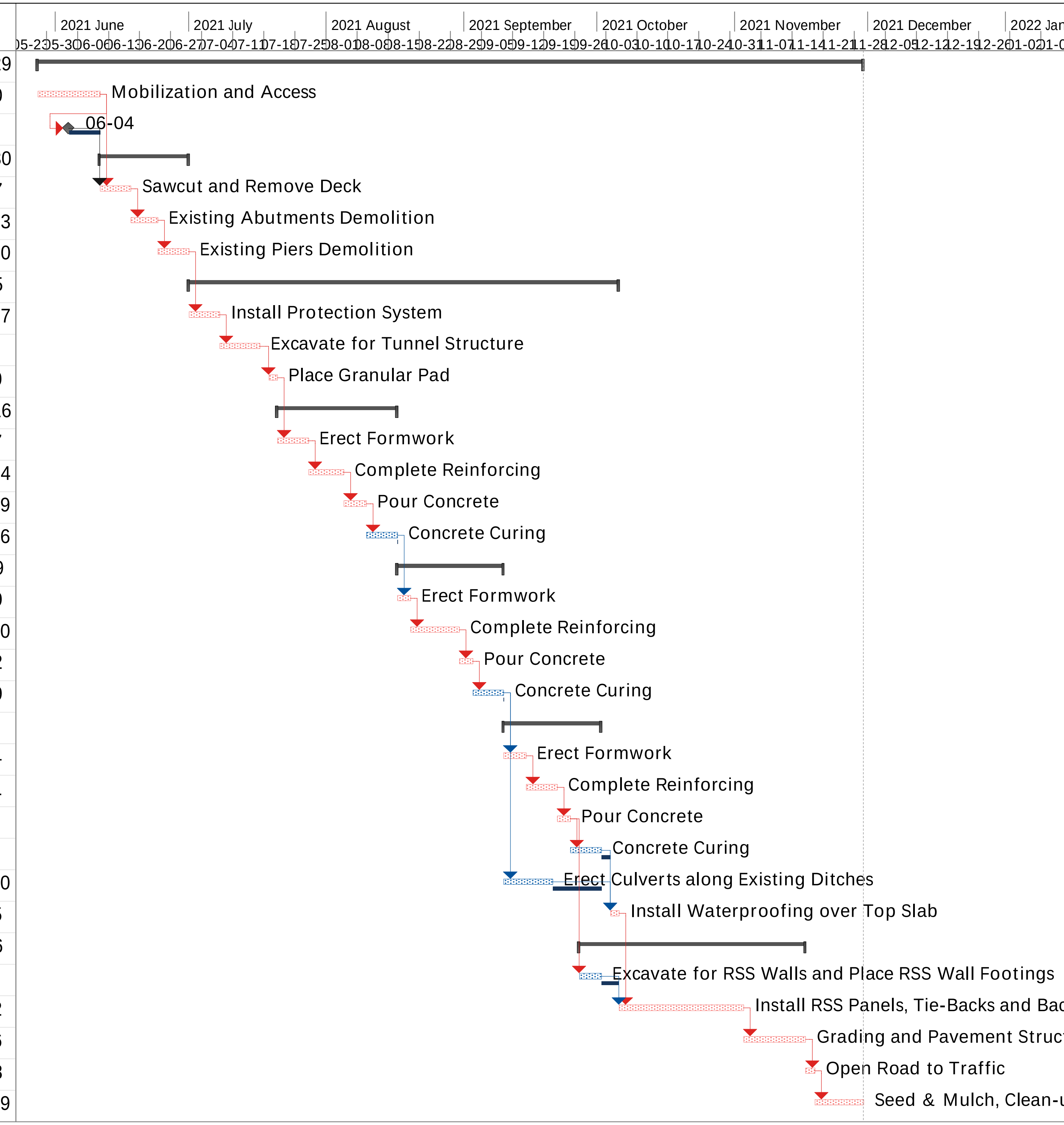


Project: Project1
Date: Tue 20-08-04

Task, Split, Milestone, Summary, Project Summary, Inactive Task, Inactive Milestone, Inactive Summary, Manual Task, Duration-only, Manual Summary Rollup, Manual Summary, Start-only, Finish-only, External Tasks, External Milestone, Deadline, Critical, Critical Split, Progress, Manual Progress, Slack

Replacement of Old Fort Overhead Bridge - Option 2: Cast-in-Place Tunnel

ID	Task Name	Duration	Start	Finish
1	Old Fort - Option 2: Cast-in-Place Tunnel	132 days	Fri 21-05-28	Mon 21-11-29
2	Mobilization and Access	10 days	Fri 21-05-28	Thu 21-06-10
3	Road Closure	0 days	Fri 21-06-04	Fri 21-06-04
4	Existing Bridge Removal	14 days	Fri 21-06-11	Wed 21-06-30
5	Sawcut and Remove Deck	5 days	Fri 21-06-11	Thu 21-06-17
6	Existing Abutments Demolition	4 days	Fri 21-06-18	Wed 21-06-23
7	Existing Piers Demolition	5 days	Thu 21-06-24	Wed 21-06-30
8	Cast-in-Place Tunnel Construction	69 days	Thu 21-07-01	Tue 21-10-05
9	Install Protection System	5 days	Thu 21-07-01	Wed 21-07-07
10	Excavate for Tunnel Structure	7 days	Thu 21-07-08	Fri 21-07-16
11	Place Granular Pad	2 days	Mon 21-07-19	Tue 21-07-20
12	Invert Slab	19 days	Wed 21-07-21	Mon 21-08-16
13	Erect Formwork	5 days	Wed 21-07-21	Tue 21-07-27
14	Complete Reinforcing	6 days	Wed 21-07-28	Wed 21-08-04
15	Pour Concrete	3 days	Thu 21-08-05	Mon 21-08-09
16	Concrete Curing	7 edays	Mon 21-08-09	Mon 21-08-16
17	Walls	18 days	Tue 21-08-17	Thu 21-09-09
18	Erect Formwork	3 days	Tue 21-08-17	Thu 21-08-19
19	Complete Reinforcing	7 days	Fri 21-08-20	Mon 21-08-30
20	Pour Concrete	3 days	Tue 21-08-31	Thu 21-09-02
21	Concrete Curing	7 edays	Thu 21-09-02	Thu 21-09-09
22	Top Slab	16 days	Fri 21-09-10	Fri 21-10-01
23	Erect Formwork	3 days	Fri 21-09-10	Tue 21-09-14
24	Complete Reinforcing	5 days	Wed 21-09-15	Tue 21-09-21
25	Pour Concrete	3 days	Wed 21-09-22	Fri 21-09-24
26	Concrete Curing	7 edays	Fri 21-09-24	Fri 21-10-01
27	Erect Culverts along Existing Ditches	7 days	Fri 21-09-10	Mon 21-09-20
28	Install Waterproofing over Top Slab	2 days	Mon 21-10-04	Tue 21-10-05
29	RSS Walls Construction and Embankment Grading	37 days	Mon 21-09-27	Tue 21-11-16
30	Excavate for RSS Walls and Place RSS Wall Footings	5 days	Mon 21-09-27	Fri 21-10-01
31	Install RSS Panels, Tie-Backs and Backfilling	20 days	Wed 21-10-06	Tue 21-11-02
32	Grading and Pavement Structure, Guiderails and Signage	10 days	Wed 21-11-03	Tue 21-11-16
33	Open Road to Traffic	2 days	Wed 21-11-17	Thu 21-11-18
34	Seed & Mulch, Clean-up	7 days	Fri 21-11-19	Mon 21-11-29



Project: Project1
Date: Mon 20-07-27

Task, Split, Milestone, Summary, Project Summary, Inactive Task, Inactive Milestone, Inactive Summary, Manual Task, Duration-only, Manual Summary Rollup, Manual Summary, Start-only, Finish-only, External Tasks, External Milestone, Deadline, Critical, Critical Split, Progress, Manual Progress, Slack

APPENDIX E

CONSTRUCTION AND LIFE CYCLE COST ESTIMATES

OLD FORT OVERHEAD BRIDGE REPLACEMENT

Option 1: Single-Span Steel (1.2m depth) Girder Bridge (Spread Footings)

Item	L	W	H	No.	Other	Units	Q	Unit Cost	Cost
Earth Excavation for Structure						m^3	354	115	40,767
Abutments	2.2	11.6	2	2		m^3	102		
Footings	3.2	11.6	3.40	2		m^3	252		
Concrete in Substructure									
Abutments	1.2	10.5	6	2		LS/m^3	151.2	3,500	529,200
Wingwalls						LS/m^3	25.9	3,500	90,563
Wingwalls 1	5.75	0.3	1.5	4		m^3	10.4		
Wingwalls 2	5.75	0.3	4.5	4	0.5	m^3	15.5		
Concrete in Footings	3.2	11.6	1.0	2		m^3	74.2	2,000	148,480
Concrete in Deck						m^3	79.1	3,500	276,885
Deck	30	10.6	0.23	1		m^3	71.6		
Haunch	30	1.26	0.05	4		m^3	7.6		
Concrete in Approach Slab	5.75	10	0.25	2		m^3	28.8	1,600	46,000
Concrete in Parapet Walls	30	0.3	1.05	2		m^3	18.9	3,000	56,700
Reinforcing Steel						t	44.6	4,800	214,137
Substructure (120 kg/m3)				251	120	t	30.2		
Deck (150 kg/m3)				79	150	t	11.9		
Approach Slab (90 kg/m3)				29	90	t	2.6		
Stainless Steel									
Parapet Walls (150 kg/m3)				19	150	t	2.8	20,000	56,700
Fabrication of Stuctural Steel	30			4	0.374	LS/t	44.9	4,500	202,116
Delivery of Stuctural Steel	30			4	0.374	LS/t	44.9	200	8,983
Erection of Stuctural Steel	30			4	0.374	LS/t	44.9	2,400	107,795
Bridge Deck Waterproofing	30	10				m^2	300.0	75	22,500
Bearings				1		LS	1.0	25,000	25,000
Temporary Covered Walkway						LS	1.0	20,000	20,000
Parapet Wall Railing	30			2		m	60.0	200	12,000
Sub-Total									**1,857,825**
20% Contingency									371,565
TOTAL (Structure Cost Only)									**2,229,389**

Removal of Bridge Structure						m^3	90.0	3,000	270,000
20% Contingency									54,000
Total (Removal of Bridge Structure)									**324,000**

Roadway Construction Costs									143,009
20% Contingency									28,602
Total (Roadway Construction Costs only)									**171,611**

OLD FORT OVERHEAD BRIDGE REPLACEMENT

Option 2: Cast-in-Place Concrete Tunnel

Item	L	W	H	No.	Other	Units	Q	Unit Cost	Cost
Earth Excavation for Structure						m^3	383	60	23,004
Tunnel	16	8.7	2.0	1		m^3	278		
RSS Walls	50	1.4	1.5	1		m^3	105		
Protection System		10.0	4.0	2		m^2	80	800	64,000
Concrete in Structure (Tunnel)						m^3	197.1	3,400	670,283
Roof Slab	15.0	7.7	0.5	1		m^3	57.8		
Walls	15.0	0.5	4.95	2		m^3	74.3		
Invert Slab	15.0	7.7	0.5	1		m^3	57.8		
Headwalls	0.3	7.7	1.6	2		m^3	7.4		
RSS Walls	1		1	1	260	m^2	259.6	1,200	311,489
(Concrete in Footings) RSS Walls Leveling Pad	50	1.00	0.50	1		m^3	25.0	2,000	50,000
Bridge Deck Waterproofing						m^2	276.0	75	20,700
Top Slab	15.0	9.7				m^2	145.5		
Invert Slab	15.0	8.7				m^2	130.5		
Granular "A" Bedding	15.0	10.9	0.60	1	2.4	t	235.4	60	14,126
Illumination						LS	1.0	60,000	60,000
Dowels into Concrete				105		EA	105.0	160	16,800
Reinforcing Steel						t	26.5	5,500	145,716
Tunnel (approx. 130 kg/m3)	15.0			750	2.355	t	26.5		
Culvert Through Embankment (assume 600mm Pipe Culvert)	18.0			2		m	36.0	700	25,200
Sub-Total									**1,401,318**
20% Contingency									280,264
TOTAL (Structure Cost only)									**1,681,582**

Removal of Bridge Structure						m^3	90.0	3,000	270,000
20% Contingency									54,000
Total (Removal of Bridge Structure)									**324,000**

Roadway Construction Costs									366,175
20% Contingency									73,235
Total (Roadway Construction Costs only)									**439,410**

OLD FORT OVERHEAD BRIDGE REPLACEMENT

Option 3: At-Grade Crossing

Item	L	W	H	No.	Other	Units	Q	Unit Cost	Cost
Road Reconstruction - Grading	0.155			2.0		per lane km	0	428,950	132,975
Guiderail	232					m	232	150	34,800
SBEAT				4		EA	4.0	5,800	23,200
Granular B					3600	t	3600	55	198,000
SSM					30330	t	30330	25	758,250
Asphalt 12.5					98.4	t	98	150	14,760
PM				2		EA	2.0	367	734
Flashers				2		EA	2.0	20,000	40,000
Culvert Through Embankment (assume 600mm Pipe Culvert)	367			2		m	734.0	500	367,000
Sub-Total									**1,569,719**
20% Contingency									313,944
TOTAL (Roadway Construction Cost only)									**1,883,662**

Removal of Bridge Structure						m^3	90.0	3,000	270,000
20% Contingency									54,000
Total (Removal of Bridge Structure)									**324,000**

75 YEAR LIFE CYCLE COST ANALYSIS

Discount Rate =	6.00%

Project:

County of Simcoe
Old Fort Overhead Bridge Replacement Design

Options:

Option 1: Single-span bridge

Option 2: Tunnel structure

Option 3: At-grade crossing

Note: Life cycle cost analysis is for the bridge construction (approch roadwork and CA costs excluded).

Table 1: Construction Cost Estimates for Actions

Item	Unit	Quantity	Unit Cost	Cost
Action 1				
Option 1 - Single-span bridge				
Item	**Unit**	**Quantity**	**Unit Cost**	**Cost**
Single-span bridge	LS	1	$ 2,725,000	$ 2,725,000
Estimate Service Life (years)	75		Total Cost	$ 2,725,000
Action 2				
Option 2 - Tunnel structure				
Item	**Unit**	**Quantity**	**Unit Cost**	**Cost**
Tunnel structure	LS	1	$ 2,445,000	$ 2,445,000
Estimate Service Life (years)	75		Total Cost	$ 2,445,000
Action 3				
Option 3 - At-grade crossing				
Item	**Unit**	**Quantity**	**Unit Cost**	**Cost**
At-grade crossing	LS	1	$ 2,208,000	$ 2,208,000
Estimate Service Life (years)	75		Total Cost	$ 2,208,000
Action 4				
Single-span bridge (minor rehabilitation)				
Item	**Unit**	**Quantity**	**Unit Cost**	**Cost**
Bridge rehabilitation (includes local concrete repairs to deck soffit, barrier walls, etc.; replacement of bearings, waterproofing and paving, etc.)	m2	300	$ 800	$ 240,000
Traffic Control	m2	300	$ 125	$ 37,500
Estimate Service Life (years)	25		Total Cost	$ 277,500
Action 5				
Tunnel structure (minor rehabilitation)				
Item	**Unit**	**Quantity**	**Unit Cost**	**Cost**
Tunnel rehabilitation (includes local concrete patch repair)	m2	116	$ 300	$ 34,800
Estimate Service Life (years)	25		Total Cost	$ 34,800
Action 6				
At-grade crossing and tunnel (rehabilitation of road)				
Item	**Unit**	**Quantity**	**Unit Cost**	**Cost**
Grading and paving	m2	716	$ 125	$ 89,500
Traffic Control	m2	716	$ 50	$ 35,800
Estimate Service Life (years)	25		Total Cost	$ 125,300
Action 6A				
Bridge - rehabilitaiton of approaches				
Item	**Unit**	**Quantity**	**Unit Cost**	**Cost**
Grading and paving	m2	296	$ 125	$ 37,000
Traffic Control	m2	296	$ 50	$ 14,800
Estimate Service Life (years)	25		Total Cost	$ 51,800
Action 7				
Single-span bridge (major rehabilitation)				
Item	**Unit**	**Quantity**	**Unit Cost**	**Cost**
Bridge rehabilitation (includes local concrete repairs to deck soffit, barrier walls, etc.; replacement of bearings, waterproofing and paving, etc.)	m2	300	$ 1,000	$ 300,000
Traffic Control	m2	300	$ 125	$ 37,500
Estimate Service Life (years)	25		Total Cost	$ 337,500

75 YEAR LIFE CYCLE COST ANALYSIS

Discount Rate =	6.00%

Project:

County of Simcoe

Old Fort Overhead Bridge Replacement Design

Options:

Option 1: Single-span bridge

Option 2: Tunnel structure

Option 3: At-grade crossing

Note: Life cycle cost analysis is for the bridge construction (approch roadwork and CA costs excluded).

Action 8

Tunnel structure (major rehabilitation)

Item	Unit	Quantity	Unit Cost	Cost
Grading	m2	715	$ 150	$ 107,250
Traffic Control	m2	715	$ 175	$ 125,125
Replacement of Culvert	LS	1	$ 25,200	$ 25,200
Excavation	m3	795	$ 60	$ 47,700
Protection System	LS	1	$ 50,000	$ 50,000
Replacement of RSS Walls	m2	144	$ 1,200	$ 172,800
Estimate Service Life (years)	25		Total Cost	$ 528,075

Action 9

At-grade crossing (major rehabilitation)

Item	Unit	Quantity	Unit Cost	Cost
Grading and paving	m2	716	$ 125	$ 89,500
Replacement of Culvert	LS	1	$ 25,200	$ 25,200
Excavation	m3	795	$ 60	$ 47,700
Protection System	LS	1	$ 50,000	$ 50,000
Traffic Control	m2	716	$ 175	$ 125,300
Estimate Service Life (years)	25		Total Cost	$ 212,400

75 YEAR LIFE CYCLE COST ANALYSIS

Discount Rate =	6.00%

Project:

County of Simcoe
Old Fort Overhead Bridge Replacement Design

Options:

Option 1: Single-span bridge

Option 2: Tunnel structure

Option 3: At-grade crossing

Note: Life cycle cost analysis is for the bridge construction (approch roadwork and CA costs excluded).

Table 2: Cost Data For Each Option for 75 Year Life Cycle

	Option 1		**Option 2**		**Option 3**	
Year	Action	Cost	Action	Cost	Action	Cost
0	1	$ 2,725,000	2	$ 2,445,000	3	$ 2,208,000
15	6A	$ 51,800	6	$ 125,300	6	$ 125,300
25	4	$ 277,500		$ -		$ -
30		$ -	5&6	$ 160,100	6	$ 125,300
40	6A	$ 51,800		$ -		$ -
45		$ -	8	$ 528,075	9	$ 212,400
50	7	$ 337,500		$ -		$ -
60		$ -	5&6	$ 160,100	6	$ 125,300
75		$ -		$ -		$ -
	Total Cost	$ 3,443,600		$ 3,418,575		$ 2,796,300
Residual Life at Year 75	Action	RL (Years)	Action	RL (Years)	Action	RL (Years)
	N/A	0	N/A	0	N/A	0

Table 3: Cost Uncertainties

Cost Variation (Vc)	Est. Cost (Cn)	Probability of Occurance P(n) **Option 1**	**Option 2**	**Option 3**
100%	100% Cn	P1= 0.65	P1= 0.75	P1= 0.75
-10%	90% Cn	P2= 0.10	P2= 0.05	P2= 0.05
10%	110% Cn	P3= 0.15	P3= 0.10	P3= 0.10
20%	120% Cn	P4= 0.10	P4= 0.10	P4= 0.10
		1.00	1.00	1.00

75 YEAR LIFE CYCLE COST ANALYSIS

Discount Rate =	6.00%

Project:

County of Simcoe
Old Fort Overhead Bridge Replacement Design

Options:

Option 1: Single-span bridge

Option 2: Tunnel structure

Option 3: At-grade crossing

Note: Life cycle cost analysis is for the bridge construction (approch roadwork and CA costs excluded).

Table 4: Residual Value Analysis (Not Applicable)

Discount Rate = 6.00%

Option 1

Action	Yr. 2nd Cycle	Replacement Cost	Residual Years	Value at Year 75	Differential Value at Year 75	Residual Value at Year 0
N/A	75	$ -	0	$ -	$ -	$ -
N/A	75	$ -	0	$ -	$ -	$ -
N/A	75	$ -	0	$ -	$ -	$ -

Option 2

Action	Yr. 2nd Cycle	Replacement Cost	Residual Years	Value at Year 75	Differential Value at Year 75	Residual Value at Year 0
N/A	75	$ -	0	$ -	$ -	$ -
N/A	75	$ -	0	$ -	$ -	$ -
N/A	75	$ -	0	$ -	$ -	$ -

Option 3

Action	Yr. 2nd Cycle	Replacement Cost	Residual Years	Value at Year 75	Differential Value at Year 75	Residual Value at Year 0
N/A	75	$ -	0	$ -	$ -	$ -
N/A	75	$ -	0	$ -	$ -	$ -
N/A	75	$ -	0	$ -	$ -	$ -

75 YEAR LIFE CYCLE COST ANALYSIS | Discount Rate = 6.00%

Project:

County of Simcoe
Old Fort Overhead Bridge Replacement Design

Options:

Option 1: Single-span bridge

Option 2: Tunnel structure
Option 3: At-grade crossing

Note: Life cycle cost analysis is for the bridge construction (approch roadwork and CA costs excluded).

Table 5: Financial Analysis of Proposed Options

Discount Rate = 6.00%

Option 1

Year		Cost	Present Value	Comments
0	2021	$ 2,725,000	$ 2,725,000	
15	2036	$ 51,800	$ 21,614	
25	2046	$ 277,500	$ 64,657	
30	2051	$ -	$ -	
40	2061	$ 51,800	$ 5,036	
45	2066	$ -	$ -	
50	2071	$ 337,500	$ 18,322	
60	2081	$ -	$ -	
75	2096	$ -	$ -	
		Total Present Value :	$ 2,834,630	
		Residual Value :	$ -	
		Net Present Value :	$ 2,834,630	
Net Present Value Adjusted for Uncertainty Cost			$ 2,905,495.63	

Option 2

Year		Cost	Present Value	Comments
0	2021	$ 2,445,000	$ 2,445,000	
15	2036	$ 125,300	$ 52,283	
25	2046	$ -	$ -	
30	2051	$ 160,100	$ 27,875	
40	2061	$ -	$ -	
45	2066	$ 528,075	$ 38,365	
50	2071	$ -	$ -	
60	2081	$ 160,100	$ 4,853	
75	2096	$ -	$ -	
		Total Present Value :	$ 2,568,376	
		Residual Value :	$ -	
		Net Present Value :	$ 2,568,376	
Net Present Value Adjusted for Uncertainty Cost			$ 2,632,585.77	

75 YEAR LIFE CYCLE COST ANALYSIS Discount Rate = 6.00%

Project:

County of Simcoe
Old Fort Overhead Bridge Replacement Design

Options:

Option 1: Single-span bridge

Option 2: Tunnel structure
Option 3: At-grade crossing

Note: Life cycle cost analysis is for the bridge construction (approch roadwork and CA costs excluded).

Option 3

Year		Cost	Present Value	Comments
0	2021	$ 2,208,000	$ 2,208,000	
15	2036	$ 125,300	$ 52,283	
25	2046	$ -	$ -	
30	2051	$ 125,300	$ 21,816	
40	2061	$ -	$ -	
45	2066	$ 212,400	$ 15,431	
50	2071	$ -	$ -	
60	2081	$ 125,300	$ 3,798	
75	2096	$ -	$ -	
		Total Present Value :	$ 2,301,329	
		Residual Value :	$ -	
		Net Present Value :	$ 2,301,329	
Net Present Value Adjusted for Uncertainty Cost			$ 2,358,862	

APPENDIX F

PROPOSED DETOUR PLAN FOR FULL ROAD CLOSURE

NOTES:

A. FOR STAGING AND TC-64 SIGNING REQUIRED TO BE INSTALLED IN THIS CONTRACT, REFER TO OTHER DRAWINGS.

B. ALL SIGNAGE TO BE PLACED AS PER OTM BOOKS.

C. SEE ADDITIONAL SHEET FOR GENERAL NOTES RELATED TO THE CONSTRUCTION SIGNING.

D. BAG EXISTING EDR ROUTE SIGNS WITHIN THE DETOUR ROUTE.

ADVANCE WARNING SIGN (AWS-D1)

Old Fort Road
CLOSED
JULY – NOV.

ALTERNATE ROUTE SIGN (ARS-D1)

Old Fort Road
Follow DETOUR D-1

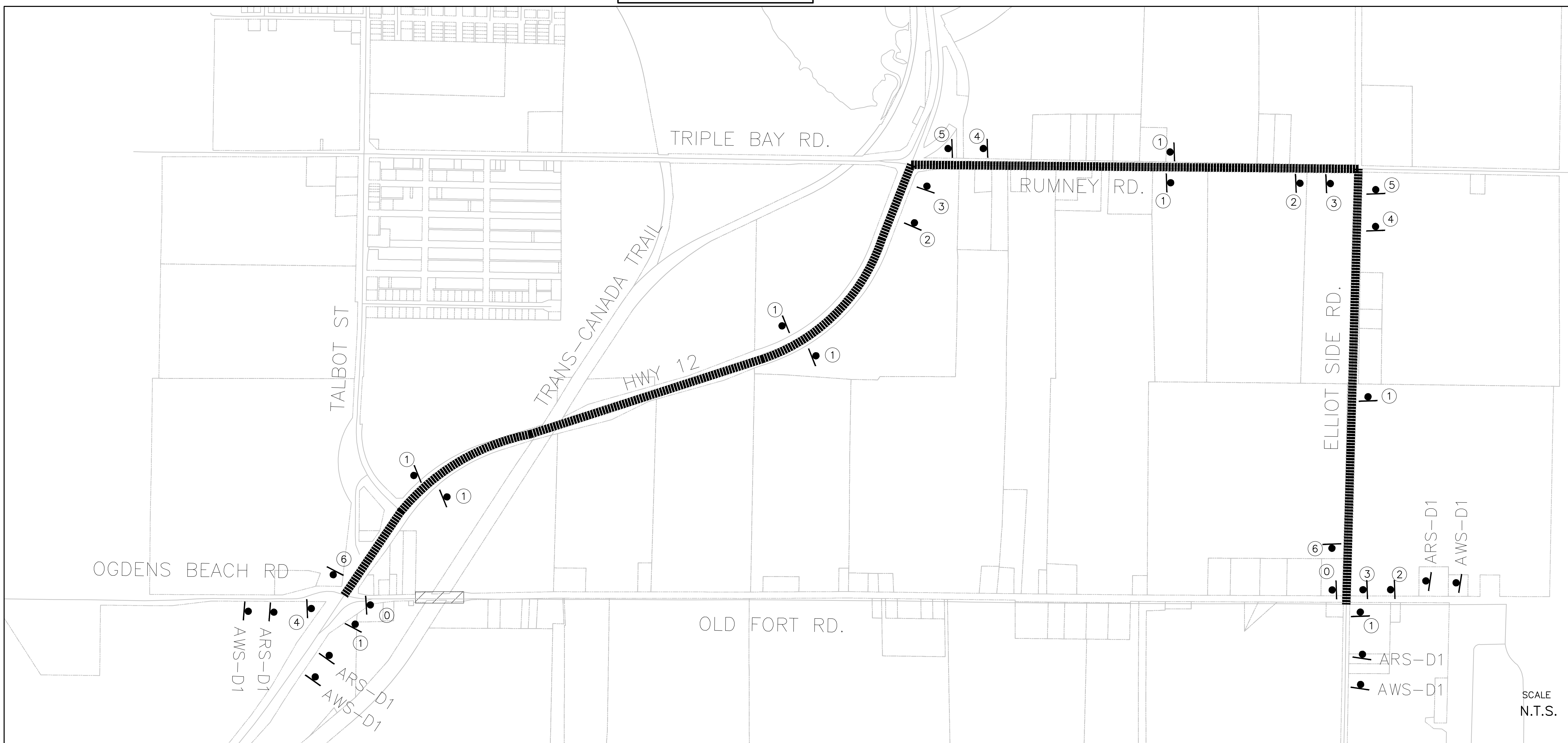
DETOUR D-1 ↑	DETOUR D-1 ↱	DETOUR D-1 →	DETOUR D-1 ↰	DETOUR D-1 ←	DETOUR D-1 ENDS
TC-10C	TC-10AR	TC-10BR	TC-10AL	TC-10BL	TC-10D
1	2	3	4	5	6

TC-7
ROAD CLOSED TC-7tA
LOCAL TRAFFIC ONLY TC-7tB
0

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

PLATE No
CONT
WP 4078-14-01
CONSTRUCTION SIGNING
PRIMARY DETOUR ROUTE-D1
SHEET

LEA Consulting Ltd.
Consulting Engineers and Planners
www.LEA.ca



SCALE
N.T.S.

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

PLOT DATE: 2020/04/22 11:42:01 AM

APPENDIX G

LEGAL (BOUNDARY FABRIC) SURVEY


LEGEND:
Boundary Lines
Property Fabric

PART 1 PLAN 51R-2429
LEGEND:
Boundary Lines
Property Fabric

LEA

COUNTY OF SIMCOE