Thorndale Bridge Improvements

Environmental Study Report

Prepared for:

County of Middlesex
399 Ridout Street North
London ON N6A 2P1

Prepared by:

Stantec Consulting Ltd.
171 Queens Avenue
6th Floor
London ON N6A 5J7

July 2021

Stantec

Thorndale Bridge Improvements, Environmental Study Report

July 2021

Prepared for:

County of Middlesex
399 Ridout Street North
London ON N6A 2P1

Prepared by:

Stantec Consulting Ltd.
171 Queens Avenue,
6th Floor
London ON N6A 5J7

Sign-Off Sheet

This document entitled Thorndale Bridge Improvements, Environmental Study Report was prepared by Stantec Consulting Ltd. (“Stantec”) for the account of Middlesex County (the “Client”). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec’s professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by _____

(signature)

Julie Werner, Environmental Planner

Prepared by _____

(signature)

Dana Elfar, P.Eng., Transportation Engineer

Reviewed by _____

(signature)

Paula Hohner, M.Sc.Pl., MCIP, RPP, Senior Environmental Planner

Reviewed by _____

(signature)

Isaac Bartlett, P.Eng., Project Manager

Table of Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

Executive Summary

Middlesex County retained Stantec Consulting Ltd. (Stantec) to identify required improvements to the Thorndale Bridge, on County Road 28 (Thorndale Road). The County of Middlesex identified the Thorndale Bridge, built in 1953, for replacement within the next 10 years.

In accordance with the Municipal Class Environmental Assessment (MCEA) (Municipal Engineers Association, 2000, as amended in 2007, 2011, and 2015), this study is being planned as a Schedule C undertaking, which includes the completion of Phases 1 through 4 of the MCEA study process.

Consultation

A contact list was developed at the outset of the study, which includes relevant government and regulatory agencies, utilities, community organizations, interested members of the public, and Indigenous communities. Project notices, including the Notice of Study Commencement, Notice of Public Information Centres (PICs), and the Notice of Study Completion were published in the Londoner in two consecutive editions and posted on the County's study webpage (https://www.middlesex.ca/departments/roads/thorndale-bridge-environmental-assessment).

Two Public Information Centres (PICs) were held throughout the study to ensure stakeholders have an understanding of the project, and to provide opportunities for stakeholders to provide input into the alternatives, evaluation criteria, and preferred alternative design.

All input from the public, review agencies/ministries, and other stakeholders has been documented. All consultation with Indigenous communities has also been documented in a consultation log.

Phase 1 – Problems and Opportunities

Phase 1 of the MCEA process includes a review of a number of planning and policy documents, related studies and reports, and initial traffic review. A number of policy documents were reviewed to understand the existing and planned conditions and objectives within and surrounding the study area, and to provide the framework for identifying improvements. Relevant policy documents include the Provincial Policy Statement, Endangered Species Act, County of Middlesex Official Plan, Municipality of Thames Centre Official Plan, and the Middlesex County Cycling Strategy.

Based on the review of existing conditions, servicing studies, planning documents, development proposals, and traffic conditions, the following summarizes the problems and opportunities within the study area:

- Active Transportation – There is a need to improve active transportation facilities within the study area (buffered paved shoulder identified in Middlesex County – Cycling Strategy) and provide a connection to the Fanshawe Lake Trail System.

- Bridge Condition – The existing bridge is 67 years old and has been identified for replacement within the next 10 years.

Improvements to the Thorndale Bridge are needed to provide sufficient road capacity, while safely and efficiently accommodating active transportation. The improved bridge corridor will serve the needs of the transportation system, including active transportation and area growth, designed for a 75-year lifespan.

Phase 2 – Existing Conditions

Phase 2 of the MCEA process includes an inventory of the existing socio-economic, cultural, and natural environments. Background information was collected from various sources to characterize the existing features within the study area.

The existing transportation network, including roads, transit, and active transportation facilities were reviewed to understand the current conditions. Existing and future land use patterns were identified to evaluate the current socio-economic conditions prior to determining alternative solutions.

An Environmental Impact Study was conducted to assess the study area, identify constraints and sensitivities, and determine the general connectivity of natural features within the study limits and surrounding area. Field investigations included the characterization of vegetation communities, botanical surveys, a wildlife habitat assessment, and an aquatic habitat assessment. Drainage and watershed characteristics were identified, and analysis was conducted to determine flow levels and connectivity.

A Stage 1 Archaeological Assessment and Cultural Heritage Assessment were completed to determine archaeological potential, identify built heritage resources and cultural heritage landscapes present within the study area. The findings of the existing conditions were considered throughout the development and evaluation of alternative solutions and designs for the bridge.

Alternative Solutions

Alternative solutions are identified and evaluated based on their ability to reduce impacts to the socio-economic, natural, cultural, and technical environments. Alternative solutions considered for the study area included: Do Nothing; Rehabilitate the Existing Bridge; Replace Superstructure and Detour; Replace Superstructure and Temporary Modular Bridge (TMB); New Bridge and Detour; New Bridge and Temporary Modular Bridge (TMB); and New Bridge and New Alignment.

The replacement of the existing bridge with a new bridge on the existing alignment with traffic being rerouted around bridge construction on a signed detour route was identified as the preferred solution. This solution was determined to have the lowest potential impacts to the project area and lowest construction complexity, which reduces overall construction duration. It will minimize the new footprint, in-water impacts and a number of construction events in order to limit environmental disturbance.

Design Alternatives

Two superstructure design alternatives were developed and assessed including “Slab-on-girder bridge”, and “Post-tensioned concrete deck bridge”. An integral abutment bridge is recommended for the substructure to eliminate the need for expansion joints on the bridge, which provides a more durable bridge.

Based on the evaluation, the recommended bridge design alternative is to replace the existing structure with a three-span integral abutment bridge with a slab-on-steel I-girder superstructure. This option allows for the construction to be completed in a single construction season and limits the environmental disturbance.

Project Description

The Thorndale Bridge replacement involves design considerations for both the bridge and road components. The two-lane cross section will be maintained, with the ability to accommodate active transportation. The bridge will accommodate 3.75 m lanes with 1.6 m paved shoulders on each side, and a 2.5 m raised bike trail on the south side. The proposed cross section will facilitate a 2% cross-fall on both sides of the road centerline. The cross section minimizes impacts to adjacent land uses and to the natural environment, while providing additional space to accommodate larger farm vehicles and commercial vehicles to pass.

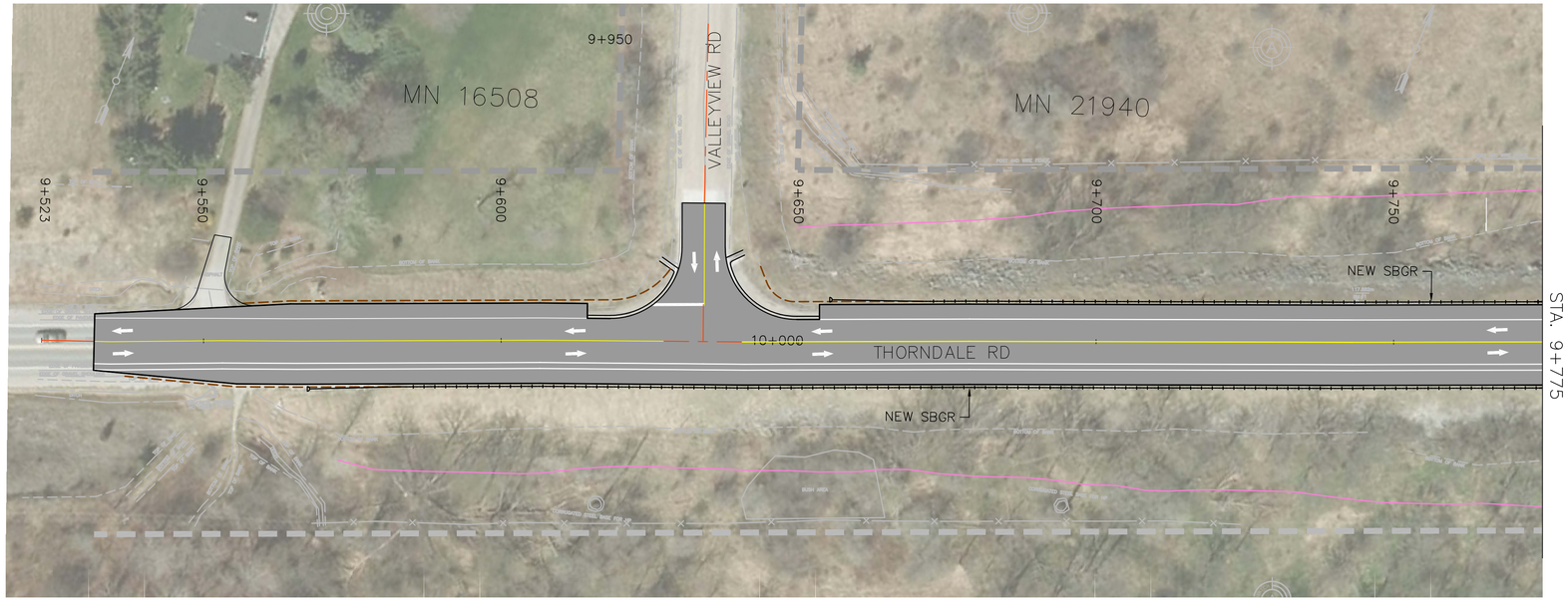
The bridge replacement is recommended due to the age of the existing structure. The horizontal alignment of Thorndale Road is not proposed to be changed and the new bridge will be situated on the existing alignment. The new bridge will be a three-span bridge, with an ultimate lifespan of 75+ years. Integral abutments are recommended for the substructure of the bridge. Each of the integral abutments consist of a concrete stem supported by a single row of steel H-piles. Three in-water piers will be removed and replaced with two in-water piers on different footprints.

Active transportation facilities along Thorndale Road includes paved shoulders on both sides of the bridge and road, and a bike trail along the south side of the Thorndale Bridge to accommodate the Thames River crossing of the Fanshawe Conservation Area Trail Network. The bike trail has been included to accommodate the alternating directional cycling traffic of the Fanshawe Trail, while maintaining an area on the paved shoulder for commuter cycling traffic.

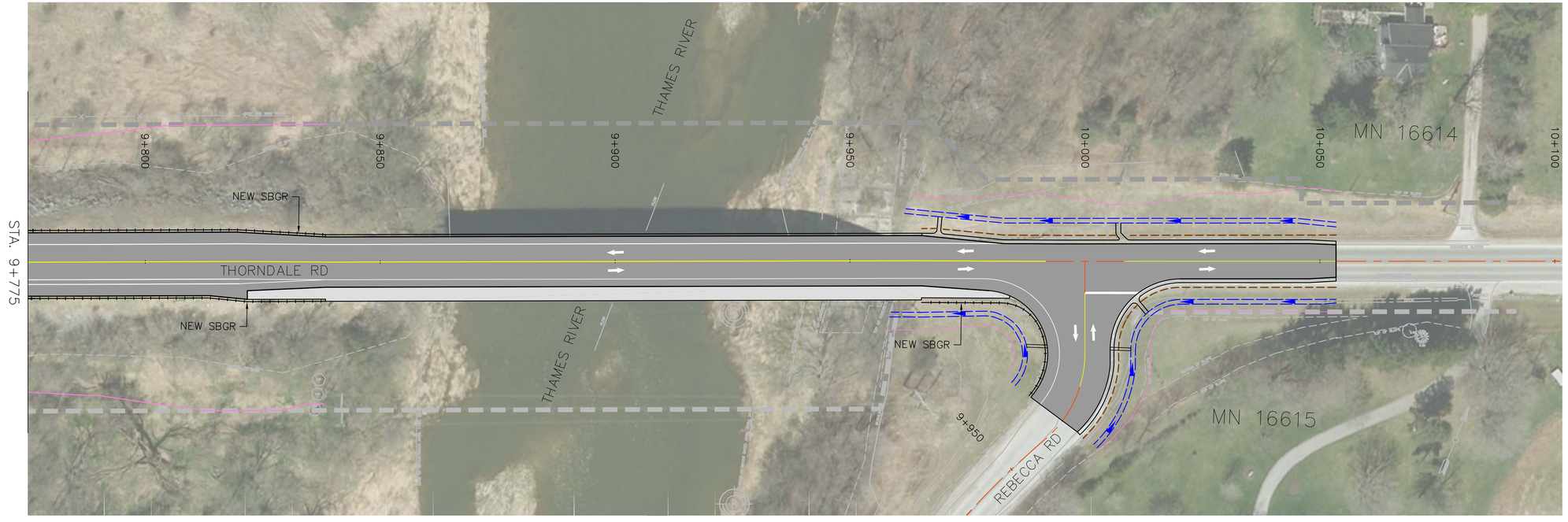
This page left blank intentionally.

SUPLEMENTARY LEGEND

- GRADE LIMIT
- NEW DITCH LINE
- GRANULAR SHOULDER
- EXISTING PROPERTY LINE



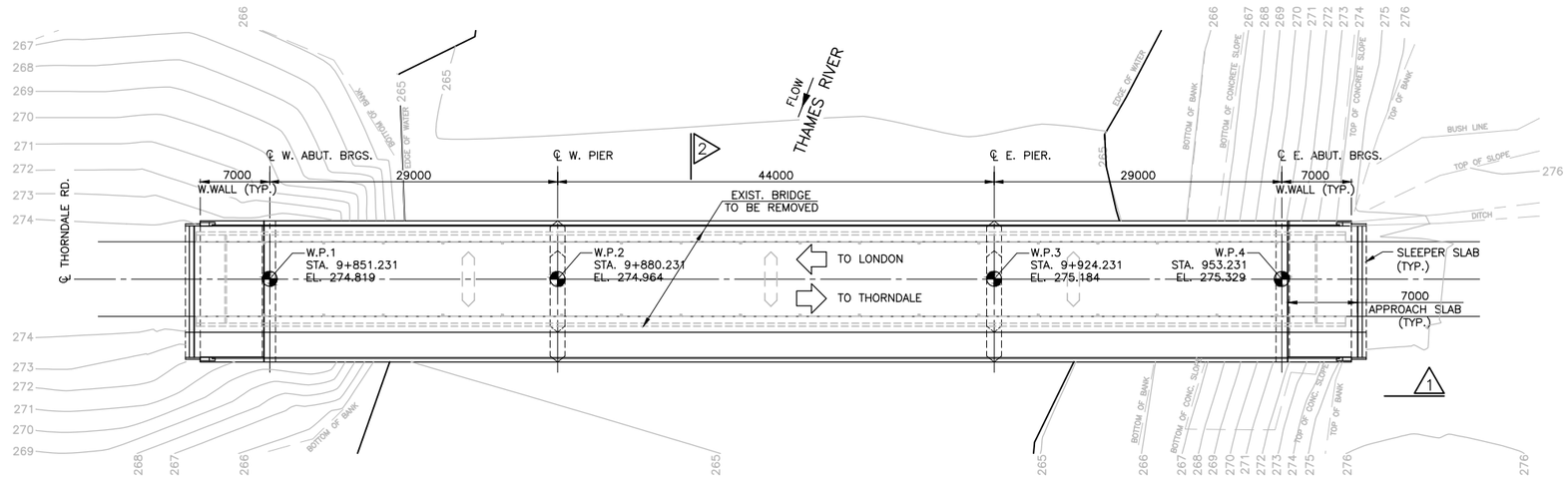
THORNDALE ROAD



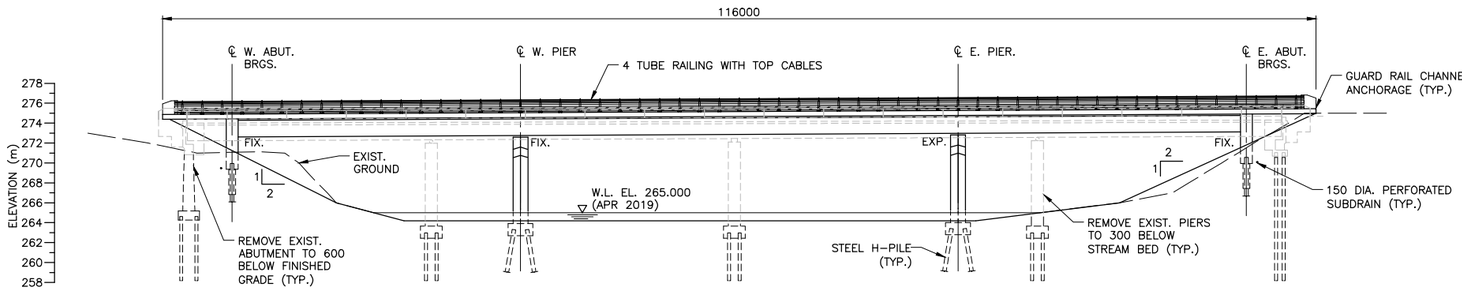
THORNDALE ROAD

Thorndale Bridge Plan View

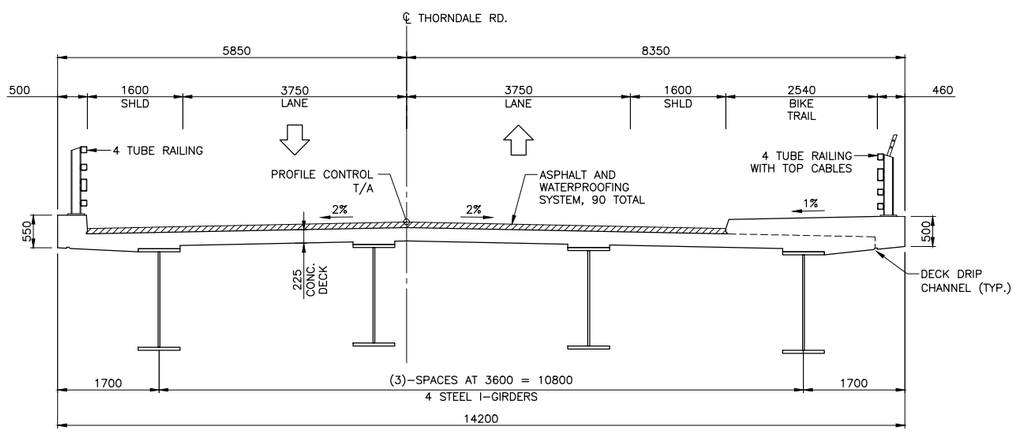
NORTH
FOR CONSTRUCTION



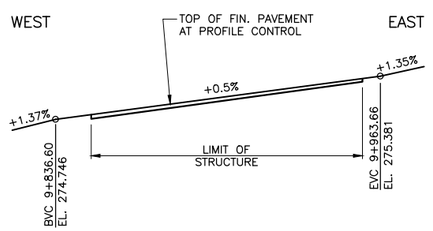
PLAN
1:300



1
1: 300



2
1 : 50



PROFILE OF THORNDALE ROAD
N.T.S.

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

COUNT. RD. 28
CONT
WP

THORNDALE BRIDGE
REPLACEMENT
PRELIMINARY
GENERAL ARRANGEMENT

SHEET
.

Stantec

GENERAL NOTES

1. CLASS OF CONCRETE
   30 MPa UNLESS OTHERWISE SPECIFIED
2. CLEAR COVER TO REINFORCING STEEL
   FOOTINGS 100±25
   DECK TOP 70±20
   BOTTOM 40±10
   REMAINDER 70±20 UNLESS OTHERWISE NOTED.
3. REINFORCING STEEL
   REINFORCING STEEL SHALL BE GRADE 500W UNLESS OTHERWISE SPECIFIED.
   STAINLESS REINFORCING STEEL SHALL BE TYPE 316LN, OR DUPLEX 2205 AND HAVE A MINIMUM YIELD STRENGTH OF 500 MPa.
   BAR MARKS WITH PREFIX 'S' DENOTE STAINLESS STEEL BARS.
   GLASS FIBRE REINFORCED POLYMER (GFRP) REINFORCING BARS SHALL BE GRADE III. THE NOMINAL DIAMETER, TENSILE MODULUS OF ELASTICITY AND GUARANTEED MINIMUM TENSILE STRENGTH SHALL BE AS SPECIFIED IN THE CONTRACT DOCUMENTS.
   BAR MARKS WITH PREFIX GIII DENOTE GRADE III GLASS FIBRE REINFORCED POLYMER BARS.
   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 ACCORDANCE WITH THE STRUCTURAL STANDARD DRAWING SS12-1, UNLESS INDICATED OTHERWISE.
4. CONSTRUCTION
   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.
   BACKFILL BEHIND ABUTMENTS SHALL NOT BE PLACED UNTIL THE DECK HAS REACHED A STRENGTH OF 25 MPa.
   BACKFILL SHALL BE PLACED SIMULTANEOUSLY BEHIND BOTH CONCRETE ABUTMENTS KEEPING THE HEIGHT OF THE BACKFILL APPROXIMATELY THE SAME. AT NO TIME SHALL THE DIFFERENCE IN ELEVATION BE GREATER THAN 500mm.

LEGEND

W.P. DENOTES WORKING POINT
T/A DENOTES TOP OF ASPHALT

APPLICABLE STANDARD DRAWINGS

OPSD-912.430	GUIDE RAIL SYSTEM, STEEL BEAM STRUCTURE CONNECTION
OPSD-3101.150	WALLS ABUTMENT, BACKFILL MINIMUM GRANULAR REQUIREMENT
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
OPSD-3390.100	DECK, DRIP CHANNEL
OPSD-3950.100	JOINTS, CONCRETE EXPANSION & CONSTRUCTION ON STRUCTURE

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN F.S.A.	CHK M.D.	CODE CHBDC-2019	LOAD CL-625-ONT	DATE JULY 2021	
DRAWN H.L.	CHK F.S.A.	SITE 174	STRUCT	SCHEME	DWG. P1

165001122-19-174-GA.DWG Jul 9 2021

Preliminary Cost Estimate

The capital costs associated with the bridge replacement and associated roadwork is estimated to be approximately $10,695,000.

Table 1: Estimated Capital Costs

Capital Cost	**Estimate $**
Roadwork	$1,000,000
Structural	$7,300,000
Miscellaneous	$200,000
Sub Total	**$8,500,000**
Contingency (10%)	$850,000
Utilities (10% Roadwork)	$100,000
Engineering (15%)	$1,245,000
Total Estimated Cost	**$10,695,000**

Implementation and Timing

The detailed design of the preferred plan is underway and will be completed as a "tender ready" package in 2022. Construction of the new Thorndale Bridge and associated roadworks is recommended in the next 10 years, pending funding and approvals, as well as coordination with other projects. Approvals for construction will need to be applied for and obtained closer to the construction date. At the time of construction, additional updated environmental investigations may be required.

Potential Impacts and Proposed Mitigation

Many of the environmental concerns related to this project have been mitigated through the process by which the preferred alternative was selected. The anticipated impacts and proposed mitigation measures have been described in **Section 7.0**. A list of specific commitments to be carried forward to Phase 5 of the Municipal Class EA process, Implementation (detailed design and construction), is provided in **Section 8.0**. The County of Middlesex will work with Upper Thames River Conservation Authority (UTRCA), the Ministry of Environment, Conservation and Parks (MECP) and Fisheries and Oceans Canada (DFO) during detailed design and prior to the start of construction to ensure that the proposed works are acceptable and to obtain required permits.

This page left blank intentionally.

1.0 Introduction

Middlesex County retained Stantec Consulting Ltd. (Stantec) to undertake a Schedule C Municipal Class Environmental Assessment (Class EA) Study to identify improvements to the Thorndale Bridge on County Road 28 (Thorndale Road; see **Figure 2)**. The bridge was constructed in 1953 as part of flood control measures on the Thames River system. The bridge is a four-span cast-in-place concrete box girder bridge. It carries two lanes of traffic on Thorndale Road over the North Thames River. and the bridge has been identified for replacement within the next 10 years.

1.1 Study Area

The study area for this Class EA includes the County Road 28 (Thorndale Road) right-of-way at the Thorndale Bridge in the Municipality of Thames Centre, Middlesex County. The approximate limits of the study area are shown in **Figure 2**.

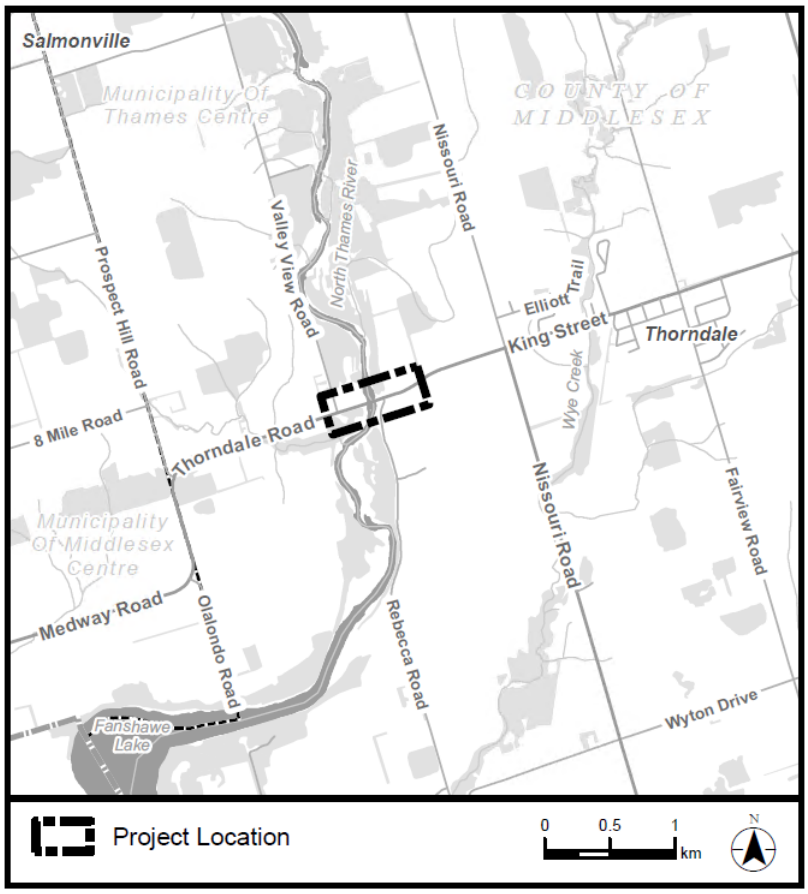


Figure 2: Project Location

Study Team Organization

General direction was provided by the County with progress meetings held at key points throughout the planning process. Key members of the study team included the following individuals:

Middlesex County	Stantec Consulting Ltd.
• Chris Traini, P.Eng. County Engineer	• Isaac Bartlett, P.Eng., Project Manager • Paula Hohner, MScPl, MCIP, RPP, Class EA/Consultation • Julie Werner-Hill, B.A., GISP, Class EA/Consultation • Dana Elfar, P.Eng., Road Design • Mark D'Andrea, P.Eng., Structural

2.0 Planning Process

2.1 Municipal Class Environmental Assessment Process

All municipalities in Ontario are subject to the provisions of the Ontario *Environmental Assessment Act* (EA Act), which mandates the completion of a Municipal Class EA study before constructing municipal infrastructure projects. The Ministry of the Environment, Conservation and Parks (MECP) is responsible for administration of the EA Act.

The Municipal Engineers Association (MEA) *Municipal Class Environmental Assessment* document (October 2000, as amended in 2007, 2011, & 2015) applies to municipal infrastructure projects including roads, water and wastewater. Key components of the Class EA planning process include:

- Consultation with potentially affected parties early and throughout the process.
- Consideration of a reasonable range of alternative solutions.
- Systematic evaluation of alternatives.
- Clear and transparent documentation.
- Traceable decision-making.

The MEA Class EA 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 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 Class EA. The proponent is responsible for identifying the appropriate schedule for any given project and reviewing the applicability of the schedule at multiple stages throughout the project.

Schedule A projects are limited in scale with minimal anticipated environmental impacts. They are pre-approved and may be implemented without undertaking public consultation or following the planning process as outlined in the Class EA. Examples of Schedule A projects include construction or removal of sidewalks, and multi-use pathways or cycling facilities within protected rights-of-way (ROWs).

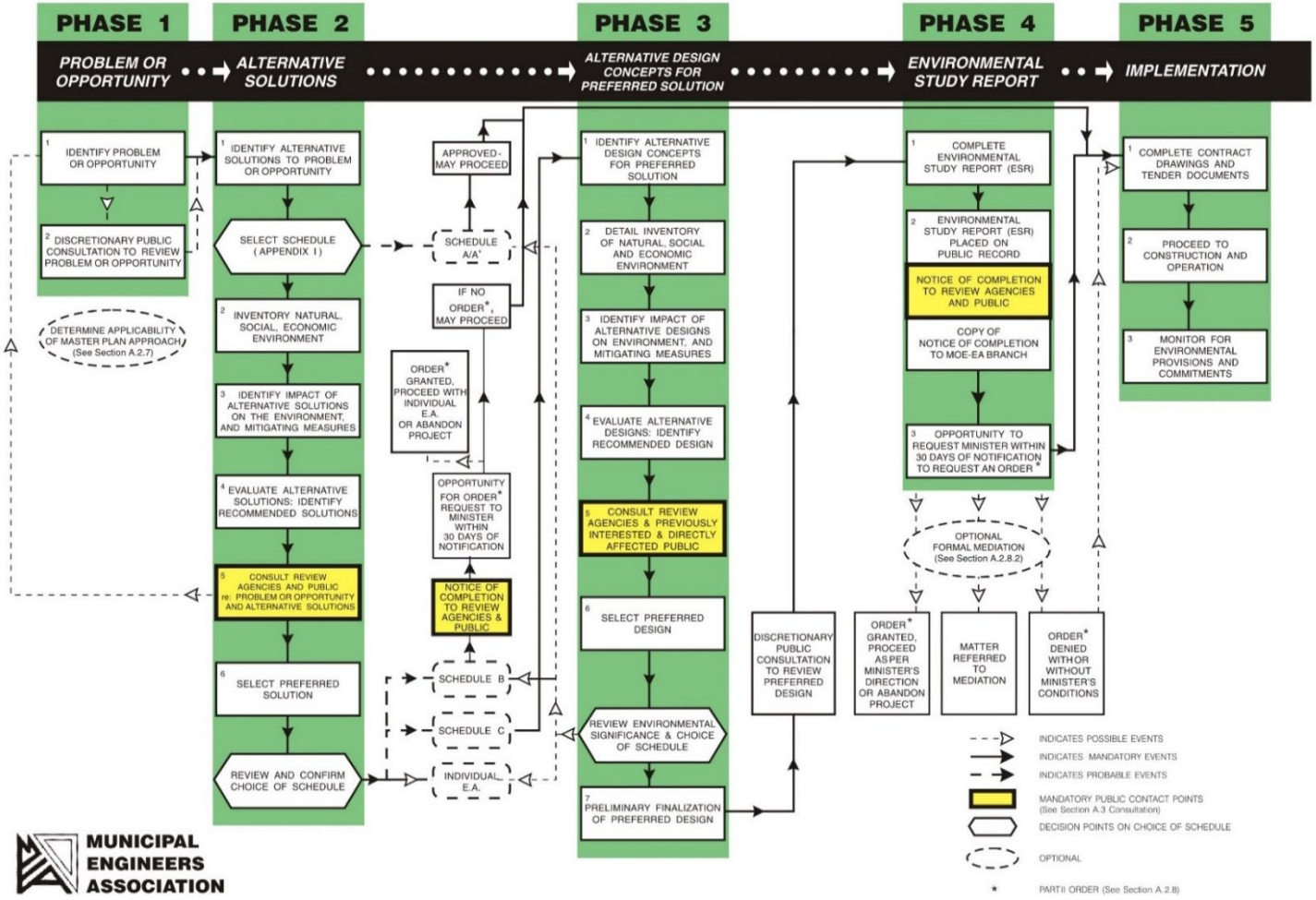
Schedule A+ projects are similarly pre-approved but require that proponents notify potentially affected parties prior to implementation. An example of a Schedule A+ project includes streetscaping within protected ROWs.

Schedule B projects have the potential for some adverse environmental and social impacts. Schedule B projects require the completion of Phases 1 and 2 of the Class EA planning process, which is documented in a Project File 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 to issue an order to comply with Part II of the EA Act, bumping up the status of the project. Part II Order requests are discussed further in **Section 2.1.3.**

Schedule C projects have the potential for significant environmental impacts and must follow the full planning process specified in the Class EA document, including Phases 1 through 4. The project is documented in an Environmental Study Report (ESR), which is then filed for review by the public, review agencies, and Indigenous communities. If concerns are raised that cannot be resolved, the Part II Order procedure may be invoked. Projects generally include the construction of new facilities, and major expansions to existing facilities.

Figure 3 illustrates the Class EA planning process and identifies the steps considered mandatory for compliance with the requirements of the EA Act. An overview of the five-phase planning process is provided below.

Figure 3: Municipal Class EA Planning Process



This page left blank intentionally.

2.1.1 Determining the Project Schedule

Appendix 1 of the Class EA document provides general guidance for determining the appropriate schedule for an undertaking. Two project descriptions in Appendix 1 of the Class EA document are relevant to this project:

- Item #30 – Reconstruction or alteration of a structure over 40 years old, which after appropriate evaluation is found to have cultural heritage value.

- Item #31 – Reconstruction or alteration of a structure over 40 years old, which after appropriate evaluation is found not to have cultural heritage value.

The criteria for determining Cultural Heritage Value or Interest (CHVI) is defined by O. Reg. 9/06 of the *Ontario Heritage Act*. These criteria are considered in the EA process, as no other formal criteria for identifying Cultural Heritage Value or Interest is identified in the Municipal Class Environmental Assessment manual.

Due to the age of the Thorndale Bridge (>40 years of age), the *Municipal Heritage Bridges Cultural, Heritage and Archaeological Resources Assessment Checklist* (revised April 11, 2014) was also used to assist with determining the requirements to comply with the Municipal Class EA. Thorndale Bridge met criteria (1.i) of *Ontario Regulation* (O. Reg.) 9/06 and scored 40 points per the Ontario Heritage Bridge Guidelines. The conclusion that the bridge has CHVI is supported by the evaluation carried out against O. Reg. 9/06, which is the only criteria required for establishing CHVI in the Municipal Class Environmental Assessment Manual. Accordingly, Thorndale Bridge was found to have CHVI as it met one criterion (1.i) under O. Reg. 9/06, for its design/physical value as a representative example of a mid-20th century box girder bridge. The CHER is provided in **Appendix B** and is summarized in **Section 4.7.2**.

Based on the conclusion that the Thorndale Bridge has cultural heritage value, and the cost limit is estimated to be more than $2.4 million[1], this study will follow the requirements of a Schedule C undertaking, which includes the completion of Phases 1 through 4 of the Class EA process.

- Phase 1 – identify the Problem and Opportunity statement.
- Phase 2 – Identify and evaluation alternative solutions.
- Phase 3 – Identify and evaluate alternative design concepts for the preferred solution.
- Phase 4 – prepare design plans and Environmental Study Report (ESR) for a minimum 30-day public review period.

[1] The identified cost thresholds are adjusted on an annual basis in accordance with the Ministry of Transportation's (MTO) tender price index. The current cost threshold for the reconstruction or alteration of a structure is $2.4 million. If the estimate is >$2.4 million, Schedule C process requirements apply.

- Phase 5 – Implement the preferred design following the end of the 30-day review period and the resolution of any Part II Order requests.

2.1.2 Class EA Documentation

The documentation for this Schedule C project consists of this ESR. The filing of the ESR for a minimum 30-day public and agency review period completes the planning and preliminary design phases of the project. A Notice of Completion was published to announce the commencement of the 30-day review period. The ESR was made available for review online:

https://www.middlesex.ca/departments/roads/thorndale-bridge-environmental-assessment

www.thamescentre.on.ca

Any concerns regarding this study should be directed to the County during the 30-day review period.

2.1.3 Part II Order Process

Interested persons may provide written comments to Middlesex County for a response using the following contact information:

Chris Traini, P.Eng.
Project Engineer
County of Middlesex
ctraini@middlesex.ca
519-434-7321 extension 2347

In addition, a request may be made to the MECP for an order requiring a higher level of study (i.e., requiring an individual/comprehensive EA approval before being able to proceed), or that conditions be imposed (e.g., require further studies), only on the grounds that the requested order may prevent, mitigate, or remedy adverse impacts on constitutionally protected Aboriginal and treaty rights. Requests on other grounds will not be considered. Requests should include the requester contact information and full name for the ministry.

Requests should specify what kind of order is being requested (request for additional conditions or a request for an individual/comprehensive environmental assessment), how an order may prevent, mitigate, or remedy those potential adverse impacts, and any information in support of the statements in the request. This will ensure that the ministry is able to efficiently begin reviewing the request.

The request should be sent in writing by mail or by email to:

Minister of the Environment, Conservation and Parks
Ministry of Environment, Conservation and Parks
777 Bay Street, 5th Floor
Toronto ON M7A 2J3
minister.mecp@ontario.ca

and

Director, Environmental Assessment Branch
Ministry of Environment, Conservation and Parks
135 St. Clair Ave. W, 1st Floor
Toronto ON, M4V 1P5
EABDirector@ontario.ca

Requests should also be sent to the County.

2.2 Policy Context

2.2.1 Provincial Policy Statement

The *Provincial Policy Statement* (PPS) (2020), issued under Section 3 of the *Planning Act* (2005), sets a policy foundation for regulating the development and use of land. It provides direction on matters of provincial interest and supports the enhancement of the quality of life for all citizens of Ontario, while still maintaining environmental integrity. In accordance with Section 3 of the *Planning Act*, decisions affecting planning matters shall have regard for the PPS. Investment in transportation infrastructure along Thorndale Road will support a range of transportation, planning and economic development objectives highlighted in the PPS, as summarized herein.

Section 1.0 Building Strong Communities outlines that maintaining a prosperous, sustainable, and healthy future within Ontario is dependent on promoting efficient land use and development patterns. Efficient land use and development patterns support resilient, livable, and healthy communities; protect all aspects of the environment; ensure public health and safety; and facilitate economic growth.

Section 1.6.7 Transportation Systems of the PPS states that safe, energy efficient transportation systems should be provided to: facilitate the movement of people and goods and are appropriate to address projected needs; support connectivity within and among multimodal transportation systems; and to support current and future use of transit and active transportation.

Investment in transportation infrastructure along Thorndale Road supports a range of transportation, planning, and economic development objectives highlighted in the PPS. Planning and design of proposed improvements for the study area will incorporate considerations for natural heritage and cultural heritage resources, as discussed in this ESR.

In accordance with Section 3 of the *Planning Act*, this Class EA shall have regard for policies of the PPS through the identification of a range of transportation improvements, considering vehicular, transit, and active transportation users, and the range of adjacent land uses.

2.2.2 Middlesex County Official Plan

The County of Middlesex Official Plan (MCOP; 2006) classifies Thorndale Bridge as an arterial roadway, as part of the County Road System. The Official Plan notes the primary objective shall be to provide optimum conditions for the movement of people and goods from one portion of the municipality to another, as well as facilitating the movement of traffic. Desired right-of-ways are 36 m, although in urban areas with existing development fronting on a County Road, the minimum right-of-way width is 20 m. Development that inhibits traffic movement along the County Road system will generally be discouraged. Mitigation measures to attenuate noise and vibration factors will be utilized.

Thorndale Road within the study area is identified as a truck haul route. Trucks are expected to access the nearest designated “truck haul route” by the shortest distance possible.

The Official Plan designates the Thames River corridor as a Flood Regulated Watercourse and Associated Floodplain within the study area.

2.2.3 Municipality of Thames Centre Official Plan

The Municipality of Thames Centre Official Plan (TCOP; 2016) classifies Thorndale Road as an arterial roadway intended to facilitate the movement of high volumes of intra-urban traffic at moderate speeds through areas with controlled or limited property access. The TCOP promotes preservation of natural heritage features, such as the Thames River, which runs directly below the Thorndale Bridge. Additionally, the Municipality of Thames Centre aims to establish and support active transportation choices for pedestrians and cyclists, including the development of a municipal wide trail system and regional cycling route network. The TCOP upholds the County of Middlesex policies with respect to design and right of way widths, as well as limited property access.

2.2.4 Middlesex County Cycling Strategy

The Middlesex County Cycling Strategy (MCCS; 2018) was undertaken to provide a comprehensive guide and blueprint for future planning, design, implementation and operation of cycling infrastructure and programming within the County. The Strategy has been developed to promote safe, accessible, comfortable, connected, and continuous cycling and active transportation facilities throughout Middlesex County and to surrounding municipalities. It recognizes that cycling is an important part of the County's existing and future multi-modal transportation and recreation network.

The Strategy identifies Thorndale Road as a Proposed Buffered Paved Shoulder, falling into the long-term (beyond 10 years) proposed network phasing. The connecting Rebecca Road is identified as a Proposed Signed Route and is scheduled to be completed in the short-term (0-10 years) network phasing.

2.2.5 Upper Thames River Conservation Authority

The Conservation Authorities Act (CAA) was created with the purpose of conservation, restoration, development, and management of natural resources in watersheds in Ontario. The CAA is administered by the Ministry of Natural Resources and Forestry (MNRF) and established Conservation Authorities with regulatory responsibility within their respective jurisdictions. The CAA was created in part to protect and manage water and other natural resources at the watershed level.

The Upper Thames River Conservation Authority (UTRCA) has the responsibility to regulate activities in wetlands, watercourses, and hazard lands (e.g., area in and near rivers, streams, floodplains, wetlands, slopes, and shorelines) through the Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation (O. Reg. 157/06). The UTRCA implements the regulation by issuing permits for works in or near watercourses, valleys, wetlands, or shorelines when required.

Under the *Conservation Authorities Act* of Ontario, the Authority has certain regulations whose objectives are:

- To prevent the loss of life and property due to flooding and erosion.
- To prevent pollution.
- To conserve and enhance natural resources.

These policies apply to fill placement and removal or site grading, flood prone areas, erosion prone areas, dynamic beach areas, alteration of watercourses, and interference with wetlands.

The study area falls within the Plover Mills Corridor sub-watershed, natural hazard, natural heritage areas and regulation limit of the UTRCA.

2.2.6 Navigation Protection Act

The *Canadian Navigable Waters Act* (CNWA) regulates interferences with the public right of navigation. CNWA approval is only required for structures on waterways which are on the *List of Scheduled Waters*. The Thames River is listed on the schedule and supports recreational boating. As a minimum, navigational clearances will be accommodated during design and construction.

2.2.7 Climate Change in the Environmental Assessment Process

The MECP's guide, *Consideration of Climate Change in the Environmental Assessment Process*, outlines two approaches for consideration and addressing climate change in project planning including:

- Reducing a project's impact on climate change (climate change mitigation).
- Increasing the project's and local ecosystem's resilience to climate change (climate change adaptation).

The objectives of the climate change document have been considered and incorporated into the generation and evaluation of alternatives and mitigation approaches.

3.0 Consultation

Consultation is an integral part of the Class EA process. Active engagement with all potentially affected parties including government agencies, community members, special interest groups, and Indigenous communities ensures a transparent and responsible planning process. In addition, the urban design and placemaking elements of this project will benefit immensely from meaningful and engaging consultation with members of the community.

3.1 Project Contact List

A project contact list was created which includes multi-level government agencies and officials, Middlesex County and Thames Centre staff, emergency service contacts, potentially interested Indigenous communities, members of the public, utility services, special interest groups, as well as land developers active within the project study area. The list was regularly updated to include those who expressed interest in the study. Addresses for all properties within the study area were compiled and used for the mail-out of the initial Notice of Study Commencement. A copy of the contact list is provided in **Appendix A.1**.

3.2 Project Notices

Notices were sent via mail or email (where requested) to property owners within the study area, the project contact list, and Indigenous communities. Each notice was published to the County's website (https://www.middlesex.ca/departments/roads/thorndale-bridge-environmental-assessment). The study notifications are provided in **Appendix A**, including:

- Notice of Study Commencement – Issued April 8, 2019; mailed to contact list, Indigenous communities, properties owners on April 8, 2019.

- Notice of Public Information Centre No. 1 – Published in the Londoner September 12, 2019 and September 19, 2019. Issued September 12, 2019; mailed to contact list, Indigenous communities, property owners on September 12, 2019.

- Notice of Public Information Centre No. 2 – Published in the Londoner January 30, 2020 and February 6, 2020. Issued January 28, 2020; mailed to contact list, Indigenous communities, property owners on January 28, 2020.

- Notice of Study Completion – Published in the Londoner July 13, 2021 and July 20, 2021 and published in the Thorndale Newspaper on July 14, 2021 and July 21, 2021. Issued July 14, 2021; mailed to contact list, Indigenous communities, property owners on July 14, 2021.

3.3 Agency Consultation

Several ministries, agencies and authorities were contacted during project initiation and throughout the study to notify them of the project and to request information related to the study area and feedback pertaining to the study. Agency comments received are included in **Appendix A.5**.

Elected Officials • MP Elgin – Middlesex – London • MPP Elgin – Middlesex - London **Provincial Agencies** • Ministry of Indigenous Affairs • Ministry of Natural Resources and Forestry • Fisheries and Oceans Canada • Ministry of Municipal Affairs and Housing • Ministry of Transportation • Ministry of Heritage, Sport, Tourism and Culture Industries • Upper Thames River Conservation Authority **Emergency Services** • Middlesex-London Emergency Medical Services Authority • Thames Centre Fire Department • Ontario Provincial Police	**Municipal/Agency Staff** • Middlesex County • Municipality of Thames Centre • City of London **Local Interest Groups** • Thames River Anglers Association • Thorndale Library • Thorndale Community Centre • I Love Thorndale • Thorndale United Church • St. George's Anglican Church • South Nissouri Presbyterian Church • Canadian Heritage River System • London Cycling Club • London Centennial Wheelers • Thames Valley Trail Association • Friends of the Thames **School Boards** • Thames Valley District School Board • London Catholic District School Board • Southwestern Ontario Student Transportation Services

Table 2: Summary of Agency Comments

Agency	Comment	Study Team Response/Action
Ministry of Transportation (MTO)	Email response to Notice of Study Commencement received April 11, 2019. MTO does not have any concerns with proposed construction.	• No action required.
Union Gas	Email response to Notice of Study Commencement received April 16, 2019. Union Gas does not have any infrastructure in the study area.	• No action required.
I Love Thorndale	Email response to Notice of Study Commencement received April 17, 2019. I Love Thorndale added Notice to website to help inform community	• No action required.
Ministry of Heritage, Sport, Tourism and, Culture and Sport Industries (MHSTCI)	Email response to Notice of Study Commencement received May 7, 2019. Archaeological and heritage assessments are to be provided to MTCS for review.	• No action required.
Upper Thames River Conservation Authority (UTRCA)	Email response to Notice of Study Commencement received May 24, 2019. Provided feedback as a regulatory Authority and a property owner. UTRCA provided background details of study area, recommendations, and considerations for project implementation.	• Consultation with UTRCA throughout the Class EA study and during Detailed Design as required.
Ministry of Environment, Conservation and Parks (MECP)	Acknowledge of receipt of Notice of Study April 16, 2019. Written letter response to Notice of Study Commencement received May 31, 2019. MECP suggested consultation with 8 Indigenous communities, Conservation Authority regarding source water protection vulnerability, and climate change mitigation/adaptation.	• Confirmed consultation with list of potentially interested Indigenous communities as identified by MECP. Stantec confirmed the Source Water Protection

Agency	Comment	Study Team Response/Action
	Email response received January 15, 2020. MECP identified the following endangered or threatened Species at Risk (SAR) in study area: • Silver Shiner (threatened, species and general habitat protection). • Barn Swallow (threatened, species and general habitat protection).	policies impacted by the study, along with climate change mitigation considerations for the project.
	On May 7, 2021, MECP acknowledged receipt of Draft ESR for review and provided comments for consideration.	• Updated ESR as required for filing.

3.3.1 Upper Thames River Conservation Authority

The presence of the Thames River within the study area has placed emphasis on retaining natural features and minimizing disturbances to the surrounding environment. The Upper Thames River Conservation Authority (UTRCA) has been a key agency throughout the study. UTRCA provided information on natural heritage features, natural hazard features, drinking water source protection area, and UTRCA owned lands data on June 18, 2019. Stantec attending a meeting with UTRCA on August 6, 2019 to review project intent, timelines, preliminary alternatives under consideration and staging of the structural improvements and the impact to the trail connection.

3.4 Indigenous Community Engagement

The written response received from the MECP on May 31, 2019 identified potentially interested Indigenous communities to be consulted as part of this study. These include:

- Aamjiwnaang First Nation
- Bkejwanong Territory/Walpole Island First Nation
- Chippewas of Kettle and Stony Point First Nation
- Chippewas of the Thames First Nation
- Caldwell First Nation
- Oneida Nation of the Thames ONYOTA'A:KA
- Eelunaapeewi Lahkeewiit (Delaware Nation)
- Munsee-Delaware Nation

Consultation
July 2021

The first point of contact for this project is the Notice of Commencement, which was sent via direct mail to the above communities on April 8, 2019. All public material has been forwarded to the above communities, and follow-up phone calls/emails were completed to ensure that communities had sufficient information to determine consultation interests. All interested parties were notified and invited to all PICs and given the opportunity to express concerns and provide feedback through an invitation to meet and via telephone calls soliciting discussion.

Comments were received from the Chippewas of the Thames First Nations stating the proposal is within their Thames First Nations Traditional Territory, as well as the Big Bear Creek Additions to Reserve Land Selection Area. There are no concerns with the project at this time. A request was made from the Chippewas of the Thames First Nations to be notified if a Stage 3 Archaeology Assessment is required.

The Bkejwanong Territory/Walpole Island expressed interest in participating in the Stage 2 Archaeological Assessment, and in SAR mitigation measures and Natural Heritage aspects of the project. During construction, they would like to be considered for employment opportunities. The Bkejwanong Territory/Walpole Island requested the ESR be sent for review during the 30-day review period. A meeting was requested by Bkejwanong Territory/Walpole Island to meet with the County of Middlesex and Thames Centre once the project design has been finalized in the summer of 2021. The study team informed the County of Middlesex and Thames Centre of this request.

3.5 Public Consultation

Two Public Information Centres (PICs) were hosted by the study team as a component of the consultation process for this project to provide the public with an opportunity to express their concerns throughout the study process while assisting in the development of a preferred alternative.

3.5.1 Public Information Centre No. 1

PIC No. 1 was held on Wednesday, September 25, 2019 from 5:00pm to 7:00pm at the Thorndale Community Centre. The PIC was conducted in a “drop-in” format, with staff from Stantec and the County of Middlesex present to discuss the project and answer questions posed by attendees. Display boards were available, detailing background information on the project, including the existing natural, socio-economic, and cultural environments, analysis of the existing and future travel demands, alternative solutions to address future conditions, and preliminary recommendations. A total of 11 individuals signed into the PIC.

The following is an overview of the general comments and verbal discussions held between the project team and PIC participants:

- Questions and concerns about the ability of the bridge to accommodate wide loads, and if paved shoulders are being considered.

- Questions and concerns about paved shoulders and/or sidewalks with an emphasis for safety of individuals participating in active transportation methods.

- Discussions about proposed detours, with concerns raised about proper detour signage surrounding study area. There were also questions about the possibility of using stop lights rather than a detour to shorten EMS response times.

- Comments about the importance of proper snow removal on the chosen detour.

- Concerns about costs of temporary fixes to the bridge when a large-scale replacement will need to be done in the near future.

- Questions about alternate trails for active transportation to increase safety of cyclists.

- Concerns of detour using Robins Hill Road due to improper winter maintenance.

The display boards presented at PIC No. 1 and copies of comments received are provided in **Appendix A.3**.

3.5.2 Public Information Centre No. 2

PIC No. 2 was held on Thursday, February 13, 2020 from 5:30pm – 7:30pm at the Thorndale Community Centre. The PIC was conducted in a “drop-in” format, with staff from Stantec and the County of Middlesex present to discuss the project and answer questions posed by attendees. Display boards were available, detailing background information on the project, including the existing natural, socio-economic, and cultural environments, analysis of the existing and future travel demands, alternative solutions to address future conditions and preliminary recommendations. A total of 12 individuals signed into the PIC, including 1 individual from UTRCA.

The following is an overview of the general comments and verbal discussions held between the study team and PIC participants:

- Questions and concerns about the environmental and socioeconomic impacts of the year-long detour.

- Concerns about the condition of Robins Hill Road with increased traffic volume.

The display boards presented at PIC No. 2 and copies of comments received are provided in **Appendix A.4**.

4.0 Existing Conditions

4.1 Technical Environment

4.1.1 Thorndale Bridge

The Thorndale Bridge was originally constructed in 1953. The structure is a two-cell cast-in-place concrete box girder bridge that spans over the Thames River, west of Thorndale, Ontario on Middlesex Country Road 28 (Thorndale Road). The current road width is 7.5 m which carries two lanes of traffic and a deck width of 9.5 m. The bridge deck also functions as the top slab of the box girders, the top slab of the structure extends beyond the exterior webs and carries a curb and railing on each side of the deck. The structure is square and oriented in generally east west direction. The deck is asphalt covered and slopes slightly downwards from east to west. The bridge is a four-span structure with an overall length of 110 m. The west abutment consists of an abutment seat supported by three rectangular columns on a single footing. The east abutment consists of a typical abutment stem and footing. All three piers consist of concrete shafts with triangular heads on the ends. All abutments and piers are founded on piles.

Figure 4: Thorndale Bridge

Thorndale Bridge under construction August 28, 1953 (Archives and Special Collections, Western Libraries, Western University 1953)

Thorndale Bridge June 19, 1953 (Archives and Special Collections, Western Libraries, Western University 1953)

4.1.1.1 Maintenance and Repair History

In 1986, rehabilitation work included expansion joints replacement, and deck and soffit concrete repairs.

In 2000, a Detailed Bridge Deck Condition Survey was completed by Dillon Consulting Limited. The report determined the asphalt surface to be in fair condition and the concrete deck in fair to good condition (Dillon Consulting Limited 2000). Following the bridge survey, in 2002, under contract M-C-02, rehabilitation was undertaken on Thorndale Bridge that included:

- Placing post-tensioning system in deck voids (to improve the superstructure capacity).
- Replacing and widening of deck cantilever with new parapet walls.
- Replacing deck drains and expansion joints.
- Building new approach slabs.
- Modifying deck crossfall.
- Patching, waterproofing, and paving bridge deck.

Figure 5: Existing Thorndale Bridge

In 2010, a bridge inspection completed by Dillon Consulting Limited determined the need for rehabilitation work to the structure due to the presence of cracks in the webs of the box girders (Dillon Consulting Limited 2010).

In 2016, rehabilitation work involved the following:

- Miscellaneous concrete repairs were performed to the superstructure.
- Replaced expansion joint strip seal at abutments.

4.1.1.2 Bridge Condition

Stantec performed a brief visual inspection of the superstructure, and delamination survey on the substructure, in April and August 2019. The following is a brief summary of the inspection findings:

- Asphalt wearing surface is in fair condition with a few unsealed longitudinal and transverse cracks, and with snowplow marks on the westbound lane near the west end of the bridge.

- Concrete deck is generally in fair condition with areas of delamination, extensive concrete patches, and sealed cracks on the outside surface. The abutment ends of the interior of the boxes were inspected from the access hatches and noted several injected cracks on the webs.

- Strip seals at both expansion joints are covered with dirt, and although no signs of leakage were evident during the inspection, they are expected to be leaking. The steel armoring exhibits surface rust, and the deck portion of the concrete end dams are partially covered with asphalt.

- Abutments are in good to fair condition. Both abutment ballast walls are expected to have areas of delamination due to the potentially leaking joints. The abutment seat is in good condition with no deterioration noted. Exposed portions of wingwalls are in good condition with patched areas on the top of all wingwalls and a medium delamination on the northwest wingwall. The curtain walls are in poor condition with very severe delaminations and spalls, narrow to wide clean cracks, honeycombing and concrete patches.

- Pier shafts are in good to fair condition with several narrow vertical cracks, severe honeycombing, light to very severe delaminations and spalls.

- Slope protection system consists of concrete panels on the east embankment and large rocks on the west embankment. The concrete slope protection on the east embankment is in fair condition with vegetation between panels and a void under the southeast deck drain. The rock slope protection on the west embankment is in good condition with uneven surface.
- No bird nests were observed on the soffit.

4.1.1.3 Stormwater and Drainage

Thorndale Bridge has widely spaced (approximately 12 m) deck drains along both curb lines. The drains are 150 mm diameter galvanized steel, generally flush with the existing asphalt pavement surface. Several additional drains are located close to the west abutment to intercept drainage flow from the bridge prior to reaching the west joint.

4.1.2 Utilities and Municipal Services

The following utilities were identified within the study area and have been contacted to identify potential impacts to existing and future infrastructure:

- Hydro One: Hydro One distribution lines run parallel to the right-of-way on the south, and cross over to the north just east of the structure. There is a minor potential for impact to the hydro line to accommodate construction activities.

- Bell: Bell cable currently runs underground and under the Thames River parallel to the structure on the north side. A second line runs under the road west of the structure and then goes overhead parallel to the structure on the south side. Cables continue underground east of the bridge on both the north and south side of the road. The cables will need to be relocated to accommodate the structural widening.

4.1.3 Geotechnical Considerations

The exact location of the abutments and piers will be determined in detail design, and a detailed geotechnical and foundation investigation and design will be undertaken for the pier locations and embankment widening. A pavement investigation will also be conducted at this time to confirm the road reconstruction strategy for the bridge approaches.

4.2 Transportation/Traffic

4.2.1 Existing Roadway and Approaches

County Road 28 (Thorndale Road) is an east-west arterial road that provides connectivity between the communities of Thorndale, Ballymonte and Arva. Thorndale Bridge is situated 30 m west of Rebecca Road, and 210 m east of Valley View Road, in the Municipality of Thames Centre, within Middlesex County. The bridge has a two-lane cross section and is located west of Thorndale. The posted speed limit on Thorndale Road is 80 km/h, with a corresponding design speed of 90 km/h.

4.2.2 Transit and Active Transportation

Currently there are no transit or active transportation facilities within the study area. In 2019, Middlesex County received a Community Transportation Grant from the government of Ontario to support transit projects connecting Oxford County, London and possibly Elgin County, to support travel for residents in rural areas. The current stage of this project is receiving Community Engagement through online focus groups (individual and business focused), and an online Microtransit Service Survey regarding the proposed routes, stops, destinations, fares, and service delivery model.

Thorndale Bridge is noted to have capacity concerns specifically relating to pedestrians and cyclists, and the trail connection around Fanshawe Lake. Buffered paved shoulders are planned for Thorndale Road as identified in the Middlesex County Cycling Strategy. Cycling routes are identified in the “long-term” proposed network. The Thorndale Bridge is included on the Fanshawe Lake Trail and provides the crossing over the Thames River for the loop trail.

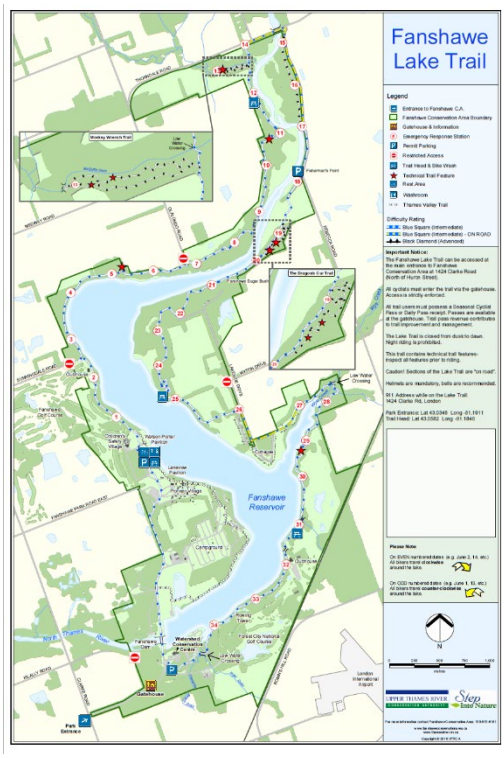


Figure 6: Fanshawe Lake Trail Map (UTRCA, 2019)

4.2.3 Road Safety Assessment

Steel Beam Guide Rail is attached to all four-parapet wall ends. An eccentric loader end treatment is currently installed at the westbound approach end of the steel beam guide rail. The eastbound approach ends are tied into the three-cable guiderail without the benefit of an attenuator.

Driver behavior, traffic composition, and the overall road environment is expected to change due to the new bridge widening. As a result, past safety performance is not a reliable indicator of future safety performance of the roadway including slope grading and roadside hazard protection. These options will be explored during the preliminary and detail design of the improvements.

New construction will be reviewed for potential hazards, and appropriate mitigation measures will be applied where required.

4.2.4 Traffic Conditions

The Average Annual Daily Traffic (AADT) count in 2019 for County Road 28 is approximately 6800 vehicles per day. Thorndale Road is identified as a truck haul route and is used by nearby aggregate resource operations and farm equipment associated with the area's agricultural industry. No significant collision trends were noted at the structure or at the intersection of Thorndale Road and Rebecca Road.

4.2.5 Future Traffic Conditions

The community of Thorndale is anticipated to expand in the future, however anticipated impacts to the traffic will not trigger the need for additional vehicular lanes. With the implementation of the County's Cycling Strategy, an increase in active transportation is anticipated and needs are to be considered with the new bridge cross section.

4.3 Natural Environment

Designated features and records of rare or protected species were identified through a review of background documents, online databases, and agency consultation. Background documents and other applicable sources of information were consulted during the preparation of this report, including the following data sources:

- The Ecosystems of Ontario, Part 1: Ecozones and Ecoregions (Crins et al. 2009)
- Land Information Ontario (LIO) database (MNRF 2019a)
- Government of Canada. Species at Risk Public Registry. Accessed July 2019
- Species At Risk in Ontario (SARO) List (database) (MECP 2019)
- Middlesex County Official Plan (2006)
- Significant Natural Areas of Middlesex County (1982)
- Middlesex Natural Heritage Study (2003)
- Middlesex Natural Heritage System Study (2014)
- Thames Centre Official Plan (2016)
- Ortho-rectified satellite imagery (Middlesex County 2019)
- The Physiography of Southern Ontario (Chapman and Putnam 2007)

Data was compiled in a GIS database to support mapping and data query requirements of the natural heritage assessment. For the potential occurrence of species at risk or provincially rare species, the following sources were consulted for recent (1990-present) records in the vicinity of the study area:

- Natural Heritage Information Centre (NHIC) Biodiversity Explorer database (MNRF 2019b)
- Atlas of the Mammals of Ontario (Dobbyn 1994)
- Ontario Reptile and Amphibian Atlas (Ontario Nature 2019)
- Ontario Breeding Bird Atlas (Cadman et al. 2007)

- Fisheries and Oceans Canada/Upper Thames Valley – Distribution of Fish and Mussel Species at Risk (DFO 2019)
- Upper Thames Region Conservation Authority

These resources generally do not note the exact locations of a species occurrence, with accuracy ranging from 1 km² (NHIC) to 10 km² (wildlife atlases), to municipal boundaries or watersheds. As such they are used as an indicator of potential occurrence in the study area.

In addition to the background data described above, information requests were sent to the UTRCA on June 10, 2019 and to MNRF on October 15, 2019 for the following information:

- Natural Heritage Features
- Natural Hazards Features
- Drinking Water Source Protection Area Features
- Hydrology Data – HEC-RAS, Flow Files
- Fish/Mussel data
- Benthic Sampling Records
- Terrestrial Species At Risk data
- Aquatic Species At Risk data
- UTRCA Owned Lands data
- Watercourse thermal regime and flow regime
- Special habitat features (e.g., groundwater upwelling, spawning areas)
- In-water construction timing window
- MNRF fisheries management objectives, if applicable

UTRCA provided natural heritage features, natural hazard features, drinking water source protection areas, and UTRCA owned lands data on June 18, 2019, and MNRF provided a response email on October 16, 2019 (**Appendix A.5**).

The Environmental Impact Study (EIS) prepared for this project is provided in **Appendix B.1**. The following sections provide a summary of the existing natural environment conditions in the study area.

4.3.1 Species at Risk

Species at Risk (SAR) are terrestrial species classified as Threatened (THR) or Endangered (END) by the Committee on the Status of Species at Risk in Ontario (COSSARO) or aquatic species classified as THR or END by COSSARO or on SARA Schedule 1. The Ontario *Endangered Species Act, 2007* (ESA) prohibits harm or harassment to threatened or endangered species, and damage or disturbance to their habitat. The ESA applies on all private and Crown owned lands in Ontario. Habitat protection under the ESA typically includes all habitats that directly or indirectly support SAR.

SAR occurrences were obtained from the NHIC (MNRF 2019a) and other online databases.

Sixteen species and/or their habitat were identified as confirmed or potentially present in the study area based on a review of background documents as well as habitat assessments and targeted surveys undertaken in the field:

- Butternut (*Juglans cinereal*) (END) – confirmed in the sugar maple inclusion of the Black Walnut lowland (FODM7-4) in the southwest of the study area.
- Eastern Spiny Softshell (*Apalone spinifera*) (END) – critical habitat is present in the Thames River per Environment Canada.
- Queensnake (*Regina septemvittata*) (END) – suitable habitat is present in the floodplain of the Thames River.
- Bank Swallow (*Riparia riparia)* (THR)
- Barn Swallow (*Hirundo rustica)* (THR)
- Bobolink (*Dolichonyx oryzivorous*) (THR)
- Eastern Meadowlark (*Sturnella magna)* (THR) – confirmed in grassland community (MEGM3) on the plateau in the southeast of the study area.
- Eastern Small-footed Myotis (*Myotis leibii)* (END)
- Little Brown Myotis (*Myotis lucifugugs*) (END)
- Northern Myotis (*Myotis septentrionalis*) (END)
- Tri-coloured Bat (*Perimyotis subflavus)* (END)
- Rayed Bean (END) – confirmed in the Thames River.
- Wavy-rayed Lampmussel (THR) – confirmed in the Thames River.
- Black Redhorse (THR) – suitable habitat present in the Thames River.
- Eastern Sand Darter (END) – suitable habitat present in the Thames River.
- Silver Shiner (THR) – suitable habitat present in the Thames River.

An assessment of habitat presence and use for all 12 species is provided in Table B-2 of the EIS (**Appendix B.1)**.

4.3.2 Species of Conservation Concern

Species of Conservation Concern (SOCC) may be designated at the global, national, provincial, or local level. For this report, SOCC includes species that are provincially rare (with a Provincial S-rank of S1 to S3), listed as Special Concern (SC) on the Species at Risk in Ontario list (SARO), or terrestrial species listed on Schedule 1 of SARA but not included on the SARO list.

Provincial ranks (S-ranks) are used by the NHIC to set protection priorities for rare species and vegetation communities. They are based on the number of factors such as abundance, distribution, population trends and threats in Ontario and are not legal designations. By comparing the global and provincial ranks, the status, rarity, and the urgency of conservation needs can be determined. Species with provincial ranks of S1 to S3, and those tracked by the MNRF, are considered SOCC. Provincial S-ranks are defined as follows:

S1: Critically imperiled; usually fewer than 5 occurrences
S2: Imperiled; usually fewer than 20 occurrences
S3: Vulnerable; usually fewer than 100 occurrences
S4: Apparently secure; uncommon but not rare, usually more than 100 occurrences
S5: Secure, common, widespread, and abundant

S-rank followed by a "?" indicates the rank is still uncertain.

Twenty-one species and/or their habitat were identified as confirmed or potentially present in the study area based on a review of background documents as well as habitat assessments and targeted surveys undertaken in the field:

- Lizard's-tail (Saururus cernuus)
- Hairy-fruited Sedge (Carex trichocarpa)
- Narrow-leaved Wild Leek (Allium tricoccum)
- Prairie Milkweed (Asclepias sullivantii)
- Striped Cream Violet (Viola striata)
- Spring Blue-eyed Mary (Collinsia verna) (EXP)
- Monarch (Danaus plexippus) (SC)
- Eastern Milksnake (Lampropeltis Triangulum) (NAR)
- Snapping Turtle (Chelydra serpentina) (SC)
- Bald Eagle (Haliaeetus leucocephalus) (SC)
- Eastern Wood-pewee (Contopus virens) (SC)
- Great Egret (Ardea alba)
- Red-headed Woodpecker (Melanerpes erythrocephalus) (SC)
- Wood Thrush (Hylocichla mustelina) (SC)
- Elktoe (Alasmidonta marginata) (NAR)
- Greater Redhorse (Moxostorma valenciennesi) (NAR)
- Greenside Darter (Etheostoma blennioides) (NAR)
- Mucket (Actinonaias ligamentina) (NAR)
- Northern Sunfish (Lepomis peltastes) (SC)
- Purple Wartyback (Cyclonaias tuberculate) (NAR)
- Rainbow (Villosa iris) (SC)

4.3.3 Physiography, Geology and Soils

The Thames River is a spillway between till moraines (Chapman and Putnam 1984). Bedrock geology is limestone, dolostone and shale (Ontario Geological Survey 1991). Valley soils are undifferentiated mineral soils which are well-drained with intermediate water storage capacity (Government of Canada 1998).

The study area is located in the Niagara section of the Deciduous Forest Region (Rowe 1972), also known as the Carolinian Forest. Forests in this region are dominated by broadleaved trees including sugar maple, American beech, basswood, red maple, red oak, white oak, and bur oak. Species such as black cherry, black walnut, common hackberry, sycamore, swamp white oak, and shagbark hickory are also occasionally present. Coniferous trees such as hemlock, white pine, tamarack, and eastern white cedar may be found in isolated patches where soil conditions are favorable.

4.3.4 Designated Natural Heritage Features

Natural heritage features identified in the Middlesex Natural Heritage System Study (MNHSS; UTRCA 2014), MCOP (2006), TCOP (2016) and Significant Natural Areas of Middlesex County (McIlwraith et al. 1982) are:

- Thames River
- Significant Woodland (significant vegetation patch) – Thorndale River Valley
- Significant Valleyland – North Thames River

The “Thorndale River Valley”, which is part of the Significant Woodland and Significant Valleyland noted above, was also described as a Significant Natural Area by McIlwraith et al. (1982) based on fieldwork completed in July 1977. In this report Black Walnut is noted as a rare species for the county.

4.3.5 Vegetation Surveys

Vegetation community assessments were conducted using the protocols outlined in the Ecological Land Classification (ELC) System for Southern Ontario (Lee et al. 1998). 2008 ELC code updates were used to classify vegetation communities that were not listed in the 1998 manual. Vegetation assessments included a general description of the community, lists of the dominant species in the canopy, sub-canopy, shrub and ground layers, a soil description, a tree size class summary, and a detailed plant species list.

Vegetation communities and botanical species observed were reviewed to determine whether any of the communities were rare in the province, contained any provincially significant plant species, or had the potential to provide significant habitat for wildlife. The nomenclature and provincial status of all plant species was based on a vascular plant species list provided by the Natural Heritage Information Centre (MNRF 2019a). Identification of potentially sensitive native plant species was based on their assigned

coefficient of conservatism (CC) value, as determined by Oldham et al. (1995). This CC value, ranging from 0 (low) to 10 (high), is based on a species' tolerance of disturbance and fidelity to a specific natural habitat. Species with a CC value of 9 or 10 generally exhibit a high degree of fidelity to a narrow range of habitat parameters.

Fifteen vegetation community types were identified in the study area, including 11 natural or naturalized types, one plantation type and three cultural types based on by ELC for Southern Ontario (Lee et al., 1998) and the updated Catalogue (ELC, 2008). Narrow marsh communities were present along the Thames River, woodland communities covered most of the valley and slopes, and meadow or cultural communities were common on the plateau above the river valley. One provincially rare vegetation community (Fresh-Moist Black Walnut Lowland Deciduous Forest, FODM7-4, S2S3) is present south of the bridge on the west side of the Thames River. This floodplain woodland is dominated by the regionally-rare tree Black Walnut, however much of the ground layer is comprised of non-native or invasive species common to southern Ontario.

The EIS includes a list and map of all vegetation communities encountered during this study (**Appendix B.1**).

4.3.6 Flora

The following is a floristic summary for the study area based on spring and summer surveys. A detailed list with all scientific plant names and species statuses is provided in **Appendix B**.

- A total of 139 species of vascular plants were recorded. This total includes taxa identified to species, subspecies (ssp.) and variation (var.) levels.

- 83 of the 139 recorded species are native to Ontario, while 56 are exotic species not native to Ontario.

- 75 native species have a provincial rank of S5, indicating they are common with a secure population in Ontario.

- Six native species have a provincial rank of S4, indicating they are uncommon to common, but not rare in the province and populations are apparently secure.

- Two provincially rare native species (Butternut and Hairy-fruited Sedge) with a provincial rank of S2? and S3, respectively, were observed in the study area south east of Thorndale Bridge. The Butternut (a single tree) was observed at the far west end of the Study area south of Thorndale Road. The Hairy-fruited Sedge was observed in the floodplain woods next to the North Thames River.

- One potential regionally rare species was observed in the Black Walnut floodplain forest. Black Walnut was noted to be a rare species in Middlesex County in the Significant Natural Areas of Middlesex County (McIlwraith et al. 1982), however in the MCNHSS (UTRCA 2014) the species status is listed as unknown.

- One SAR plant (the above-mentioned Butternut) was observed in the study area. It is located along a hiking trail on an upland slope forest at the west end of the study area.

- Three sensitive native plant species with a high coefficient of conservatism value of 8 (Common Hackberry, Canada Garlic and Hairy-fruited Sedge) were observed in the study area. Common Hackberry was observed throughout the study area but is most abundant south east of the bridge. Canada Garlic and Hairy-fruited Sedge were observed south west of the bridge in the floodplain woods.

4.3.7 Wildlife and Wildlife Habitat

4.3.7.1 Migratory Bird Nesting Survey

Searches for nests of migratory birds protected under the MBCA, such as Cliff Swallows, or SAR birds protected by the ESA, such as Barn Swallows, on the bridge structure were conducted during habitat assessments. Species, activity, and condition were documented for all nests observed.

On the south side of the bridge, 15 old Cliff Swallow nests were observed in April 2019, and two active nests in June 2019. On the north side of the bridge, five active Cliff Swallow nests were observed in June 2019. No nests of Barn Swallow or other migratory bird species were observed during field investigations.

4.3.8 Bat and Bat Habitat Survey

Treed communities within the study area were assessed for their suitability to support bat maternity roost habitat as per *Species at Risk Bats within Treed Habitats Little Brown Myotis, Northern Myotis & Tri-Colored Bat* (MNRF 2017) and *Survey Methodology for the Use of Buildings and Isolated Trees by Species at Risk (SAR) Bats* (MNR 2014). Each tree with a diameter at breast height (DBH) larger than 10 cm was assessed, with details recorded for:

- Species
- DBH
- Height
- Presence of loose/ peeling bark
- Cavity height (if present)
- Decay class
- Presence of other snags in proximity
- Open canopy

Suitable bat maternity roost trees were observed in ecosites FOD (four trees) and FODM4-3 (one tree) on the east side of the bridge, as well as in the naturalized hedgerows north (one tree) and south (one tree) of the road on the west side of the bridge. Per MNRF guidance (2017), there is no minimum threshold for number of maternity roost trees per hectare for an ELC ecosite to be considered suitable maternity roost habitat for SAR bats.

4.3.9 Wildlife Observations

Wildlife (birds, reptiles, mammals, amphibians, and insects) were noted incidentally during all site investigations. When areas where wildlife are likely to concentrate (i.e., along the riverbank, in woodlands or thickets) were encountered, particular attention was paid to document wildlife use, as appropriate. Species, number, notes on habitat and behavior were recorded.

An Eastern Meadowlark (THR) was observed in the meadow (ecosite MEGM3) south of the road in the eastern end of the study area on June 21, 2019. A second observation of Eastern Meadowlark (dead on road) adjacent to this meadow was made on July 10, 2019, by a Stantec archaeologist. The Eastern Meadowlark typically occurs in meadows, hayfields, and pastures; however, it will utilize a wider range of habitat than most grassland species, including mown lawn (e.g., golf course, parks), wooded county ravines, young conifer plantation and orchards (Peck and James 1987). These records of a SAR bird in or adjacent to suitable habitat and within the typical nesting period for the species suggest the meadow provides breeding habitat for this SAR. The locations of the Eastern Meadowlark observations are provided on Figure 4, Appendix A of the EIS report.

Two Eastern Gartersnakes were observed in the rip rap embankments north and south of the road west of Thorndale Bridge, as shown on Figure 4, Appendix A. Both snakes were observed in April, suggesting that the snakes may be using these embankments for overwintering. The locations of the Eastern Gartersnake observations are provided on Figure 4, Appendix A of the EIS report.

A groundhog was observed at the entrance to a burrow in the bridge embankment on the east bank of the river, where the concrete slabs have crumbled away exposing bare earth. The location of this burrow, and a second unidentified burrow, is shown on Figure 4, Appendix A of the EIS report.

4.3.10 Wildlife Habitat Assessment

General wildlife habitat assessments were completed at the study area. These assessments focused on the identification of wildlife habitat features, specifically Significant Wildlife Habitat (SWH) features as outlined in the MNRF's Criteria Schedules for Ecoregion 6E (MNRF 2015). When encountered, these features were identified, recorded, and assessed for significance. All wildlife species were observed by sight, sound and/or through distinctive signs (e.g., tracks, scat).

Wildlife habitat suitability assessments were also completed for SARA and ESA protected species that may occur in the area, including species identified in the NHIC database and Ontario wildlife atlases during the literature review process.

4.3.11 Aquatic Habitat Survey

A review of the background databases identified five aquatic SAR, seven SOCC and an additional 26 fish and mussel species that were not at risk with records that overlap with the study area. MNRF indicated in correspondence that the North Thames River has a warmwater thermal regime. A restricted in-water work timing window based on fish species present falls between March 15 and July 15. The relocation timing window based on mussel species and habitat present restricts handling of mussels to a period when water temperatures are above 16˚C, which typically occurs between June 15 and September 30.

A fish habitat assessment was conducted on August 22, 2019. The study area for the habitat assessment was 40 m upstream and 40 m downstream of the existing Thorndale Bridge. Substrates within the study area were generally dominated by gravel and cobble with silt, sand, and boulder present in lower proportion. Sand substrates were in higher proportion on the east side of the river. In-stream cover was provided by deep pools, cobble, boulder and aquatic macrophytes. Riparian vegetation within 5 m of the banks of the river included bull rushes, cut grass, reed canary grass, Joe Pye weed, giant ragweed, willow and jewel weed. Riffle and run morphologies dominated the area in the vicinity of Thorndale Bridge.

The section of the North Thames River that was assessed provides foraging, rearing, spawning, and overwintering habitat for a number of Unionid mussels and warmwater fish species. It is also categorized as critical habitat for Rayed Bean mussels (DFO 2019).

During the habitat assessment, shell evidence for the following mussel species was found within the study area:

- Rayed Bean (*Villosa fabale)* – recent shells
- Rainbow (*Villosa iris)*
- Plain Pocketbook (*Lampsilis cardium)*
- Creeper (*Strophitus udulatus)*
- Purple Wartyback (*Cyclonaias tuberculata)*
- Wavy-rayed Lampmussel (*Lampsilis fasciola)* – shells and live specimens
- Fluted Shell (*Lasmigona costata*)
- Spike (*Elliptio dilatata)*
- Elktoe (*Alasmidonta marginata)*

4.3.12 Assessment of Significance

4.3.12.1 Significant Woodlands

A significant woodland is present within the study area which is comprised of all contiguous woodland communities within the North Thames River valley in the municipality of Thames Centre. This feature was first designated as a Significant Natural Area (Thorndale River Valley) in the Significant Natural Areas of Middlesex County (McIlwraith et al. 1982) and was subsequently included in more natural heritage studies for the country (UTRCA 2003, UTRCA 2014).

4.3.12.2 Significant Valleylands

The North Thames River valley is a Significant Valleyland, per the MNGSS (UTRCA 2014).

4.3.12.3 Significant Wetlands

There are no mapped significant wetlands in the study area. Unelevated wetlands are present in the study area:

- An organic deciduous swamp community (SWDO3) is located within the study area, approximately 100 m north of the bridge, in an area of seepage along the valley wall.
- The east and west banks of the North Thames River in the ROW and larger study area consist of a band of reed-canary grass meadow marsh (MAMM1-3).

4.3.12.4 Significant Wildlife Habitat

Wildlife habitat includes habitat for species listed as Special Concern under the ESA or ranked provincially rare (S1-S3) and the four categories of *Significant Wildlife Habitat*. The *Significant Wildlife Habitat Criteria Schedules for Ecoregion 6E* (MNRF 2015) provide descriptions of wildlife habitats and guidance on criteria for determining the presence of candidate and confirmed wildlife habitats. Targeted wildlife surveys are typically required to confirm habitat use and significance.

This section discusses these categories of significant wildlife habitat relative to the proposed Airport Pit licence area. A full description of the evaluation of specific types of wildlife habitat is provided in the EIS.

4.3.12.5 Seasonal Concentration Areas

Seasonal concentration areas are sites where large numbers of a species gather together at one time of the year, or where several species congregate. Only the best examples of these concentration areas are typically designated as SWH. Review of the NHIC & LIO databases did not identify any confirmed seasonal concentration areas within the study area. The following candidate seasonal concentration areas were identified in the study area:

- Bat maternity colony (candidate)
- Reptile hibernaculum (candidate)

4.3.12.6 Rare Vegetation Communities or Specialized Habitats for Wildlife

Rare Vegetation Communities or Specialized Habitats for Wildlife are defined as separate components of SWH. Rare habitats are habitats with vegetation communities that are considered rare (S1-S3) in the province. These habitats are generally at risk and may support wildlife species that are considered significant. Specialized habitats are microhabitats that are critical to some wildlife species. No rare vegetation communities were identified in the study area. The following specialized habitats for wildlife were identified:

- Seeps and springs (confirmed)

4.3.12.7 Habitat for Species of Conservation Concern

Habitat for species of conservation concern includes four types of species: those that are rare, those whose populations are significantly declining, those that have been identified as being at risk to certain common activities, and those with relatively large populations in Ontario compared to the remainder of the globe. An evaluation of candidate habitats for species of conservation concern, including provincially designated Special Concern species that were identified during the background review, is provided in the EIS. The following habitat for species of conservation concern were identified in the Study area:

- Hairy-fruited sedge (confirmed)
- Monarch (candidate)
- Eastern Milksnake (candidate)
- Snapping Turtle (candidate)
- Eastern Wood-Pewee (candidate)
- Red-headed Woodpecker (candidate)
- Wood Thrush (candidate)

4.3.12.8 Animal Movement Corridors

Animal movement corridors are distinct passageways or defined natural features that are used by wildlife to move between habitats, usually in response to seasonal requirements. Movement corridors are identified once the following seasonal concentration areas or specialized habitats are confirmed as SWH: amphibian breeding habitat and deer wintering habitat. Riparian wetlands along the Thames River in the study area likely provide a movement corridor for amphibians.

4.4 Tree Inventory

A limited number of immature trees are growing from the sides of the embankment along the road on both sides of the existing bridge. The majority of mature trees are limited to the base of the embankment. The species observed are a mix of locally common, native species and non-native species. The Arborist Report prepared for this project is provided in **Appendix B.2**.

A total of 200 trees have been included in the inventory, including the following tree species:

Family	Genus species (common name)
Cannabaceae (hemp family)	*Celtis occidentalis (hackberry)*
Cupressaceae (cypress family)	*Thuja occidentalis (eastern white cedar)*
Juglandaceae (walnut family)	*Juglans nigra (black walnut)*
Malvaceae (mallow family)	*Tilia Americana (basswood)*
Moraceae (mulberry family)	*Morus alba (mulberry)*
Oleaeceae (olive family)	*Fraxinus pennsylvanica (green ash)* *Fraxinus sp. (ash sp.)*
Pinaceae (pine family)	*Pinus nigra (Austrian pine)* *Pinus Sylvestris (Scots pine)*
Rosaceae (rose family)	*Crataegus monogyna (common hawthorn)* *Crataegus sp. (hawthorn species)* *Malus pumlia (common apple)* *Malus sp. (apple sp.)* *Prunus avium (sweet cherry)* *Prunus serotina (black cherry)*
Salicaceae (willow family)	*Populus alba (white poplar)* *Populus deltoides ssp. deltoides (eastern cottonwood)* *Populus tremuloides (trembling aspen)* *Salix sp. (willow sp.)*
Sapindaceae (soapberry family)	*Acer platanoides (Norway maple)* *Acer rubrum (red maple)* *Acer saccharum (sugar maple)*
Ulmaceae (elm family)	*Ulmus Americana (white elm)*

4.5 Drinking Water Source Protection

Drinking Water Source Protection represents the first barrier in the protection of drinking water. Protecting surface and ground water from becoming contaminated or overused will ensure a sufficient supply of clean, safe drinking water. The *Clean Water Act 2006* (CWA) is intended to protect existing and future sources of drinking water as part of the government's overall commitment to protecting human health and the environment. The CWA sets out a framework for source protection planning on a watershed basis with Source Protection Areas established based on the watershed boundaries of Ontario's 36 Conservation Authorities.

The study area is located within the *Thames-Sydenham Source Protection Region* (SPR) and is subject to the policies of the *Thames-Sydenham Source Protection Plan (SPP), Volume III – Policies* affecting the Thames-Sydenham SPR except Oxford County. According to the current mapping (**Figure 7**), UTRCA *Source Protection Assessment Report* mapping, portions of the study area are located within Significant Groundwater Recharge Areas (SGRA) and Highly Vulnerable Aquifers (HVA) with a maximum vulnerability score of six. Policies of the SPP generally apply to activities considered 'significant threats' to drinking water sources, which can only occur within areas with a vulnerability score of eight or higher. It is not anticipated that improvements associated with this Class EA study will be impacted by existing SPP policies.

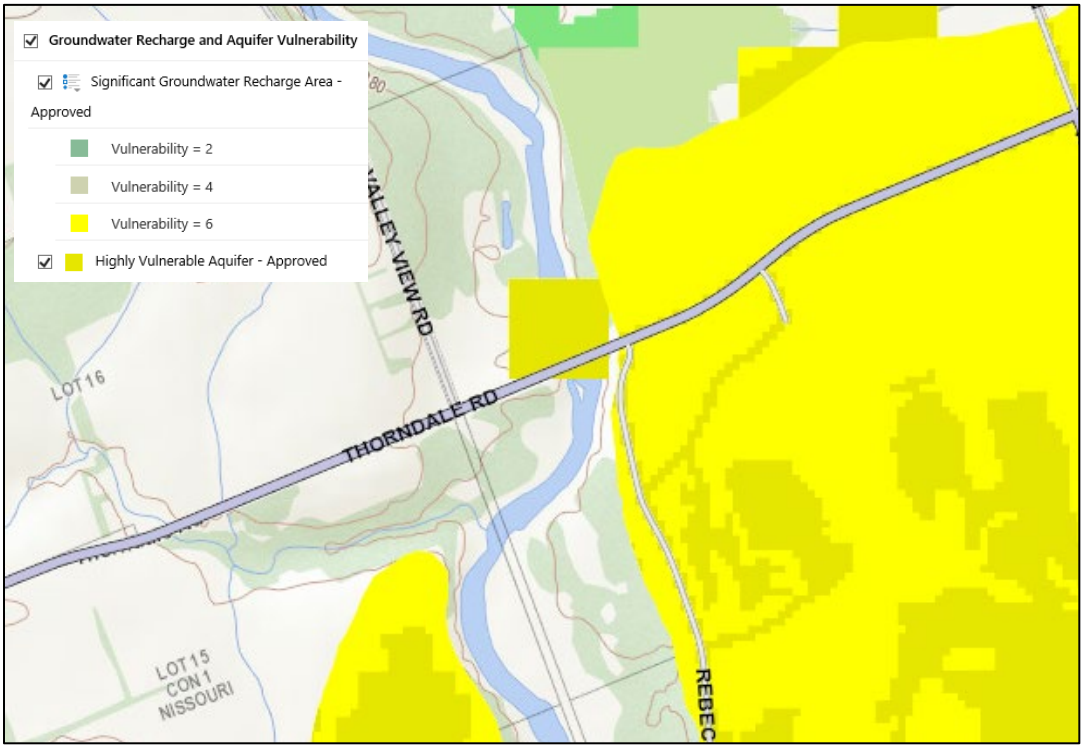


Figure 7: **Groundwater Recharge and Aquifer Vulnerability**

4.6 Socio-Economic Environment

Schedule A Land Use Plan of the Municipality of Thames Centre Official Plan designates the study area as “Natural Area”. Designated “Extractive Areas” are located northeast and southwest of the study area. The Thorndale Bridge is surrounded by designated “Agricultural Areas” and is located west of the Thorndale Urban Settlement Area. A “Settlement Industrial” area is located between Rebecca Road and Nissouri Road, south of Thorndale Road.

Schedule A Land Use of the Middlesex County Official Plan designates the study area as a “Flood Regulated Watercourse and Associated Floodplain”. Schedule B Transportation designates County Road 28 (Thorndale Road) as an “Arterial Road – County”. Schedule C Natural Heritage Features designates the area as an “Aggregate Resource Area”.

The Thames River is a designated Canadian Heritage River and intersects the study area. Existing land use adjacent to the study area is predominantly agricultural. A Low Water Crossing trail maintained by UTRCA is located south of the Thorndale Bridge on the west side of the Thames River. During periods of high-water flow, this trail may be impassable. There are no active planning applications.

4.7 Cultural Environment

4.7.1 Archaeological Resources

A Stage 1 Archaeological Assessment has been completed for the Thorndale Bridge. background, and archival research determined the study area retains potential for the identification of pre-contact Indigenous, and Euro-Canadian archaeological resources. The area surrounding the Thames River contains soil conditions and topography that would have been suitable for Indigenous and Euro-Canadian agriculture. Additionally, historical mapping demonstrates the area follows early interior roads and concessions with structures illustrated as fronting these roads, particularly Thorndale Road. These factors increase the potential for archaeological finds within the study area.

Stage 2 Archaeological Assessments will be undertaken in areas impacted by the proposed improvements which retain archaeological potential. The limits and scope of the work will be completed during detailed design in accordance with the appropriate policies of the *Standards and Guidelines for Consultant Archaeologists* (Government of Ontario 2011).

The portion of the study area containing the Thames River retains potential for the identification of marine archaeological resources. It is anticipated that impacts to the Thames River will occur and will be confirmed as part of the detailed design phase. The potential for marine archaeological resources will be evaluated using the MHSTCI's Criteria for Evaluating Marine Archaeological Potential Checklist during detailed design.

The Stage 1 Archaeological Assessment prepared for this project is provided in **Appendix B.3**.

4.7.2 Built Heritage and Cultural Landscapes

A Cultural Heritage Assessment Report (CHAR) was prepared to identify cultural heritage resources (built heritage and cultural heritage landscapes) within the study area. The following resources have been identified as having cultural heritage value or interest:

- The Thames River – a designated Canadian Heritage River and intersects the study area, passing under the Thorndale Bridge. The study area is located within the Plover Mills Corridor of the Upper Thames River Watershed. The River is wide but shallow, controlled by the Fanshawe Dam and reservoir.

- Thorndale Bridge – first bridge built in 1869. In 1902, a new bridge was constructed including a four-span metal pin-connected truss bridge with a wood deck and stone pillars. The existing Thorndale Bridge structure was erected in 1953.

- 16614 Thorndale Road – was built mid to late 19th century and is a one- and one-half storey residence. It is depicted on the 1878 Township of West Nissouri map in the Illustrated Historical Atlas of Middlesex County.

- 16615 Thorndale Road – was built mid to late 19th century and is a one- and one-half storey residence. Adjacent to the residence is a timber frame barn with a gambrel roof and stone foundation. It is depicted on the 1878 Township of West Nissouri map in the Illustrated Historical Atlas of Middlesex County.

The bridge scored 40 points per the Ontario Heritage Bridge Guidelines, and therefore does not meet the threshold of 60 points to be considered provincially important and worthy of inclusion on the *Ontario Heritage Bridge List.* However, the Thorndale Bridge was determined to have local Cultural Heritage Value or Interest (CHVI), as it met one criterion under O. Reg. 9/06 (1.i) given that Thorndale Bridge is the only box girder structure in the Municipality of Thames Centre and Middlesex County. While this type of bridge was common in the 1950s and 1960s, there are not a lot of bridges of this type remaining in the province, especially over watercourses.

The Thorndale Bridge is considered to have local CHVI according to O. Reg. 9/06 with the following heritage attributes:

- Four-span cast-in-place concrete two-cell box girder bridge.
- Concrete abutments.
- Piers with concrete shafts and triangular ice breaker heads on the sides.

The CHAR prepared for this project is provided in **Appendix B.4**.

4.8 Problem and Opportunity Statement

Based on the review of existing conditions, servicing studies, planning documents, development proposals, and traffic conditions, the following summarizes the problems and opportunities within the study area:

- Active Transportation – There is a need to improve active transportation facilities within the study area (buffered paved shoulder identified in Middlesex County – Cycling Strategy) and provide a connection to the Fanshawe Lake Trail System.

- Bridge Condition – The existing bridge is 67 years old and has been identified for replacement within the next 10 years.

Improvements to the Thorndale Bridge are needed to provide sufficient road capacity, while safely and efficiently accommodating active transportation. The improved bridge corridor will serve the needs of the transportation system, including active transportation and area growth, designed for a 75-year lifespan.

4.9 Development of Alternative Solutions

Under the Municipal Class EA process, all aspects of the environment are to be considered in the assessment of infrastructure projects. The EA Act includes a broad definition of environment, including technical, natural, social, cultural, built, and economic. To determine potential impacts of an infrastructure project on the environment, a systematic evaluation of alternatives is undertaken, in consideration of the advantages and disadvantages.

To identify a Preferred Solution for the Thorndale Bridge, a staged approach to evaluating Alternative Solutions was used. As a first step, a number of preliminary alternatives were identified. The alternatives were developed based on the observed condition of the existing infrastructure and the environmental sensitivities associated with the underlying aquatic and terrestrial environment. The alternatives were subjected

to a screening assessment using a reasoned argument method of evaluation. This method identifies and highlights the differences in net impacts associated with the various alternatives, and the relative significance of the identified impacts is examined to provide a clear rationale for screening out unreasonable solutions. In general, these preliminary planning alternatives consisted of the following:

- Alternative 1 – Do Nothing: No physical modifications to the existing infrastructure would be undertaken within the study area. This alternative was included as a benchmark for the assessment of the other alternatives.

- Alternative 2 – Rehabilitation of the Existing Bridge: As part of this alternative, the existing bridge would remain in place; however, portions of the bridge would be repaired and/or restored to improve portions of the existing structure. Temporary lane closures would be imposed to maintain traffic during construction activities.

- Alternative 3 – Replace Superstructure and Detour: Modifications to the existing bridge would be limited to replacement of the superstructure with a new, two-lane structure that closely replicates the existing structure; however, the existing piers would remain in place. Further, the new superstructure would maintain the existing alignment of the bridge. During construction, traffic would be temporarily diverted off-site to a nearby roadway.

- Alternative 4 – Replace Superstructure and Temporary Modular Bridge: Modifications to the existing bridge would be limited to replacement of the superstructure with a new, two-lane structure that closely replicates the existing structure; however, the existing piers would remain in place. Further, the new superstructure would maintain the existing alignment of the bridge. To accommodate onsite traffic during construction activities, a Temporary Modular Bridge (TMB) would be placed adjacent to the existing bridge. As part of this alternative, temporary approaches to the TMB would also need to be constructed.

- Alternative 5 – New Bridge and Detour: A new, two-lane bridge would be constructed, including new piers, bridge abutment and superstructure, on the existing alignment. Traffic would be rerouted around project area during construction using a signed detour route.

- Alternative 6 – New Bridge and Temporary Modular Bridge: A new, two-lane bridge would be constructed, including new piers, bridge abutment and superstructure. To accommodate onsite traffic during construction activities, a Temporary Modular Bridge (TMB) would be placed adjacent to the existing bridge. As part of this alternative, temporary approaches to the TMB would also need to be constructed.

- Alternative 7 – New Bridge on New Alignment: A new, two-lane bridge would be constructed on a new alignment adjacent to the existing bridge. Traffic would be maintained on the existing bridge during construction.

4.10 Evaluation of Alternative Solutions

To facilitate the assessment of the preliminary planning alternatives, the evaluation factors and criteria outlined in **Table 3** were developed by members of the project team and subsequently confirmed in consultation with the public through Public Information Centre (PIC) #1.

Table 3: Evaluation Factors and Criteria

Factors	Criteria
Transportation	• Traffic Operations • Fire and Emergency Medical Services • Property Accessibility • Active Transportation
Engineering	• Structural • Constructability Construction Staging/Detours • Municipal Services and Utilities • Hydraulic Capacity • Cost
Socio-Economic Environment	• Property Impacts
Natural Environment	• Aquatic Species and Habitat • Wildlife and Wildlife Habitat • Vegetation • Species of Conservation Concern
Cultural Environment	• Cultural Heritage Resources • Archaeological Resources

Members of the project team evaluated the preliminary alternatives to screen unsuitable alternative solutions, and to ensure that only feasible solutions that adequately addressed the identified problems and opportunities in the study area were carried forward for detailed assessment. Based on the findings of the screening assessment as presented at PIC#1 (**Table 4**), three alternative solutions were recommended for further evaluation:

- Alternative 5 – New Bridge and Detour
- Alternative 6 – New Bridge and Temporary Modular Bridge
- Alternative 7 – New Bridge and New Alignment

Table 4: Screening Evaluation of Alternative Solutions

Alternative	Evaluation Summary	Recommendation
Alternative 1 - Do Nothing	Does not address problems and opportunities identified in the study area.	Not recommended for further consideration.
Alternative 2 – Rehabilitate the Existing Bridge	Meets requirements for a two-lane cross section. Does address County of Middlesex active transportation objectives (buffered paved shoulder) but does not improve connectivity of the Fanshawe Lake Loop trail. Does not address long-term structural needs at the bridge.	Not recommended for further consideration.
Alternative 3 – Replace Superstructure and Detour	Two lane cross section maintained, and ability to accommodate additional active transportation if superstructure widening occurs with standard shoulders. Temporary impacts to existing traffic and trail users due to detour. Potential for Emergency Medical Services (EMS) delays due to detour route. Remaining service life of the existing piers will be shorter than that of new the new structure, thereby reducing the service life of the entire structure. Strengthening of the existing piers is required.	Not recommended for further consideration.
Alternative 4 – Replace Superstructure and Temporary Modular Bridge (TMB)	Same as Alternative 3, although a TMB accommodates traffic adjacent to the existing structure. Minimal impacts to traffic during construction due to TMB. Some additional property and natural heritage impact due to the TMB. Remaining service life of the existing piers will be shorter than that of new the new structure, thereby reducing the service life of the entire structure. Strengthening of the existing piers is required.	Not recommended for further consideration.

Alternative	Evaluation Summary	Recommendation
Alternative 5 – New Bridge and Detour	Two lane cross section maintained with the ability to accommodate active transportation. High potential for temporary impacts to existing traffic and trail users due to detour. Potential for Emergency Medical Services (EMS) delays due to detour route. Designed for a 75-year lifespan.	**Carry forward for further consideration**
Alternative 6 – New Bridge and Temporary Modular Bridge (TMB)	Same as Alternative 5, although detours are not needed due to TMB. Minimal impact to traffic, EMS, and trail users during construction due to TMB. Designed for a 75-year lifespan. Some additional natural heritage/ property impacts due to the TMB footprint.	**Carry forward for further consideration**
Alternative 7 – New Bridge and New Alignment	Two lane cross section with new structure and ability to accommodate active transportation. Minimal impact to traffic, EMS, and trail users during construction due to construction offline. Designed for a 75-year lifespan. Higher natural heritage/property impacts due to new alignment.	**Carry forward for further consideration**

The second step in the assessment involved the evaluation of potential temporary and permanent impacts associated with each alternative solution. To effectively assess these impacts, the evaluation assessed both permanent and temporary impacts using the factors and criteria outlined in **Table 5**.

Table 5: Evaluation Criteria for Permanent and Temporary Impacts

Factors	Criteria
Permanent Impacts	
Transportation	• Traffic Operations • Property Accessibility • Property Acquisition and Impacts • Active Transportation
Natural Environment	• Aquatic Species and Habitat • Wildlife and Wildlife Habitat • Vegetation • Species at Risk
Cultural Environment	• Archaeological Resources
Temporary Impacts	
Transportation	• Delays to Emergency Medical Services, Public and Active Transportation • Construction Duration • Property Accessibility • In-Water Impacts
Natural Environment	• Aquatic Species and Habitat • Wildlife and Wildlife Habitat • Vegetation • Species at Risk
Engineering	• Structural • Constructability • Municipal Services and Utilities • Hydraulic Capacity • Cost
Socio-Economic Environment	• Property Impacts

The evaluation criteria used to assess alternative solutions considered both qualitative and quantitative measures. Where possible, quantitative measures were used to compare the advantages and disadvantages of each Alternative Solution in numeric terms. Qualitative methods were used to describe the advantages and disadvantages for each criteria that are not easily measured or quantified. In addition, criteria used to evaluate the preliminary planning alternatives were carried forward into the detailed evaluation of Alternative Solutions only where significant differences between the alternatives were recognized. The detailed evaluation of the feasible Alternative Solutions is outlined in **Table 6.**

Table 6: Detailed Evaluation of Alternative Solutions

Factors	ALTERNATIVE SOLUTIONS			
	Evaluation Criteria	**Alternative 5 New Bridge and Detour**	**Alternative 6 New Bridge and Temporary Modular Bridge (TMB)**	**Alternative 7 New Bridge and New Alignment**
PERMANENT IMPACTS				
TRANSPORTATION ENVIRONMENT				
Traffic Operations	• Ability to accommodate future travel demands.	New bridge will maintain a two-lane configuration to accommodate future travel demands with improved lane widths and shoulders.		
		All alternatives will accommodate future travel demands.		
Active Transportation	• Potential to accommodate future active transportation facilities (sidewalk, multi-use pathway and/or on-road bike lanes). • Ability to improve Fanshawe Loop Trail connectivity.	High potential to accommodate future active transportation facilities. • Raised trail connection on bridge (2.5 m wide) • Shoulders (1.6 m either side)		
		All alternatives provide the same amount of space for cyclists and pedestrians (shoulders and raised trail connection).		
SOCIO-ECONOMIC ENVIRONMENT				
Property Accessibility	• Impacts to future property access.	No permanent impact to property access onto Thorndale Road. All accesses will remain open.		
		All alternatives avoid impacts to future property access.		
Property Acquisition and Impacts	• Property to be permanently acquired and / or impacted.	Relatively minor amount of property required or impacted. Existing property maintained.	Grading impacts can be restored but some permanent impacts to trees and fencing required on private property to accommodate the TMB.	Property acquisition required to accommodate new bridge alignment. Potential impact to UTRCA due to the need to acquire property for the new alignment and bridge structure. Potential permanent property impacts to MN 16614 and MN 16626 to accommodate new approach.
		Most Preferred	**Moderately Preferred**	**Least Preferred**

Factors	ALTERNATIVE SOLUTIONS			
	Evaluation Criteria	**Alternative 5** **New Bridge and Detour**	**Alternative 6** **New Bridge and Temporary Modular Bridge (TMB)**	**Alternative 7** **New Bridge and New Alignment**
NATURAL ENVIRONMENT				
Aquatic Species and Habitat	• Permanent impacts to aquatic species and habitat. • Number of piers/areas of in-water disturbance. • Area of floodplain disturbance + 30 m buffer required for the Silver Shiner (Species at Risk). • Impacts to in-water sensitive features during construction (i.e., area and instances of in-water work required).	Potential aquatic habitat impacts due to in-water work for new bridge piers and removal of existing piers. One time in-water impact during construction of new bridge and remove old piers along same bridge alignment.	Potential aquatic habitat impacts due to in-water work for TMB piers in undisturbed areas, new bridge piers on same alignment and removal of existing piers. Three separate in-water impacts to build TMB in undisturbed area, remove and build new bridge on same bridge alignment, and remove TMB.	Potential aquatic habitat impacts due to in-water work for new bridge piers in undisturbed areas and removal of existing piers. Two separate in-water impacts to build new bridge on new alignment, dismantle old bridge and build remaining bridge in partially disturbed area.
		Most Preferred	**Least Preferred**	**Moderately Preferred**
Wildlife and Wildlife Habitat	• Impacts to wildlife and wildlife habitat (i.e., bat roosts; turtle wintering; snake hibernaculum; seeps).	Lowest potential for permanent impacts to wildlife and wildlife habitat adjacent to the existing structure.	Moderate potential impacts to wildlife habitat adjacent to structure due to construction of TMB and permanent structure.	High potential for permanent impacts to existing wildlife and wildlife habitat areas adjacent to the existing structure to accommodate new bridge and new roadway alignment.
		Most Preferred	**Moderately Preferred**	**Least Preferred**
Vegetation	• Permanent impact to vegetation communities, particularly Special Concern and provincially rare plant species.	Lowest potential for permanent impacts to vegetation communities adjacent to the existing structure.	Moderate potential for permanent impacts to vegetation communities due to construction of TMB and permanent structure.	High potential for greater permanent impacts to existing vegetation communities adjacent to the existing structure to accommodate new bridge and new roadway alignment.
		Most Preferred	**Moderately Preferred**	**Least Preferred**
Species at Risk	• Impact to Species at Risk and Species at Risk habitat (i.e., (Butternut; Meadowlark; Bats; Rayed Bean; Other Fish/ Mussels).	Potential impact to terrestrial and aquatic SAR habitat due to permanent embankment alteration and in-water piers associated with new structure.	Medium potential impact to terrestrial and aquatic SAR due to permanent and temporary embankment alteration and larger in-water footprint associated with TMB and new structure.	Highest potential impact to terrestrial and aquatic SAR due to permanent embankment alteration associated with new structure on new alignment and larger in-water footprint.
		Most Preferred	**Moderately Preferred**	**Least Preferred**

Factors	ALTERNATIVE SOLUTIONS			
	Evaluation Criteria	**Alternative 5** **New Bridge and Detour**	**Alternative 6** **New Bridge and Temporary Modular Bridge (TMB)**	**Alternative 7** **New Bridge and New Alignment**
CULTURAL ENVIRONMENT				
Archaeological Resources (Land/Marine)	• Potential impacts on lands with archaeological potential.	A Stage 1 Archaeological Assessment was completed. The study area has not been previously disturbed and exhibits potential for the identification and recovery of archaeological resources. A Stage 2 Archaeological Assessment is required if the land is to be impacted. Potential for marine archaeological resources to be evaluated using the MHSTCI's Criteria for Evaluating Marine Archaeological Potential Checklist.		
		Least area impacted.	Most area impacted.	Area less than Alternative 6 but much greater than Alternative 5.
		Most Preferred	**Least Preferred**	**Moderately Preferred**
SUMMARY OF PERMANENT IMPACTS		**MOST PREFERRED**	**MODERATELY PREFERRED**	**LEAST PREFERRED**

Factors	ALTERNATIVE SOLUTIONS			
	Evaluation Criteria	**Alternative 5** **New Bridge and Detour**	**Alternative 6** **New Bridge and Temporary Modular Bridge (TMB)**	**Alternative 7** **New Bridge and New Alignment**
TEMPORARY IMPACTS				
TRANSPORTATION ENVIRONMENT				
Delays to Emergency Medical Services (EMS), Public and Active Transportation	• Impacts to the EMS response time, public travel time and active transportation (Fanshawe Lake Loop. Trail) during construction.	Greatest potential for temporary impacts to existing traffic for one construction season to complete superstructure replacement; traffic to use off-site detour. No trail connection during construction.	No impacts to EMS access due to TMB. No delay for the public due to TMB. Trail connection maintained on TMB as separate walkway from traffic. Possible safety concern for pedestrians/cyclists crossing. Thorndale Road to access the TMB.	No impact to EMS access due to building offline. No delay for the public due to construction of new bridge adjacent to the existing bridge. Trail connection maintained on road for duration of construction.
		Least Preferred	**Most Preferred**	**Moderately Preferred**
Property Accessibility	• Temporary impacts to existing property access during construction.	Access points on Thorndale Road maintained.	Temporary realignment of property accesses fronting onto Thorndale Road during construction.	Temporary realignment of property accesses fronting onto Thorndale Road during construction would cross through the construction zone.
		Most Preferred	**Moderately Preferred**	**Least Preferred**

NATURAL ENVIRONMENT				
Wildlife and Wildlife Habitat	• Temporary Impacts to wildlife and wildlife habitat (Bat Roosts; Turtle wintering; snake, hibernaculum; seeps)	Lowest potential for temporary impacts to wildlife and wildlife habitat adjacent to the existing structure.	Highest potential for direct temporary impacts to wildlife habitat adjacent to structure due to construction of TMB.	Moderate potential for temporary impacts to existing wildlife and wildlife habitat areas adjacent to the existing structure outside the construction area to accommodate the new bridge and new roadway alignment.
		Most Preferred	**Least Preferred**	**Moderately Preferred**
Vegetation	• Temporary Impact to vegetation communities, particularly Special Concern and provincially rare plant species.	Potential for minor temporary impacts to vegetation communities adjacent to the existing structure.	Potential for more significant temporary impacts to vegetation communities due to new alignment requirements. Temporary area needed larger than Alternative 7.	Potential for more significant temporary impacts to vegetation communities due to new alignment requirements.
		Most Preferred	**Least Preferred**	**Moderately Preferred**
ENGINEERING				
Construction Duration	• Potential impact due to the length of time to build each option.	One construction season to complete structure replacement.	Two construction seasons required. TMB substructures, temporary approaches and some prep work for new structure foundation constructed in first season. TMB installation and new bridge construction in second season.	Two construction seasons likely required to build the bridge in two stages. Embankment approaches and structure completed in first season. Traffic switch to new structure and removal of old structure in second season. Shorter overall duration than Alternative 6.
		Most Preferred	**Least Preferred**	**Moderately Preferred**
Structural	• Ability to maximize structural capacity and durability (complexity of the design, including construction, staging and long-term maintenance).	New bridge can accommodate lanes, standard shoulders, and multi-use pathway. Three-span integral abutment bridge configuration would require small grade raise (< 0.2 m) to maintain existing soffit elevation. The new bridge will be designed for 75-year design life as per the CHBDC.		
		All alternatives provide for the same structure type and cross section.		

Constructability	• Potential for difficulties and risks during construction (a more complex construction approach tends to take more time, cost more, and introduces additional construction stages that could impact the public).	Relatively low potential for difficulties/risk with easy access to bridge work zone: • Able to construct with reduced traffic conflicts. • Fewer constraints for material storage and laydown activities.	Some construction difficulties/risk due to construction of temporary detour and TMB: • Construction of new structure will be adjacent to the TMB carrying traffic, reducing productivity. • Slight impact to site access due to shared road between traffic and construction equipment when approaching the structure. • Additional construction required for the TMB, including TMB removal.	Relatively low potential for difficulties/risk with easy access to bridge work zone: • New structure construction will be adjacent to the existing bridge carrying traffic, reducing productivity. • Slight impact to site access due to shared road between traffic and construction equipment when approaching the structure.
		Most Preferred	**Least Preferred**	**Moderately Preferred**
Municipal Services and Utilities	• Potential impact to municipal services and utilities within the corridor	Relocation of Bell underground line to accommodate widening. Small potential for impact to hydro pole to accommodate grading.	Relocation of Bell underground line to accommodate widening. Hydro pole relocation to accommodate the construction for TMB.	Relocation of Bell underground line to accommodate new alignment. Hydro pole relocation to accommodate new bridge alignment.
		Most Preferred	**Least Preferred**	**Least Preferred**
Hydraulic Capacity	• Potential impact to hydraulic capacity of the structure opening over Thames River.	Slight reduction to structural hydraulic capacity due to shorter bridge, lengthened piers and deeper structure depth. Potentially mitigated through grade raise.	Slight reduction to structural hydraulic capacity due to shorter bridge, lengthened piers and deeper structure depth. Potentially mitigated through grade raise. Additional site disturbance with TMB approaches, and slight temporary restriction on hydraulic capacity due to TMB piers.	Slight reduction to structural hydraulic capacity due to shorter bridge, lengthened piers and deeper structure depth. Potentially mitigated through grade raise. Additional site disturbance with new bridge approaches, and slight temporary restriction on hydraulic capacity due to having both existing and new piers simultaneously.
		Most Preferred	**Moderately Preferred**	**Moderately Preferred**
Cost	• Relative magnitude cost of construction, including the bridge removal and replacement, any temporary works, utilities, and property.	Lower temporary cost since traffic utilizes existing roadway during construction. Some minor roadway improvements may be required. Cost includes new structure plus potential improvements to detour routes.	Requires temporary road approach and TMB removal at completion of construction. Cost includes TMB, temporary alignment shift plus new structure, temporary property easement.	Cost includes new permanent alignment plus new structure and permanent property acquisition.
		Most Preferred	**Moderately Preferred**	**Least Preferred**

SOCIO-ECONOMIC ENVIRONMENT				
Property Impacts	• Temporary impacts to property and existing land use.	No temporary impact to adjacent properties and existing land use anticipated.	Potential impact to UTRCA due to the need for temporary use of property for the temporary modular bridge structure and alignment.	No temporary impact to adjacent properties and existing land use anticipated.
		Most Preferred	**Least Preferred**	**Most Preferred**
SUMMARY TEMPORARY IMPACTS		**MOST PREFERRED**	**LEAST PREFERRED**	**MODERATELY PREFERRED**
SUMMARY OF PERMANENT IMPACTS		**MOST PREFERRED**	**MODERATELY PREFERRED**	**LEAST PREFERRED**
Recommended Alternative Solution for Phase 3 - Development of Alternative Designs		**MOST PREFERRED**	**LEAST PREFERRED**	**MODERATELY PREFERRED**

4.11 Preferred Alternative Solution

Based on the detailed evaluation of Alternative Solutions 5, 6 and 7, Alternative 5 is recommended. The preferred alternative solution is to replace the existing bridge with a new bridge on the existing alignment using a signed detour route for traffic during construction.

This page left blank intentionally.

5.0 Development and Assessment of Alternative Design Concepts

Following confirmation of the preferred solution, the next stage of the Class EA process is to develop feasible design alternatives to implement the recommendation for replacing the Thorndale Bridge. Bridge design alternatives developed for this project considered many factors including:

- Importance of minimizing the new footprint and changes to the existing road elevation to limit environmental disturbance and consideration of construction timing constraints.
- Constructability (risks during construction, length of time to build each option).
- Relative cost.
- Structure type and feasibility of various superstructure and substructure options.
- Potential impact to municipal services and utilities within the corridor.

Two superstructure design alternatives were developed to replace the existing Thorndale Bridge:

- Design Alternative 1 – Slab-on-girder bridge.
- Design Alternative 2 – Post-tensioned concrete deck bridge.

An integral abutment bridge is recommended for the substructure to eliminate the need for expansion joints on the bridge, which provides a more durable bridge.

5.1 Design Alternative 1 – Slab-on-Girder Bridge

The selection of the appropriate girder type is constrained by the need to minimize the grade raise on Thorndale Road. Minimizing the grade raise can be accomplished by providing a thin superstructure and matching the elevation of the existing bridge soffit to maintain existing hydraulic clearance and capacity. Two sub-options for the Slab-on-Girder Bridge were reviewed, including the Steel I-Girder and the NU Concrete Girder.

Slab-on-Steel I-Girders have some flexibility in span-to-depth ratios and are lighter than concrete girders. Slab-on-Precast/Prestressed Concrete NU Girders require very closely spaced girders, and high concrete strengths to achieve shallow girders. Concrete NU girders also need wider piers and more piles to accommodate the heavier girders and the semi-continuous spans (i.e., two girder ends on each pier), resulting in a larger area of environmental disturbance.

It was determined that for this site, Slab-on-Steel I-Girders are preferred over the Concrete NU Girders to limit the environmental disturbance and to provide flexibility in the design of the structure.

5.2 Design Alternative 2 – Post-Tensioned Concrete Deck Bridge

The construction of a post-tensioned concrete deck would require significant in-water work to build the falsework system, which is not desirable due to natural environmental disturbances. Post-tensioned concrete deck bridges are, in most cases, more expensive to construct than slab-on-girder bridges and are generally not used in conjunction with integral abutment bridges.

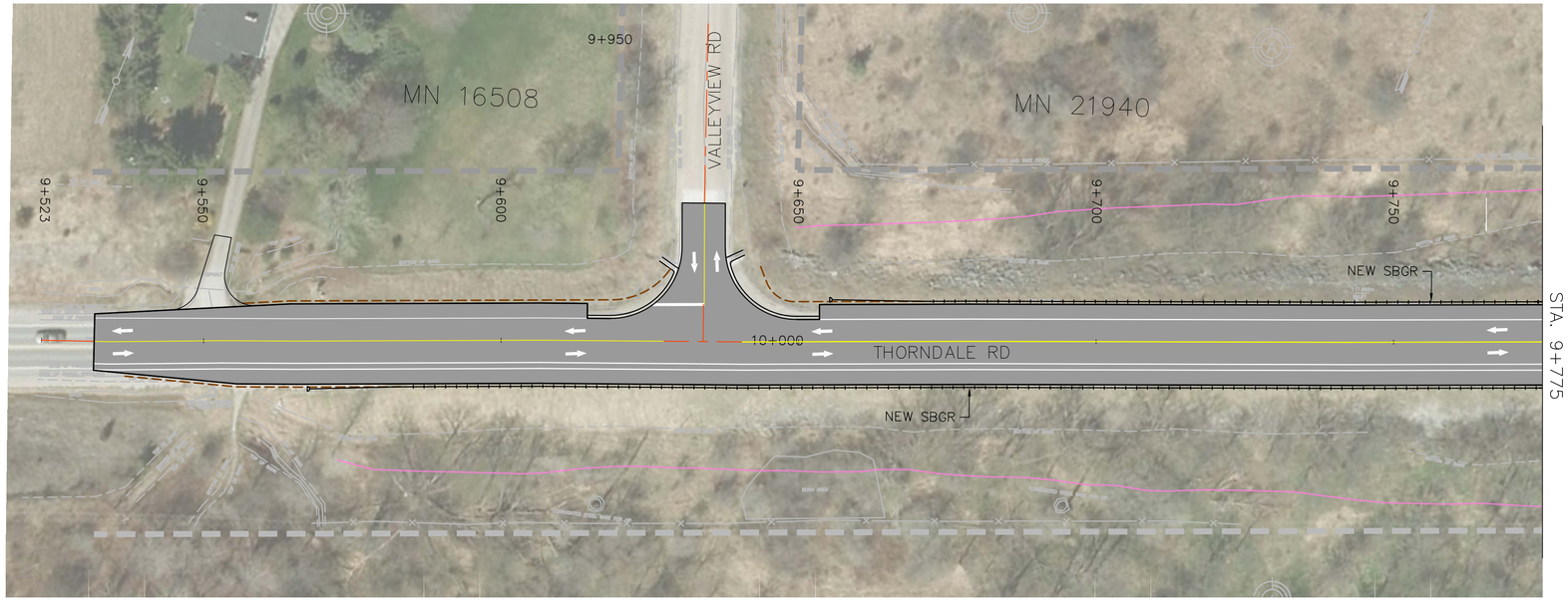
5.3 Preferred Bridge Design Concept

Based on the evaluation, the recommended bridge design alternative is to replace the existing structure with a three-span (29 m – 44 m – 29 m) integral abutment bridge with a slab-on-steel I-girder superstructure. This option allows for the construction to be completed in a single construction season and limits the environmental disturbance.

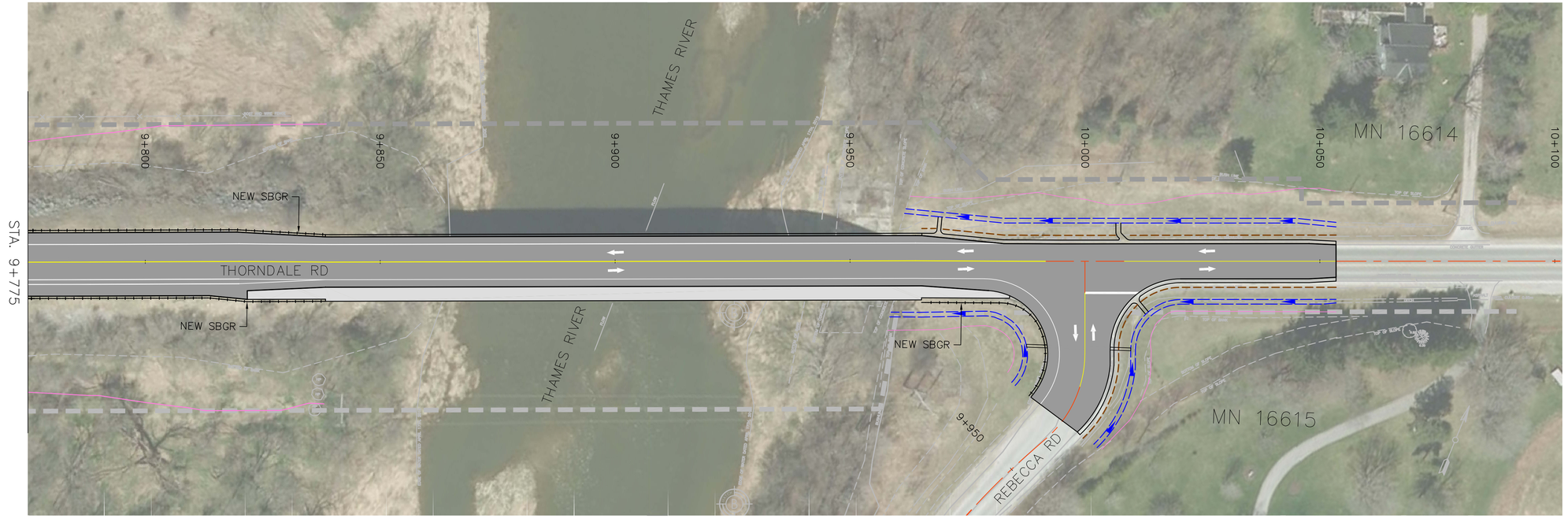
This recommendation was presented to the public at PIC #2. No comments or concerns were received. As a result, this concept was confirmed as the Preferred Design Concept.

SUPLEMENTARY LEGEND

- GRADE LIMIT
- NEW DITCH LINE
- GRANULAR SHOULDER
- EXISTING PROPERTY LINE



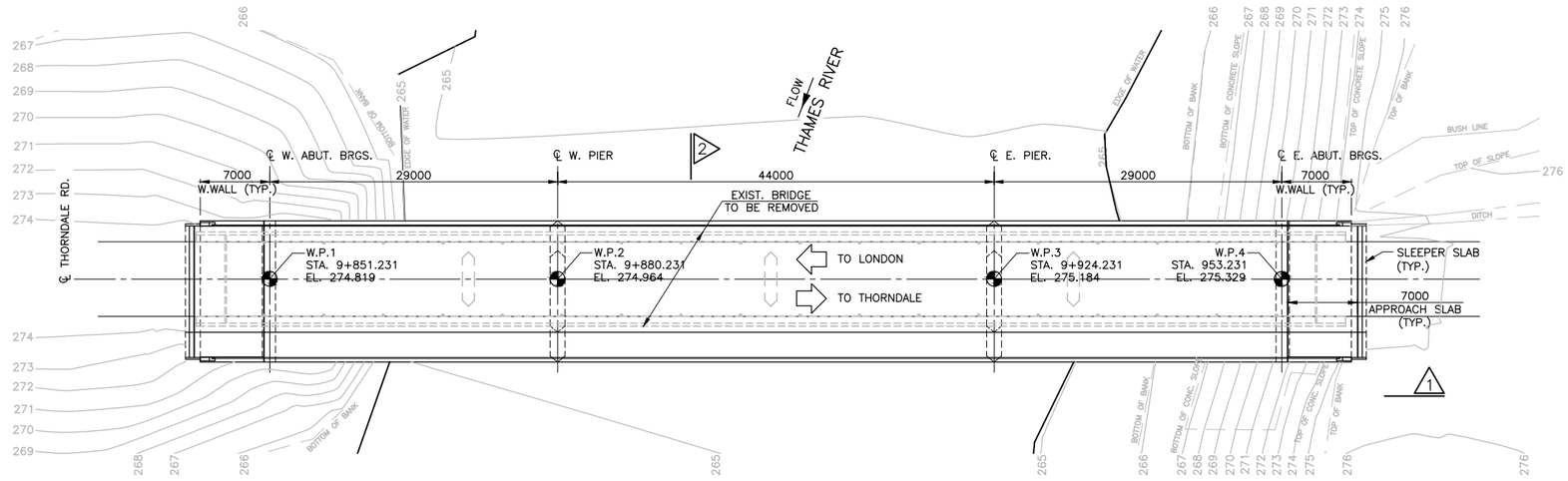
THORNDALE ROAD



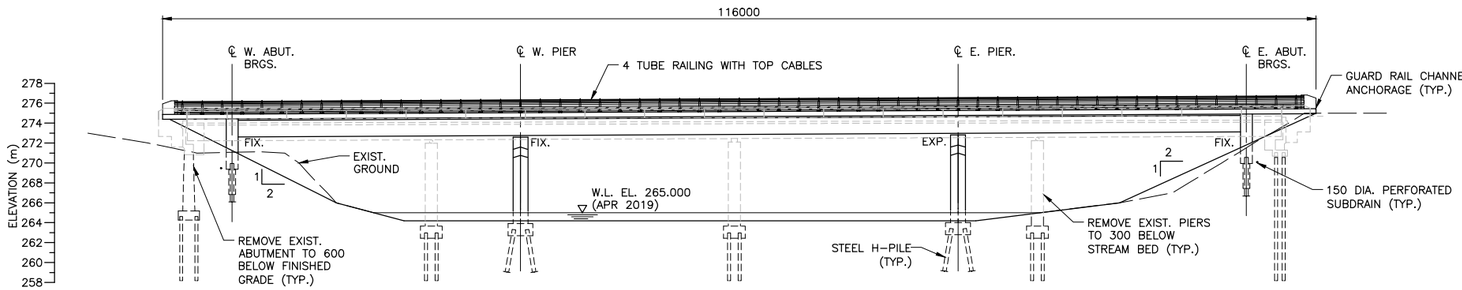
THORNDALE ROAD

Thorndale Bridge Plan View

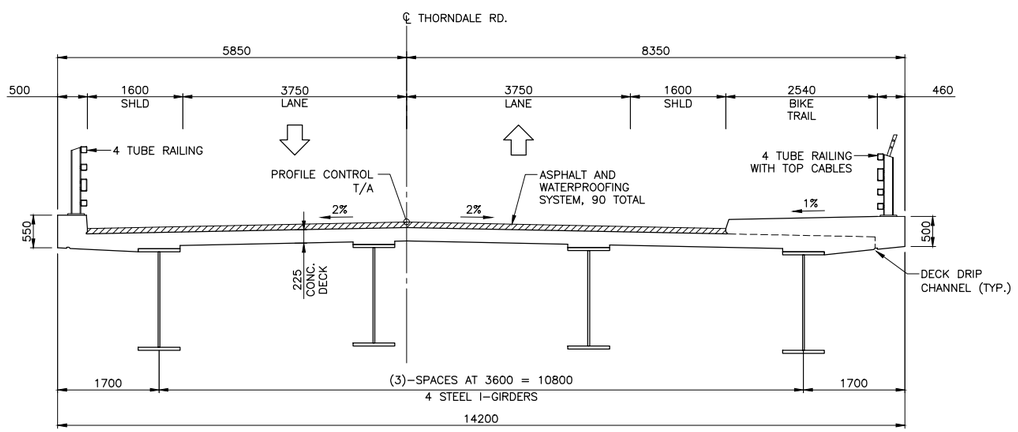
NORTH
FOR CONSTRUCTION



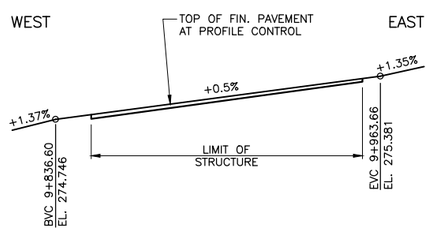
PLAN
1:300



1
1: 300



2
1 : 50



PROFILE OF THORNDALE ROAD
N.T.S.

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

COUNT. RD. 28
CONT
WP

THORNDALE BRIDGE
REPLACEMENT
PRELIMINARY
GENERAL ARRANGEMENT

SHEET
.

Stantec

GENERAL NOTES

1. CLASS OF CONCRETE
   30 MPa UNLESS OTHERWISE SPECIFIED
2. CLEAR COVER TO REINFORCING STEEL
   FOOTINGS 100±25
   DECK TOP 70±20
   BOTTOM 40±10
   REMAINDER 70±20 UNLESS OTHERWISE NOTED.
3. REINFORCING STEEL
   REINFORCING STEEL SHALL BE GRADE 500W UNLESS OTHERWISE SPECIFIED.
   STAINLESS REINFORCING STEEL SHALL BE TYPE 316LN, OR DUPLEX 2205 AND HAVE A MINIMUM YIELD STRENGTH OF 500 MPa.
   BAR MARKS WITH PREFIX 'S' DENOTE STAINLESS STEEL BARS.
   GLASS FIBRE REINFORCED POLYMER (GFRP) REINFORCING BARS SHALL BE GRADE III. THE NOMINAL DIAMETER, TENSILE MODULUS OF ELASTICITY AND GUARANTEED MINIMUM TENSILE STRENGTH SHALL BE AS SPECIFIED IN THE CONTRACT DOCUMENTS.
   BAR MARKS WITH PREFIX GIII DENOTE GRADE III GLASS FIBRE REINFORCED POLYMER BARS.
   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 ACCORDANCE WITH THE STRUCTURAL STANDARD DRAWING SS12-1, UNLESS INDICATED OTHERWISE.
4. CONSTRUCTION
   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.
   BACKFILL BEHIND ABUTMENTS SHALL NOT BE PLACED UNTIL THE DECK HAS REACHED A STRENGTH OF 25 MPa.
   BACKFILL SHALL BE PLACED SIMULTANEOUSLY BEHIND BOTH CONCRETE ABUTMENTS KEEPING THE HEIGHT OF THE BACKFILL APPROXIMATELY THE SAME. AT NO TIME SHALL THE DIFFERENCE IN ELEVATION BE GREATER THAN 500mm.

LEGEND

W.P. DENOTES WORKING POINT
T/A DENOTES TOP OF ASPHALT

APPLICABLE STANDARD DRAWINGS

OPSD-912.430	GUIDE RAIL SYSTEM, STEEL BEAM STRUCTURE CONNECTION
OPSD-3101.150	WALLS ABUTMENT, BACKFILL MINIMUM GRANULAR REQUIREMENT
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
OPSD-3390.100	DECK, DRIP CHANNEL
OPSD-3950.100	JOINTS, CONCRETE EXPANSION & CONSTRUCTION ON STRUCTURE

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN F.S.A.	CHK M.D.	CODE CHBDC-2019	LOAD CL-625-ONT	DATE JULY 2021	
DRAWN H.L.	CHK F.S.A.	SITE 174	STRUCT	SCHEME	DWG. P1

165001122-19-174-GA.DWG Jul 9 2021

6.0 Project Description

The Thorndale Bridge is identified as a required replacement within the next 10 years due to the bridge reaching the end of it is service life. The horizontal alignment of Thorndale Road is not proposed to be changed; the new bridge will be situated on the existing alignment.

6.1 Design Criteria

The Thorndale Bridge replacement involves design considerations of both the bridge and road components. The preferred design concept for the Thorndale Bridge and associated road works has been developed using several design standards, including:

- City of London Design Specifications and Requirements Manual
- Transportation Association of Canada (TAC) Geometric Guide for Canadian Roads
- CSA-S6-14, Canadian Highway Bridge Design Code (CHBDC)
- Ministry of Transportation Design Supplement for TAC Geometric Design Guide for Canadian Roads – June 2017
- Ministry of Transportation of Ontario Structural Manual
- Ministry of Transportation of Ontario Drainage Manual
- Ontario Traffic Manual

6.2 Overview of Bridge Design

The new bridge will be a three-span bridge. Four 1700 mm deep steel I-girders, spaces at about 3.6 m which will be used to support the concrete deck. The girders will be spaced continuously over piers and spliced at zero moment locations. The concrete deck will be 225 mm thick with a 90 mm thick asphalt and waterproofed for protection. A 2% crossfall from the centerline crown of the bridge will be applied to provide adequate drainage.

Integral abutments are recommended for the substructure of the bridge. Each of the integral abutments consist of a concrete stem supported by a single row of steel H-piles. The new bridge abutments will be situated about 4.0 m in front of the existing abutments to avoid conflict with the existing abutment footing and piles. The use of integral abutments eliminates the expansion joints at the end of the deck.

Each pier will consist of a concrete pier shaft on a concrete footing (or pile cap) supported by steel H-piles. The pier shaft will have a hammerhead top to support the steel I-girders. The ends of the pier shaft will be shaped and protected to accommodate water/ice loading.

Approach slabs will be cast-in-place in accordance with Structural Standard Drawing SS116-1.

Plain elastomeric pads will be used for the fixed bearings at the abutments. Elastomeric laminated bearings will be used for the bearings at the piers.

The required barrier performance level at this site is Test Level 4 (TL-4) and a 4-tube open railing barrier system will be used. The south railing system will be raised to accommodate the required bicycle height of 1.37 m. The railing system will conform to a crash tested system and a more detailed arrangement will be assessed during detailed design.

6.3 Bridge Hydraulics

The profile of Thorndale Road will be raised to maintain the existing hydraulic clearance to the bridge soffit and to provide a constant grade of 0.5% (rising to the east) on the bridge.

Stantec has used the HEC-RAS model provided by UTRCA and ensured that hydraulic parameters were appropriately chosen in accordance to the USACE HEC-RAS modelling guidelines. Furthermore, under the same guidance bounding cross sections were modified to accurately represent the hydraulic losses through the bridge opening. These modifications are summarized in the table below:

Table 7: Cross Section Modifications

Original Station Name	Changed Station Name	Modifications
2546		Downstream reach lengths.
2260	2273	Downstream reach lengths as well as section and bridge details.
2246	2236	Downstream reach lengths as well as section and bridge details.
2190		Removed cross section.
2088	2126	Downstream reach lengths.

The design discharge of 1120 m³/s was used as provided by the UTRCA and is assumed to be the 1:250-year peak flow event. Similarly, the high-water elevation (271.3 m) of the dam reservoir was used as the boundary condition of the downstream end of the modelled reach. The minimum soffit elevation provided in the model is 272.38 m. The results calculated are shown below.

Table 8: Existing Conditions

Cross Section	Water Surface Elevation (m)	Energy Gradeline (m)	Clearance from Soffit (m)
Station: 2546	271.65	271.81	
Station: 2273 (North of Bridge Deck)	271.52	271.70	0.86
Station: 2236 (South of Bridge Deck)	271.49	271.67	0.89
Station: 2126	271.48	271.57	

Proposed bridge replacement will change the soffit elevation approximately 0.5 m below the existing soffit. This results in a minimum low chord elevation of 271.88 m. The existing configuration of three piers along the span of the bridge with an approximate width of 1 m each will be replaced with two piers with a width of 2 m each. The width of the bridge deck is 14.2 m to allow for a bike trail; this is an approximate 4.2 m increase from existing conditions. The span of the proposed bridge has reduced approximately 8 m. The edge of water will be maintained and 2:1 side slopes will start in front of the existing side slope resulting in a slight decrease to the cross sectional area of the bridge waterway opening. Under the same peak flow and known water surface elevation the calculated results are shown in the table below.

Table 9: Proposed Conditions

	Water Surface Elevation (m)			
Cross Section	**Existing Conditions**	**Proposed Conditions**	**Energy Gradeline (m)**	**Clearance from Soffit (m)**
Station: 2546	271.65	271.64	271.81	
Station: 2273 (North of Bridge Deck)	271.52	271.55	271.69	1.074
Station: 2236 (South of Bridge Deck)	271.49	271.51	271.66	1.114
Station: 2126	271.48	271.48	271.57	

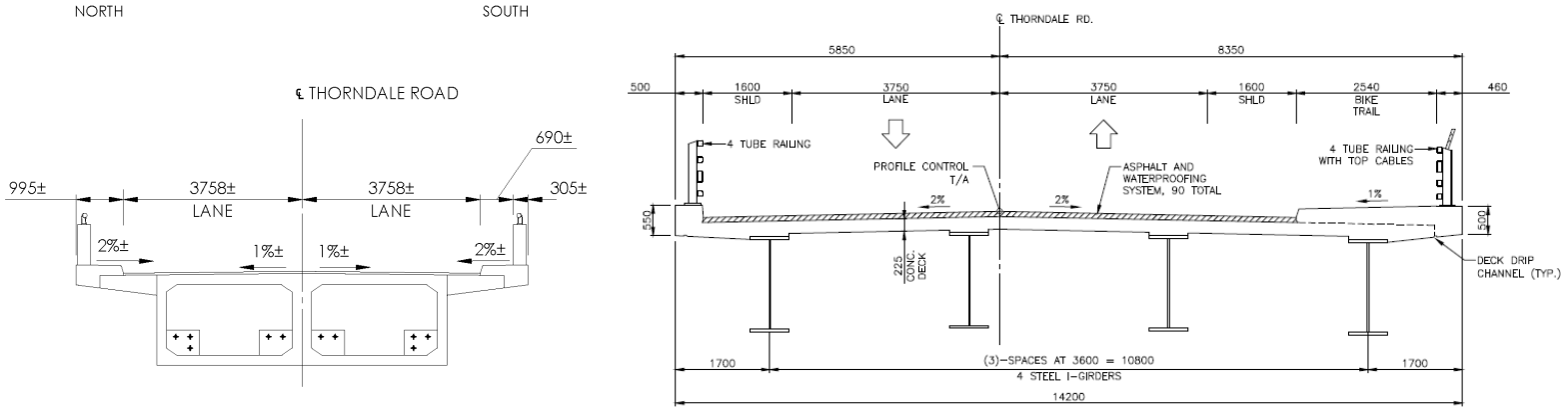
Findings indicate that pressurized flow and overtopping will not occur with the new bridge configuration under the provided peak flow. The water surface elevations increased slightly from existing conditions however, results show a minimum clearance of 0.34 m from soffit is still provided under proposed changes.

The proposed increase to the pier widths may contribute to increased local scour depths around the base of the piers compared to the exiting piers. This will be examined further during detail design.

6.4 Cross Section

The preferred cross section accommodates two 3.75 m lanes with 1.6 m paved shoulders on each side, and a 2.5 m raised bike trail on the south side. The proposed cross section will facilitate a 2% cross-fall on both sides of the road centerline.

Figure 9: Existing & New Bridge Cross Sections



The preferred cross section minimizes impacts to adjacent land uses and to the natural environment, while providing additional space to accommodate larger farm vehicles and commercial vehicles to pass.

6.5 Active Transportation Improvements

Active transportation facilities proposed along Thorndale Road are in accordance with Middlesex County Cycling Strategy. The cross section includes paved shoulders on both sides of the new bridge and road, and a bike trail along the south side of the Thorndale Bridge to accommodate the Thames River crossing of the Fanshawe Conservation Area Trail Network. The bike trail has been included to accommodate the alternating directional cycling traffic of the Fanshawe Trail, while maintaining an area on the paved shoulder for commuter cycling traffic.

6.6 Roadway Stormwater Design

There are no existing catchbasins within the construction limit of the bridge, and no new catchbasins are being proposed. The existing ditches will be realigned to accommodate the new cross section.

6.7 Climate Change

The proposed bridge replacement and associated roadworks provide the opportunity to address climate change impacts through the identification of an efficient transportation network and through the provision of facilities that encourage active forms of transportation (e.g., paved shoulders, raise bike trail along the south side of the bridge). The design of the new bridge over the Thames River also accommodate changes in climate parameters (i.e., increased episodes of flooding, increased flood levels, freezing rain, gale/hurricane force winds).

6.8 Geotechnical Design

6.8.1 Pavement

The proposed geotechnical design elements include pavement over the concrete bridge deck, approach slabs, and roadway within the construction limits, including driveways and sideroads. The bridge deck will be waterproofed, and asphalt paved for a total thickness of 90 mm. The pavement design of the road reconstruction will be confirmed through a geotechnical investigation during detail design.

6.8.2 Foundations

With the preferred alternative proposing new piers and abutments, a foundations investigation will be required during detail design. During this next phase of the project, the final pier and abutment locations will be confirmed.

It is anticipated that an in-water investigation will be required in order to access the new pier locations. The drill rig will require access through the Thames River to the proposed pier locations either through the river during low flow or utilizing a causeway. The Thames River is regulated for Species at Risk, and consultation and permitting with MECP, DFO and UTRCA will be required.

6.9 Utilities

Consideration must be made for the utilities present within the study area, including Bell cables, and Hydro One poles. The following outlines the potential conflicts and proposed relocations for each affected utility.

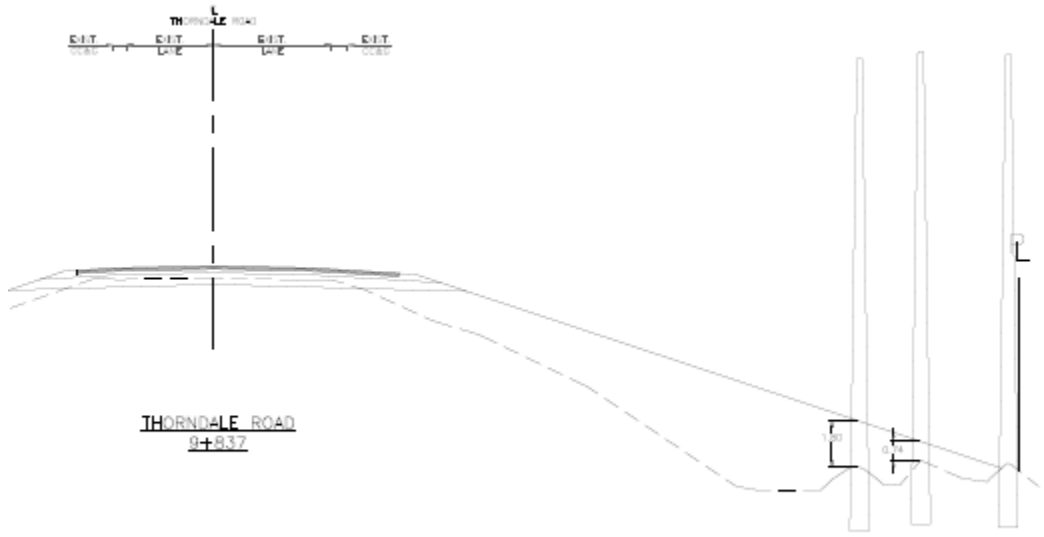
Bell Cables

Existing Bell infrastructure cannot be disconnected and will need to be either protected during construction or relocated either temporarily/permanently outside of the conflicting construction activities. Discussion can be made during detail design whether conduits can be imbedded in the new structure and the aerial crossing removed.

Hydro One

Aerial Hydro One distribution lines run parallel to the structure on the south side of the road. The Preferred Alternative includes widening of the road platform to the south, which will increase the buried depth of the poles and reduce the clearance to the ground. A sample cross section is shown in **Figure 10**.

Figure 10: Sample Cross Section



The potential impact and mitigation measures to the Hydro One poles located south of the structure will be discussed and reviewed with Hydro One during detail design.

6.10 Property

There are potential impacts to the property at MN 16614 and the lands owned by the UTRCA. Grading may encroach onto these properties to accommodate the preferred road cross section. The limits will be reviewed in detail design to determine if localized slope adjustments can be made to avoid impacting these properties, or if temporary permission to enter may be required from the land owners to regrade and restore the slopes.

6.11 Municipal Services

There are currently no municipal services within the right-of way of the project area. No future servicing is being planned for the area, as the bridge falls outside of the Thorndale growth boundary.

6.12 Staging and Traffic Management

The type of the existing structure is such that removing part of the structure and implementing single lane construction staging is not feasible. The preferred alternative includes the closure of Thorndale Road temporarily for one construction season in order to reduce the complexity of construction, reduce the cost of temporary measures, reduce the environmental impacts of the temporary measures, provide for an efficient construction schedule, and reduce the risk of traffic and construction conflicts.

Potential detour routes were developed based on the following criteria:

- Primarily use County and City of London roads.
- Road must be paved (no gravel).
- Road must be able to accommodate truck/agricultural traffic.

The following potential alternative detour routes were presented at PIC No. 1:

Figure 11: Proposed Detour 1

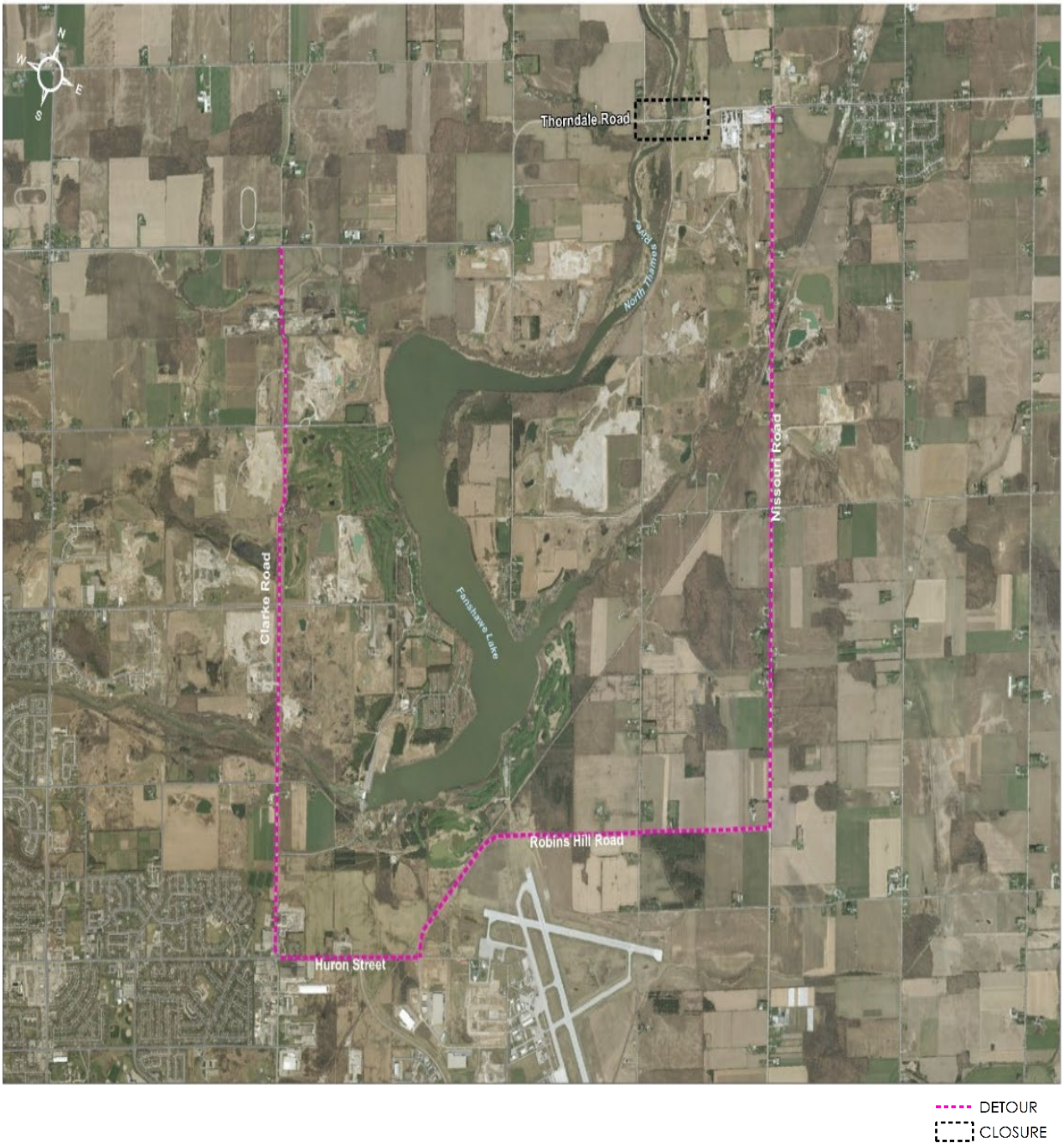
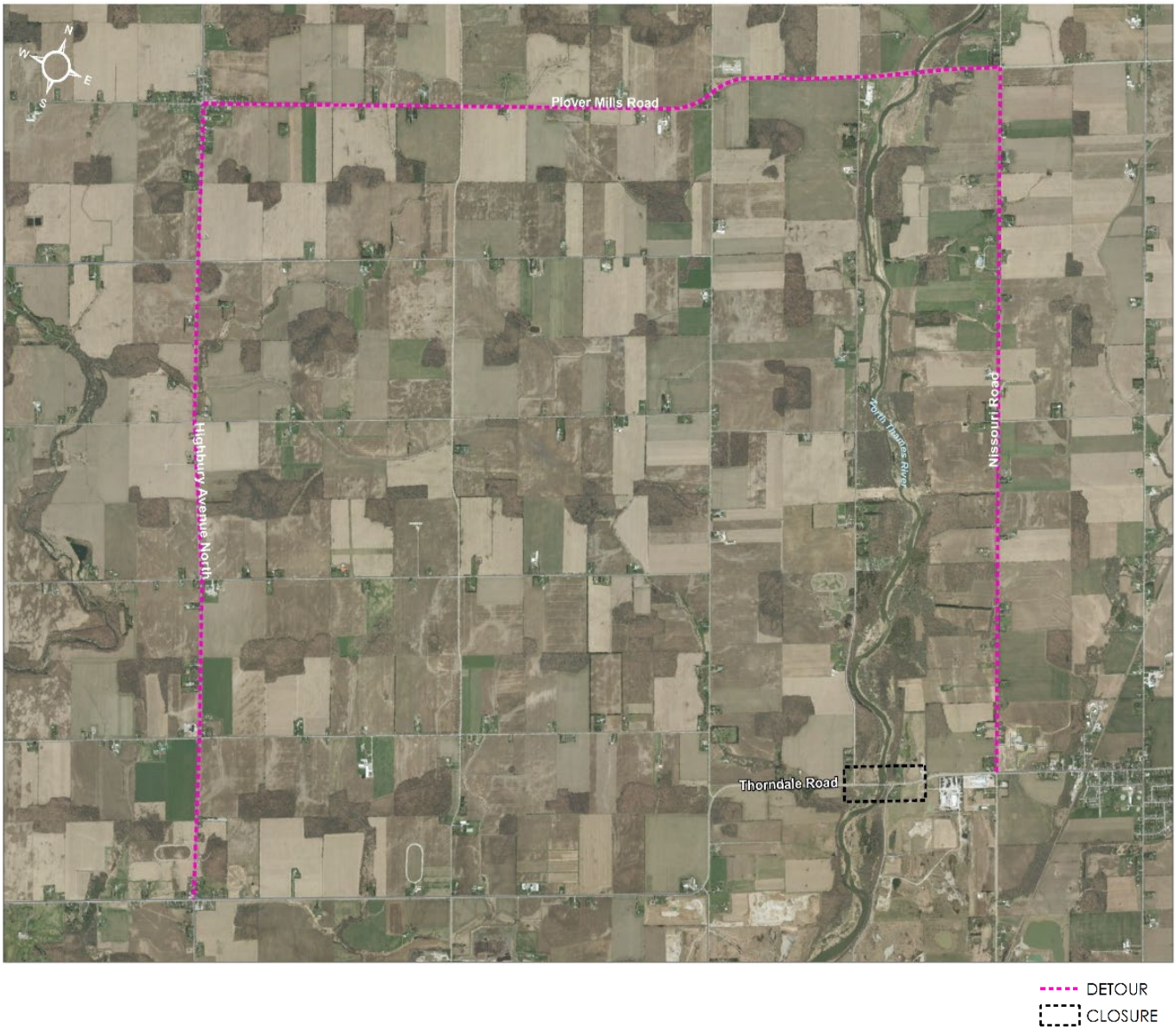


Figure 12: Proposed Detour 2



The impact of the detour on the commuter traffic heavily depends on the origin and destination of the trip. For example, a trip originating in Thorndale and travelling to downtown London would utilize a portion of the detour and would only experience a delay of a few kilometers. Similarly, a resident in Arva travelling to Stratford could take an alternate route and experience virtually no difference. Alternatively, that same trip originating in Arva with a destination of Kintore will experience the more significant out of way travel, similarly with any trip originating in Thorndale with a destination of Arva.

The distances and “out of way travel” (which is the total distance of the detour minus the distance along Thorndale Road as if the road was open) were measured as:

- Proposed detour 1 is approximately 16.8 km long and includes approximately 11 km out of way travel.
- Proposed detour 2 is approximately 20.8 km long and includes approximately 12 km out of way travel.

The final determination of which detour route will be made shortly before construction, which will need to consider the condition of the detour road network, any other area construction projects, and coordination with the City of London.

6.13 Preliminary Cost Estimate

The capital costs associated with the bridge replacement and associated roadwork is estimated to be approximately $10,695,000.

Table 10: Estimated Capital Costs

Capital Cost	**Estimate $**
Roadwork	$1,000,000
Structural	$7,300,000
Miscellaneous	$200,000
Sub Total	**$8,500,000**
Contingency (10%)	$850,000
Utilities (10% Roadwork)	$100,000
Engineering (15%)	$1,245,000
Total Estimated Cost	**$10,695,000**

6.14 Implementation Timeframe and Schedule

The detailed design of the preferred plan will be completed as a “tender ready” package in 2022. Construction of the new Thorndale Bridge and associated roadworks is recommended in the next 10 years, pending funding, approvals as well as coordination with other projects. Approvals for construction will need to be applied for and obtained closer to the construction date. At the time of construction, updated environmental investigations may be required for species as outlined later in this report.

7.0 Environmental Impacts and Proposed Mitigation

The potential impacts to natural features that might reasonably be expected to occur as a result of the proposed bridge reconstruction are identified and discussed in this section. Both direct and indirect impacts associated with the project are considered and appropriate mitigation measures recommended. An assessment of overall environmental impacts is also provided based on the implementation of appropriate mitigation, restoration, and enhancement measures to improve the overall integrity of the natural system in the area. Where direct impacts to SAR habitat or are expected to occur, recommended steps to consult with relevant agencies and/or obtain authorization are discussed.

7.1 Natural Environment

Reconstruction of the existing Thorndale Bridge has the potential to impact the study area, including:

- Vegetation and thereby altering species composition.
- Suitable habitat for Significant Wildlife Habitat (Bat maternity colony, Reptile hibernaculum, Seeps and springs, Hairy-fruited sedge, Monarch, Eastern Milksnake, Snapping Turtle, Eastern Wood-Pewee, Red-headed Woodpecker, Wood Thrush).
- Suitable habitat for Threatened and Endangered Species (Butternut, Eastern Spiny Softshell, Queensnake, Bat Roost, Eastern Meadowlark, Rayed Bean, Black Redhorse, Eastern Sand Darter, Silver Shiner).

Potential direct and indirect impacts to natural features outside of the Thorndale Bridge study area include:

- Siltation and/or spills of deleterious substances into natural areas during construction, and salt application during regular road operations.
- Sedimentation and spills leading to the smothering of vegetation, introduction of harmful toxins to vegetation and wildlife, and the overall alteration of species composition within the area.
- Possible disturbances resulting from clean-up activities.

- Indirect impacts to fish habitat can include sediment introductions from adjacent graded areas, increasing turbidity which impairs vision for feedings. Suspended sediments can abrade gill membranes leading to physical stress, and impact prey organisms' behavioral changes. Heavy sediments can deposit on coarser substrates generally used for spawning, incubation of juvenile fish, or food production.

The primary mitigation strategy to reduce direct loss of significant features is to minimize the area of impact. Temporary removal of vegetation cover is mitigated by utilizing construction barrier fencing along natural areas and re-vegetation of all disturbed substrates using mixes of native seed suitable for site conditions.

Standard mitigation measures are available to reduce potential impacts. Impacts to habitat for SAR will require consultation with the MECP to determine authorization requirements under the ESA. Anticipated direct loss of suitable habitat for SAR will require input from both the MECP and the UTRCA. Mitigation strategies suggested for significant features within the study have been highlighted in **Table 11**.

Table 11: Environmental Mitigation

Feature	Recommended Mitigation
Reptile hibernaculum	• Reptile barrier fencing should be installed prior to construction activity to direct reptiles away from the construction zone. • A thorough visual search shall be conducted by construction contractors and project inspectors each day to avoid interaction with reptiles. • If construction is initiated during the turtle nesting season (June 1 to September 1), the site should be inspected to identify and avoid potential snake hibernacula. If unavoidable, a qualified biologist should inspect the feature to determine use by snakes during the suitable season. • If necessary, hibernacula should only be disturbed during peak reptile active period to allow snakes to flee when overnight temperatures are relatively warm. • Potential snake hibernation sites (rock embankment of Thorndale Road west of Thorndale Bridge) will not be disturbed from November 1 to March 31. • Factsheets will be provided to all construction staff to assist with the identification of Queensnake, Eastern Milksnake and Eastern Spiny Softshell

Feature	Recommended Mitigation
Monarch	• If vegetation clearing will proceed when Monarch larvae may be present (April 1 to September 31), milkweed plants must be inspected prior to their removal. If larvae is present, they may be moved to a location that is suitable under the direction of a qualified professional.
Bat Maternity Colony	• Removal of suitable bat maternity roost trees should occur outside the period when bats use trees for maternity roosts (May 1 to September 1).
SAR Mussels	• All mussels will need to be relocated from the prescribed search area affected by in-water works. The relocation timing window when water temperatures are above 16° is typically between June 15 and September 30.
Fish SAR, including Silver Shiner	• Maintain flow of the North Thames River without interruption during construction. • Stabilize exposed soil, earth, or substrates to prevent sediment or deleterious substances from entering the stream of watercourse. • Equipment or construction material shall be stored outside of the Silver Shiner habitat. • Double row of sediment control fencing shall be installed and maintained to prevent sediment from entering Silver Shiner habitat.

7.1.1 Terrestrial Environment

7.1.1.1 Vegetation Management

All proposed work will occur within the existing ROW or portions of roadside meadow. The removal of common herbaceous species is not expected to require mitigation. Mitigation measures for tree and shrub communities, including the Black Walnut Lowland Deciduous Forest, are:

- Clearly mark the limits of vegetation removal along sensitive features (rare vegetation community (FODM7-4) and wetland community (MAMM1-3)) to ensure no disturbance extends beyond the limits. A pre-clearing survey is recommended to avoid removal of regionally-rare Black Walnut to the extent possible. Barrier fencing used to delimit sensitive features may be coincident with silt fencing used to control erosion and sediment transport at the site.

- Preserve and stockpile existing native topsoil and seed banks from the riparian areas of the North Thames River for reuse in restoration. Seed banks should not be used from areas where invasive species are present.

- Supplement seed banks with native seed mixes to improve native species diversity. Seed mixes and other planting lists shall be designed to include only native species adapted to the site conditions, including soil type, moisture, and sun exposure. Where possible, seed mixes and other plant material shall be sourced from within the Carolinian Zone (Deciduous Forest Region).

- Seed mixes shall include fast-growing, short-lived perennial cover crop to stabilize soil and reduce competition from weedy exotics. Native cover crops are preferred. A light (2 cm) layer of mulch (e.g., shredded bark) is recommended above the waterline to retain soil moisture and improve germination rates; however, the layer shall be sparse enough to retain approximately 20 to 40% visible soil. An erosion mat may also be used to stabilize final grades where necessary and shall be applied post seeding and mulch application. Manufacturer specifications shall indicate the erosion mat is non-woven, made of biodegradable material, wildlife-friendly to avoid entanglement by snakes, and designed to allow sufficient light penetration for seed germination.

- Seeded areas shall receive water either through precipitation or irrigation after every seven successive days without rainfall for the first two months after planting.

- A clean equipment protocol will be used for machinery entering riparian areas to prevent the spread of invasive species into the feature.

- Develop a monitoring and adaptive management plan to control vegetation establishment.

- Refer to the tree protection and management plan for specific guidance on tree protection measures.

7.1.1.2 Avoidance of Wildlife

The following mitigation measures are recommended to avoid impacts to wildlife during project construction.

- A visual search of the work area will be conducted by construction contractors before work commences each day, particularly for the period when most wildlife is active (generally April 1 to October 31). Visual inspections will locate and avoid snakes, turtles, and other ground dwelling wildlife such as small mammals. Visual searches will include inspection of machinery and equipment left in the work area overnight prior to starting equipment.

- If wildlife is encountered, work at that location will stop, and the animal(s) will be permitted reasonable time to leave the work area on their own.

- Any observations of species at risk or species of conservation concern should be reported to MECP and MNRF within 48 hours. Species at risk should not be handled, harassed, or moved in any way, unless they are in immediate danger.

7.1.1.3 Protection of Migratory Bird Nests

The MBCA provides legal protection of migratory birds and their nests in Canada. Construction timing must consider restrictions imposed by the MBCA. To avoid damaging or disturbing bird nests and contravening the MBCA, the timing of any vegetation clearing should occur outside of the primary nesting period (i.e., the period when the percent of total nesting species is greater than 10% based on Environment Canada's Nesting Calendars and the period for which due diligence mitigation measures are generally recommended).

The primary nesting period (PNP) identified for the study area is April 9 – August 16, although nesting also infrequently occurs outside of this period (Environment Canada 2014). Vegetation removal during this core nesting period is not recommended; however, if required, a nest survey may be carried out by a qualified person in simple habitats such as an urban park, a vacant lot with few possible nest sites, a previously cleared area, or a structure (Government of Canada 2019). If a migratory bird nest is located within the work area at any time, a no-disturbance buffer will be delineated. This buffer will be maintained for the entire duration of the nest activity, which will be determined using periodic checks by the avian biologist. The radius of the buffer generally varies from 5 m – 60 m depending on the sensitivity of the nesting species. The project will not resume within the nest buffer until the nest is confirmed to be no longer active.

7.1.2 Fish Habitat

In general, potential impacts to aquatic habitat can be mitigated through site control measures, such as previously mentioned sediment and erosion controls, and other measures to prevent the entry of substances and debris into the water. If in-water work or access is required, construction timing windows can be employed to reduce the risk of impacts occurring during sensitive life periods such as spawning and emergence of young fish. For works in the North Thames River, no in-water work or access should take place from March 15 to July 15. Harm to fish can be reduced through isolation of work areas using coffer dams or other work area isolation techniques, removal of fish and mussels from the isolated area and performing works in the dry work area to reduce resuspension of sediments during construction.

7.1.3 Wetlands

Shoreline marsh community MAMM1-3 and the shallow aquatic environment may experience temporary disturbance during Project construction, due to grading and placement of a causeway to access pier locations. Temporary impacts to shoreline wetland communities can be addressed using Standard Sediment and Erosion Control measures by restoring these communities as soon as practicable following construction. No permanent or long-term wetland impacts are anticipated as a result of the Project.

7.2 Forest Edge Management and Restoration Planting

Forest edges disturbed during construction provide an opportunity for naturalization using native plant species in order to mitigate the loss of vegetation and provide habitat for wildlife. These proposed naturalization areas will strengthen the natural heritage values of existing features and increase connectivity among woodlands, hedgerows, wetlands, and meadows south of the ROW. Naturalization Areas will be designed with a self-sustaining seed mix of grass and forb species suitable for planting in the Upper Thames River watershed. Clusters of native trees and shrubs should be planted to buffer existing woodlands along the ROW or where the woodland edge has been disturbed by tree removal. Along forest edges trees and shrubs will be planted to provide a protective buffer, and plant species will be selected based on the adjacent vegetation community (e.g., THDM2-6, FODM7-4). Where possible, locally sourced material, including species which provide habitat for butterflies and other pollinators, should be incorporated into the restoration plan.

Shredded bark mulch or wood chips should be applied in a ring around the base of all planted trees and shrubs to a depth no greater than 4 inches, avoiding contact with the plant stem. If wood chips from trees and brush chopped on site are used as mulch, do not use wood chips from Black Walnut as this may inhibit growth of desirable native plant species. Wood chips extending beyond the drop line of any planted trees or shrubs should be thinned to allow light penetration for groundcover regeneration or establishment.

Any seed mix should first be approved by UTRCA to ensure it contains regionally appropriate species which are not considered nuisance or of conservation concern. Control of Eurasian grasses or other weeds associated with agricultural production may be required prior to installation, either by mechanical or chemical means.

7.3 Property Impacts

Property acquisition is not required to implement the preferred design. Meetings with UTRCA have been conducted throughout the Class EA study to ensure their input and concerns are addressed. The project team and UTRCA discussed anticipated property impacts and mitigation techniques to minimize these impacts. This meeting was held prior to PIC #1.

Permission-to-enter from UTRCA and Thames Centre will be required, and continued correspondence will be conducted to address issues that may arise.

Permission-to-enter on to private properties will be required to perform driveway reconstruction and minor grading activities associated with the roadway reconstruction. Continued correspondence with property owners will be conducted to address issues that may arise.

7.4 Archaeology

A Stage 1 Archaeological Assessment was completed for the Thorndale Bridge study area to determine areas of archaeological potential. The Stage 1 property inspection has determined that portions of the study area, particularly along municipal road right-of-way and beneath the existing Thorndale Bridge, have been subject to extensive land disturbance which has removed archaeological potential. Further, the Thames River itself represents a low and permanently wet area and is considered to retain low to no archaeological potential for land-based archaeological resources. However, the Thames River retains potential for the identification of marine archaeological resources. A Stage 2 Archaeological Assessment will be completed in areas which retain archaeological potential and will be impacted by the proposed improvements during detail design. Stage 2 Archaeological Assessments will be undertaken in accordance with the appropriate policies of the *Standards and Guidelines for Consultant Archaeologists.*

In addition to the above, the portion of the study area containing the Thames River retains potential for the identification of marine archaeological resources. It is anticipated that impacts to the Thames River will occur and will be confirmed as part of the Project's detailed design phase. The potential for marine archaeological resources will be evaluated using the MHSTCI's *Criteria for Evaluating Marine Archaeological Potential Checklist* during detailed design.

Consultation and engagement will continue with interested Indigenous communities during detailed design as it relates to the project and future archaeological assessment.

7.5 Cultural Heritage Resources

Potential impacts to cultural heritage resources within the study area were evaluated as part of the Cultural Heritage Assessment Report (CHAR). Both direct and indirect impacts were considered, and of the cultural heritage resources identified within the study area, direct impacts were identified for the Thorndale Bridge.

Table 12: Cultural Environment Impacts and Mitigation

Feature	Impact	Recommended Mitigation
Thorndale Bridge	Direct Alteration	• Documentation should be undertaken during the detailed design work program prior to any change in site conditions and include.
Thames River	Direct Alteration	• Alteration of the Thames River is anticipated in localized areas of the riverbank and embankments where the abutments and piers for a replacement bridge structure will be located. The bridge design will be confirmed during the detailed design stage of the project. • It is recommended that the riverbanks and vegetation be restored similarly to preconstruction conditions following completion of the new bridge. Restoration should include replacement of similar vegetation if vegetation is removed, preferably using native riparian species to maintain the naturalized character of the banks.

7.6 Noise

The contractor will be required to abide by the municipal noise control by-laws and ensure that all construction equipment is kept in good working order to limit additional noise. The contractor shall also ensure that the idling of construction equipment is kept to a minimum. Additional noise control measures will be addressed during detailed design and included in the construction contract.

7.7 Air Quality

During construction, best management practices will be applied to mitigate any air quality impacts caused by construction dust (non-chloride dust suppressants).

7.8 Climate Change

The proposed improvements to the Thorndale Bridge study area provides the opportunity to reduce the project's impact on climate change through the identification of an efficient transportation network and through the provision of facilities that encourage active forms of transportation (e.g., paved shoulders for cycling). The design of the new bridge over the Thames River will consider options to accommodate changes in climate parameters (i.e., increased episodes of flooding, increased flood levels, freezing rain, gale/hurricane force winds).

This page left blank intentionally.

8.0 Approvals and Permits

Permit requirements will be confirmed during detailed design. Prior to commencing design implementation, the following permits/approvals may be required:

8.1 Fisheries Act

The *Fisheries Act* includes prohibitions against harmful alteration, disruption, or destruction (HADD) of fish habitat. It extends protection to all fish and fish habitat. When a HADD cannot be avoided or mitigated, a subsection 35(2) authorization with appropriate offsetting of residual adverse effects is required.

The proposed bridge construction plan will be submitted to DFO as a Request for Review. If DFO determines that the proposed work will result in the Harmful Alteration, Disruption or Destruction (HADD) of fish habitat for the killing of fish through means other than fishing, an application for Authorization under the *Fisheries Act* will be submitted to DFO.

8.2 Endangered Species Act

In order to proceed with the Project, authorizations under the ESA may be required for Eastern Spiny Softshell, Queensnake, Wavy-rayed Lampmussel, Rayed Bean, Black Redhorse, Eastern Sand Darter and Silver Shiner. A summary of requirements is presented below:

- Eastern Spiny Softshel – Suitable habitat for the species occurs within the Study area. Consultation with MECP is recommended during or prior to the detailed design stage in order to determine authorization requirements, if any.

- Queensnake – As this species is extremely sensitive to trampling during targeted surveys, early consultation with MECP and UTRCA during or prior to the detailed design stage is recommended to determine presence / absence (including records of the species and if regulated habitat has been identified) and authorization requirements.

- Black Redhorse, Eastern Sand Darter, Silver Shiner, Wavy-rayed Lampmussel, Rayed Bean – Consultation with MECP is recommended to determine authorization requirements under the EAS. It is unlikely, due to the predicted area of in-water disturbance (i.e., greater than 100m²), that the project could qualify for an exemption under Ontario Regulation 23.4 of the ESA (Aquatic Species). The project will likely require an ESA 17(2)(c) Permit from MECP for all in-water activities that could potentially affect Black Redhorse, Eastern Sand Darter, Silver Shiner, Rayed Bean and Wavy-rayed Lampmussel or their habitat. Habitat protection for Silver Shiner extends to the meander width of the watercourse plus 30 m. A 17(2)(c) net benefit permit may require additional offsetting measures for each of these species that will be negotiated with MECP as part of the authorization process.

8.3 Species At Risk Act

The Project has the potential to harm or harass protected fish and mussel species and will, therefore, require a federal SARA Permit from the DFO for all in-water activities that could potentially affect Rayed Bean, Silver Shiner, Eastern Sand Darter and Black Redhorse or their habitat. Typical permit requirements involving mussel SAR require two years of post-relocation monitoring, so it is anticipated that the SARA Permit will need to cover at least three years of activity.

8.4 Conservation Authority Regulated Area

Under O.Reg.157/06 permit is required for development or interference with wetlands and alterations to shorelines and watercourses. This may include the planned work within regulated areas associated with the North Thames River. A permit application package will need to be prepared and submitted to UTRCA that includes the following information:

- Maps and photographs showing the location of project work relative to regulated features.
- Environmental mitigation measures for sediment and erosion control, re-vegetation and seeding.
- Other site-specific data as required.

Consultation with UTRCA is recommended to confirm complete permit application requirements.

8.5 Fish and Wildlife Conservation Act

If in-water work involving isolation techniques require relocation of fish, turtles or other wildlife, a Wildlife Scientific Collectors Authorization may be required from the MNRF under the *Fish and Wildlife Conservation Act*.

8.6 Ministry of Heritage, Sport, Tourism and Culture Industries

The Stage 1 Archaeological Assessment was submitted to MHSTCI for review and has been accepted into the Ontario Public Register of Archaeological Reports. The Stage 2 Archaeological Assessment shall be completed during detailed design.

8.7 Detailed Design Commitments

Many of the environmental concerns related to this project have been mitigated through the process by which the preferred design was selected, as described in this ESR. The anticipated impacts and proposed mitigation measures have been described in **Section 7.0**. **Table 13** provides a list of specific commitments to be carried forward to Phase 5 of the Municipal Class EA process, Implementation (detailed design and construction). The County will work with UTRCA, DFO, MECP and MNRF during the detailed design and implementation phases to ensure that the proposed works are acceptable and to obtain required permits.

This page left blank intentionally.

Table 13: Detailed Design Commitments

ID#	Detailed Design Commitments
	Ecological and Environmental Water Quality Monitoring
1	• Staff will work with UTRCA to develop a monitoring program during detailed design for inclusion into the tender document for construction. Existing conditions will be established for comparison of during construction results against background levels. The baseline will also provide an indication of variation in the water quality constituents that will assist with determining acceptable levels of deviation that may be observed when monitoring during construction. The monitoring program will allow for adjustment of mitigation measures in an adaptative manner to address issues that may arise.
	Aquatic Environment
2	• Mitigation strategies will be developed during detailed design for the avoidance of wildlife within the aquatic environment. The Thames River supports several diverse species, including Species at Risk, and therefore requires a comprehensive mitigation plan. • Mitigation will be determined in consultation with the MECP and UTRCA as part of the ESA permit application process.
	Sediment and Erosion Control
3	• A Sediment and Erosion Control Plan will be developed during detailed design to address site-specific requirements for protection and landscape considerations such as topography, slope, and drainage patterns. Specific sediment and erosion control measures will be identified and depicted on plans associated with grading and construction.
	Protection of Species at Risk
4	• Authorization from MECP is required for any work that may cause harm to identified SAR or SAR habitat. Formal consultation with MNRF will commence through the submission of an Information Gathering Form (IGF) and detailed design plan/consultation footprint impacts for the preferred alternative. Middlesex County will work with the MECP and UTRCA to determine additional study requirements and mitigation and compensation requirements during their review of IGF and permit application. • Prior to in-water works, all mussels will need to be relocated from the prescribed search area likely to be affected by construction activities. The relocation timing window based on mussel species and habitat present restricts handling of mussels to a period when water temperatures are above 16°C, which typically occurs between June 15 and September 30. • Additional detailed studies will be completed during detailed design, as required by MECP, MNRF and UTRCA.
	Terrestrial Environment
5	• Mitigation strategies will be developed during detailed design for the protection of the diverse terrestrial environment along the Thames River corridor. • During the construction phase, a thorough visual search of the area shall be conducted by construction contractors and project inspectors each day to avoid interaction with reptiles. Visual searches should include inspection of machinery and equipment prior to starting equipment. In the event that reptiles are encountered, construction work impacting the reptile should stop until the reptiles are no longer present. • Reptile barrier fencing should be installed before any construction activity is initiated within the study area. Installation should occur during reptile active season (April 15 to November 1, ideally between June 1 and September 1) and outside of turtle nesting season (June 1 to September 1) in order to define work zones and prevent the movement of reptiles into that area. Specifications for reptile barrier fencing should follow Best Practices Technical Note – Reptile and Amphibian Exclusion Fencing (MNRF 2013). A qualified biologist should be required as part of the construction contract to be onsite during installation of fencing in order to minimize the potential for reptiles or habitat to be destroyed or disturbed during construction. • If construction is initiated during the turtle nesting season (June 1 to September 1), the site should be inspected to identify and avoid potential snake hibernacula if possible. If potential snake hibernacula cannot be avoided, a qualified biologist should inspect the feature to determine use by snakes during the suitable season. If necessary, hibernacula should only be disturbed during peak reptile active period from April 15 to November 1, and ideally between June 1 and September 1 to allow snakes to flee when overnight temperatures are relatively warm.

ID#	Detailed Design Commitments
	Breeding Birds
6	• The primary nesting period (PNP) is April 9 - August 16. Vegetation removal during this core nesting period is not recommended; however, if required, a nest survey may be carried out by a qualified person (i.e., ecologist) • If a migratory bird best is located within the work area at any time, a 'no-disturbance buffer' will be delineated and maintained for the duration of the nest activity, which will be determined using periodic checks by the avian biologist. Work will not resume within the nest buffer until the nest is confirmed to be no longer active.
	Vegetation Management
7	• Clearly mark the limits of vegetation removal along sensitive features (rare vegetation community FODM7-4, wetland community MAMM1-3) to ensure no disturbance extends beyond the limits. A pre-clearing survey is recommended to avoid removal of regionally-rare Black Walnut to the extent possible. Barrier fencing used to delimit sensitive features may be coincident with silt fencing used to control erosion and sediment transport at the site. • If vegetation clearing will proceed when Monarch larvae may be present (April 1 to September 30), milkweed plants must be inspected for Monarch larvae prior to their removal. If larvae are present, they may be moved to a location that is suitable and safe under the direction of a qualified professional. Monarch caterpillars may be moved to other milkweed plants; for other larval stages (i.e., eggs and chrysalis), entire milkweed plants should be transplanted. • Removal of suitable bat maternity roost trees should occur outside the period when bats use trees for maternity roosts (i.e., May 1 to September 31) to reduce the likelihood of harm to bats. Two snag trees providing suitable maternity roost habitat are proposed for removal during Project construction.
	Tree Protection
8	• The Contractor shall install Tree Protection Fencing (TPF) to protect trees identified for preservation. All TPF will conform with the Arborist Report and details included in Contract Documents. • The Contractor shall contact the Project Arborist to review and approve the location of the fencing, prior to commencement of construction activities. • The TPF shall remain in the approved locations throughout the duration of construction and shall not be moved at any time to accommodate construction or site work. • The Contractor shall inspect TPF weekly and maintain as required through all stages of development/construction. The TPF shall be removed at the completion of all site works and disturbed areas shall be restored to original condition. • No substitutions of materials, products or quantities will be accepted without the prior written permission of the Project Arborist. • If required, branches interfering with construction activities should be pruned by a Certified Arborist using proper arboricultural techniques prior to the start of construction. If additional branches interfere during construction, a Certified Arborist shall be contacted and will determine next steps. • If roots from retained trees are exposed, or if it is necessary to remove limbs or portions of trees, a Certified Arborist shall be informed and the proper actions conforming to the County's Policies shall be carried out. • The Tree Protection Zone (TPZ) is not to be used for any type of storage. No trenching or tunneling for underground services shall be located within the TPZ. Construction equipment shall not be allowed to idle or exhaust within the TPZ. • Trees shall not have any rigging cables or hardware of any sort attached or wrapped around them, nor shall any contaminants be dumped within the protective areas. • No contaminants shall be dumped or flushed where they may come into contact with the feeder roots of the trees. • Upon completion of the tree removals, all felled trees will be removed from the site. No lumber or brush from the clearing will be stored on-site. Any chipping, cutting or brush cleanup will be completed outside of the bird nesting season.
	Invasive Species Control
9	• A clean equipment protocol will be implemented to reduce the potential to spread invasive species (European swallow-wort) and will reference the industry standard guide prepared by MNRF's Steward Council and the Invasive Species Council. The protocol will be specified on contract drawings, including specifications for cleaning equipment prior to entering and/or leaving work sites. • Seed banks should not be used from areas where invasive species are present. Native seed mixes shall be used to improve native species diversity.

ID#	Detailed Design Commitments
	Air Quality
10	• During construction, vehicles/machinery and equipment will be good in repair, equipped with emission controls, as applicable, properly maintained and operated within regulatory requirements. • A minimal number of machines operating in one area shall be considered during construction activities. • Water and non-chloride dust suppressants will be applied during construction to protect air quality associated with dust.
	Stormwater/Drainage
11	• Stormwater Management (SWM) controls will be assessed for the various roadway run-off controls, including the potential use of Low Impact Development (LID) measures in accordance with Middlesex County guidelines.
	Excess Soil Management
12	• All excavated soils will be handled in accordance with the MECP's guidance document entitled "Management of Excess Soil – A Guide for Best Management Practices". • Activities involving the management of excess soil should be completed in accordance with O. Reg. 406/19, "On-Site and Excess Soil Management", to support improved management of excess construction soil. • If required, a toxicity characteristic leachate procedure (TCLP) analysis will be completed in accordance with O.Reg. 558/00 to determine the waste classification of the soil prior to disposal. • Should any spills occur during construction, the Spills Action Centre of the Ministry of Environment and Climate Change will be contacted immediately. • All waste generated during construction will be disposed of in accordance with MECP requirements.
	Noise
13	• Standard noise mitigation measures shall be installed on construction equipment and equipment will be properly maintained. • Construction equipment shall be turned off when not in use (i.e., a no idling policy) • Where noise levels for construction equipment exceed the criteria in the MECP noise guidelines and policies, the contractor shall provide equipment that complies with the MECP noise criteria where reasonably available. Instances where adherence to the local bylaws is not possible and mitigation is not feasible, an exemption should be obtained from the County, prior to construction.
	Archaeology
14	• A Stage 2 archaeological assessment will be completed during detailed design. • The potential for marine archaeological resources within the Thames River be evaluated using the MHSTCI's *Criteria for Evaluating Marine Archaeological Potential Checklist.* • Consultation and engagement will continue with interested Indigenous communities during detailed design as it relates to the project and further archaeological assessment. The County will contact Indigenous communities to arrange an on-site monitor as part of the fieldwork.
	Cultural Heritage

15	• Thorndale Bridge met one criterion under O. Reg. 9/06 (1.i), for its design/physical value. Thorndale Bridge scored 40 points according to the OHBG and therefore does not meet the threshold of 60 points to be considered provincially important.
	• In order to mitigate the effects of the project on these heritage attributes prior to the removal of the bridge, a full recording and documentation of the existing structure and its landscape setting should be completed to create a public record of the structure.
	• Documentation should be undertaken during the detailed design work program prior to any change in site conditions and include:
	  ○ Documentation in the form of detailed photography should be completed under the direction of a heritage professional in good standing with the Canadian Association of Heritage Professionals.
	  ○ The results of the documentation activities should be made available at local libraries for public use.

ID#	Detailed Design Commitments
	Utilities
16	• The County will continue to engage with utilities during detailed design. • The design will attempt to minimum disruption to existing services to residential and commercial users before and during construction.
	Property
17	• Permission-to-enter onto private properties will be required to perform driveway reconstruction and minor grading activities associated with the roadway reconstruction. The County will continue to engage with affected property owners.

9.0 Closing

This Environmental Study Report has been prepared following the Municipal Class EA study process for Schedule C projects. It outlines the process which the County has undertaken to address the problems identified, and the preferred solution and design alternative to be implemented.

The Class EA study process has involved consultation with directly affected members of the public, Indigenous communities, and review agencies to ensure that they were aware of the project and that their concerns have been addressed.

The filing of this report represents the conclusion of Phase 1 through Phase 4 of the Class EA planning process as outlined in the MCEA document. Provided that no Part II Order requests are received, and provided all appropriate permits are obtained, the County may proceed with implementation (Phase 5).

APPENDICES

Appendix AConsultation and Communication

A.1 Contact List

A.2 Notice of Study Commencement

A.3 Public Information Centre #1

A.4 Public Information Centre #2

A.5 Summary of Agency Comments

A.6 Indigenous Consultation

A.7 Notice of Study Completion

Appendix B Background Reports

B.1 Environmental Impact Study

B.2 Tree Inventory

B.3 Stage 1 Archaeological Assessment

B.4 Cultural Heritage Assessment Report

Appendix CPreliminary Design Plans