Etobicoke Creek Trunk Sewer Improvements and Upgrades Environmental Study Report

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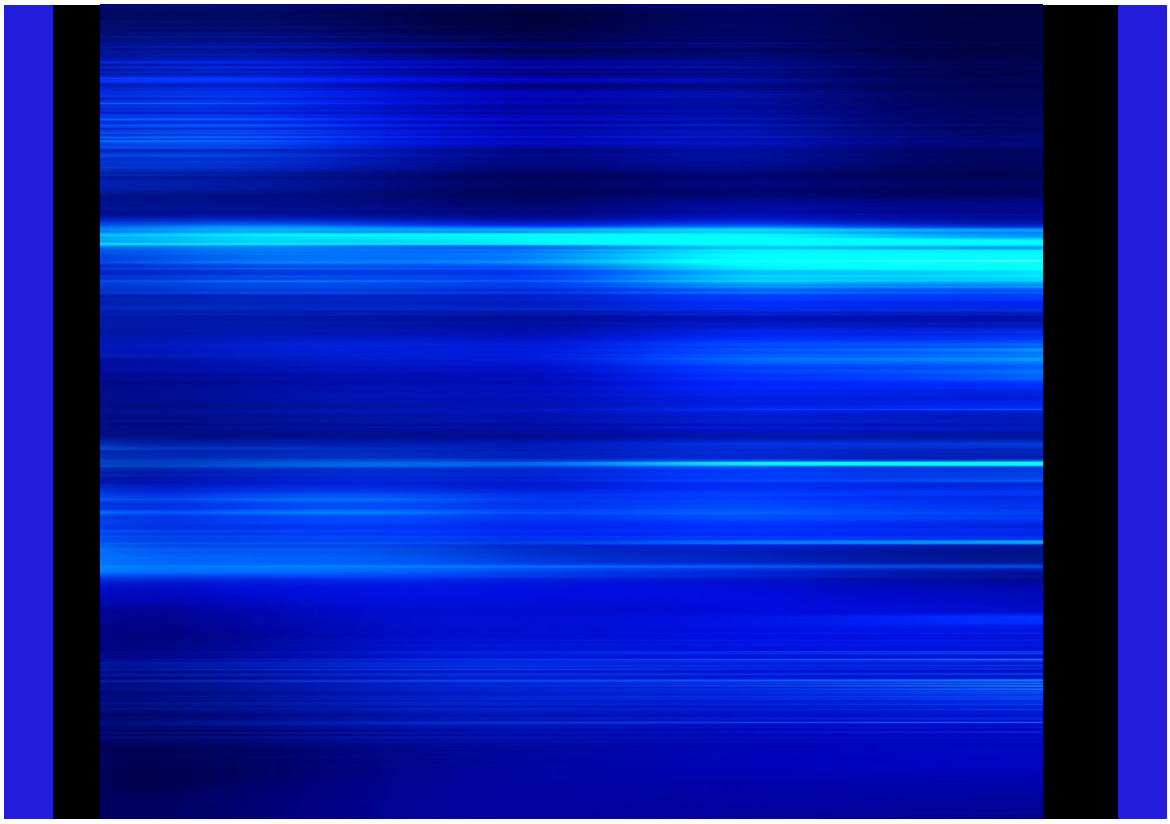
Region of Peel

Schedule 'C' Municipal Class Environmental Assessment: Etobicoke Creek Trunk Sewer Improvements and Upgrades
May 2023



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Project Name:	Schedule 'C' Municipal Class Environmental Assessment: Etobicoke Creek Trunk Sewer Improvements and Upgrades
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Executive Summary

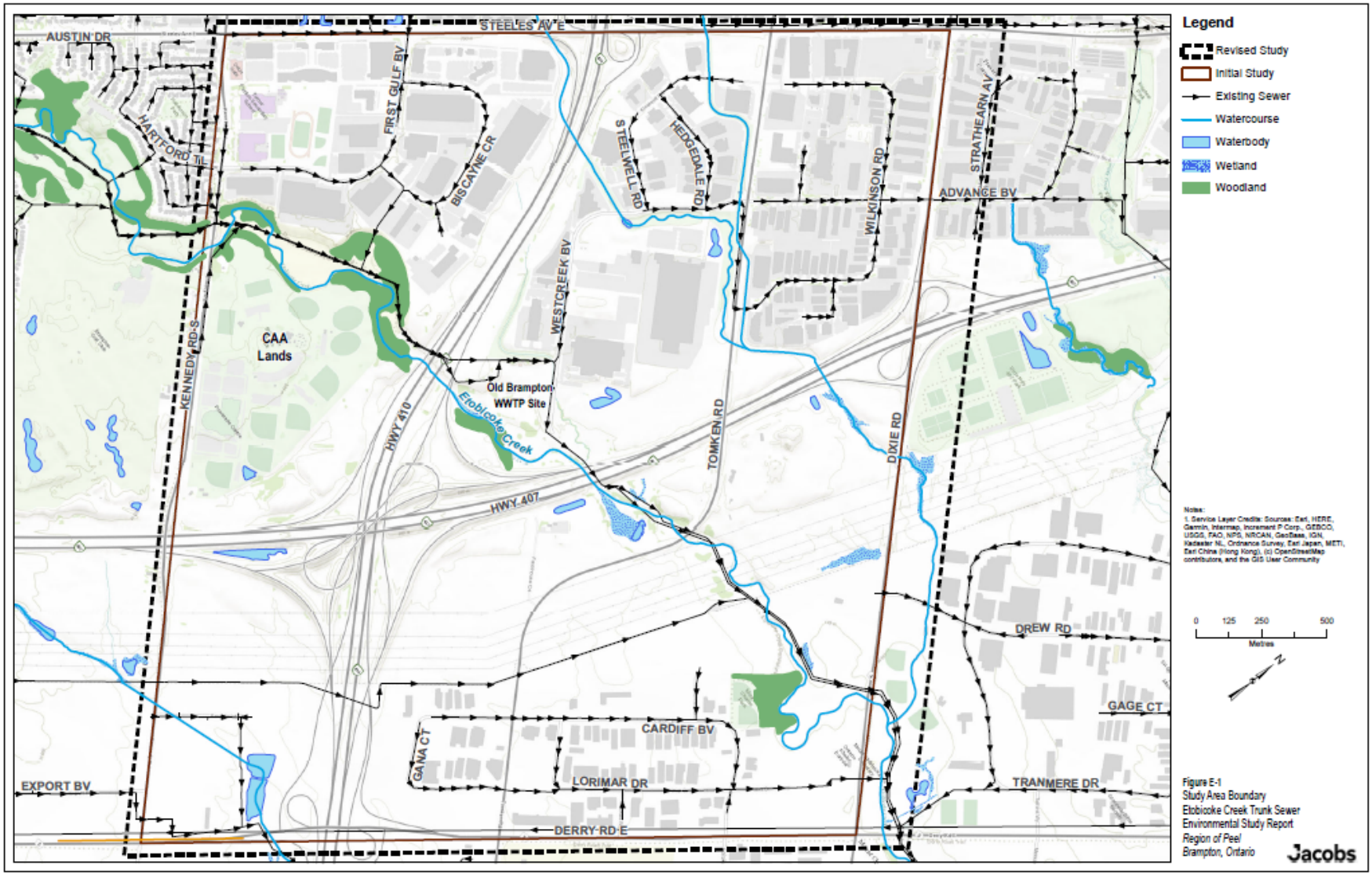
Introduction and Purpose of Environmental Assessment

The existing Etobicoke Creek Trunk Sewer from Kennedy Road to south of Highway 407 consists of primarily twin sewers ranging in size from 1050 mm to 1350 mm diameter pipes constructed as early as 1957. Several operational and maintenance issues have been reported in the existing twin sewers, including surcharging, defects in previous rehabilitation efforts, abandoned infrastructure on the former treatment plant site, and difficulty accessing certain sections of the sewer for required operations and maintenance. Additionally, the residential and employment populations within the trunk sewer's drainage area is expected to increase.

The Region of Peel (Region) retained Jacobs to complete a Municipal Class Environmental Assessment (EA) study with the purpose of identifying, developing, and implementing a solution to provide future capacity to meet forecasted growth needs while addressing existing sewer operation and maintenance issues.

Figure ES-1 shows the original and revised study area. The study area was expanded slightly as the study progressed to include the connection to the East West diversion sewer.

Figure ES-1. Study Area Boundary



Environmental Assessment Process

The Municipal Class EA is being completed as a Schedule C EA, which covers Phase 1 to 4 of the EA Process:

- **Phase 1:** Defining the problem or opportunity
- **Phase 2:** Identifying and assessing alternative solutions and selecting a preferred solution
- **Phase 3:** Identifying and assessing the alternative methods/design concepts and selecting a preferred method/design concept
- **Phase 4:** Preparing an Environmental Study Report (ESR)

Consultation and Engagement

A Public Agency and Consultation Plan was created to facilitate timely, effective, and consistent communication with all stakeholders during the study. The plan was used throughout the study as guidance on the communications strategy to engage both internal and external stakeholders.

There have been several opportunities for participation, including:

- Pre-consultation with key stakeholders
- Notice of Commencement
- Public Information Session under Phase 2 of the Class EA process
- Public Information Session under Phase 3 of the Class EA process
- Notice of Completion

Problem and Opportunity Statement

A review of the condition and capacity of the existing Etobicoke Creek Trunk Sewer reveals that while the existing sewer is in relatively good condition with isolated areas requiring structural repair or operational and maintenance attention, repair or rehabilitation would not address the operational challenges posed by deep manholes, access limitations and proximity to the Etobicoke Creek.

The sewer is considered to be constrained conveying existing flows along approximately 26% of its length and would be unable to accommodate current development applications or the ultimate growth envisioned by the City of Brampton.

The purpose of this study is therefore to develop and evaluate alternative solutions and recommend a preferred solution to provide the additional trunk sewer capacity required to service future growth needs while addressing current operation and maintenance challenges in the existing sanitary trunk sewer system.

Alternative solutions will need to be guided by the following key principles.:

- Appropriate sizing to provide sufficient conveyance capacity for future growth, while addressing current operational challenges and considering the potential for more frequent, more intense storm events.
- An alignment that accommodates required interconnections and provides appropriate solutions to the access and operational challenges noted.
- Minimize impacts on key stakeholders, including the City of Brampton, Toronto and Region Conservation Authority and Infrastructure Ontario.
- Where possible, allow for long-term flexibility with managing flows in the system

These key principles will be developed through Phase 2 of the Class EA process to help establish the criteria by which a long list of alternatives will be evaluated.

Baseline Features and Servicing Conditions

Planning and Servicing Considerations

Concepts and aspects from the following documents were taken into consideration in developing the Problem and Opportunity Statement and ultimately recommending a preferred solution:

- City of Brampton Official Plan
- City of Brampton 2040 Vision
- Region of Peel Official Plan
- Growth Plan for the Greater Golden Horseshoe
- Provincial Policy Statement
- Parkway Belt West Plan

Existing Land Uses

The existing study area is designated as employment lands as per the 2019 Region's Generalized Land Use Shapefile.

Based on the City of Brampton's Official Plan (City of Brampton, 2006), the study area that is within the City of Brampton's limits is composed on lands designated as Business Corridor, Provincial Highway, Industrial, Open Space, and Parkway Belt West.

As per the City of Mississauga's 2019 Existing Land Use, the study area that is within the City of Mississauga is generally on lands classified as Industrial and Commercial.

Future Land Uses

Future land use is determined by the City of Brampton's 2040 Vision, the City of Mississauga's Official Plan, and the Regional Official Plan. Acceptance of the City of Brampton's 2040 Vision resulted in land use redesignations including areas of Residential/ Housing, Institutional, Entertainment/Culture, Office Space, and Mixed Use.

Future Capacity Forecasts

The population growth projected for the City of Brampton was used to develop population forecasts for the Etobicoke Creek Trunk Sewer's sewershed, as is presented in Table ES-1. The information presented in Table ES-1 is intended for capacity analysis only and would be subject to review and approval through the official planning processes of the City of Brampton and Region of Peel.

Table ES-1. Master Plan Population Forecast for Brampton

Population Type	Population	Intensification Forecast	Population Forecast for Sizing
Residential	209,560	37,955	247,515
Employment	83,720	22,835	106,555

Source: Program Planning Material for 2041 Population Forecast (provided August 2019) and Master Plan Development Areas for Intensification Forecast (provided April 2019)

Note: Additional flows to represent previously approved development applications were added during future conditions modelling scenario

Condition Assessment of Existing Infrastructure

The Region's CCTV database was reviewed in order to obtain the most current condition assessment information. Based on current available data, the sewers can be considered to be in relatively good condition with few structural defects identified, primarily consisting of varying degrees of surface damage.

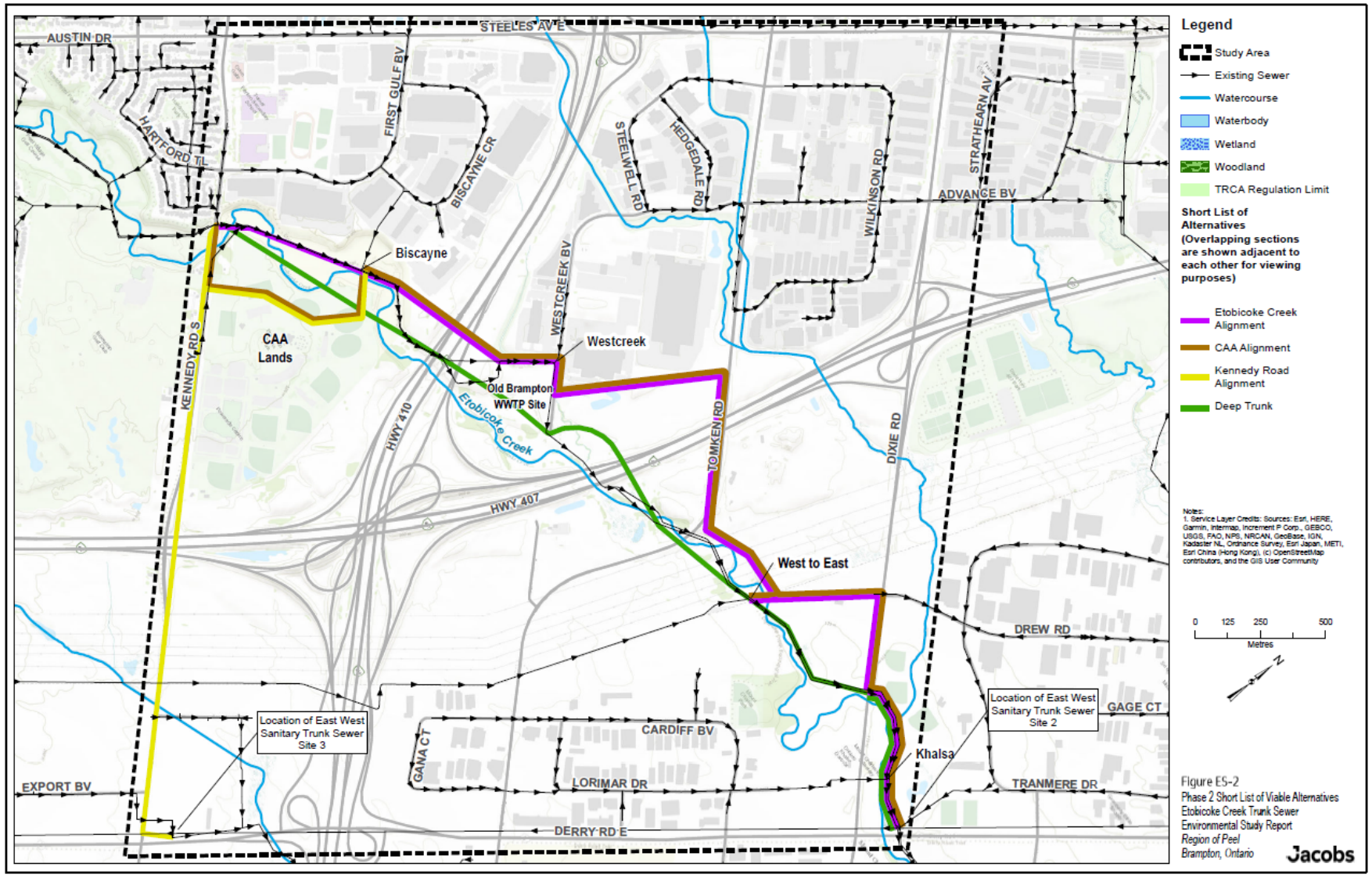
An analysis of the trunk sewer system capacity within the study area was assessed using the Region's hydraulic model. The hydraulic analysis concluded that the existing trunk sewer system capacity was constrained when flows exceeded 85 percent of the sewer capacity during the 5-year storm event during both existing flow conditions and future flow conditions.

Development and Evaluation of Alternative Solutions

Several servicing strategies were screened with upsizing/upgrading the wastewater system capacity with new infrastructure being the preferred servicing strategy. A long list of segment and concept alternatives were developed to address the problem/opportunity statement. This long list of alternatives was then screened using a set of criteria, resulting in the following four alternatives (Figure ES-2) being short-listed for further evaluation:

1. **Etobicoke Creek Alternative:** The first and last segments of this alignment are through the Etobicoke Creek Valley, while the remainder is routed outside the Etobicoke Creek Valley. This alignment spans from the existing Etobicoke Creek Trunk Sewers at Kennedy Road to the existing Etobicoke Creek Trunk Sewers at Derry Road. A large portion of the alternative is open-cut, with the crossings of Highways 407, and 410 being tunnelled.
2. **CAA Lands Alternative:** The first segment is routed on a future road through CAA Lands, while the remaining alignment is routed out of the Etobicoke Creek Valley, requiring property negotiation. This alignment spans from the existing Etobicoke Creek Trunk Sewers at Kennedy Road to the existing Etobicoke Creek Trunk Sewers at Derry Road. A large portion of the alternative is open-cut, with the crossings of Highways 407, and 410, as well as a small portion at the start of the alignment being tunnelled.
3. **Kennedy Road Alternative:** This alignment is within the Kennedy Road Right of Way and extends from the existing Etobicoke Creek Trunk Sewers at Kennedy Road to the East-to-West Diversion Sanitary Trunk Sewer (EWD STS) through its Site 3 (refer to Figure ES-2). The majority of the alignment will be tunnelled with a shorter open-cut section.
4. **Deep Trunk Alternative:** This alternative is mainly tunnelled and generally follows Etobicoke Creek, with the majority of the alignment within the valley lands. This alignment spans from the existing Etobicoke Creek Trunk Sewers at Kennedy Road to the existing Etobicoke Creek Trunk Sewers at Derry Road.

Figure ES-2. Short List of Viable Alternatives



The four short-listed alternatives were then further evaluated based on triple-bottom-line-plus approach using technical, natural environmental, socio-cultural environmental, and economic criteria. Hydraulic analysis, sewer size estimation, cost estimation, archaeological assessment, cultural heritage, natural heritage, and other supporting studies were conducted to support the evaluation and selection of the preliminary preferential concept alternative. The short-listed alternatives were evaluated against each of the comparative criteria and a score as shown in Table ES-2 was assigned.

Table ES-2. Scoring for the Evaluation of the Short List of Viable Alternatives

Score	Definition
● Most Preferred	Least Impacts/Most Benefits
◐ Moderately Preferred	Moderate Impacts/Moderate Benefits
○ Least Preferred	Most Impacts/Least Benefits

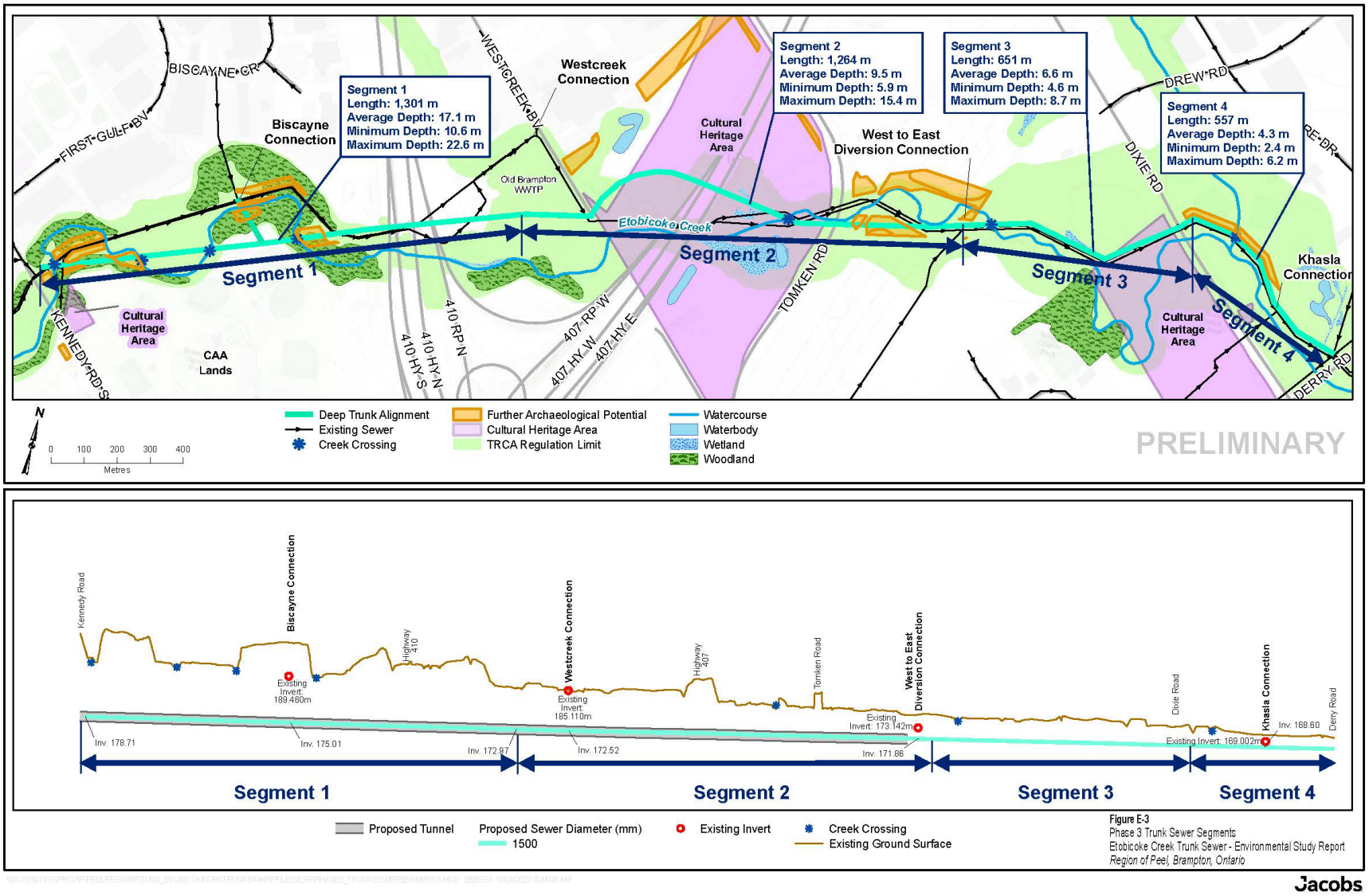
The Etobicoke Creek Alternative (Alternative 1) and the CAA Lands Alternative (Alternative 2) are the least preferred alternatives due to these alternatives having the most impact on the natural environment during construction as well as pumping stations being required to service growth. Although the Kennedy Road Alternative (Alternative 3) would have the least impact on the natural environment, the main disadvantage of this alternative was that it did not provide the Region with the flexibility to deliver flows to the east. The Deep Trunk Alternative (Alternative 4) was deemed to be the preliminary preferred alternative since it has the ability to service future growth without pumping stations, the tunnelled construction limits the impacts to the natural environment, and it has the flexibility to divert flows to the EWD STS at Derry Road.

Review of Alternative Design Concepts

Segment Definition

The Deep Trunk alignment was split into four segments, as shown in Figure ES-3, based on logical breakpoints to consider all feasible design concepts. The segments were differentiated by construction specifics, property availability, existing sanitary sewer configuration and impacts on community and natural features. Design concepts were evaluated and selected for each segment.

Figure ES-3. Phase 3 Trunk Sewer Segments



Segment 1 extends approximately 1.3 km from the upstream connection point of the existing trunks at Kennedy Road to the Old Brampton WWTP Site. Segment 2, approximately 1.3 km in length, commences at the Old Brampton WWTP Site and extends east to the West-to-East Diversion Chamber. Segment 3 spans approximately 0.7 km in length from the West-to-East Diversion Chamber to the eastern side of Dixie Road. Segment 4 generally parallels Etobicoke Creek from east of Dixie Road and extends 0.6 km southeast to the connection point at Derry Road.

Segment 1 to Segment 3 is relatively deep. This depth is necessary to connect the existing Etobicoke Creek Trunk Sewer to the existing sewer system at Derry Road and Dixie Road, while also allowing for gravity to convey the flows downstream. Additionally, portions of the existing sewers systems' operational and maintenance issues can be attributed to shallow sewers. Therefore, a deeper sewer should mitigate these issues.

Stage 1 Evaluation – Open-Cut and Trenchless Construction

The Stage 1 evaluation assessed the practicality of using open-cut versus trenchless technology for each trunk segment. Open-cut construction refers to the use of trenches for the installation of infrastructure, whereas trenchless construction is installed below ground without the use of extensive trenches, often through tunneling.

The Stage 1 evaluation indicated that open-cut construction is not practical for Segments 1 and 2 due to the proposed depths of the segments, and trenchless construction is recommended. Both open-cut and trenchless construction are practical for Segment 3. The preferred construction methodology for Segment 4 is open-cut excavation due to the insufficient cover to undertake tunnelling.

Stage 2 Evaluation – Trenchless Construction Methodologies

An additional evaluation, Stage 2 evaluation, was completed for Segments 1, 2, and 3, where trenchless technology was deemed practical during the Stage 1 evaluation. An initial screening of trenchless construction methodologies indicated that Rock Tunnel Boring Machine (TMB) was feasible for Segment 1 and Segment 2, while Microtunnel Boring Machine (MTBM) was feasible for Segment 1, Segment 2, and Segment 3.

Evaluation of Tunnelling Methodologies

Evaluation of the tunnel methodologies was completed using criteria under technical considerations, natural environment, social-cultural environment, and economic factors. The tunneling design concepts were evaluated against each of the comparative criteria and a score shown in Table ES-3 was assigned. A tunneling design concept's total score was then assigned based on its scoring of the criteria types; the alternative with the highest number of criteria types in which it scored "Preferred" was selected as the preferred design concept for the tunneled segments.

Table ES-3. Construction Methodology Evaluation Summary

Criteria Type	Segment 1 Rock TBM	Segment 1 MTBM	Segment 2 Rock TBM	Segment 2 MTBM	Segment 3 Trenched	Segment 3 MTBM
Technical Considerations	◐ Moderately Preferred	● Most Preferred	◐ Moderately Preferred	◐ Moderately Preferred	○ Least Preferred	◐ Moderately Preferred
Natural Environment	◐ Moderately Preferred	● Most Preferred	◐ Moderately Preferred	◐ Moderately Preferred	○ Least Preferred	● Most Preferred
Socio-Cultural Environment	◐ Moderately Preferred	◐ Moderately Preferred	◐ Moderately Preferred	○ Least Preferred	○ Least Preferred	◐ Moderately Preferred
Economic Factors	○ Least Preferred	● Most Preferred	○ Least Preferred	◐ Moderately Preferred	○ Least Preferred	● Most Preferred
Concept Selection		**Preferred**		**Preferred**		**Preferred**

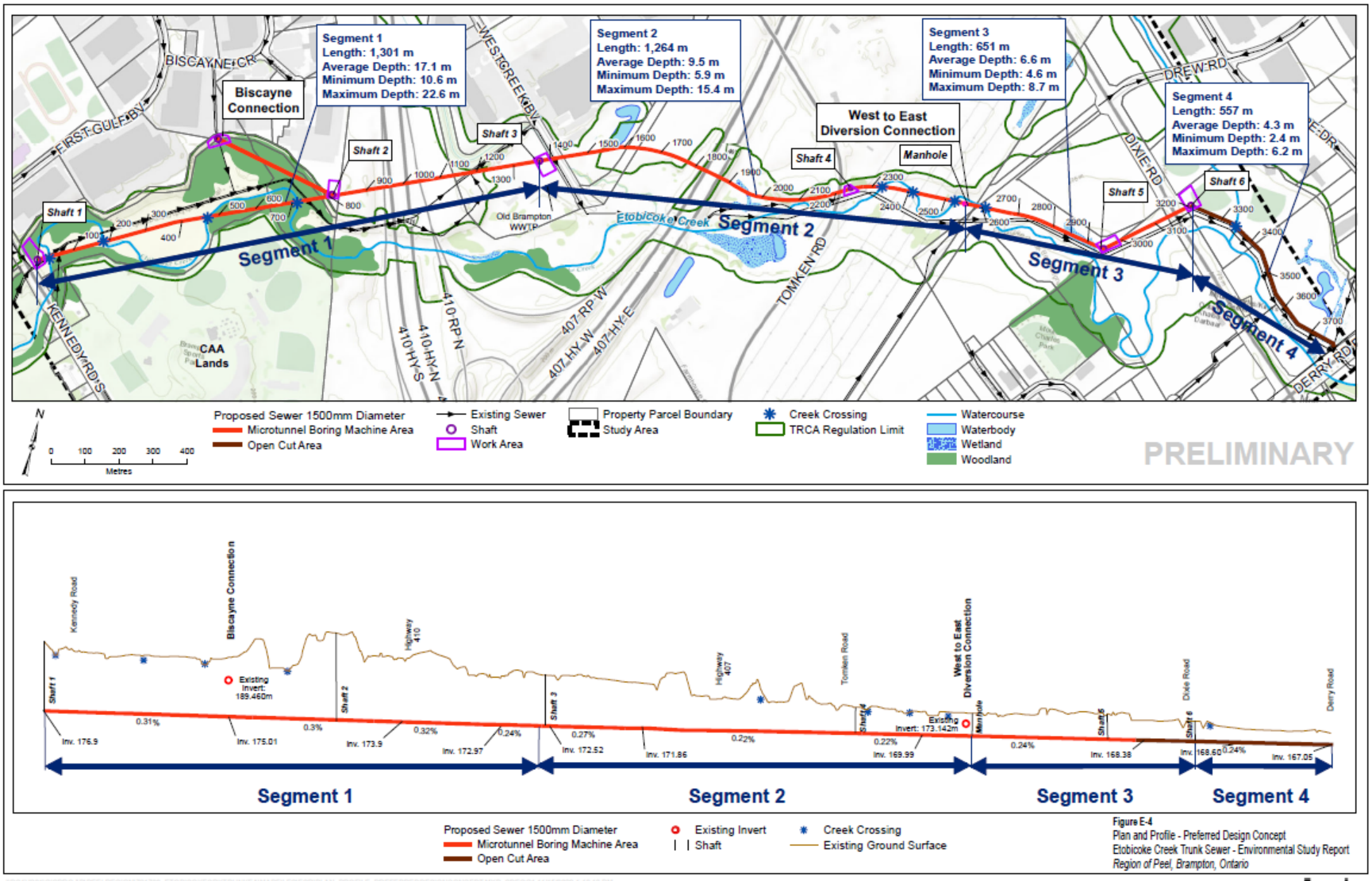
The preferred construction methodology for Segment 1, Segment 2, and Segment 3 is MTBM.

Summary of Preferred Design Concept

MTBM is the preferred construction methodology for Segment 1, Segment 2, and Segment 3, while open-cut is recommended for Segment 4.

Following the evaluation of design concepts, the proposed Deep Trunk alignment was refined to address a number of constraints identified. Alternatives to Shaft 1 were considered: immediately east of Kennedy Road, on Kennedy Road, west of Kennedy Road, and a further downstream location at the multiuse trail. The proposed location for Shaft 1 is immediately east of Kennedy Road. Several locations for Shaft 2 were considered and assessed to avoid existing land use conflicts, and the selected location was the most easterly connection southeast of Biscayne Crescent and west of Highway 410. Shaft 3 was shifted slightly to the eastern limits of the Old Brampton WWTP property to avoid future anticipated construction. The proposed Shaft 4 proposed location was moved from north of Tomken Road, which was in close proximity to a proposed wetland, to south of Tomken Road. The southeast shift of Shaft 4 resulted in a reduced length between Shaft 4 and Shaft 5 and eliminated the need for intermediary shaft, Shaft 5B. Shaft 5 is a launching shaft located approximately 300 m west of Dixie Road and north of Etobicoke Creek. The alignment between Shaft 6 and Derry Road was modified slightly from Phase 2 to provide a 5m clearance between the existing sewer and the proposed alignment. Shaft 6 is located immediately east of Dixie Road and less than 50 m north of Etobicoke Creek. The refined alignment is shown in Figure ES-4.

Figure ES-4. Plan and Profile -Preferred Design Concept



Implementation Plan

Several permits and approvals are required prior to project implementation, including approvals from the Ministry of Environment, Conservation and Parks, TRCA, Ministry of Natural Resources and Forestry (MNRF), Department of Fisheries and Oceans (DFO), Ministry of Transportation, Ministry of Citizenship and Multiculturalism, and Infrastructure Ontario. A number of approvals are also required from The City of Brampton and the City of Mississauga.

The expected phases of construction are as follows:

- **Phase 1:** East of Dixie Road to north Derry Road including connections to the E-W Trunk and the existing Etobicoke Creek twin sewers.
- **Phase 2**: From East of Dixie Road to Kennedy Road
- **Phase 3:** Biscayne Connection

It is anticipated that construction will take approximately 3 years pending property acquisition, permits and approvals with an expected completion year of 2028-2029.

Contents

Appendices

Tables

Figures

Acronyms and Abbreviations

Acronym	Definition
AA	archaeological assessment
APEC	area of potential environmental concern
ASI	Archaeological Services Inc.
EA	environmental assessment
EAA	Environmental Assessment Act
ECA	Environmental Compliance Approval
ESR	Environmental Study Report
EWD STS	East-to-West Diversion Sanitary Trunk Sewer
GTA	Greater Toronto Area
IO	Infrastructure Ontario
km	kilometre(s)
MCFN	Mississaugas of the Credit First Nation
MCM	Ministry of Citizenship and Multiculturalism
MEA	Ontario Municipal Engineers Association
MECP	Ministry of Environment, Conservation and Parks
m	metre(s)
mm	millimetre(s)
MMAH	Ministry of Municipal Affairs and Housing
MTBM	microtunnel-boring machine
MTO	Ministry of Transportation
NDMNRF	Ministry of Northern Development, Mine, Natural Resources and Forestry
NSR	Natural Sciences Report
O&M	operations and maintenance
PIC	Public Information Centre
PCA	potentially contaminating activity
PACP	Pipeline Assessment Certification Program
Region	Region of Peel
ROW	right-of-way
SAR	species at risk
SCS	Soil Conservation Service
SOGR	state of good repair

Acronym	Definition
SUE	subsurface utility engineering
TBL+	Triple Bottom Line Plus
TBM	tunnel-boring machine
TRCA	Toronto and Region Conservation Authority
WWTP	wastewater treatment plant

1. Introduction

The Region of Peel (Region) has retained CH2M HILL Canada Limited (Jacobs) to complete a Municipal Class Environmental Assessment (EA) study for the Etobicoke Creek Trunk Sewer. This Schedule C Class EA follows the Municipal Engineers Class Environmental Assessment process. It incorporates public and stakeholder comments and recommends a roadmap for the proposed Etobicoke Creek Trunk Sewer to meet future growth needs while addressing existing wastewater system challenges.

1.1 Study Purpose and Objectives

The existing Etobicoke Creek Trunk Sewer from Kennedy Road to south of Highway 407 consists of primarily twin sewers ranging in size from 1050 millimetre (mm) to 1350 mm diameter pipes constructed as early as 1957. The former Brampton wastewater treatment plant located northeast of Highways 410 and 407, also contains a portion of the trunk sewers that form a key part of the East Trunk System. Several operational and maintenance issues have been reported in the existing sewer, including surcharging, defects in previous rehabilitation efforts, abandoned infrastructure on the former treatment plant site, and difficulty accessing certain sections of the sewer for required operations and maintenance.

The drainage area serviced by the existing Etobicoke Creek Trunk Sewer is projected to grow significantly, with residential and employment populations forecasted in the current 2020 Water and Wastewater Master Plan Update to increase by 27 percent and 46 percent, respectively, by 2041. Further, in 2018, the City of Brampton endorsed a vision for growth that would transform the local area around Kennedy Road (including the CAA Centre lands, formerly the Powerade Centre), north of Highway 407 and south of Steeles Avenue. Currently, there are no trunk sanitary sewers on Kennedy Road to service this growth.

The purpose of this Municipal Class EA is to identify, develop and implement a solution to address future capacity needs and existing sanitary sewer operational issues in the Etobicoke Creek Trunk Sewer.

The goals and objectives of this study are as follows:

- Review and understand the condition of the existing infrastructure to develop all feasible alternatives that can appropriately address and solve the existing and anticipated needs.
- Undertake the Municipal Class EA process in a transparent and defensible manner, including the preparation of all study documentation.
- Engage with the public and stakeholders at the appropriate times and gather meaningful input that will help develop alternatives, determine criteria, and select the preferred solution.
- Identify other ongoing and planned work in the area to coordinate at an early stage such that unnecessary construction delays and disruption to the study area are avoided.
- Assess alternatives on the impact that they may have on all aspects of the environment, including the natural, social, cultural, built, and economic environments.
- Select a preferred design that can be easily transferred to capital delivery.
- Improve overall operation of the system to support servicing of future growth.

1.2 Class Environmental Assessment Process

1.2.1 Environmental Assessment Act

Ontario's Environmental Assessment Act, R.S.O. 1990, c. E.18, s. 2. (EAA) is the governing legislation that prescribes the planning and decision-making process to confirm that potential environmental effects and impacts are considered before a project begins. The purpose of this act is "…the betterment of the people of the whole or any part of Ontario by providing for the protection, conservation, and wise management in

Ontario of the environment. (Part 1-Section 2). The definition of environment encompasses the natural, social, cultural, built, and economic environments.

The EAA identifies two types of environmental assessments: Individual EA and Class EA. The Individual EA requires that an individual EA be carried out and submitted for review and approval by the Minister of the Environment, Conservation and Parks. A Class EA must follow and comply with an approved class EA process for a class of undertakings; the process is explained further in Section 1.2.1.1.

1.2.1.1 Principles of Environmental Planning

Ontario municipalities are subject to the provisions of the EAA and its requirements to prepare a Class EA for applicable public works projects. The Ontario Municipal Engineers Association's Municipal Class EA document provides municipalities with a five-phase planning procedure approved under the EAA to plan and undertake all municipal sewage, water, stormwater management, and transportation projects that occur frequently, are usually limited in scale, and have a predictable range of environmental impacts and applicable mitigation measures (OMEA 2015). Key components of the Class EA planning process include the following:

- Consultation early and throughout the process
- Reasonable range of alternatives
- Consideration of effects on the environment and ways to avoid or reduce impacts
- Systematic evaluation of alternatives
- Clear documentation
- Traceable decision making

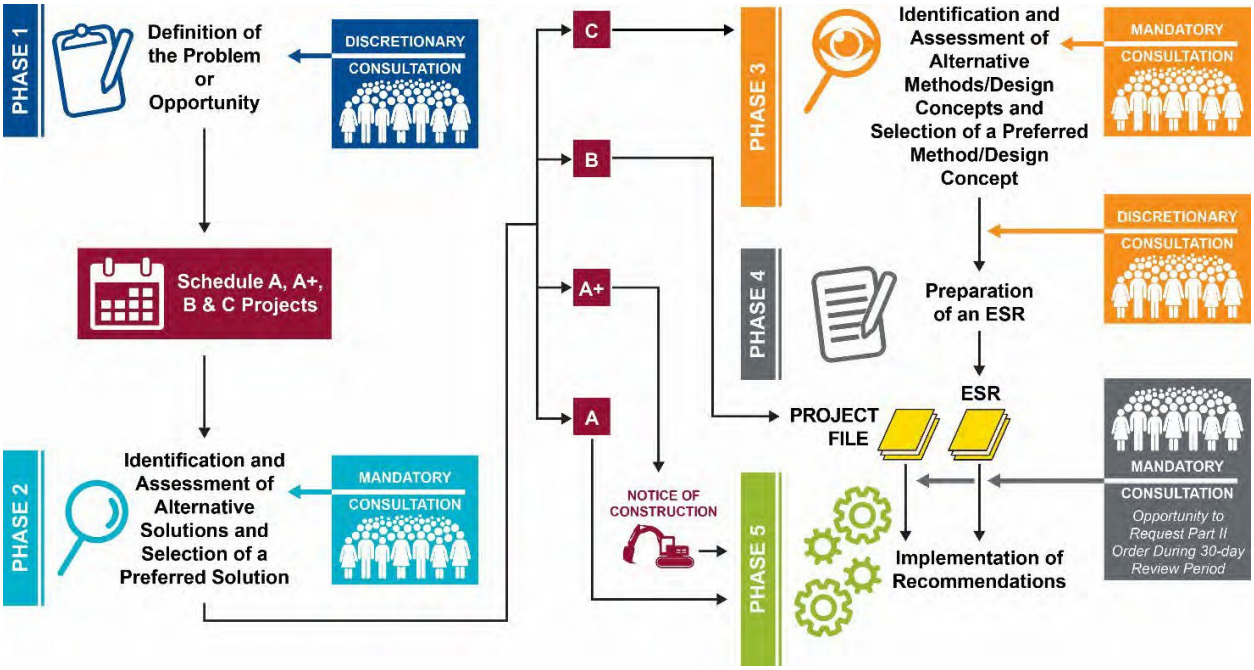
1.2.1.2 Class Environmental Assessment Process and Schedules

Municipal projects affect the environment to varying degrees; as such, projects are classified in terms of Municipal Class EA schedules. Based on the Ontario Municipal Engineers Association's Municipal Class EA document and subsequent amendments, projects are classified as Schedule A, A+, B, or C projects, summarized herein. Each classification requires a different level of review and public and stakeholder engagement to complete the Municipal Class EA requirements, as seen on Figure 1-1 and described as follows.

- Schedule A projects are limited in scale, have minimal adverse effects, and include the majority of municipal sewage, stormwater management, and water operations and maintenance activities. These projects are preapproved and may be implemented without following further phases in the Class EA planning process. Schedule A projects typically include normal or emergency operational maintenance activities, with typically minimal environmental effects.
- Schedule A+ projects are preapproved but require public notification because of their potential to affect local landowners during construction.
- Schedule B projects have the potential for some adverse environmental effects. The proponent is required to undertake a screening process involving mandatory contact with directly affected public and relevant review agencies to make them aware of the project and to provide an opportunity to address their concerns. Schedule B projects require that Phases 1 and 2 of the Class EA be followed and that a Project File report be prepared and filed for review by the public and the Ministry of Environment, Conservation and Parks (MECP). If there are no outstanding concerns raised by the public, stakeholders, or review agencies, and no requests for a Part II order are received, the proponent may proceed to project implementation.
- Schedule C projects have the potential for greater environmental impacts and must proceed under the full planning and documentation procedures covered in Phases 1 to 4 specified in the Municipal Class EA document. Schedule C projects require that an Environmental Study Report be prepared and filed for review by the public, stakeholders, and review agencies. As with Schedule B projects, provided no significant impacts are identified, and no requests for a Part II order are received, the project may then proceed to implementation.

Given the nature of this project's study area, in particular the proximity to Etobicoke Creek, the major highway and road crossings, and the site conditions on the former Brampton wastewater treatment plant site, the Region has decided to undertake this Class EA as a Schedule C study.

Figure 1-1. Environmental Assessment Process



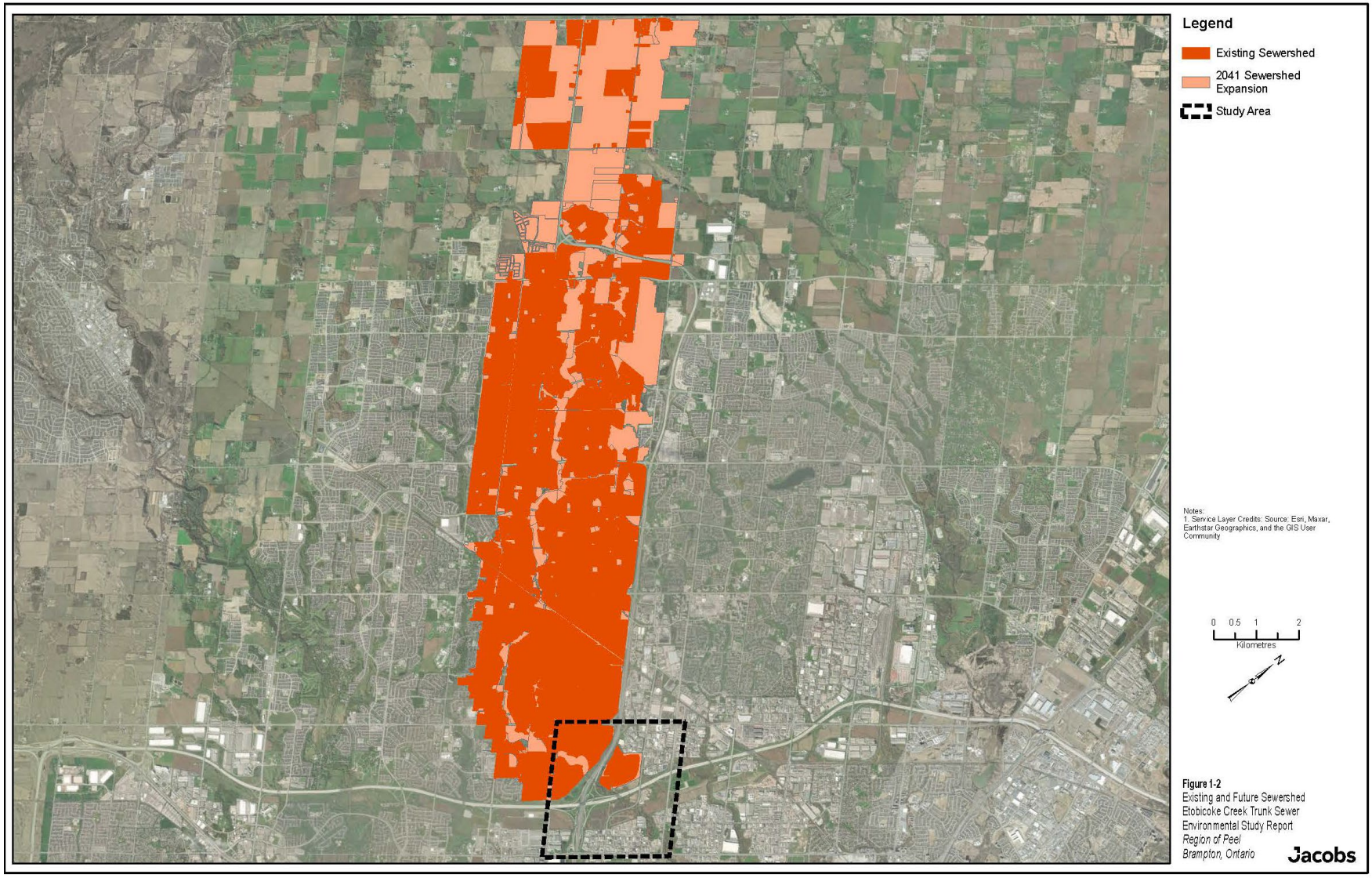
The Environmental Study Report (ESR) documents the entire planning process undertaken through Phases 1. 2 and 3. Following the completion of the draft ESR, a Notice of Completion is released to initiate a 30-day review period where stakeholders and members of the public are encouraged to review and provide comments on the ESR. Additional information on the Notice of Commencement is in Section 2.7.

It is important to note that interested persons may provide written comments at any time during the execution of the project to the project proponent (Region of Peel), or provide feedback on the project at formalized periods of consultation. In addition, a request may be made to the Ministry of the Environment, Conservation and Parks 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 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.

1.3 Study Area

As shown in Figure 1-2, the Etobicoke Creek Trunk Sewer's sewershed extends north beyond the City of Brampton's municipal boundary and captures flow generally from McLaughlin Road to the west and Highway 410 to the east. The study area is also shown on Figure 1-2.

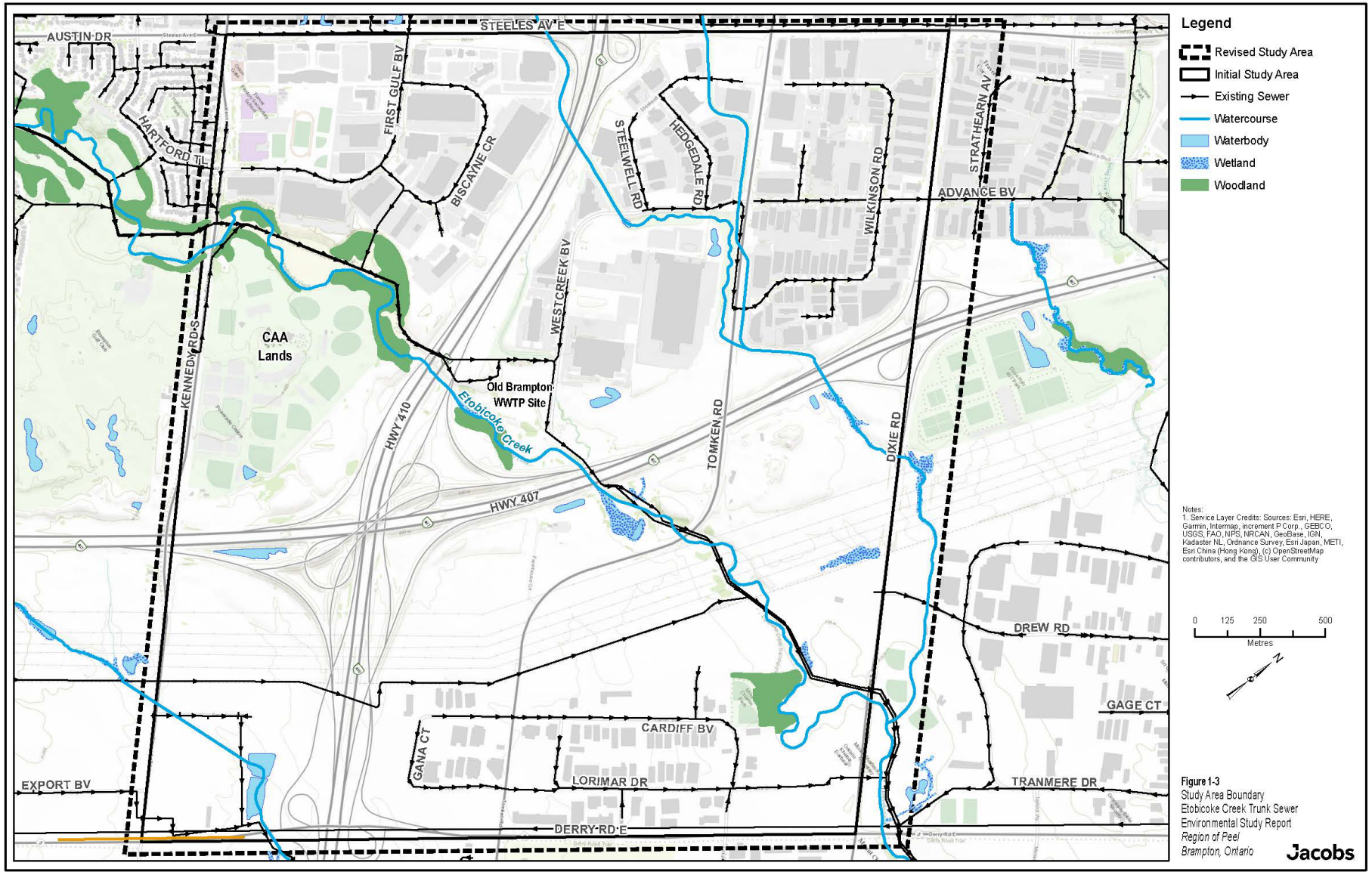
Figure 1-2. Sewershed



The Initial Study Area was bounded by Kennedy Road, Steeles Avenue, west of Dixie Road, and Derry Road East. During Phase 2, the study area was expanded slightly to include opportunities to coordinate with the ongoing East-to-West Diversion Sanitary Trunk Sewer (EWD STS), and to address the flow constraints identified beyond the initial study area's eastern boundary based on the Region's 2020 Water & Wastewater Master Plan for the Lake-Based System. The Initial Study Area and the Revised Study Area are shown in Figure 1-3.

As shown in Figure 1-3, the revised study area is slightly larger than the initial study area, with the key difference being an expansion to the east of Dixie Road.

Figure 1-3. Study Area



2. Consultation and Engagement

2.1 Public and Agency Consultation Plan

At project initiation, a Public and Agency Consultation Plan (Appendix A1) was developed to facilitate timely, effective, and consistent communications with all stakeholders throughout the EA process. The plan outlines the communications strategy and points of notification and consultation during Phases 1 to 5, as required by the Municipal Class EA process for a Schedule C EA.

In alignment with the Municipal Class EA requirements, a Schedule C project requires, at a minimum, a Public Information Centres (PICs) at the end of Phase 2 and a PIC at the end of Phase 3 to update the public and stakeholder on the development and selection of alternatives. The Notice of Study Completion is published at the end of Phase 4 prior to the publishing and filing of the Environmental Study Report (ESR).

The Public and Agency Consultation Plan was revised during Phase 2 of the EA to adapt to public gathering restrictions during the Covid-19 pandemic. The key changes to the Public and Agency Consultation Plan were:

- Notices were sent to stakeholders by email rather than by mail to reflect the closure of many workplaces during the pandemic.
- In-person Public Information Centres were not held and were instead replaced with Online Public Engagement opportunities. The Online Public Engagement occurred by posting presentation material on the Region's webpage with a designated period identified for feedback to be provided to the Region on the study findings.

2.2 Stakeholder Contact List

The Stakeholder Contact List (Appendix A2) includes external stakeholders and internal stakeholders. External stakeholders include municipalities, TRCA, provincial ministries and agencies, indigenous communities, utilities, local businesses, institutions, property owners, and interested parties. Internal stakeholders include project sponsors and advisors, and other Region of Peel Departments.

As the approval regulatory body for EAs, MECP was contacted on April 3, 2019, in accordance with MECP process for Class EAs. The project team reached out to confirm the appropriate MECP representative for the area to ensure that the consultation correspondence was directed to the appropriate person and obtain the list of indigenous communities within the study area that may be impacted by our project.

2.3 Review Agencies Consultation

City of Brampton, City of Mississauga, and the Toronto and Region Conservation Authority (TRCA) were identified as key stakeholders for consultation due to the location of the existing Etobicoke Creek Trunk Sewer being located within City of Brampton, City of Mississauga and within TRCA's Regulatory Area limits. Meetings with the Ministry of Transportation and 407 ETR also took place as part of the consultation. Several stakeholder meetings took place throughout the project. The date and purpose of each meeting has been summarized in Table 2-1.

Table 2-1. Stakeholder Pre-Consultation Summary

Ministry/Agency	Date	Type of Consultation	Summary
City of Brampton	May 31, 2019	Meeting	Introduction of the project, discussion on CAA lands redevelopment, and to solicit early input on the planned growth resulting from the 2040 Vision.
City of Brampton	November 9, 2020	Meeting	Provided overview of the preliminary preferred alternative (the Deep Trunk alternative) ahead of PIC 1.
City of Brampton	August 16, 2021	Meeting	A summary of the Phase 3 work completed was provided.
City of Brampton	May 11, 2022	Meeting	The preliminary preferred alignments, construction methods, and shaft locations were presented ahead of PIC 2.
City of Mississauga	November 16, 2020	Meeting	Overview of the preliminary preferred alternative.
City of Mississauga	May 19, 2022	Meeting	The preliminary preferred alignments, construction methods, and shaft locations were presented ahead of PIC 2.
407 ETR/Ministry of Transportation Ontario (MTO)	December 14, 2020	Meeting	A project update was provided to 407ETR and MTO.
TRCA	May 24, 2019	Meeting	To introduce the project team and gather preliminary areas of concern that the project team would need to be aware of prior to the development of alternatives.
TRCA	November 10, 2020	Meeting	The preliminary preferred alternative results were presented and discussed.
TRCA	June 14, 2021	Meeting	Overview of Phase 3 progress was provided.
TRCA	May 3, 2022	Meeting	The preliminary preferred alignments, construction methods, and shaft locations were presented ahead of PIC 2.

A full list of communications throughout Phases 1 to 3 are included in the Communications Log in Appendix A3. Appendix A3 also includes copies of the communications.

2.4 Notice of Commencement

A formal Notice of Commencement was published on June 27, 2019, in the Brampton Guardian newspaper and sent to stakeholders on June 28, 2019. Notices are in Appendix A4. It was also posted on the Region's project webpage. The purpose of the Notice was to announce the commencement of the Class EA and to briefly describe the purpose of the study. MECP was also provided with a completed Project Information Form during the mail-out.

Responses to the Notice of Commencement are included in the Correspondence Log in Appendix A3.

2.5 Public Information Centers (PICs)

2.5.1 Public Information Center (PIC) 1

PIC 1 was held as an Online Public Engagement between November 26 and December 11, 2020.

Notices were published on November 26, 2020, in the Brampton Guardian, the Mississauga News, and posted on the Region of Peel's website. This notice is in Appendix A4. Region of Peel councillors were also provided a briefing of the PIC 1 material. Additionally, email notifications were sent to those on the Stakeholder Contact List on November 26, 2020.

Presentation material for the Online Public Engagement was posted on the Region's website on November 26, 2020, in PDF and PowerPoint format. A copy of the material presented is provided in Appendix A4. Feedback on the Phase 2 findings and results were accepted for a 2-week time period from the public and all stakeholders, starting on November 26, 2020, and ending on December 11, 2020. At the completion of the comment period, follow-up requests for feedback were made to key stakeholders, City of Brampton, City of Mississauga, and TRCA.

Feedback and comments on PIC 1 material were received from the City of Brampton, the City of Mississauga, the TRCA, internal Regional departments, Mississauga of the Credit First Nation, Nation Huronne-Wendat, and one member of the general public. Key comments included TRCA's concerns on the Deep Trunk alternative and preference for the Kennedy Road alternative and requesting additional information on the impacts to the environment. Additional comments included questions on impacts to property and general inquiries. Responses to the feedback can be found in Appendix A3.

2.5.2 Public Information Center (PIC) 2

PIC 2 was held as an Online Public Engagement between May 18 to June 1, 2022.

Notices were published on May 5, 2022, in the Brampton Guardian, the Mississauga News, and posted on the Region's website. Email notifications were also sent to those on the Stakeholder Contact List on May 17, 2022. A copy of the notice can be found in Appendix A4.

Presentation material for the Online Public Engagement was posted on the Region of Peel's website on May 18, 2022, in PDF and PowerPoint format. A copy of the material presented is provided in Appendix A4. Feedback on the Phase 3 findings and results were accepted for a 2-week time period starting on May 18, 2022, and ending on June 1, 2022.

Feedback and comments were received from the City of Mississauga, Regional Capital Works, Regional Transportation Division, Peel Regional Police, Ministry of Transportation (MTO), Ministry of Northern Development, Mine, Natural Resources and Forestry (NDMNRF), and Hydro One. The City of Mississauga's Transportation and Works group provided comments primarily surrounding the new four-lane Drew Road from Dixie Road to Tomken Road, which is pending construction in 2029. Hydro One comments confirmed the presence of existing high voltage transmission facilities within the study area. Other comments received included questions on property impacts, permitting requirements, and general inquiries. Responses to the feedback received can be found in Appendix A3.

2.6 Engagement with First Nations and Indigenous Groups

Potentially affected or interested First Nations and Indigenous Communities and organizations were identified based on consultation with the MECP and include the following:

- Six Nations of the Grand River
- Mississaugas of the Credit First Nation
- Haudenosaunee Confederacy Chiefs Council
- Nation Huronne-Wendat

First Nations and Indigenous communities were sent the Notice of Completion and the draft ESR for review. The First Nations Engagement Plan and the communications log can be found in Appendix A1. Feedback from the Mississauga of the Credit First Nation, Nation Huronne-Wendat, and Six Nations of the Grand River was received throughout the study.

2.6.1 Six Nations of the Grand River

In response to the draft ESR, the Six Nations of the Grand River confirmed that they had no comments or concerns at the time.

2.6.2 Mississaugas of the Credit First Nation

In response to the Notice of Online Public Engagement for PIC 1, the Mississaugas of the Credit First Nation (MCFN) provided a formal response expressing interest in participating in field surveys for the natural environment and archaeology and providing MCFN's standards and guidelines to be followed. An agreement was executed to support participation in subsequent filed activities undertaken throughout the study, including Stage 2 Archaeological Assessment (AA) field work. However, the Field Liaison Representative was unavailable on the day of the site visit. The email communications are included in Appendix A3.

2.6.3 Nation Huronne-Wendat First Nation

The Nation Huronne-Wendat contacted the Region and requested to review the archaeological assessment undertaken for the project. The Archaeological Resources Existing Conditions Memorandum, prepared during Phase 1, was provided for their review, followed by the Stage 1 Archaeological Assessment Report completed during Phase 2.

Additional email communications were received from the Nation Huronne-Wendat First Nation indicating their interest in participating in the Stage 2 AA field work. The Nation Huronne Wendat First Nation opted to not participate in the field work but requested to be updated and indicated an interest in commenting on the draft Stage 2 AA report. The email communications are included in Appendix A3.

2.7 Notice of Completion

The Notice of Completion was issued on May 30, 2023. The Notice of Completion marks the completion of the ESR and initiates the 30-day review period of the ESR. It contains a brief description of the study, a summary of the preferred design alternative, next steps, details on how to view the ESR, dates and timing of the review period, and contact information and procedures for providing feedback on the ESR. As mentioned in Section 1.2.1.2, the ESR documents the entire planning process undertaken through Phases 1, 2, and 3. A copy of the Notice can be found in Appendix A4. Feedback obtained after the 30-day review period and in response to the Notice of Completion will be added to the final ESR in Appendix A3.

3. Baseline Features and Servicing Conditions

3.1 Planning and Servicing Considerations

Several plans and documents were used to support the establishment of baseline features and servicing conditions:

- City of Brampton Official Plan (City of Brampton, 2006)
- City of Brampton 2040 Vision (City of Brampton, 2018)
- Region of Peel Official Plan (Region, 2018a)
- Growth Plan for the Greater Golden Horseshoe (MMAH, 2019)
- Provincial Policy Statement (MMAH, 2014)
- Parkway Belt West Plan (Ontario, 1995)

These documents are described in Appendix B.

3.2 Existing and Future Land Uses

This section describes the existing and future land uses within the study area.

3.2.1 Existing Land Uses

3.2.1.1 Region of Peel

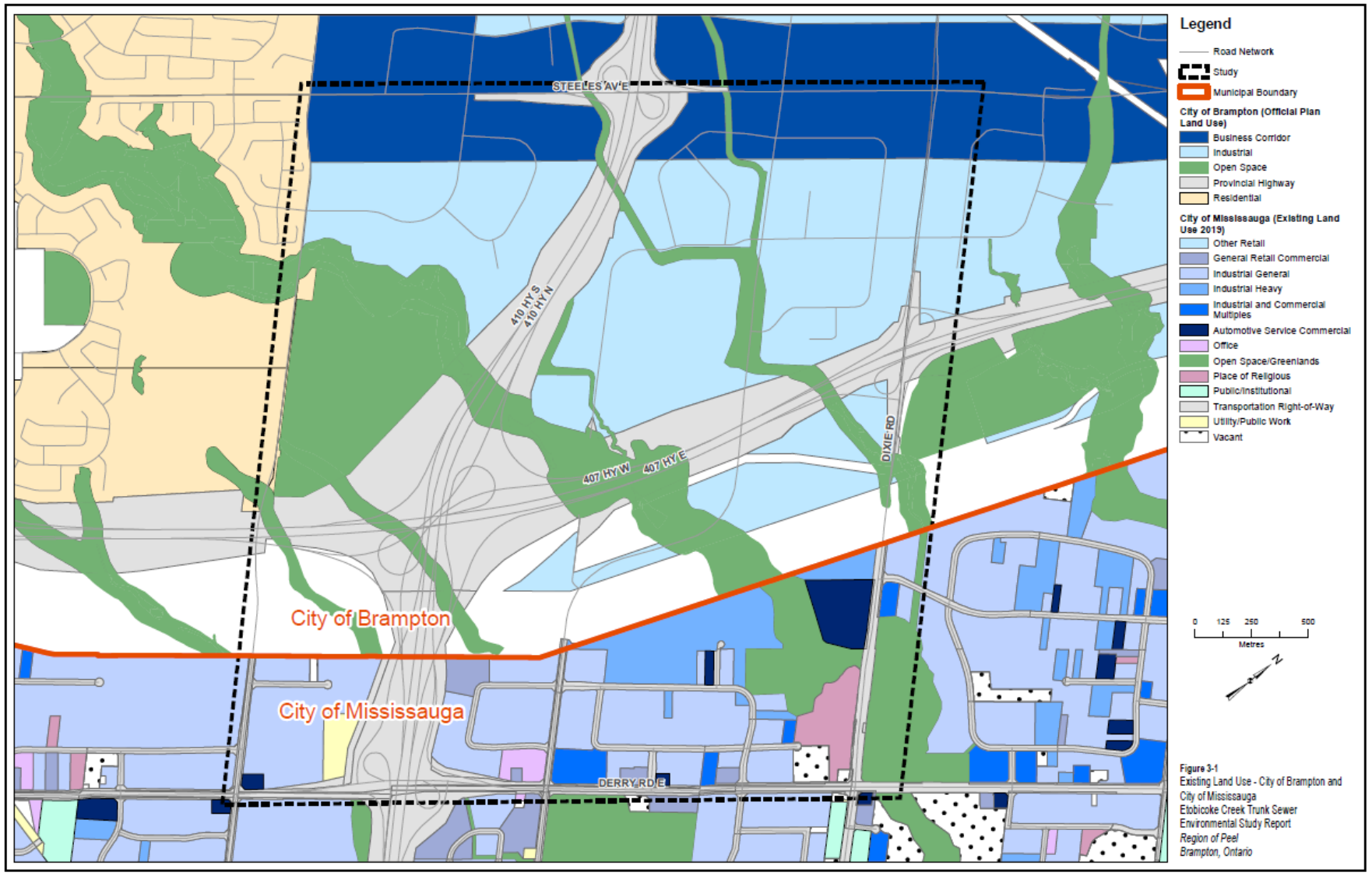
As per the Phase 1 analysis, the Initial Study Area is designated as employment lands as per the Region's 2019 Generalized Land Use shapefile.

3.2.1.2 City of Brampton

The City of Brampton's GIS information on existing land use is based on its Official Plan (City of Brampton, 2006). As shown in Figure 3-1, and the City's Official Plan (Schedule A – General Land Use Designations), the study area that is within the City of Brampton's limits is composed of lands designated as follows:

- Business Corridor in the northern part of the study area, parallel to Steeles Avenue
- Provincial Highway along both Highway 410 and Highway 407
- Industrial south of the Business corridor, reaching the limits of the Provincial Highway and south of Highway 407
- Open Space along the Etobicoke Creek valley and south of the Industrial area on the western side of the study area (current CAA Centre lands)
- Parkway Belt West south of the Provincial Highway along the utility corridor that is parallel to Highway 407

Figure 3-1. Existing Land Use - City of Mississauga and City of Brampton



3.2.1.3 City of Mississauga

As per the City of Mississauga's 2019 Existing Land Use shapefile (Mississauga, 2019), the existing land use in the City of Mississauga (Figure 3-1) shows that the majority of the study area is generally Industrial and Commercial. There is a pocket of land on the southeastern corner of the study area (northwest of Dixie Road and Derry Road) that is designated as a Place of Religious Assembly, whereas the lands of Etobicoke Creek valley are designated as Open Space/Greenlands. There is a small pocket of Utility/Public Work area northwest of Highway 410 and Derry Road East currently being used as a stormwater management pond (Toronto and Region Conservation 2006).

3.2.1.4 Toronto Region Conservation Authority

The TRCA regulatory flood plain surrounds the Etobicoke Creek that runs through the study area. The regulatory flood plain are boundaries determined by the TRCA and indicate the extent of flooding expected to be seen during the 100-year flood or the Regional Storm event, whichever is greater.

3.2.1.1 Utility Corridors

There is a hydro corridor and Infrastructure Ontario lands within the study area. The Infrastructure Ontario lands include Highway 407 and Highway 410. The hydro corridor runs parallel to Highway 407. See Section 3.4.2 for more information on the hydro corridor.

3.2.2 Future Land Uses

3.2.2.1 Region of Peel

Based on the broad category land use designation in the Regional Official Plan future land designations for the study area include Urban System (Schedule D) and Built-up Area (Schedule D4).

3.2.2.2 City of Brampton

Based on the 2040 Vision, land uses within the Brampton Uptown area are redesignated from the 2006 Brampton Official Plan to include the following:

- Residential/ Housing west of Highway 410 and just south of Steeles Avenue East
- Institution east of Kennedy Road and just south of Steeles Avenue East
- Entertainment/ Culture northwest of the intersection of Highway 410 and Highway 407
- Office Space at the southwest corner of Highway 410 and Steeles Avenue and another at the northwest corner of Highway 410 and Highway 407
- A small pocket of Mixed-Use area east of Kennedy Road and north of Highway 407

3.2.2.3 City of Mississauga

As per the City of Mississauga's Official Plan (Schedule 10 – Land Use Designations), the small southern section of the study area that falls within the City of Mississauga would be designated as follows:

- Business Employment for most of the study area
- Large pockets of Industrial on either side of Tomken Road
- Greenlands along the Etobicoke Creek valley area and a small pocket northwest of the intersection of Highway 407 and Derry Road
- A pocket of Public Open Space northeast of the bend at Cardiff Boulevard

3.2.3 Future Capacity Forecasts

The planning information and population forecast were selected for the project by the Region of Peel to reflect the future growth anticipated within the service area for the Etobicoke Creek trunk sewer. The following population forecast (Table 3-1) was obtained from the Region's *2013 Water and Wastewater Master Plan* for the City of Brampton for the 2031 planning horizon and from the Region's *2020 Water and Wastewater Master Plan for the Lake-based Systems* for the 2041 population projections.

Table 3-1. Master Plan Population Forecast for Brampton

Population Type	2011	2016	2021	2026	2031	2041
Residential	534,000	599,000	659,000	714,000	758,000	890,000
Employment	203,000	239,000	274,000	295,000	320,000	325,000
Total	737,000	838,000	933,000	1,009,000	1,078,000	1,215,000

* Populations for 2011-2031 are from the completed 2012 Master Plan, whereas the 2041 populations are from the 2020 Master Plan update (PIC #2).

The population growth projected for the City of Brampton was used to develop population forecasts for the Etobicoke Creek Trunk Sewer's sewershed, as is presented in Table 3-2. The information presented in Table 3-2 is intended for capacity analysis only and would be subject to review and approval through the official planning processes of the City of Brampton and Region of Peel.

Table 3-2. 2041 Intensified Population Forecast for Trunk Sewer Sizing

Population Type	Population	Intensification Forecast	Population Forecast for Sizing
Residential	209,560	37,955	247,515
Employment	83,720	22,835	106,555

Source: Program Planning Material for 2041 Population Forecast (provided August 2019) and Master Plan Development Areas for Intensification Forecast (provided April 2019)

It should be noted that the planning numbers presented in Table 3-2 were used to develop flows in the future growth scenario in the hydraulic model during Phase 1. However, during Phase 2, the Region requested additional flows beyond the population forecasts to also be accounted for. These additional flows correspond to previously approved development applications, and the impact of these flows is explained in Section 3.3.3.

3.3 Condition Assessment of Existing Infrastructure

The existing Etobicoke Creek Trunk Sewer within the Study Area primarily consists of twinned section of reinforced concrete pipe, ranging in diameter from 1050 mm to 1350 mm, constructed at different times between 1957 and 2007. The majority of the sewer was constructed in the early 1970s.

3.3.1 Previous Studies

A feasibility study titled "*Feasibility Study of Sanitary Sewer at Old Brampton WWTP*" (Region 2018) was completed in 2018 in order to provide recommendations on a solution that would resolve issues in the exiting trunk sewer in the area around the Old Brampton Wastewater Treatment Plant (WWTP). A number

of operating and performance issues were identified in the report for the stretch of sanitary trunk sewers from Kennedy Road to the area just south of the 407. The identified issues include:

- A repair using CIPP (cured in place pipe) lining is defective
- High permanent water level in sections of the trunk sewer and historical surcharging
- Uneven flow indicating inconsistent sewer slopes
- Inadequate cover above the Biscayne sewer connection with one section of exposed pipe found
- In some areas there are excessively deep access chambers due to installation of highway ramps over top of the alignment
- Inflow from an abandoned connection to the trunk sewer
- Two access chamber locations are located within a major highway (Hwy 410) road allowance. Access to the MHs is difficult and a health and safety hazard
- A section of the sewer is located within the abandoned Old Brampton WWTP site. Contaminated soil has been found on the site and poses a risk to workers if emergency repairs are required on the sewer
- An influent chamber, flume and outlet drop pipe are located along the run of the trunk sewer at the Old Brampton WWTP site. These structures disrupt flow in the existing sewer and are no longer required as the treatment plant has been abandoned.

A field visit carried out in May 2019 to review the findings of the feasibility study, noted additional concerns, including difficulty accessing some maintenance holes and a missing access cover at the Old Brampton WWTP. Photos and additional details are provided in Appendix B.

3.3.2 CCTV Database Review

The Region's CCTV database was reviewed in order to obtain the most current condition assessment information of the existing sewers. The assets conditions were reviewed and graded according to NASSCO's Pipeline Assessment Certification Program (PACP). NASSCO's PACP categorizes defects as either Structural or Operations & Maintenance defects, each of which are assigned one of five different Condition Grades, defined as follows:

1. Minor defect grade
2. Minor to moderate defect grade
3. Moderate defect grade
4. Significant defect grade
5. Most significant defect grade

Table 3-3 provides a summary of the findings of the review of available reports and videos.

Table 3-3. CCTV Summary

Asset	Peak Structural Condition Grade (*indicates Condition Grade)	CCTV Report Available	CCTV Video Available	CCTV Analysis Comments
768396	3*	No	Yes	Structural defects consist of one continuous defect of Surface Roughness Increased, and one Circumferential Crack. Given two structural defects of Condition Grade 1, no rehabilitation or replacement recommended. Operation and Maintenance defects consist of one Infiltration Gusher, two Infiltration Runners, one Infiltration Dripper, three Ragging Deposits, and eleven Encrustation Deposits.
789887	3*	Yes	Yes	Liner installed. Structural defects consist of one continuous defect of Liner Wrinkled. Given the orientation, clock reference position, and size of the wrinkling, no rehabilitation or replacement recommended, however reinspection recommended due to age and video quality for reassessment
768022	4*	No	Yes	Structural defects observed consist of one Surface Reinforcement Projecting consisting of 4 point locations (identified as Hole in report). Rehabilitation is recommended. No Operation and Maintenance defects observed.
548613	3*	No	No	No data available.
789889	3*	Yes	Yes	Liner installed. Structural defects consist of one continuous defect of Liner Wrinkled, and what appears to be one point defect and one continuous defect of Liner Delamination. Given the orientation, clock reference position, and size of the wrinkling, no rehabilitation or replacement recommended, however reinspection recommended due to age and video quality for reassessment.
548614	3*	No	No	No data available.
221922	3*	No	Yes	Structural defects observed consist of one Surface Reinforcement Projecting. Rehabilitation or replacement is recommended. Operation and Maintenance defects consist of one Encrustation Deposit.

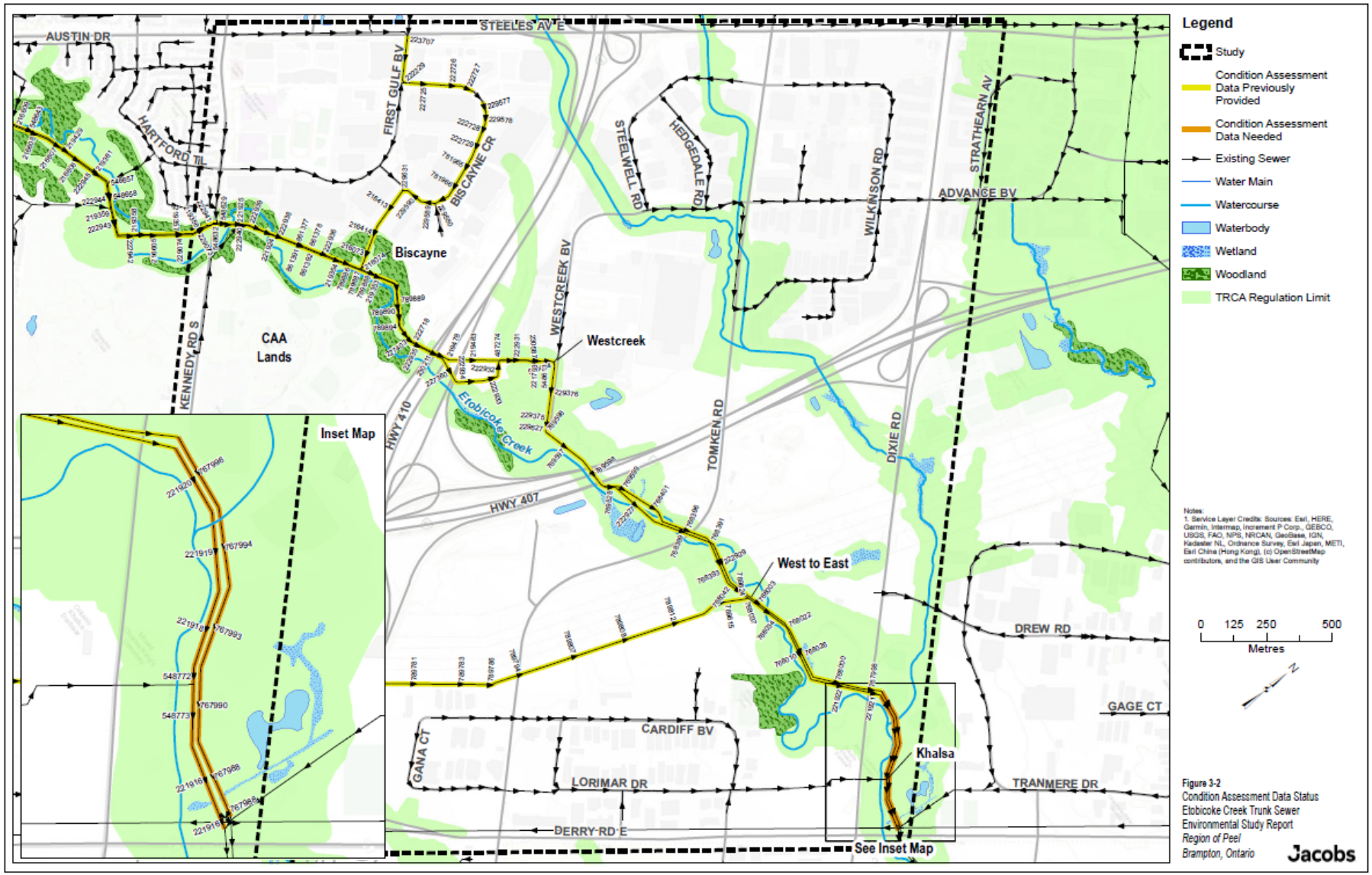
Asset	Peak Structural Condition Grade (*indicates Condition Grade)	CCTV Report Available	CCTV Video Available	CCTV Analysis Comments
769598	3*	Yes	Yes	Structural defects observed consist of one Longitudinal Fracture. Given one observed structural defect of Condition Grade 3, no rehabilitation or replacement recommended. Operation and Maintenance defects consist of two Infiltration Drippers, two Infiltration Runners, and one Hard/Compact Settled Deposits (% not provided).
219354	3*	Yes	Yes	No structural defects observed. Operation and Maintenance defects consist of five Encrustation Deposits (% not provided).
SMH-1802514-SMH-1802509	3	No	Yes	Structural defects observed consist of continuous Surface Damage Aggregate Projecting, Surface Damage Roughness Increased; surface lining recommended. No Operation and Maintenance defects observed.
SMH-1802515-SMH-1802514	3	No	Yes	Structural defects observed consist of continuous Surface Damage Roughness Increased and continuous Surface Aggregate Projecting; surface lining recommended. Operation and Maintenance defects consist of Ragging.
SMH-1802516-SMH-1802515	2	No	Yes	Structural defects observed consist of continuous Surface Damage Roughness Increased and Surface Damage Spalling; surface lining recommended. Operation and Maintenance defects consist of Ragging at both the start and end MH, and Encrustation Deposits (5%).
SMH-1802517-SMH-1802516	3	No	Yes	Structural defects observed consist of Surface Damage Roughness Increased, continuous Surface Damage Spalling, Surface Aggregate Projecting; surface lining recommended. Operation and Maintenance defects consist of Ragging at both the start and end MH.
SMH-1802518-SMH-1802517	3	No	Yes	Structural defects observed consist of Surface Damage Roughness Increased, continuous Surface Damage Spalling, and Surface Aggregate Projecting; surface lining recommended. Operation and Maintenance defects consist of Deposits Attached Encrustation and Ragging.

Asset	Peak Structural Condition Grade (*indicates Condition Grade)	CCTV Report Available	CCTV Video Available	CCTV Analysis Comments
SMH-6539627-SMH-6539626	3	No	Yes	Structural defects observed consist of Surface Damage Corrosion, continuous Surface Damage Spalling, and Surface Damage Roughness Increased; surface lining recommended. Operation and Maintenance defects consist of Infiltration Runner, Infiltration Stain, Infiltration Gusher, Infiltration Dripper, Deposits Attached Grease, and Deposits Attached Encrustation (5%).
SMH-6539628-SMH-6539627	2	No	Yes	Structural defects observed consist of continuous Surface Damage Spalling, and Surface Damage Roughness Increased; no rehabilitation or replacement recommended. Operation and Maintenance defects consist of Deposits Attached Encrustation (5%).
SMH-6539629-SMH-6539628	1	No	Yes	Structural defects observed consist of Surface Damage Roughness Increased; no rehabilitation or replacement required. No Operation and Maintenance defects observed.
SMH-6539630-SMH-6539629	1	No	Yes	Structural defects observed consist of Surface Damage Roughness Increased; no rehabilitation or replacement required. No Operation and Maintenance defects observed.
SMH-6539631-SMH-6539630	1	No	Yes	Structural defects observed consist of Surface Damage Roughness Increased; no rehabilitation or replacement required. No Operation and Maintenance defects observed.

Based on current available data, the sewers can be considered to be in relatively good condition with few structural defects identified, primarily consisting of varying degrees of surface damage. Some segments that had previously been rehabilitated were noted as exhibiting structural defects on the liners. Additionally, segments with surface damage type defects with structural defect scores of 3 or higher have had rehabilitation recommended to increase the remaining lifespan of the sewer. Increased re-inspection frequency of the sewer is recommended to monitor the rate of deterioration.

Figure 3-2 shows the locations of the pipes in which condition assessment data has been received and assessed. The condition of the existing Etobicoke Creek Trunk sewer between Dixie Road and Derry Road has not been assessed as part of this study.

Figure 3-2. Condition Assessment Data Status



Risk-based prioritization of the rehabilitation works has not been conducted.

3.3.3 Hydraulic Analysis of Pipe Capacity

The analysis of the existing Etobicoke Creek trunk sewer system capacity within the study area was assessed using the Region's hydraulic model (received on April 12, 2019), which had recently been updated as part of the 2020 Water and Wastewater Master Plan Update project to include 2041 conditions and recent flow calibration efforts.

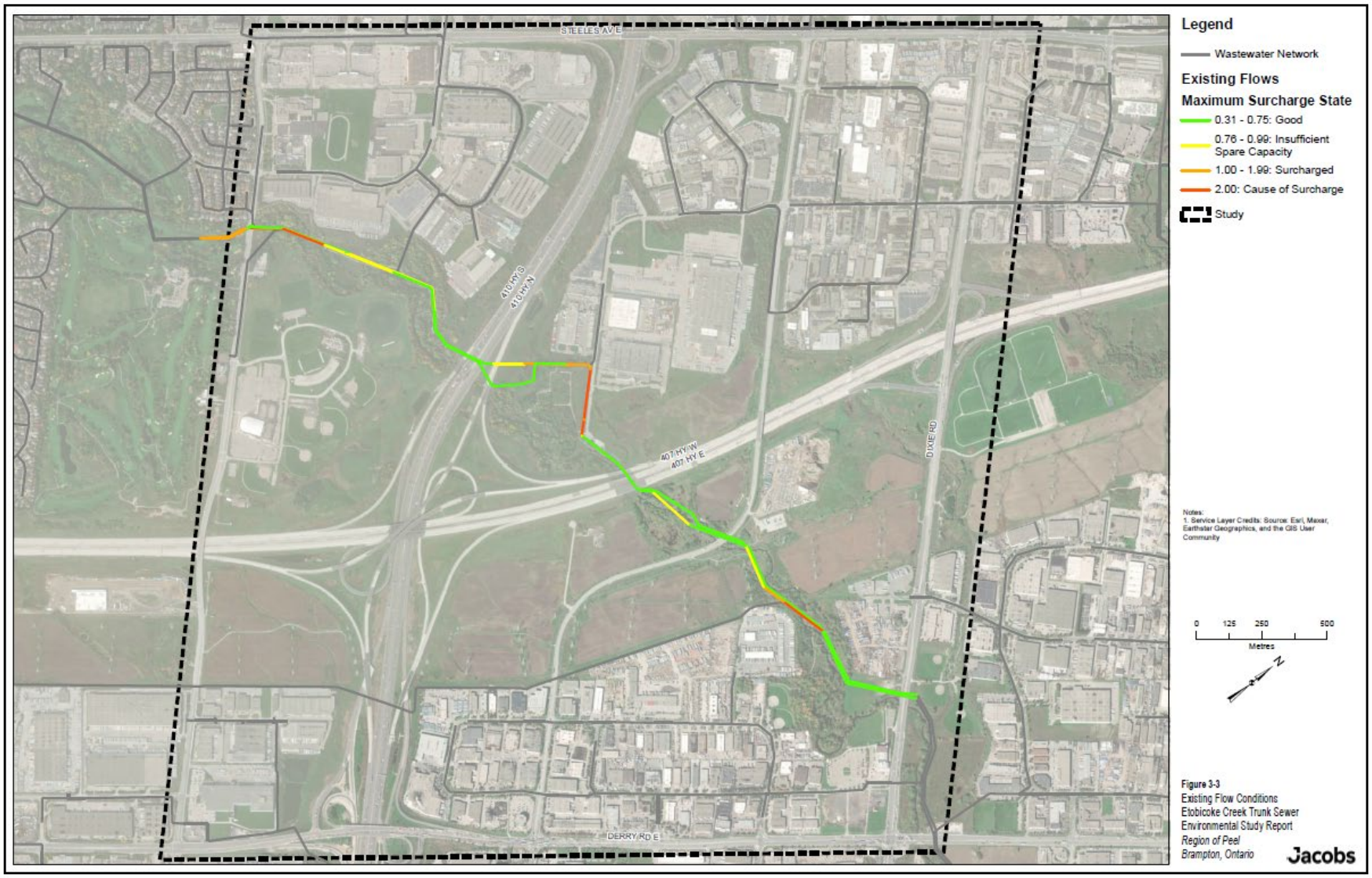
The model was used to assess hydraulic and capacity issues under existing conditions and the ability of the existing infrastructure to accommodate the projected future growth. A 5-year storm event was used to assess capacity under wet weather flow conditions; for conservative planning purposes, the Soil Conservation Service (SCS) type storm profile was applied, which models more aggressive and peaky flows in the sewers compared with the AES type storm counterparts.

The existing sewer was determined to be constrained from a capacity standpoint when flows exceeded 85% of the sewer capacity during the 5-year storm event. The results of the modelling are summarized as follows.

3.3.3.1 Existing Conditions

Under the existing conditions scenario, the model was run to identify segments within the study area with existing capacity constraints as defined by degree of surcharging. Pipes with a surcharge state of 1 or 2 are considered to have capacity constraints. These locations are shown on Figure 3-3.

Figure 3-3. Existing Flow Conditions

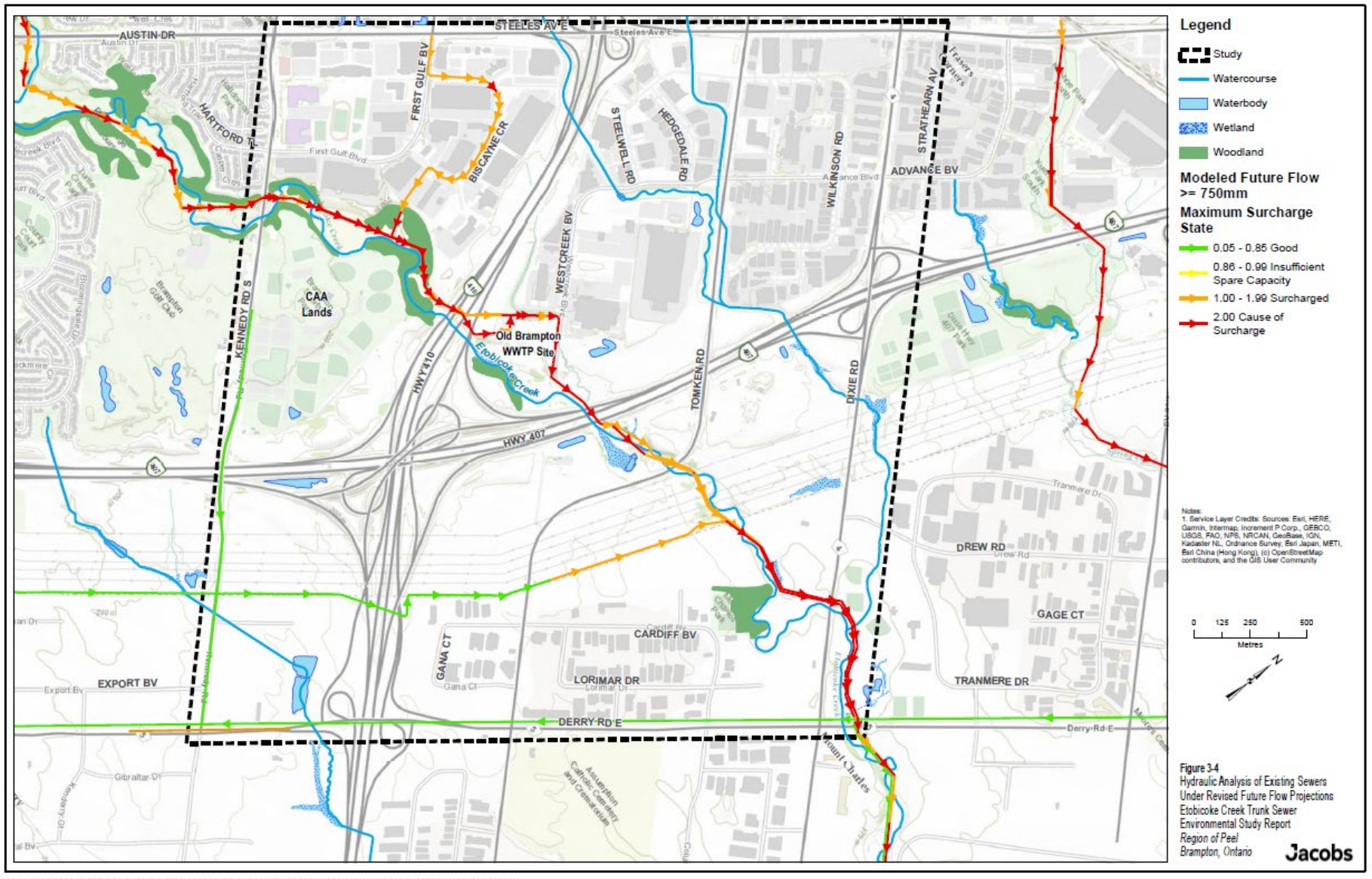


Of the 65 segments running through the study area, 28% can be considered to be constrained from a capacity standpoint under existing conditions, which equates to 26.3% of the total length of the sewer. Note that the sewers south of Dixie Road were not included in the existing conditions analysis, however, were considered during updated future conditions analysis as indicated in Section 3.3.3.2.

3.3.3.2 Future Conditions

An analysis of the ability of the existing infrastructure to accommodate future flow was undertaken by using a 2041 Model Scenario. The hydraulic analysis of the existing sanitary trunk sewer completed during Phase 2 reflected the revised future flow projections and the Revised Study Area to understand potential constraints on the existing system. The revised future flow projections included the addition of flows from previously approved development applications. The results indicated that of the 74 segments running through the study area, 100% are constrained from a capacity standpoint to meet future flow conditions. Therefore, additional capacity will be required to meet the future flow demands. The results are summarized on Figure 3-4.

Figure 3-4. Hydraulic Analysis of Existing Sewers under Revised Future Flow Projections



3.4 Existing Utilities

The following section contains a preliminary list of utility companies generally known to have infrastructure within the Region of Peel. They were assessed for available information on their infrastructure and subsequent location within the study area.

3.4.1 Gas/Oil

There is potential for the presence of gas infrastructure owned by Enbridge Gas Distribution Inc., specifically since a section of its Greater Toronto Area (GTA) project 0 EB-2012-0451 passes along the Parkway Belt/ Utility Corridor.

There is also potential for the presence of infrastructure owned by Enbridge Pipelines Inc. based on the interactive map available on its website.

3.4.2 Hydro

There is a hydro transmission line/corridor parallel to the south of Highway 407 in the Parkway Belt West Plan area with a related substation just east of Tomken Road. As the area is serviced by Alectra Utilities, there is potential for Alectra's infrastructure to be present within the study area.

3.4.3 Telecommunication and Cable

As the study area is included within Rogers Communications' and Bell Canada's coverage network, there is potential for their respective infrastructure to be present within the study area.

3.4.4 Municipal Infrastructure

3.4.4.1 Region of Peel -Water and Wastewater Infrastructure

The water distribution network is shown in Figure 3-5. Critical water infrastructure crosses the study area as shown in Figure 3-5, including a 1200mm,1500mm, and 2100mm transmission main. The 2100mm transmission main crosses the Etobicoke creek on the north west side of the study area near Kennedy Rd. The location and depth of this infrastructure will need to be taken into consideration in the development of alternative solutions for this project. The wastewater collection network is shown in Figure 3-6.

Figure 3-5. Water Distribution Network

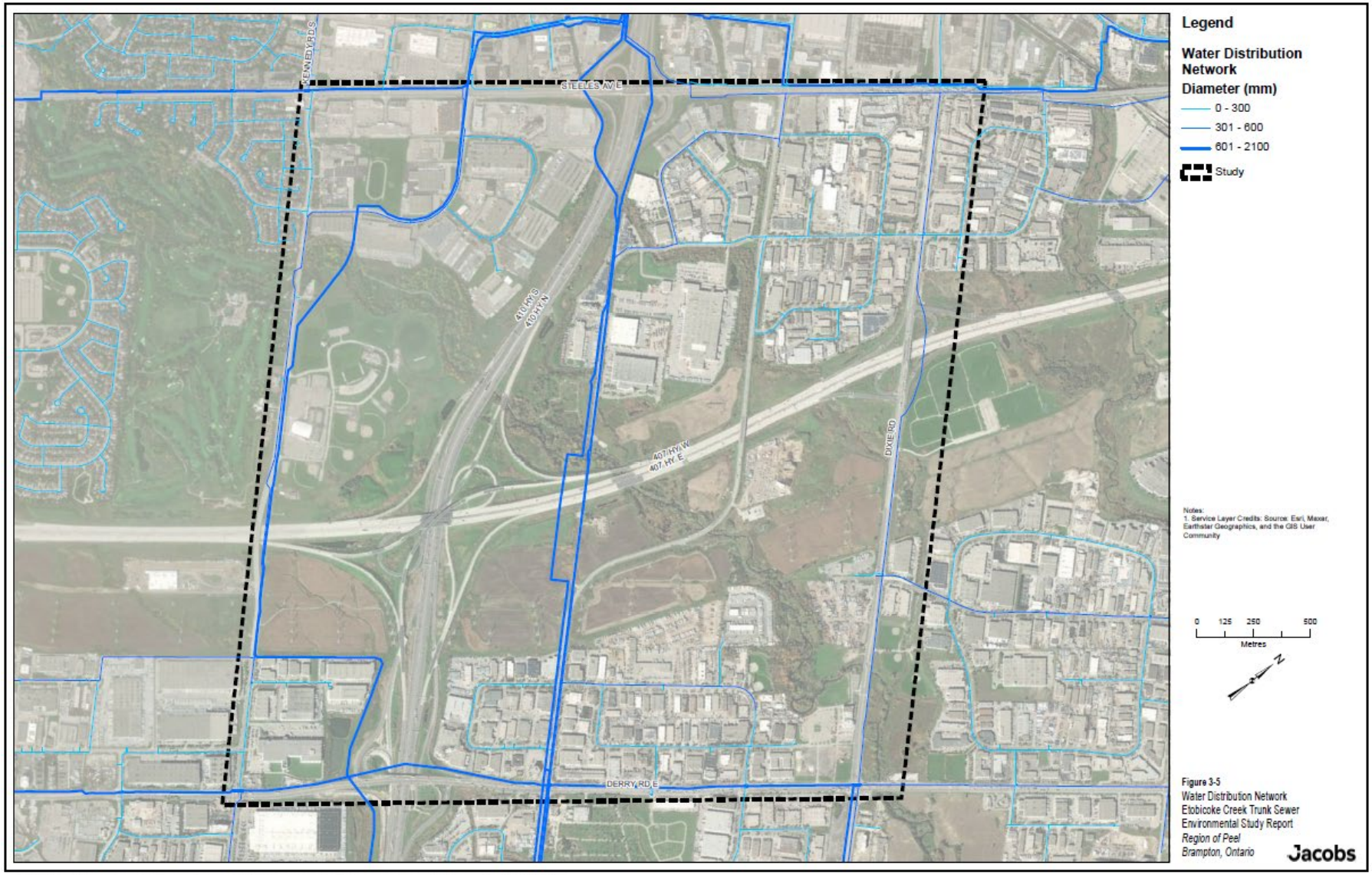
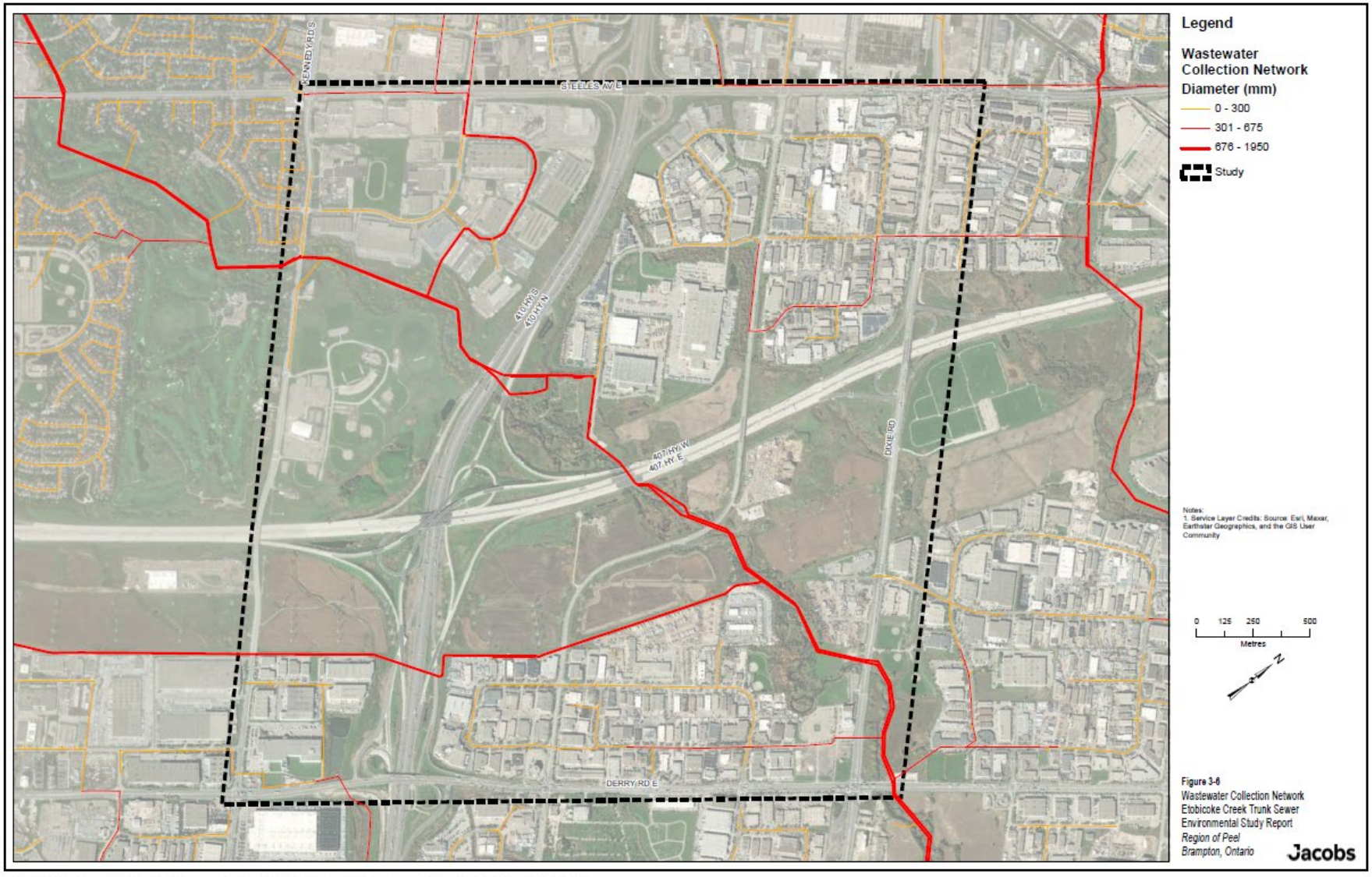


Figure 3-6. Wastewater Collection Network



3.5 Existing Transportation Network

3.5.1 Road Network

The road network within the study is composed of the following key roads classified by the Region, the City of Brampton, and the City of Mississauga within the study area:

- Steeles Avenue (Regional – Commercial Connector west of Highway 410 and Industrial Connector east of Highway 410)
- Derry Road (Regional – Industrial Connector throughout the study area)
- Dixie Road (Regional – Industrial Connector throughout the study area)
- Kennedy Road (City of Mississauga – Major Collector throughout the study area; City of Brampton – Minor Arterial throughout study area)
- Tomken Road (City of Mississauga – Major Collector throughout the study area; City of Brampton – Minor Arterial throughout study area)
- First Gulf Boulevard (City of Brampton – Minor Arterial throughout the study area)
- Westcreek Boulevard (City of Brampton – Minor Arterial throughout the study area)
- Advance Boulevard (City of Brampton – Minor Arterial throughout the study area)

3.5.2 Public Transit

The study area contains transit routes operated by both the City of Brampton and the City of Mississauga, and routes operated in conjunction by both. The routes are summarized as follows:

The City of Brampton operates the following transit routes within the study area:

- Route 7/7A along Kennedy Road South within the study area
- Route 10 along Rutherford Road South and looped through the industrial/commercial area in the northwestern corner of the study area
- Routes 11/11A along Steeles Avenue within the study area
- Route 18 along Dixie Road within the study area
- Route 40 along Advance Boulevard, West Drive and looped through the industrial/commercial area in the northeastern corner of the study area.
- Züm routes 511/511A/511C along Steeles Avenue East within the study area

The City of Mississauga operates the following transit routes within the study area:

- Route 5 along Columbus Road and looped through the industrial/commercial area in the southeastern corner of the study area
- Route 15 along Dixie Road south of Drew Road, along Derry Road and looped through the industrial/commercial area in the southeastern corner of the study area
- Route 42 along Derry Road within the study area
- Route 51 along Tomken Road and looked through the industrial/commercial area in the southeastern corner of the study area

City of Brampton and City of Mississauga jointly operate the following routes within the study area:

- Express Route 104 along Derry Road within the study area
- Express Route 185 along Dixie Road within the study area

Based on the Official Plans of City of Brampton and City of Mississauga, the following roads are considered important for transit services and also form the boundary limits of the study:

- Kennedy Road is a Primary Transit Corridor in the City of Brampton.
- Dixie Road is a Primary Transit Corridor in the City of Brampton and a Transit Priority Corridor in the City of Mississauga.
- Steeles Avenue is a BRT Corridor.
- Derry Road is a Transit Priority Corridor in the City of Mississauga.

3.5.3 Cycling Routes

There are several roads and routes within the study area that are designated as cycle routes by both the City of Brampton and City of Mississauga.

The City of Brampton has designated the following areas as part of its cycling paths:

- Kennedy Road from Brampton Sports Park onwards to the south: Multi-use Path – paved and located within the roadway boulevard (in place of a sidewalk) and shared by both pedestrians and cyclists.
- Etobicoke Valley Trail from Kennedy Road at Brampton Sports Park diagonally crossing under Highways 410 and 407 and onwards to southeast of Tomken Road: Paved Park Path – paved paths through parks or connections between two streets.

The City of Mississauga has allocated the following areas as part of its cycling paths:

- Derry Road from Tomken Road to Dixie Road: Multi-Use Trail – Paved trails separated from the road and shared by cyclists and pedestrians.
- Cardiff Boulevard from Derry Road until south of Mount Charles Park: Signed Bike Route – Green bike route signs indicate bike route; cyclists and motorists share the road.

3.6 Current and Future Infrastructure Projects

The study area has recent, ongoing, and future planned projects within its boundaries. The projects are listed as follows:

- TRCA undertook an Etobicoke Creek Restoration Planning project to the northeast of the intersection of Highway 410 and Highway 407, specifically to the northeast of the Old Brampton WWTP.
- Kennedy Valley Trail: City of Brampton, in collaboration with TRCA, completed a pathway southeast from Kennedy Valley (western extent at Kennedy Road South) to Mississauga Trail (east of Etobicoke Creek and south of the boundary between Brampton and Mississauga), including under Highway 410 with TRCA along Etobicoke Creek. This project was completed in 2021.
- Westcreek Boulevard: City of Brampton's Traffic Operations section upgraded street lighting on Westcreek Boulevard from Tomken Road to the southern limits of the road. This project was completed in 2020.
- Watermain Replacement and Improvement on Steeles Avenue East: The Region of Peel replaced a watermain in the City of Brampton along Steeles Avenue East from Tomken Road to Dixie Road. This project was completed in 2019.
- Highway 410 Widening: MTO widened Highway 410 from Queen Street to south of Highway 401. The construction commenced in 2014 and completed in 2018.

- East to West Diversion Sanitary Trunk Sewer: The Region is implementing a diversion sanitary trunk sewer that is anticipated for its first contract at the beginning of 2020 and the other in late 2020. Completion of construction is expected for 2024.
- Dixie Road/Drew Road: The Region's infrastructure planning included road work being done on the westbound right-turn lane of the intersection.
- Derry Road/Cardiff Boulevard: The Region's infrastructure planning included road work being done on the northbound left-turn lane of the intersection.
- Derry Road/Kennedy Road: The Region's infrastructure planning included road work being done on the northbound right-turn lane of the intersection.
- Derry Road/Tomken Road: The Region's infrastructure planning included road work being done on the eastbound dual left and northbound right-turn lanes of the intersection. The budget was allocated for 2021.

3.7 Geotechnical Analysis

3.7.1 Regional Geology and Overburden

A Geotechnical Desktop Study was undertaken as part of a technical baseline review that identified the physiography of the Initial Study Area as Peel Plain composed of glacial till soils and characterized as a level to undulating tract of clayey soils covering approximately 800 square kilometres across central portions of the Regional Municipalities of York, Peel, and Halton. These sediments represent the bottom of the former glacial Lake Peel, which formed between an ice front to the north, the Niagara Escarpment to the west and the Trafalgar Moraine located to the east. The beveled till of the Peel Plain is made up of clay soils and overlies shale and limestone till. The Peel Plain sediments gradually slope towards Lake Ontario, following the topography of the underlying Halton Till. The general elevation is from 186 metres above mean sea level (masl) to 210 masl. The groundwater recharge in the area is relatively low because of the predominance of clay and silt substrate and deforestation.

The *Quaternary Geology of Ontario, Southern Sheet*, Map 2556, issued by the Ontario Ministry of Energy, Northern Development and Mines (MENDM 1991a), indicates that the overburden soils in the region of study area consist of Halton Till deposits. The Halton Till is formed by the last major advance of the Lake Ontario basin ice lobe (Sharpe and Russel 2007). These deposits primarily comprise a dense, sandy to silty clay till that is clast poor and reddish brown in colour and often interbedded with silt, clay, sand, and gravel. The Halton Till is typically 3 m to 6 m thick but locally can range from 15 m to 30 m in thickness.

Isolated glaciolacustrine deposits are also identified in the vicinity of Etobicoke Creek located within the study area. These deposits consist of massive to laminated silt and clay and may contain poorly sorted diamicton (unsorted to poorly sorted and contains particles ranging in size from clay to boulders).

The *Bedrock Geology of Ontario, Southern Sheet*, Map 2544 (MENDM 1991b) indicates that the bedrock underlying the region is identified as Georgian Bay Formation. This formation of the Upper Ordovician age consists of a dark grey to olive shale with numerous thin, fossiliferous, hard layers of limestone and siltstone. The Georgian Bay Formation is well exposed in outcrop as cliffs along the valleys of the Humber River, Mimico Creek, Etobicoke Creek, and lower Credit River.

3.7.2 Fill

Fill was encountered below the topsoil in most of the referenced historical boreholes in the Initial Study Area and ranged in thickness from about 0.8 m to 8.0 m. Both cohesive and cohesionless fill soils were encountered in the referenced historical boreholes. The cohesive portion of the fill consists of clayey silt with sand to some sand, containing trace gravel and silty clay to gravelly sandy silty clay as well as organic matter and rootlets. The Atterberg testing results indicate the material is classified as silty clay of low plasticity to intermediate plasticity. The cohesionless portion of the fill consists of silty sand containing

some gravel and trace clay and gravelly silty sand to gravelly sand to sand and gravel, as well as organic material and rootlets in some boreholes.

3.7.3 Surficial Deposits

The surficial deposits were found mainly below the fill material along the creeks and their flood plain lines in the referenced historical boreholes. These deposits consist of clayey silt to silty clay containing some sand, silty sand with some gravel, and sand and gravel.

Alluvial deposits consist of silty sand with gravel to gravel with silty sand. Some areas containing fragments of shale in the lower portion of stratum were inferred in the southern part of Etobicoke Creek that extends from ground surface down to bedrock. There were also some areas covered by a thin layer of Glacial Till.

3.7.4 Cohesive Glacial Till

The cohesive clayey silt to silty clay till deposit is the predominant strata that were encountered mostly below the surficial soils through referenced historical investigation in the vicinity of the Initial Study Area. The Glacial Till deposit consists of clayey silt – silty clay to silty clay with sand to clayey sand, containing trace to some gravel. Based on the Atterberg limits tests, results indicate the silty clay till is a low to intermediate plasticity.

The presence of cobbles and boulders within the till deposit were inferred, as noted, on the borehole records, based on observation of cobbles, auger grinding and difficult drilling conditions.

3.7.5 Non-cohesive Glacial Till

Underlaying the cohesive Glacial Till in some boreholes were a grey non-cohesive till described as a very dense silty sand. However, if this non-cohesive material is subjected to an unbalanced hydrostatic head, “boiling” may result.

3.7.6 Bedrock

Ontario Geological Survey (OGS) Map 2544 (MENDM 1991b) indicates that the Region is located on the contact boundary of the Queenston and Georgian Bay Formations. The Queenston Formation consists of reddish shale, and the Georgian Bay Formation consists of grey shale with limestone interbedding.

The limited number of OGS boreholes referenced previously were advanced to the bedrock surface and encountered grey shale bedrock (Georgian Bay Formation) at a depth of approximately 1 m to 24 m below grade. However, based on the surficial geology of Ontario (OGS 2010), the bedrock surface has been exposed in the ground surface along the Etobicoke Creek from Kennedy Road at the western side to southeast of the study area south of Highway 407.

3.8 Hydrogeology

The revised hydrostratigraphic framework model of Halton Till in the Greater Toronto Area under interpretation (D.R. Sharpe and H.A.J. Russell 2013) presents that Halton Till strata comfortably rest on, and are intercalated with, Oak Ridges Moraine sediment rather than being explicitly associated with a glacial Lake Ontario basin ice advance (Sharpe and Russel 2013).

The low-relief Halton Till plain setting (west of the Humber River in Peel) is the thickest, most fine-grained, and most homogeneous Halton Till. Sediment may be up to 30 m thick; however, it can thin to less than 5 m where the till plain meets the Oak Ridges Moraine (Russell et al. 2005). Halton Till has a gradational basal contact, laminated interbeds, and it becomes more massive and richer in gravel upward. Massive diamicton has horizontal hydraulic conductivity (K) of I x 10-5 cm/s to I x 10-3 cm/s and vertical

K of I x 10-6 cm/s to 1 x 10-7 cm/s (Golder and Associates 1994). Interbedded sand and gravel sediment has K values of I x 10-4 cm/s, whereas interbedded sand-gravel and diamiclon has K values of I x 10-3 cm/s (Golder and Associates 1994). In general, low gradients on thick, muddy Halton Till sediment promote direct run-off to streams rather than infiltration to groundwater.

The groundwater level that has been recorded on the historical geotechnical investigations in the vicinity of the study area indicate the groundwater level range of 0 m to 7 m below ground surface. For boreholes close to the creek, the groundwater levels have been observed to follow the creek water level. These observations also indicate that the natural hydraulic gradient is towards the creek, confirming that the Etobicoke Creek controls the drainage in the general area.

3.9 Natural, Cultural, and Social Environment Inventory

3.9.1 Natural Features Assessment

A desktop review was undertaken as part of this Class EA to identify environmentally sensitive features that may affect the study area and potential alternatives. The work involved a records review and a preliminary site visit and resulted in a Baseline Natural Features Assessment Report that summarizes the baseline findings and provides preliminary guidance on the selection of alternatives and mitigation recommendations to protect sensitive features.

Etobicoke Creek and its valley lands are identified as natural features of various classifications in both the City of Brampton and the City of Mississauga Official Plans. There are no areas of Provincial significance that were identified within the study area.

The study area is considered to be well vegetated, especially in the area that falls within the Etobicoke Creek watershed. According to TRCA, there are a few pockets of forest communities that are along the valley slopes and some marsh wetland pockets within the floodplains. The terrestrial communities predominantly fall within the following classes: cultural meadow, cultural plantation, cultural thicket, cultural woodland, deciduous forest, mineral meadow marsh, mineral shallow marsh, and open aquatic. A preliminary list of vegetation species within the study area can be found in Appendix C1. Updated information from the City of Mississauga for the southern part of the study area (in the City of Mississauga) indicates that the vegetation types there are Dry-fresh Sugar Maple-Beech Deciduous Forest, Dry-fresh Deciduous Forest Ecosite, Fresh-moist Willow Lowland Deciduous Forest Type,

Dry-moist Black Walnut Lowland Deciduous Forest Type, and Dry-moist Old Field Meadow Type.

The desktop assessment using TRCA data resulted in the identification of 19 flora species, all of which are commonly occurring native species. The City of Mississauga's Natural Areas Survey (2015) claims that the southern area of the study area within its boundaries has 196 floral species, with a significant percentage of them (41.33%) being introduced plant species.

Based on the desktop review, there are a total of 11 reptile and amphibian species, 20 bird species, and 8 mammal species in the study area. However, the City of Mississauga indicates that the study area falling within its boundaries has 47 bird, 3 mammal, 2 dragonfly, and 4 butterfly species. The site visit completed by LGL Limited resulted in the identification of 59 wildlife species, including 5 mammal species, 1 amphibian species, 52 bird species and 1 invertebrate.

Areas that provide habitat for wildlife within the study area are Etobicoke Creek and its valley lands. There are also two constructed wetlands between Highway 407 and Tomken Road used by a variety of wildlife. Habitat enhancement and restoration through tree plantings, wetland construction, and invasive species removal have also helped provide additional wildlife habitats. Some wildlife also use human- made habitats on the nearby golf course, sports fields, industrial lands (including the old wastewater treatment plant site), and inactive agricultural lands.

There are a total of 23 potential Species at Risk that were identified through the desktop assessment. Confirmation on the Species at Risk is pending from the MECP.

3.9.2 Cultural Heritage Assessment

ASI undertook a Cultural Heritage Resource Assessment on the Built Heritage Resources and Cultural Heritage Landscapes. Background historical research was completed, which indicated that the study area had transformed from a rural land use to land uses such as commercial, industrial, and transportation. Four cultural heritage resources were located within or adjacent to the study area through the desktop analysis (Appendix C2). However, the ensuing field review confirmed that one of the four resources has been demolished and no longer retains its cultural heritage value. Of the remaining three resources, one is within the City of Brampton and two are within the City of Mississauga.

3.9.3 Archaeological Assessment

Similar to the cultural heritage resource assessment, a desktop archaeological assessment was also undertaken in the study area (Appendix C3). There are six archaeological sites that have previously been registered within the study area. However, all six have been fully mitigated and do not contain further cultural heritage value or interest. As per the requirements of the Ministry of Citizenship and Multiculturalism (MCM), their locations cannot be identified or made public.

4. Problem and Opportunity Definition

4.1 Problem and Opportunity Statement

A review of the condition and capacity of the existing Etobicoke Creek Trunk Sewer reveals that while the existing sewer is in relatively good condition with isolated areas requiring structural repair or operational and maintenance attention, repair or rehabilitation would not address the operational challenges posed by deep manholes, access limitations and proximity to the Etobicoke Creek.

The sewer is considered to be constrained conveying existing flows along approximately 26% of its length and would be unable to accommodate current development applications or the ultimate growth envisioned by the City of Brampton.

The purpose of this study is therefore to develop and evaluate alternative solutions and recommend a preferred solution to provide the additional trunk sewer capacity required to service future growth needs while addressing current operation and maintenance challenges in the existing sanitary trunk sewer system.

Alternative solutions will need to be guided by the following key principles.:

- Appropriate sizing to provide sufficient conveyance capacity for future growth, while addressing current operational challenges and considering the potential for more frequent, more intense storm events.
- An alignment that accommodates required interconnections and provides appropriate solutions to the access and operational challenges noted.
- Minimize impacts on key stakeholders, including the City of Brampton, Toronto and Region Conservation Authority and Infrastructure Ontario.
- Where possible, allow for long-term flexibility with managing flows in the system

These key principles will be developed through Phase 2 of the Class EA process to help establish the criteria by which a long list of alternatives will be evaluated.

5. Phase 2: Development of Alternative Solutions

This Section describes the development of alternative solutions to address the constraints of the Etobicoke Creek Trunk Sewer and address the problem/opportunity statement, as per Phase 2 of the EA Process. Alternative Development Process Summary

The identification of alternative solutions to address the problem/opportunity statement was guided by the opportunities and constraints within the study area, identified in Section 3 of this ESR. Initially, servicing strategies that could address the problem and opportunity statement were identified and screened on their ability to meet a series of pass/fail criteria. A preferred servicing strategy was selected.

A long list of concept alternatives was identified for the preferred servicing strategy by using details identified in the *Feasibility Study of Sanitary Sewer at Old Brampton WWTP* (Region 2018) as a foundation, with further refinements identified to reflect changes to the study area boundary and the study's key drivers. The *Feasibility Study of Sanitary Sewer at Old Brampton WWTP* (Region 2018) is described in Section 3.3.1.

A short list was created from the viable concept alternatives based on their ability to meet key criteria. The short list of alternatives was assessed by using the triple-bottom-line-plus (TBL+) approach in a comparative evaluation against a series of sub-criteria identified to differentiate between alternatives. The short list of alternatives was then ranked based on this assessment to identify a preliminary preferred alternative for consideration.

5.1 Servicing Strategies

The following servicing strategies were developed to address the problem and opportunity statement:

- **Do Nothing:** This servicing strategy is identified as the baseline strategy where no interventions beyond current operation and maintenance (O&M) activities are undertaken to address the problem/opportunity statement.
- **Limit Growth:** Under this strategy, no additional growth is approved, and solutions are identified to address issues with the existing infrastructure to service the existing community without accommodating future growth.
- **Increase Efficiency**: This strategy represents non-structural measures to improve the existing trunk sewer's efficiency, including cleaning, repairs to reduce inflow and infiltration, and operational modifications to allow for additional flow diversions/flow balancing between the trunk's twinned reaches.
- **Rehabilitate Existing Trunk Sewer:** This strategy reflects measures to rehabilitate and repair the existing trunk sewers to address current state-of-good-repair (SOGR) issues without increasing system capacity.
- **Replace with Upsized Infrastructure:** This strategy includes measures to replace some or all sections of the existing trunk sewers to address SOGR issues and increase capacity.
- **Upsize/Upgrade with New Infrastructure:** This strategy includes the construction of a new sewer to provide for increased capacity, followed by rehabilitation and repairs to the existing sewers to address SOGR issues.

Each servicing strategy's ability to address the study's various problems and opportunities was screened by using the following set of pass/fail criteria:

- Addresses existing SOGR issues
- Addresses existing capacity issues
- Provides capacity for identified growth
- Feasibility/constructability

The screening results are presented in Table 5-1 and summarized as follows:

- Do Nothing and Limit Growth servicing strategies do not address any of the criteria and are not considered viable strategies to address the problem statement.
- Increasing Efficiency through cleaning, reduction of inflow/infiltration and additional flow diversion/flow balancing may restore some capacity to address current constraints but would not provide a complete solution for all SOGR and accessibility issues nor provide sufficient capacity for future growth.
- Rehabilitating the Existing Trunk Sewers would address the identified SOGR issues but would not provide a complete solution, as accessibility issues would remain and there would be insufficient capacity for future growth or resolution of the accessibility issues.
- Replacing with Upsized Infrastructure would allow for SOGR issues and capacity issues to be addressed but would create considerable complexity from a constructability standpoint, as it involves complex bypass pumping for the sections of the existing trunk that are not twinned, and significant modifications would be needed to existing maintenance holes and chambers to accommodate a larger sewer.
- Upsize/Upgrade with New Infrastructure addresses all criteria, as it provides sufficient capacity for future growth and allows flows to be rerouted from the existing sewers to permit repairs and modifications to improve maintenance access.

Table 5-1. Screening of Servicing Strategies

Servicing Strategy	Addresses Existing SOGR Issues	Addresses Existing Capacity Issues	Provides Capacity for Identified Growth	Feasibility/ Constructability
Do Nothing	No	No	No	N/A
Limit Growth	No	No	No	N/A
Increase Efficiency	In Part	In Part	No	In Part
Rehabilitate Existing Trunk Sewer	In Part	In Part	No	In Part
Replace with Upsized Infrastructure	Yes	Yes	Yes	In Part
Upsize/Upgrade with New Infrastructure	Yes	Yes	Yes	Yes

Note:

N/A = not applicable

The screening of strategies indicates that only Upsize/Upgrade with New Infrastructure provides a solution that meets all criteria, and alternatives were identified to implement this strategy. Furthermore, consideration was given to the sizing of the new sewer: sized to work with the two existing sewers to provide future flow capacity or sized for the full capacity of existing and future flows. The latter option would provide the flexibility to repurpose the existing sewers for redundancy and storage during wet weather events; however, it is estimated to add approximately 30% to the overall capital cost, and system oversizing could result in low-flow periods that generate operational issues such as odour and solids deposition. As wet weather flow control has not been identified as a significant challenge in the study area, it is considered that the new sewer will be sized to provide the incremental flow capacity required to address existing flow constraints and provide sufficient capacity for planned and future growth.

5.2 Long List of Concept Alternatives

5.2.1 Identification of Long List of Concept Alternatives

The following general concepts on how the preferred servicing strategy, Upsize/Upgrade with New Infrastructure Servicing Strategy, could be achieved were identified:

- **Concept Alternative 1**: a new sewer to convey flows from Kennedy Road southeast to Dixie Road
  - Defined connection points to the existing system for flow diversion and flow balancing; requires a segmental analysis due to the numerous alignments possible between each connection point
  - Alignment and profile similar to the existing trunk in order to match existing inverts of connections
- **Concept Alternative 2**: a new sewer along Kennedy Road to connect to the EWD STS at Derry Road
- **Concept Alternative 3:** new sewer to convey flows from Kennedy southeast to Dixie Road at maximum depth available

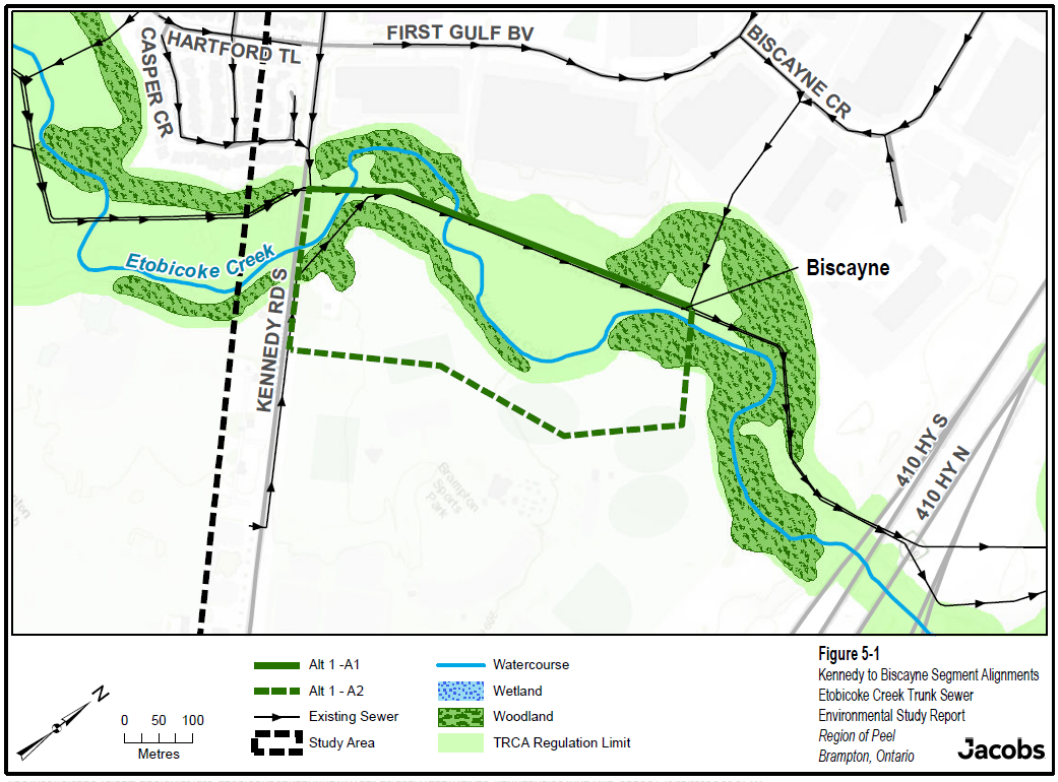
5.2.1.1 Concept 1 and Segmental Analysis

The purpose of this concept alternative is to connect to as many existing system connections as possible for flow diversion flexibility and flow balancing with the existing trunk sewer. As such, the existing trunk and its connections were split into the following five segments:

1. Kennedy to Biscayne

   This segment spans from the upstream point of the existing trunks within the study area to the connection of the local Biscayne sewer. A new connection to the proposed alternative is required for the Biscayne sewer because of the exposed condition of the existing connection and the need to service the CAA Lands. There are two alignments (A1 and A2) identified for this segment (Figure 5-1). Alignment A2 will use the future road planned for the development within CAA Lands.

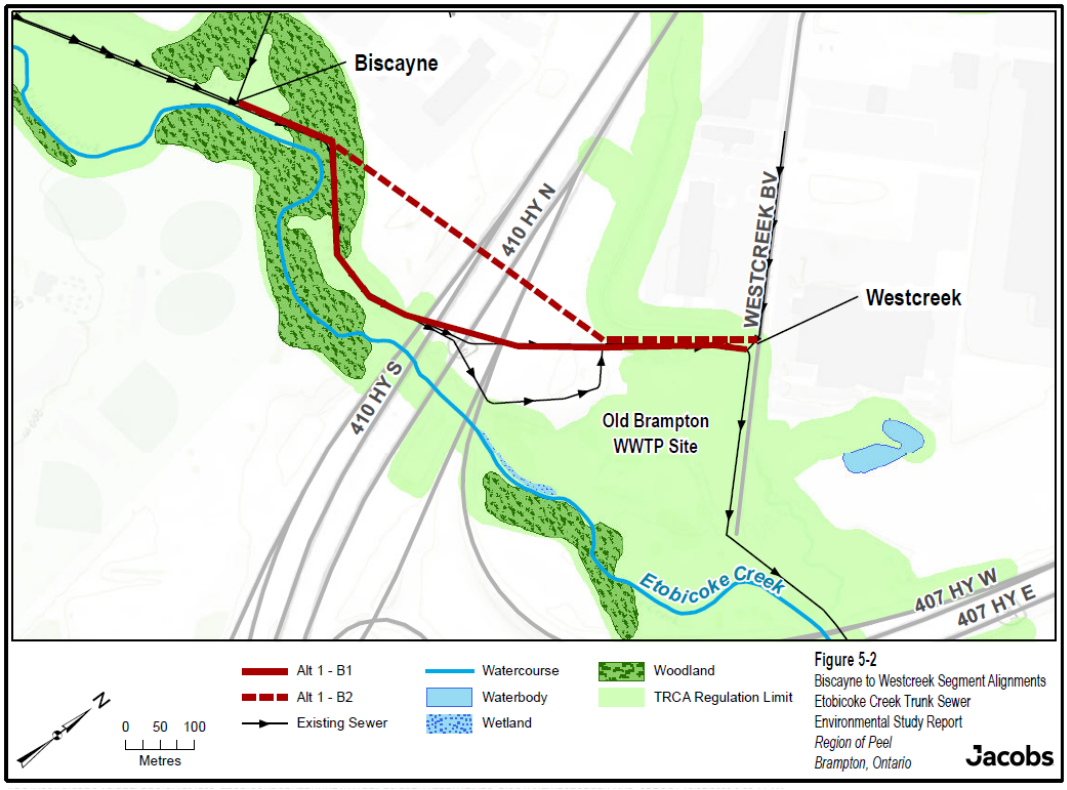
   Figure 5-1. Kennedy to Biscayne



2. Biscayne to Westcreek

The next segment extends east to the local Westcreek connection to the existing trunk. It includes a crossing of Highway 410 and passes through the Region-owned Old Brampton WWTP site. There are two alignments (B1 and B2) available for this segment; B1 follows the route of the existing sewer and B2 provides a direct route from the Biscayne connection (Figure 5-2).

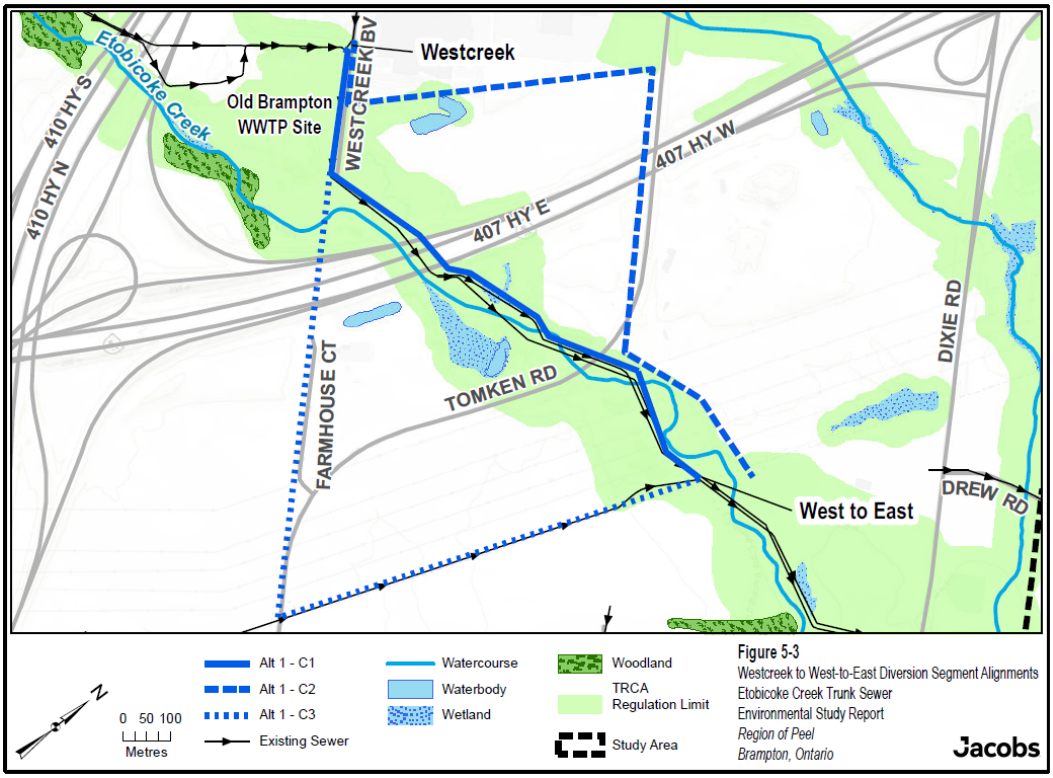
Figure 5-2. Biscayne to Westcreek



3. Westcreek to West-to-East Diversion

The third segment extends to the West-to-East Diversion, south of Highway 407. This section includes a crossing of Highway 407, which is currently not twinned. There are three possible alignments (C1, C2, and C3). C1 follows the same route of the existing trunk sewers, C2 extends to Tomken and runs north of the sewers to the West-East Diversion, and C3 is a longer route and follows Westcreek Boulevard across Highway 407 to meet the West-East Diversion (Figure 5-3).

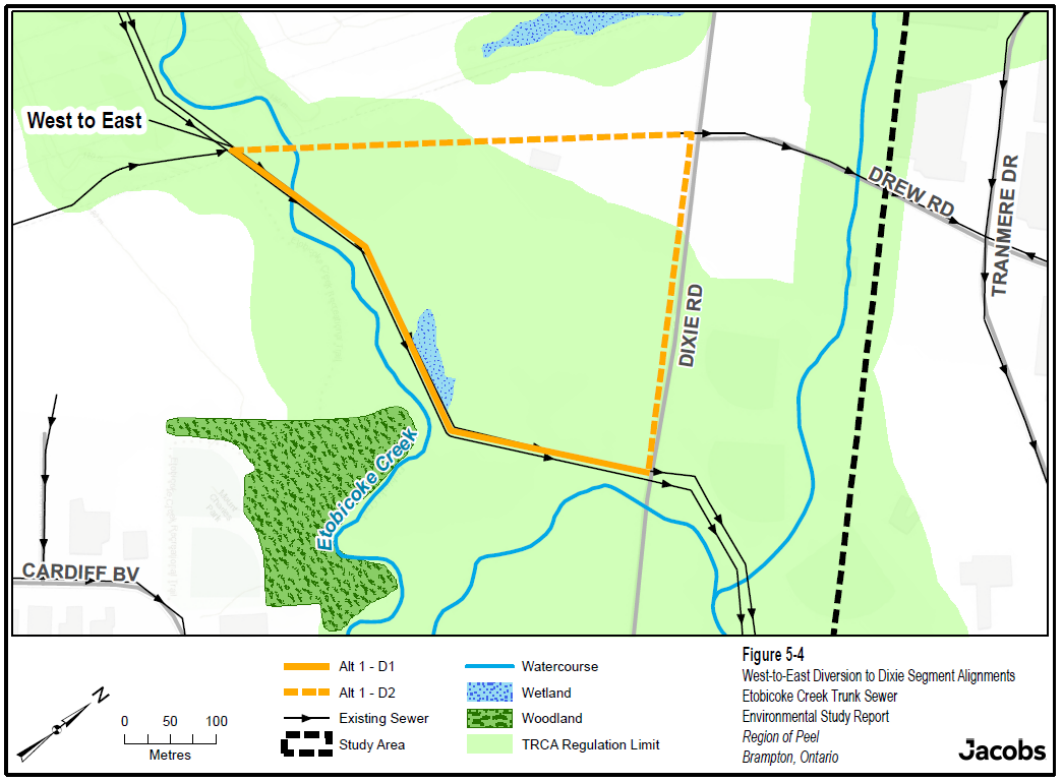
Figure 5-3. Westcreek to West-to-East Diversion



4. West-to-East Diversion to Dixie

   The fourth segment reaches to Dixie Road and could provide flow balancing to the existing trunks. There are two alignments (D1 and D2) possible for this segment; D1 follows the existing sewers while D2 is longer and continues the West-East Diversion alignment to Dixie Road and then south to the existing sewers (Figure 5-4).

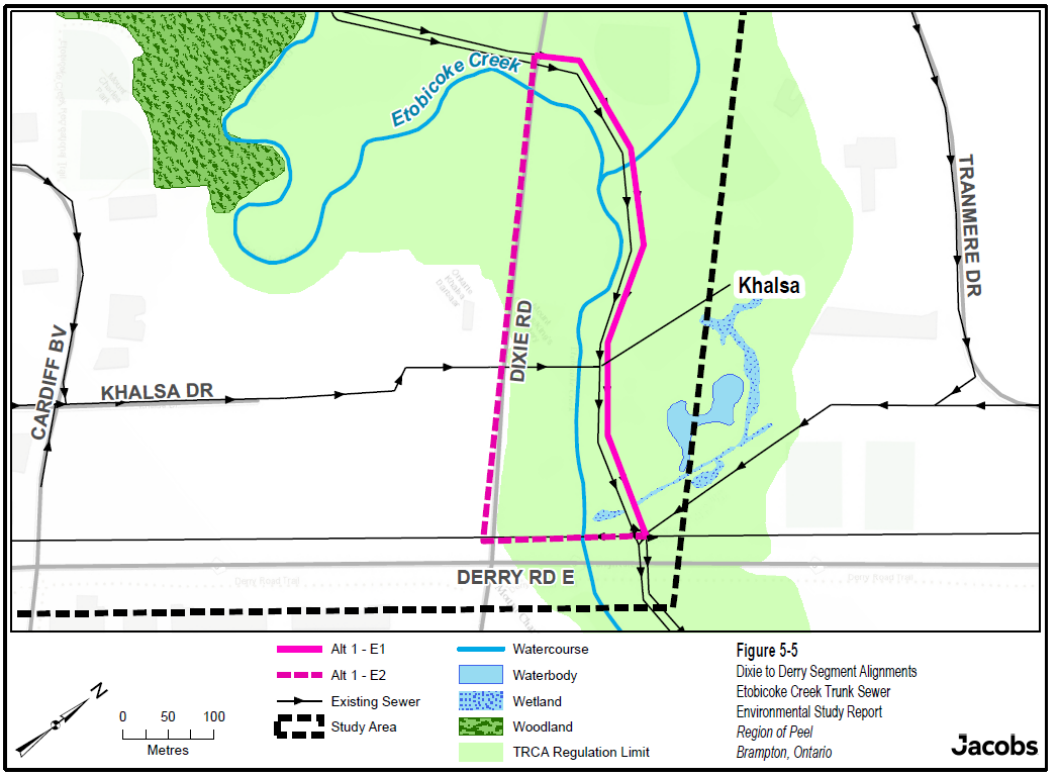
Figure 5-4. West-to-East Diversion (EWD) to Dixie



5. Dixie to Derry

   The final segment extends to Derry Road and includes the section of the study area that was added after completion of Phase 1. This segment encompasses connection to the EWD Sanitary Trunk Sewer's (STS) Site 2, which offers flexibility for the conveyed flows to go west to the Clarkson WWTP via the EWD STS or east to the G.E. Booth WWTP via the Etobicoke Creek Trunk Sewers that continue south. There are two alignments (E1 and E2) available for this segment (Figure 5-5).

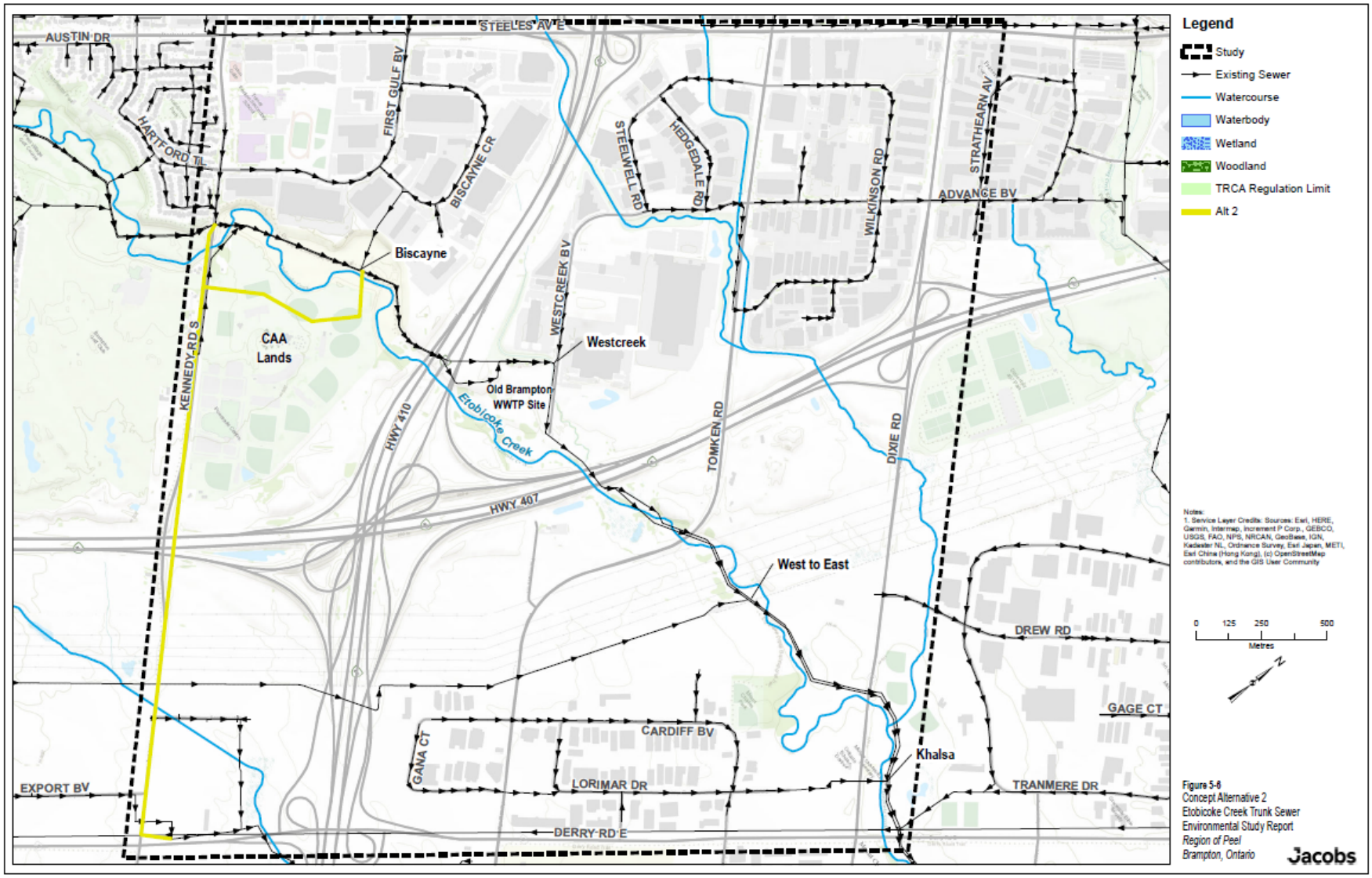
Figure 5-5. Dixie to Derry



5.2.1.2 Concept Alternative 2

Alternative 2 includes a new sewer installed along Kennedy Road from the point where the existing sewers cross Kennedy Road, south to a connection with the EWD STS's Shaft 3 at Derry Road. The local Biscayne sewer would be extended to connect to this alternative to provide the required capacity and address the condition of its current connection to the existing trunk sewer.

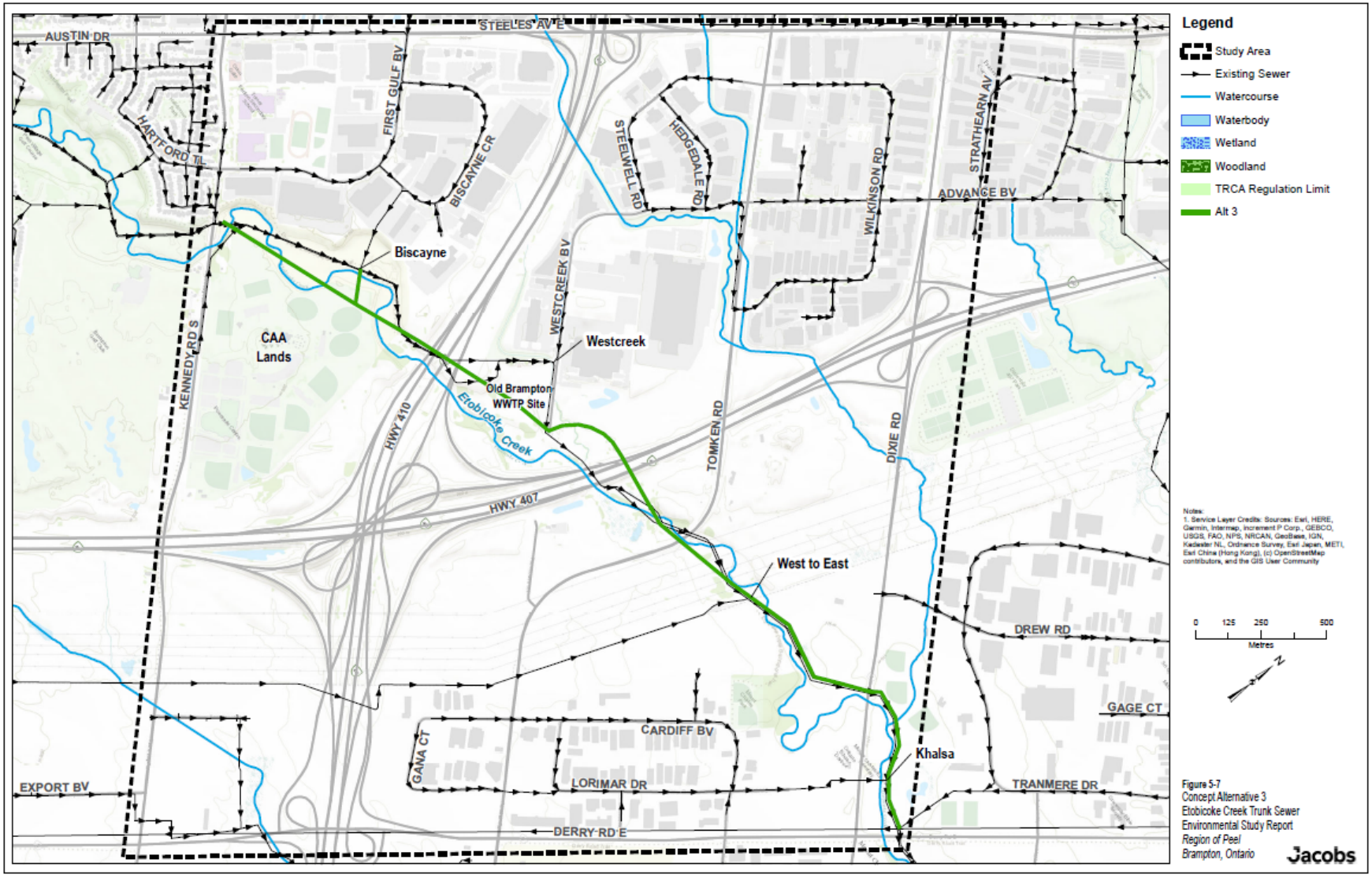
Figure 5-6. Concept Alternative 2



5.2.1.3 Concept Alternative 3

Alternative 3 provides a new sewer installed from the point where the existing sewers cross Kennedy Road, southeast to Derry Road, diagonally across the study area. The invert of the new sewer would be lowered to the maximum depth available while maintaining the necessary slope to match the existing downstream invert at Derry Road east of Dixie Road by eliminating the drops that exist in the current sewer alignment. As the contemplated depth would allow for trenchless construction, a direct route is identified to facilitate tunnelling and reduce costs. New connections to the proposed alternative will be provided for the local Biscayne connection and to the West-to-East sewer.

Figure 5-7. Concept Alternative 3



5.2.2 Evaluation of the Long-List of Concept Alternatives

The following criteria were developed to evaluate the long list of concept alternatives:

- **Services Existing Connections:** existing connections to the system can be connected
- **Impact on Natural Environment:** the degree of impact/disturbance to the natural environment
- **O&M Requirements**: the ease of operating and maintaining once implemented
- **Property Requirements:** the extent of property needs
- **Services CAA Lands**: future developments within CAA Lands can be serviced
- **Major Highway Crossing**: avoids interchange onramps/offramps to reduce complexity of crossing
- **Relative Cost:** comparative cost based on the alignment's characteristics

For Concept Alternative 1, the screening criteria were used to compare two or more alignments within each segment to identify the preferred alignments to carry forward. It should be noted that not all criteria were applicable for each concept alternative or segment given the nature of the alignment.

The evaluation of the concept alternatives under each of the previously listed criteria used the scoring shown in Table 5-2.

Table 5-2. Scoring for the Evaluation of the Long List of Concept Alternatives

Score	Definition
Most Preferred	This concept easily satisfied the criterion.
Preferred	This concept somewhat satisfied the criterion.
Least Preferred	This concept hardly/not at all satisfied the criterion.

The following summarizes the evaluation that was undertaken to arrive at the short list of viable alternatives. For Concept Alternative 1, a segmental analysis was undertaken with the results shown in Table 5-3, Table 5-4, Table 5-5, Table 5-6, and Table 5-7.

Concept Alternatives 2 (Table 5-8) and 3 (Table 5-9) were assessed on their ability to meet the criteria on an individual basis.

5.2.2.1 Concept Alternative 1

5.2.2.1.1 Kennedy to Biscayne

Table 5-3. Screening of Concept Alternative 1's Segment A

Route Option	Services Existing Connections	Impact on Natural Environment	O&M Requirements	Property Requirements	Services CAA Lands	Relative Cost	Total
A1	Preferred	Least Preferred	Least Preferred	Least Preferred	Least Preferred	Most Preferred	Preferred
A2	Least Preferred	Preferred	Preferred	Preferred	Preferred	Least Preferred	Preferred

- A1 provides easier connection to Biscayne.
- A2 alignment has less impact on the natural environment.
- A2 installed in the future ROW will facilitate O&M and require less property.
- A2 provides opportunity for cost sharing, provided coordinated timing of projects.

- A1 is considerably lower in capital cost because of shorter length and no additional crossings.
- Neither alignment provides for complete gravity servicing of CAA Lands; however, A2 allows for servicing of a greater area.

Both alternatives score similarly, and therefore, both A1 and A2 were carried forward.

5.2.2.1.2 Biscayne to Westcreek

Table 5-4. Screening of Concept Alternative 1's Segment B

Route Option	Services Existing Connections	Impact on Natural Environment	O&M Requirements	Property Requirements	Major Highway Crossing	Relative Cost	Total
B1	Most Preferred	Least Preferred	Least Preferred	Preferred	Least Preferred	Least Preferred	Least Preferred
B2	Most Preferred	Preferred	Preferred	Least Preferred	Preferred	Preferred	Preferred

- B2 provides connection for West Creek.
- B2 avoids crossing Etobicoke Creek meanders.
- B2 provides improved access to new sewer.
- B2 provides more direct routing, reducing easement requirements.
- B2 requires shorter segment crossing Highway 410 and less interference with interchange.
- B2 is lower in capital cost because of shorter length.

B2 was most preferred and thus carried forward.

5.2.2.1.3 Westcreek to West-to-East Diversion

Table 5-5. Screening of Concept Alternative 1's Segment C

Route Option	Impact on Natural Environment	O&M Requirements	Property Requirements	Major Highway Crossing	Relative Cost	Total
C1	Least Preferred	Least Preferred	Preferred	Least Preferred	Preferred	Least Preferred
C2	Most Preferred	Preferred	Preferred	Most Preferred	Preferred	Most Preferred
C3	Preferred	Preferred	Preferred	Least Preferred	Preferred	Preferred

- C2 is mostly outside of regulated area and does not require a creek crossing.
- Majority of C2's alignment is along the ROW, reducing property requirements and improving access.
- C2 has the more direct crossing of Highway 407, with no impact on interchange or bridge.

C2 was most preferred and thus carried forward.

5.2.2.1.4 West-to-East Diversion to Dixie

Table 5-6. Screening of Concept Alternative 1's Segment D

Route Option	Services Existing Connections	Impact on Natural Environment	O&M Requirements	Property Requirements	Relative Cost	Total
D1	Most Preferred	Least Preferred	Least Preferred	Preferred	Preferred	Preferred
D2	Most Preferred	Preferred	Most Preferred	Preferred	Least Preferred	Most Preferred

- D2 presents less impact on the natural environment.
- D2 provides access from the ROW.
- Property impacts are considered similar.
- D1 is lower in capital cost because of shorter length.

D2 was most preferred and thus carried forward.

5.2.2.1.5 Dixie to Derry

Table 5-7. Screening of Concept Alternative 1's Segment E

Route Option	Services Existing Connections	Impact on Natural Environment	O&M Requirements	Property Requirements	Relative Cost	Total
E1	Most Preferred	Least Preferred	Preferred	Preferred	Preferred	Preferred
E2	Least Preferred	Preferred	Preferred	Most Preferred	Least Preferred	Least Preferred

- E1 routing along existing sewers in creek valley provides most impact on natural environment but minimizes impact on Dixie Road traffic volumes.
- E1 avoids conflict with existing sewers crossing Dixie Road and avoids impact on bridge structure and historical cemetery on Dixie Road.
- E1 provides most direct connection with existing sewers on Derry Road.

E1 was most preferred and thus carried forward.

5.2.2.2 Concept Alternative 2

Table 5-8. Screening of Concept Alternative 2

Concept Alternative 2	Services Existing Connections	Impact on Natural Environment	O&M Requirements	Property Requirements	Services CAA Lands	Major Highway Crossing	Relative Cost
Concept Alternative 2	Preferred	Most Preferred	Most Preferred	Most Preferred	Most Preferred	Most Preferred	Preferred

This concept alternative was carried forward based on the following reasons:

- It is able to resolve capacity and SOGR issues with the existing Biscayne connection.
- It does not provide the opportunity to connect to the existing Etobicoke Creek Trunk Sewer System or West to-East.
- It minimizes impact on the natural environment.
- Its location in the ROW provides improved access for O&M purposes and reduces property requirements.
- It is able to service future development on CAA lands.
- It has only one major highway crossing.
- Tunnelling will be a more costly methodology, but the route will be short because of its direct nature.

5.2.2.3 Concept Alternative 3

Table 5-9. Screening of Concept Alternative 3

Concept Alternative 3	Services Existing Connections	Impact on Natural Environment	O&M Requirements	Property Requirements	Services CAA Lands	Major Highway Crossing	Relative Cost
Concept Alternative 3	Most Preferred	Preferred	Preferred	Preferred	Most Preferred	Preferred	Most Preferred

This concept alternative was carried forward based on the following reasons:

- It is able to resolve capacity and SOGR issues with the existing Biscayne connection.
- It facilitates servicing of CAA Lands and connection to West-to-East and EWD STS.
- It lies mainly within the natural environment, but trenchless construction will mitigate impacts.
- It makes access challenging because of its location within the valley lands; however, key maintenance holes would be located in areas that are easier to access (e.g., Kennedy Road ROW, Region owned Old Brampton WWTP site, existing West-to-East chamber).
- It requires some property acquisition.
- It is able to service future development on CAA Lands.

5.2.2.4 Short-Listed Concept Alternatives

Based on the segments and concept alternatives carried forward, the short list of alternatives was created. As both alignments for Segment A (A1 and A2) of Concept Alternative 1 were carried forward, two unique short-listed alternatives were created in combination with the other segments' preferred alignments. Both Concept Alternatives 2 and 3 were carried forward and short-listed individually. The four short-listed alternatives are as follows:

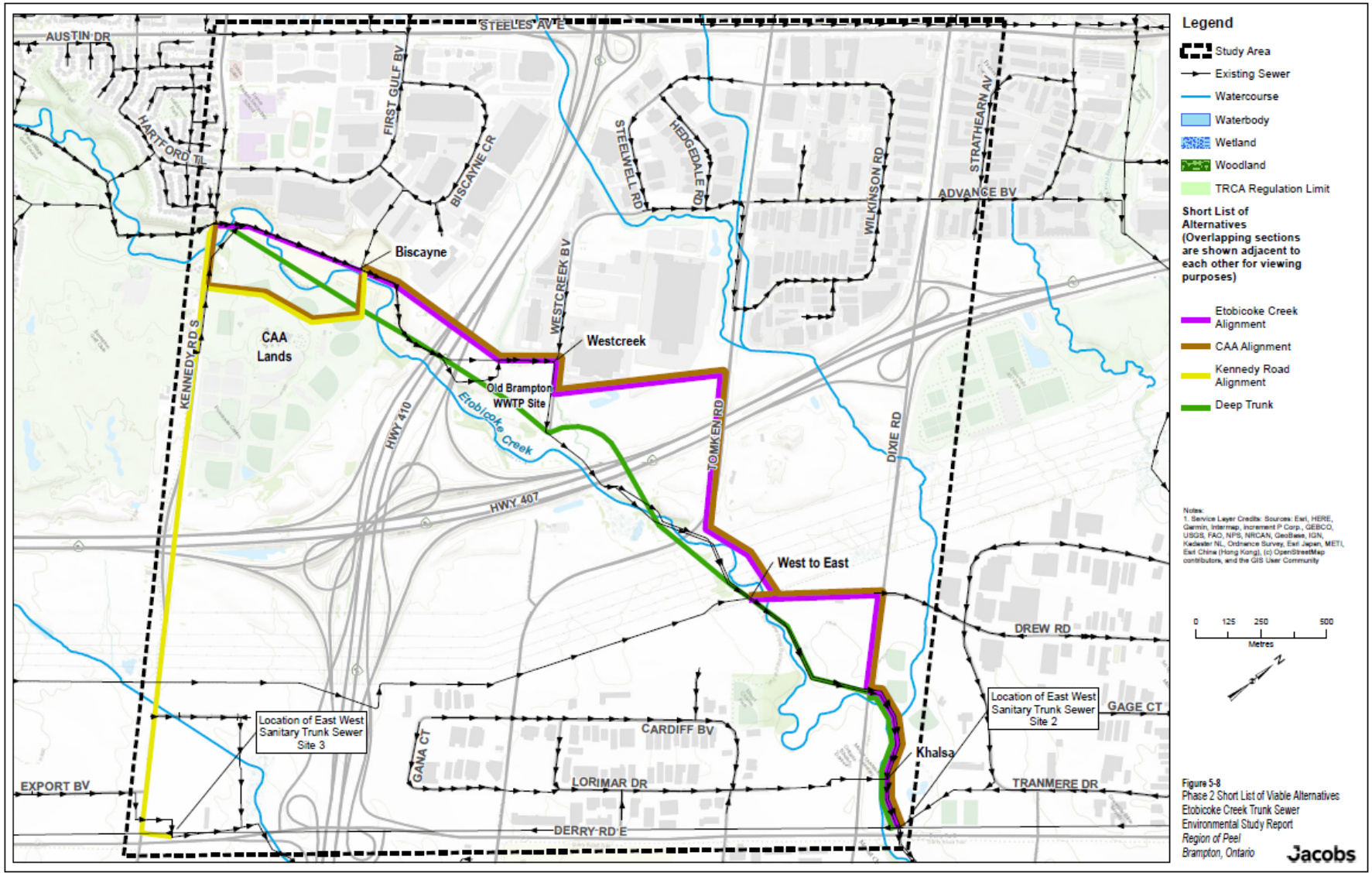
- Etobicoke Creek Alternative: Concept Alternative 1's Segments A1, B2, C2, D2 and E1
- CAA Lands Alternative: Concept Alternative 1's A2, B2, C2, D2 and E1
- Kennedy Road Alternative: Concept Alternative 2
- Deep Trunk Alternative: Concept Alternative 3

5.3 Short List of Viable Alternatives

5.3.1 Description of Short List of Viable Alternatives

The following subsections provide a description of each of the short-listed alternatives. Figure 5-8 shows the short list of viable alternatives.

Figure 5-8. Short List of Viable Alternatives



5.3.1.1 Etobicoke Creek Alternative

The Etobicoke Creek Alternative is approximately 4.6 kilometres (km) long with the first 0.5 km up to the Biscayne connection installed as a 1,350-mm diameter pipe and the remaining 4.1-km span installed as a 1,500-mm diameter pipe. The majority of this alternative would be open cut, with the crossings of Highways 407 and 410 being tunneled. The first and last segments follow the existing alignment in the creek valley, with the remainder routed outside the valley, requiring private property negotiations. This alternative would connect to the existing Etobicoke Creek trunks at Derry Road to maintain conveyance to the East Trunk System, while still making it possible for flows to be conveyed to the West Trunk System, as the existing sewers connect a short distance downstream to the EWD STS's Site 2 (as shown Figure 5-8).

5.3.1.2 CAA Lands Alternative

The CAA Lands Alternative is approximately 4.8 km long. The first 0.7 km up to the Biscayne connection is installed as a 1,350-mm diameter pipe, and the remaining 4.1 km is installed as a 1,500-mm diameter pipe. A significant portion of this alternative is open cut, with the crossings of Highways 407 and 410 as well as the first segment of the alignment being tunnelled. The first segment is routed on a future north road identified in the CAA Lands Redevelopment 7575 Kennedy Road South – Functional Servicing Report (June 2019). The majority of the remaining alignment is routed out of the creek valley, requiring property negotiation. This alternative would also connect to the existing Etobicoke Creek trunks at Derry Road, just north of the existing trunk's connection to the EWD STS's Shaft 2. This will allow flows to convey to the East Trunk System as well as opportunity for flow to be routed to the West Trunk System through the EWD STS (as shown Figure 5-8).

5.3.1.3 Kennedy Road Alternative

The shortest alternative of the four is the Kennedy Road Alternative, spanning a length of 2.5 km with a 1,500-mm diameter pipe. The majority of the alternative will be tunnelled with a small section to be open cut for the extension of the local Biscayne connection. The alignment will be within the Kennedy Road ROW thereby minimizing the construction within valley lands. As the downstream point is farther west than the existing trunks at Derry Road, it will connect directly into the EWD STS through its Site 3 (as shown Figure 5-8).

5.3.1.4 Deep Trunk Alternative

The fourth and final alternative is the Deep Trunk Alternative. It is a 1,500-mm diameter pipe spanning approximately 3.7 km in length. It will be mainly tunnelled with a shorter open-cut section for a new Biscayne connection and at the southeastern end because of a lack of sufficient ground cover caused by elevation changes. The majority of the alignment is located within valley lands, with the impact mitigated through tunnelling. This alternative offers the opportunity to place a key maintenance hole and construction compound within the Old Brampton WWTP site. The downstream end connects to the existing Etobicoke Creek Trunk Sewers at Derry Road just north of the existing trunks' connection to EWD STS's Site 2 (as shown Figure 5-8), similar to the first two short-listed alternatives. This will allow flows to convey to the East Trunk System, as well as opportunity for flow to go to the West Trunk System.

5.3.2 Cost Estimation

Cost estimates for each of the four alternatives are detailed in Appendix D. The approximate cost estimated for each of the alternatives is as follows:

- **Etobicoke Creek Alternative**: $32.3 million
- **CAA Lands Alternative**: $45.3 million
- **Kennedy Road Alternative:** $64.1 million
- **Deep Trunk Alternative:** $61.3 million

5.3.3 Supporting Studies

A number of supporting investigations and studies were completed to allow for the assessment of potential impacts and the required mitigating measures for each alternative. Their findings, conclusions, and recommendations are summarized as follows, with the individual reports included in Appendix C and the Hydraulic Analysis details included in Appendix E.

5.3.3.1 Hydraulic Analysis

Expanding on the updated future conditions model (as discussed in Section 3.3.3.2), model scenarios were generated for each of the four alternatives to identify preliminary sizing and to understand the system's response to the addition of infrastructure. The 5-year SCS storm profile was used to assess capacity under wet weather flow conditions for conservative planning purposes, and sewer sizing was identified so that the system operated at less than 85% capacity during the storm event. As an additional check, a 25-year SCS storm event was modelled for each alternative to quantify the number of maintenance holes where freeboard was less than 1.8 metres (m), which serves as an indicator of possible basement flooding issues.

As noted in Section 3.3.3.2, the future flows considered for sizing of the new trunk sewer exceed the capacity of the existing trunk sewer throughout the study area, and the modelling noted that this constraint continues in the system south of Derry Road. As upgrades outside the study area are not within the scope of this study, for the purposes of modelling, it was assumed that flows in excess of the Etobicoke Creek Trunk Sewer System's downstream capacity would discharge into the EWD STS, now in construction, permanently consuming capacity originally intended for diversion purposes.

Table 5-10 to Table 5-14 summarize the hydraulic analysis, including required sizing and the flow allocation assumptions developed at each of the major connection chambers (Kennedy Road, Biscayne, West-East Diversion) for modelling of each alternative, and also identify the resulting flow to EWD STS that would minimize surcharging in the Etobicoke Creek Trunk Sewer System, downstream of the study area.

Table 5-10. Modelled Sewer Diameters for Future Flow Projections

Alternative	Etobicoke Creek	CAA	Kennedy	Deep Trunk
Kennedy Road – Biscayne	1,350 mm	1,350 mm	1,500 mm	1,500 mm
Biscayne – 407	1,500 mm	1,500 mm		1,500 mm
407-West-East Diversion	1,500 mm	1,500 mm		1,500 mm
West-East Diversion – Derry Road	1,500 mm	1,500 mm		1,500 mm

Table 5-11. Flow Allocation Assumptions for Etobicoke Creek and CAA Alternatives

Connection Chamber	Contributing Flow	Existing 1050-N Allocation (L/s)	Existing 1050-S Allocation (L/s)	New Sewer Allocation (L/s)
Kennedy	3,490	750	890	1,850
Biscayne	1,850	450	Not Applicable	1,400
West-East	854	Not Applicable	300	554

Note:

L/s = litre(s) per second

Table 5-12. Flow Allocation Assumptions for Kennedy Alternative

Connection Chamber	Contributing Flow (L/s)	Existing 1050-N Allocation (L/s)	Existing 1050-S Allocation (L/s)	New Sewer Allocation (L/s)
Kennedy	3,490	270	350	2,870
Biscayne	1,850	660	Not Applicable	1,190
West-East	854	554	300	N/A

Table 5-13. Flow Allocation Assumptions for Deep Trunk Alternative

Connection Chamber	Contributing Flow (L/s)	Existing 1050-N Allocation (L/s)	Existing 1050-S Allocation (L/s)	New Sewer Allocation (L/s)
Kennedy	3,490	100	550	2,840
Biscayne	1,850	770	Not Applicable	1,080
West-East	855	555	300	Not Applicable

Table 5-14. Flow Allocation Assumptions between Etobicoke Creek STS and EWD STS

Alternative	Etobicoke Creek STS Allocation (L/s)	East-West Diversion STS Allocation (L/s)
Etobicoke Creek/CAA	1,618	2,500
Kennedy	0	3,900
Deep Trunk	1,230	2,500

Results of the hydraulic analysis are included in Appendix E. There was no surcharging seen along the trunk in any of the four modelled alternatives. Generally, the flow within the trunks of the modelled alternatives was less than 85 precent of the capacity of the trunk, with few exceptions in the Etobicoke Creek Alternative and the CAA Alternative.

5.3.3.2 Natural Sciences Report

A Natural Sciences Report (NSR) (2020) was completed by LGL Limited (LGL) as part of Phase 2 to summarize the environmental sensitivities present within the study area and to help support the assessment of the alternatives. Initially, a background information records review was completed for the study area, where available information was reviewed and used to identify natural environmental constraints. Field surveys (May 22 and May 27, 2019, and October 16, 2020) were then completed to verify and update the extent of the constraints identified, assess the natural and semi-natural vegetation communities, and screen for Species at Risk (SAR). A roaming breeding bird survey was conducted on May 27, 2019, and June 7, 2019, and additional point count breeding bird investigations were completed on June 29 and July 7, 2020. SAR grassland birds were screened for on May 26, 2020.

5.3.3.2.1 Natural Heritage Features

The main natural heritage feature within the study area is Etobicoke Creek, flowing southeast through the study area. The study area falls within the jurisdiction of the Toronto and Region Conservation Authority (TRCA) and is located within the Etobicoke Creek watershed. The study area does not have any Areas of Natural or Scientific Interest, Provincially Significant Wetland, or Significant Wildlife Habitat.

5.3.3.2.2 Vegetation and Vegetation Communities

Field investigations undertaken in May 2019 and October 2020 noted the majority of the study area no longer retains its native vegetation communities as a result of alterations made for previous agricultural purposes and more recent recreational and industrial uses. Natural and semi-natural vegetation communities were observed along the entire length of Etobicoke Creek valley, with no observations of rare or uncommon communities. No plant SAR were identified. There was also no observation of species regulated under the *Ontario Endangered Species Act*, 2007; however, 14 plant species considered a species of conservation concern with TRCA were encountered.

5.3.3.2.3 Wildlife and Wildlife Habitat

The field survey documented 60 wildlife species, including 5 mammal species, 1 amphibian species, 53 bird species, and 1 invertebrate. Most of the observed bird species are regulated. The Etobicoke Creek valley and the surrounding natural areas provide a corridor for wildlife movement. The bridge structures within the study area provide nesting habitat for birds, as evidenced by active nests. There are two constructed wetlands and other areas enhanced/restored through tree plantings, wetland construction, and removal of invasive species observed through the study area. Bat boxes attached to large trees as well as trees with cavities suitable for roosting bats were observed in the forested aeras. Additionally, human-made spaces such as golf courses, sports fields, fallow lands, and agricultural lands present habitats for some fauna. Two wildlife species (Eastern Wood-pewee and Monarch) part of the species of Special Concern in Ontario under the *Endangered Spices Act*, 2007 were noted. Other SAR, such as Barn Swallow, Bobolink, Chimney Swift, Eastern Meadowlark, Jefferson Salamander, Snapping Turtle and Wood Thrush were not observed. Additionally, screening indicated that there were no designated Significant Wildlife Habitat areas in the study area.

5.3.3.2.4 Aquatic Habitat and Communities

The key aquatic feature of the study area is the Etobicoke Creek, with headwaters originating in the Oak Ridges Moraine and flowing into Lake Ontario. It is considered to be an urban creek that has been degraded (water quality rated as poor), with efforts having been made to restore it in recent years. The study area consists of several smaller tributaries that feed into the Etobicoke Creek. The creek flows through a series of riffles and pools within the study area and is managed as a warmwater system. A total of 21 fish species are present in Etobicoke Creek in the study area; however, there are no reported aquatic SAR.

5.3.3.2.5 Potential Impacts

Potential impacts to the natural environment as a result of the four short-listed alternatives were considered. Wildlife and wildlife habitat in the area are considered to be tolerant to human disturbance based on the current presence of urban landscapes. Direct impacts to wildlife habitat could result from the removal of vegetation for all four alternatives. Additionally, the crossings and construction work in close proximity to Etobicoke Creek and its tributaries could affect the aquatic habitat. There is also potential to affect the Eastern Wood-Pewee habitat and bat maternal roosting habitat.

5.3.3.3 Hydrogeology and Geotechnical

A hydrogeology desktop review was undertaken to provide baseline hydrogeological information and assess the potential impacts of proposed construction designs to the hydrogeological features. The regional topography decreases from north to south and slopes toward Lake Ontario. Geological layers are understood to have consistent hydrogeological properties. The bedrock in the area is interpreted to be relatively shallow, given the bedrock outcroppings along the Etobicoke Creek, and it is expected that some overburden units that are present in the greater region will not be encountered in the study area. Bedrock is expected to be either Queenston Formation, Georgian Bay Formation, or Blue Mountain Formation. Queenston formation bedrock is relatively soft and permeable to groundwater flow, whereas the Georgian

Bay and Blue Mountain formations tend to be harder and less permeable. The groundwater flow direction is expected to be toward Etobicoke Creek and other streams that flow through the study area.

Hydrogeological considerations were presented for each of the four short-listed alternatives. The considerations address the following:

- Open-trench excavation and shafts beneath the water table needing groundwater control during construction
- Precipitation into trenches and shafts during construction requiring management
- Impact to private wells during construction
- Impact to water table and reduction of groundwater flow into water features during construction
- Localized depression of the water table during construction of vertical shafts.
- Erosion of streambanks in the Etobicoke Creek or other small surface water features, generating turbidity and decreasing water quality

Further to the geotechnical desktop review undertaken in Phase 1, the four short-listed alternatives were considered from a geotechnical perspective. All four alternatives are through the physiographic region identified as the Peel Plains (Bevelled Till Plains). The overburden along the creek was determined to consist of surficial deposit and alluvial deposit primarily composed of clayey silt to silty clay containing some sand, silty sand with gravel to gravel with silty sand, whereas the overburden in other area consists predominantly of Halton Till deposits primarily composed of stiff to hard silt, silty clay, and sand soils. There is some potential to encounter boulders where the alternatives' profile is not expected to be within bedrock.

5.3.3.4 Archaeology

A Stage 1 Archaeological Assessment and a subsequent report was completed by Archaeological Services Inc. (ASI). The background assessment determined that 16 previously registered archaeological sites were located in close proximity (within 1 km) of the study area. A Stage 1 Archaeological Assessment property inspection was conducted on June 15, 2020, to assess the archaeological potential along the short-listed alternatives based on the geography, topography, and current conditions. The property inspection was visual and did not include excavation or collection of archaeological resources. In addition to examining previously identified features of archaeological potential, additional features that were not previously identified were documented.

Based on assessment of the historical and archaeological data, some areas were deemed as exhibiting archaeological potential and thus needing a Stage 2 Archaeological Assessment (Appendix C3). Pedestrian surveys will be used on terrain that is actively or recently cultivated fields, whereas test pit surveys will be required where ploughing is not viable (e.g., wooded areas or overgrown farmland, etc.).

5.3.3.5 Built Heritage Resources and Cultural Heritage Landscapes

As described in Section 3.9.2, ASI undertook a Cultural Heritage Resource Assessment on the Built Heritage Resources and Cultural Heritage Landscapes. Three cultural heritage resources that retain their cultural heritage value were located within or adjacent to the study area through the desktop analysis (Appendix C2). Of the three resources, one is within the City of Brampton and two are within the City of Mississauga. Each of the four short-listed alternatives affects the three cultural resources to varying levels.

5.3.3.6 Environmental Review

Jacobs completed an environmental desktop review to identify areas with actual or potential environmental concerns through a review of records. This includes reports and information supplied by the Region, as well as records available in the public domain, including a search of the Environmental Risk Information Services (ERIS) database, aerial photographs, and other readily available historical records. No

intrusive work, such as sample collections and analyses or engineering or structural evaluations, was completed as part of the records review. Neither site visits (visual examination of surface features) nor interviews with personnel familiar with the subject site(s) were completed. The desktop review was undertaken for the four short-listed alternatives. Through the identification of Potentially Contaminating Activities (PCAs), a total of eight Areas of Potential Environmental Concern (APECs) were identified along the four short-listed alternatives, with some APECs overlapping multiple routes as indicated as follows:

- Etobicoke Creek Alternative has 5 APECs along its alignment.
- CAA Lands Alternative has 6 APECs along its alignment.
- Kennedy Road Alternative has 5 APECs along its alignment.
- Deep Trunk Alternative has 5 APECs along its alignment.

Further, more definitive analysis, developed during the completion of a Phase I Environmental Site Assessment are provided in Section 8.4.2.

6. Assessment of Alternative Solutions

6.1 Overview of Evaluation Process

The purpose of the evaluation process is to assess the impacts on the environment associated with each alternative solution and select a preferred alternative that can adequately service the Etobicoke Creek Trunk Sewer drainage area under existing conditions and using 2041 projected flows.

To meet the objectives of the MEA Class EA, the impacts of alternatives on aspects of the environment must be considered. These include the natural and social/cultural environments, as well as a consideration of the technical and economic impacts. This section provides a detailed discussion on the following:

- The evaluation criteria and methodology for assessing the alternative solutions presented in Section 5;
- The evaluation of alternatives, including a review of natural, social/cultural, and technical impacts as well as estimated capital costs; and
- The selection and description of the recommended alternative.

6.2 Evaluation Criteria and Methodology

Criteria to evaluate the alternatives were identified under Technical, Natural Environment, Socio-Cultural, and Economic Factors. The criteria are presented in Table 6-1.

Table 6-1. Evaluation Criteria Type and Comparative Criteria

Type	Comparative Criteria	Description	Main Consideration
Technical Considerations	Implementation Feasibility	Feasibility of implementation in terms of: ▪ construction accessibility ▪ constructability (including water crossings) ▪ easements ▪ length of pipe ▪ pipe slope ▪ construction compounds	▪ Construction access from existing ROWs preferred, as it allows for lower construction cost and shorter construction period. ▪ Fewer creek crossings are preferred to reduce complexity during construction. ▪ Routes with fewer property owners are preferred to prevent delays in easement/property acquisition. ▪ Shorter length of pipe is preferred, as the subsequent capital cost, construction time, and disturbance to the natural and social environments are lower. ▪ Slopes between 0.15–0.5% are preferred to achieve self-scouring velocity while avoiding solid settlement, separation, odours, corrosion, and maintenance issues.

Type	Comparative Criteria	Description	Main Consideration
Technical Considerations	Permits and Approvals	Ease of receiving permits and approvals, including the agency approvals necessary ▪ number of key stakeholders to obtain permits/approvals from ▪ extent of infrastructure within lands of concern to each of the key stakeholders	▪ It is preferred to have the minimum number of key stakeholders (MTO, 407 ETR, Hydro One, TRCA) to obtain permits/approvals from. ▪ Minimum extent of infrastructure within lands of concern to each of the key stakeholders is preferred.
Technical Considerations	Reliability	Ability to provide reliable/continuous service: ▪ degree of reliance on EWD for conveyance, thereby reducing overall system diversion capability ▪ ability to service future CAA Lands development by gravity	▪ Ability to flow to both west and east trunks is preferred to provide reliable service and system redundancy. ▪ Preference is to service CAA Lands development entirely by gravity to minimize new pumped infrastructure and its subsequent capital and O&M costs.
Technical Considerations	Effectiveness	Effectiveness at meeting current and future conveyance requirements (i.e., modelling results) ▪ ability to conform to Region's Master Plan design parameter and be within 85% capacity ▪ possibility of basement flooding issues indicated by freeboard < 1.8 m	▪ Proposed and existing infrastructure preferred to be flowing below 85% capacity to minimize surcharge. ▪ Freeboard of 1.8 m or higher in proposed and existing infrastructure is preferred to minimize basement flooding potential.
Technical Considerations	Compatibility with Existing Infrastructure	Ease of connection with the existing sewer system Feasibility of connections: ▪ Biscayne Connection ▪ Westcreek Connection ▪ West-to-East Connection ▪ Khalsa Connection	▪ Preference is to connect to as many existing connections as possible.

Type	Comparative Criteria	Description	Main Consideration
Technical Considerations	Maximize Lifecyle Investment	Continued use of existing infrastructure	▪ Connections to the existing Etobicoke Creek trunks are preferred to continue use of existing infrastructure for flow balancing.
Technical Considerations	Flexibility	Flexibility: ▪ With respect to routing and operating the system ▪ In being able to meet future demands/expansion requirements; or future regulatory requirements	▪ Opportunities to use the existing Etobicoke Creek trunks for flow balancing is preferred for greater flexibility in operating the system. It is preferred that existing inverts and subsequent proposed infrastructure is deep to provide opportunities for flows beyond current future projection.
Technical Considerations	Operational Accessibility	ROW accessibility for O&M needs	▪ Access to proposed infrastructure via ROW preferred to avoid permanent easements.
Natural Environment	Terrestrial Systems	Proximity to any sensitive features and regulated lands Potential impacts to the local vegetation, trees, wildlife, and SAR due to construction and crossings	▪ Preference is to have as little of the alignment within valley lands as possible. ▪ Shortest length of open-cut work in green area is preferred. ▪ Alignment with less impact to wildlife habitat is preferred. ▪ Lowest potential to impact SAR is preferred.
Natural Environment	Aquatic Systems	Proximity to any sensitive features and regulated lands Potential impact to the local aquatic flora and fauna, and SAR due to construction and crossings	▪ Alignment that is farthest away from watercourse is preferred. ▪ Fewer creek crossings are preferred.
Natural Environment	Contamination	Considerations regarding contaminated areas	▪ Fewest contaminated areas present adjacent to the alignment are preferred.

Type	Comparative Criteria	Description	Main Consideration
Natural Environment	Hydrogeology and Surface and Groundwater	Hydrogeologic setting, description of groundwater in the area and impact to/on water table Potential impact to the quality of surface and groundwater	▪ Alignment with lowest potential to impact the water table is preferred. ▪ Alignment with smallest open-trench construction is preferred to minimize groundwater contamination. ▪ Alignment that entails of construction farther away from water course is preferred to minimize impact to surface water.
Natural Environment	Soil, Bedrock and Geology	Geology and geotechnical considerations	▪ Preference is to be within rock as much as possible.
Socio-Cultural Environment	Recreational Land Uses and Visual Landscape	Potential to impact existing parks and open spaces or impact the character of the existing community (i.e., interference with views)	▪ Alignment with least impact to the spaces used by the community (i.e., least number of spaces and shortest duration of impact) are preferred.
Socio-Cultural Environment	Future Planning Policies/Initiatives	Compatibility with Region of Peel and municipal growth initiatives MP Strategies (pumped versus gravity)	▪ Accommodation to the growth initiatives is preferred. ▪ Alignment with little to no pumping is preferred.
Socio-Cultural Environment	Disruption During Construction	Disruption to existing community during construction (traffic, noise, and air quality)	▪ Alignment preferred to be in non-residential areas. ▪ Alignment preferred to result in least disruptions to key roadways. ▪ Alignment preferred if there are no long-term odour or noise concerns.
Socio-Cultural Environment	Cultural Heritage Resources	Potential impacts to cultural heritage resources	▪ Alignment preferred to have little to no future archaeological potential. ▪ Alignment preferred to pose little to no permanent or temporary impact to adjacent to sites/properties of cultural heritage value or interest.

Type	Comparative Criteria	Description	Main Consideration
Economic Factors	Capital Cost	Estimated Capital Costs	▪ Capital costs include engineering, construction, and commissioning. Construction cost includes open-cut excavation, tunnelling, shaft construction, cost of pipe, site preparation and restoration. Also includes re-instatement, mobilization/ demobilization, traffic management, bonding, dewatering, etc. ▪ Lower capital cost alternative is preferred.
Economic Factors	Operation and Maintenance	Estimated Operational and Maintenance Costs	▪ Operational expenditure incurred throughout the life of the asset, including labour, power and consumables, and asset monitoring. Lower O&M cost alternative is preferred.

Notes:

% =percent

< = less than

The short-listed alternatives were evaluated against each of the comparative criteria and a score shown in Table 6-2. Weightings for each criteria category were assumed equal.

Table 6-2. Scoring for the Evaluation of the Short List of Viable Alternatives

Score	Definition
● Most Preferred	Least Impacts/Most Benefits
◐ Moderately Preferred	Moderate Impacts/Moderate Benefits
○ Least Preferred	Most Impacts/Least Benefits

A short-listed alternative's total score was then assigned based on the scoring of the criteria types; the alternative with the highest number of criteria types in which it scored Most Preferred was selected as the preliminary preferred alternative.

6.3 Evaluation of Short-Listed Alternative Solutions

The results of the evaluation of the short-listed alternatives are summarized in Table 6-3 and the discussion that follows. The complete evaluation of the short list of viable alternatives is presented in Appendix F.

Table 6-3. Summary of the Evaluation of Short-Listed Alternatives

Category	Evaluation Criteria	Etobicoke Creek	CAA Lands	Kennedy Road	Deep Trunk
Technical Considerations	▪ Implementation Feasibility ▪ Permits and Approvals ▪ Reliability ▪ Effectiveness ▪ Compatibility with Existing Infrastructure ▪ Maximize Lifecyle Investment ▪ Flexibility ▪ Operational Accessibility	○ Least Preferred	◐ Moderately Preferred	◐ Moderately Preferred	● Most Preferred
Natural Environment	▪ Terrestrial Systems ▪ Aquatic Systems ▪ Soil Contamination ▪ Hydrogeology and Surface and Groundwater ▪ Soil, Bedrock, and Geology	○ Least Preferred	◐ Moderately Preferred	● Most Preferred	◐ Moderately Preferred
Socio-Cultural Environment	▪ Recreational Land Uses and Visual Landscape ▪ Future Planning Policies/Initiatives ▪ Disruption During Construction ▪ Cultural Heritage Resources	◐ Moderately Preferred	○ Least Preferred	◐ Moderately Preferred	● Most Preferred
Economic Factors	▪ Capital Cost ▪ Operation and Maintenance	● Most Preferred	◐ Moderately Preferred	○ Least Preferred	◐ Moderately Preferred
Alternative Ranking		**4**	**3**	**2**	**1**

The Deep Trunk Alternative was deemed to be the preliminary preferred alternative based on the evaluation that was undertaken. The key factors for the ranking and the decision are summarized for each alternative.

Etobicoke Creek -Least Preferred

- Most limited access for construction and O&M
- Pumping stations required to service growth
- Integrates with existing sewers for reduced impact on EWD STS capacity
- Most impact on natural environment through construction
- Temporary impact to the paved multiuse trail in valley and King's Park during construction
- May impact archaeological resources
- Lowest cost

CAA Lands -Least Preferred

- Pumping stations required to service growth
- Integrates with existing sewers for reduced impact on EWD STS capacity
- Most impact on natural environment through construction
- Temporary impact to the paved multiuse trail in valley and King's Park during construction
- Impacts existing sports field on CAA Lands
- May impact archaeological resources
- Longest alignment leads to moderate cost

Kennedy Road – Less Preferred

- Most accessible for both construction and O&M
- Able to service future growth without pumping stations
- Not all existing sewers connected to Etobicoke Creek Trunk Sewer can be connected to this alternative
- Permanent diversion of significant capacity from East Trunk System to West Trunk System, affecting available capacity in EWD STS and operation of Region's diversion strategy
- Tunnelled construction results in least impact on natural environment
- Temporary traffic disturbance during construction at tunnel shaft locations
- Shortest alignment, but tunnelled construction leads to highest cost

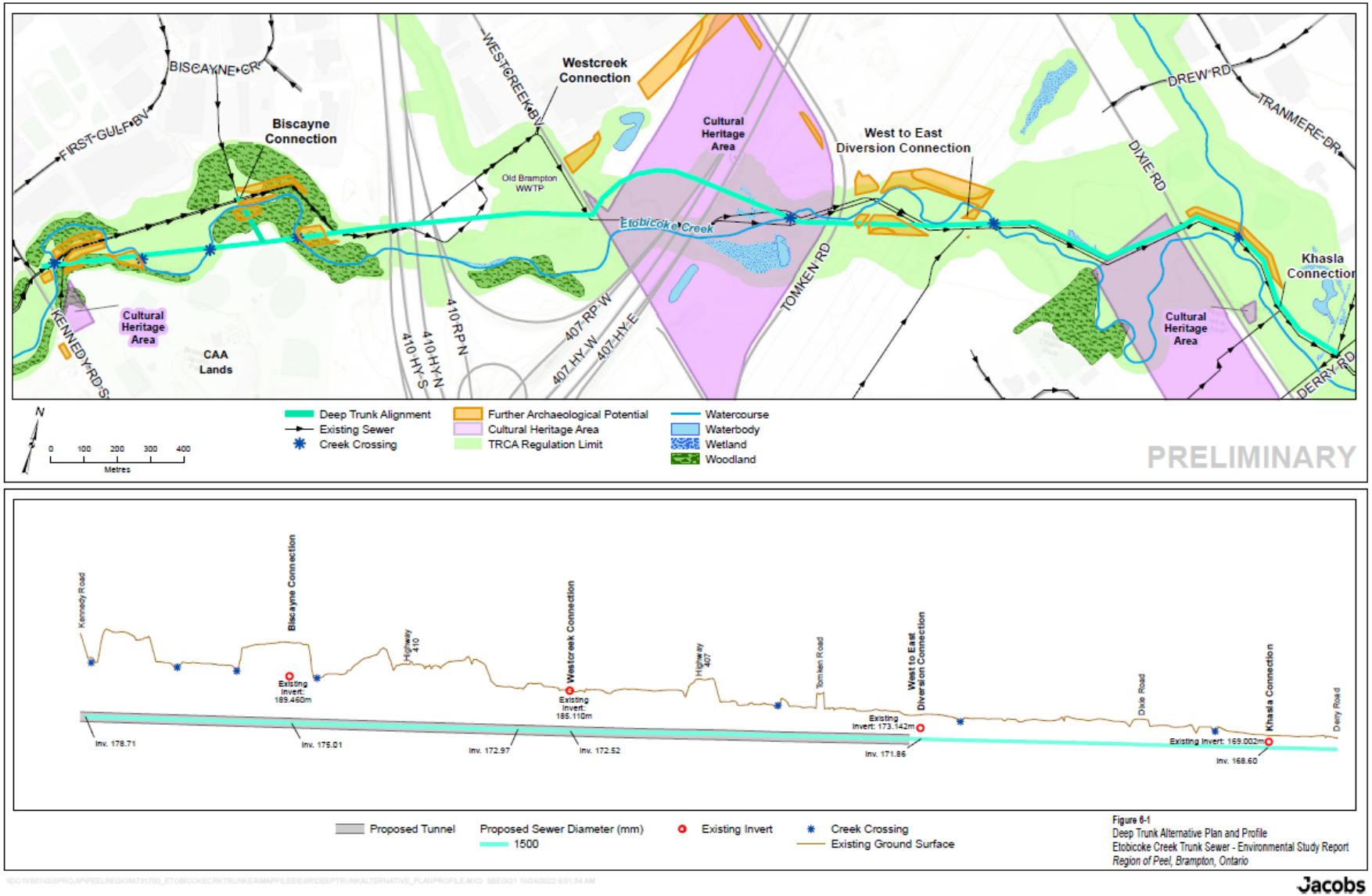
Deep Trunk – Most Preferred

- Ability to improve access for construction and O&M
- Able to service future growth without pumping stations
- Integrates with existing sewers with reduced impact on EWD STS capacity
- Tunnelled construction limits impact to natural features and archaeological and cultural heritage resources
- Trenched construction required at southern end of alignment (from West-East Diversion to Dixie and Derry)
- Tunnelled construction leads to higher cost

6.4 Recommended Alternative Solution

As described in Section 6.3, the Deep Trunk alternative was the most preferred. The implementation of the Deep Trunk Alternative will provide service to future growth via gravity and will integrate with the East to West diversion strategy via the EWD STS. It is able to connect to many key connections that currently are serviced by the existing trunks. Although it is within the Etobicoke Creek valley, tunnelling will mitigate the impact to the natural environment for a majority of the alignment. It also provides the least disturbance to community uses in the study area, as a Region-owned property can be used for some of the construction staging areas. However, access to most of the alignment will remain challenged because of the location and depth in the valley. The plan and profile for the preferred solution (the Deep Trunk alternative) is presented in Figure 6-1.

Figure 6-1. Deep Trunk Alternative Plan and Profile



7. Phase 3: Review of Alternative Design Concepts

Phase 2 of the Class EA process concluded with the selection of the Deep Trunk alignment as the preferred alternative (Figure 6-1). During Phase 3, the proposed Deep Trunk sewer was divided into four segments based on the length of the alignment, physical constraints (such as connection points and changes in direction of the alignment), and features associated with the study area.

During Phase 3, a two-stage process was undertaken to arrive at the preferred construction method for each segment. Stage 1 determined the practicality of trenchless and open-cut construction methods for each segment. Stage 2 assessed various design considerations for trenchless and open-cut segments of the alignment to determine the preferred design concept for each segment.

7.1 Development of Design Concepts

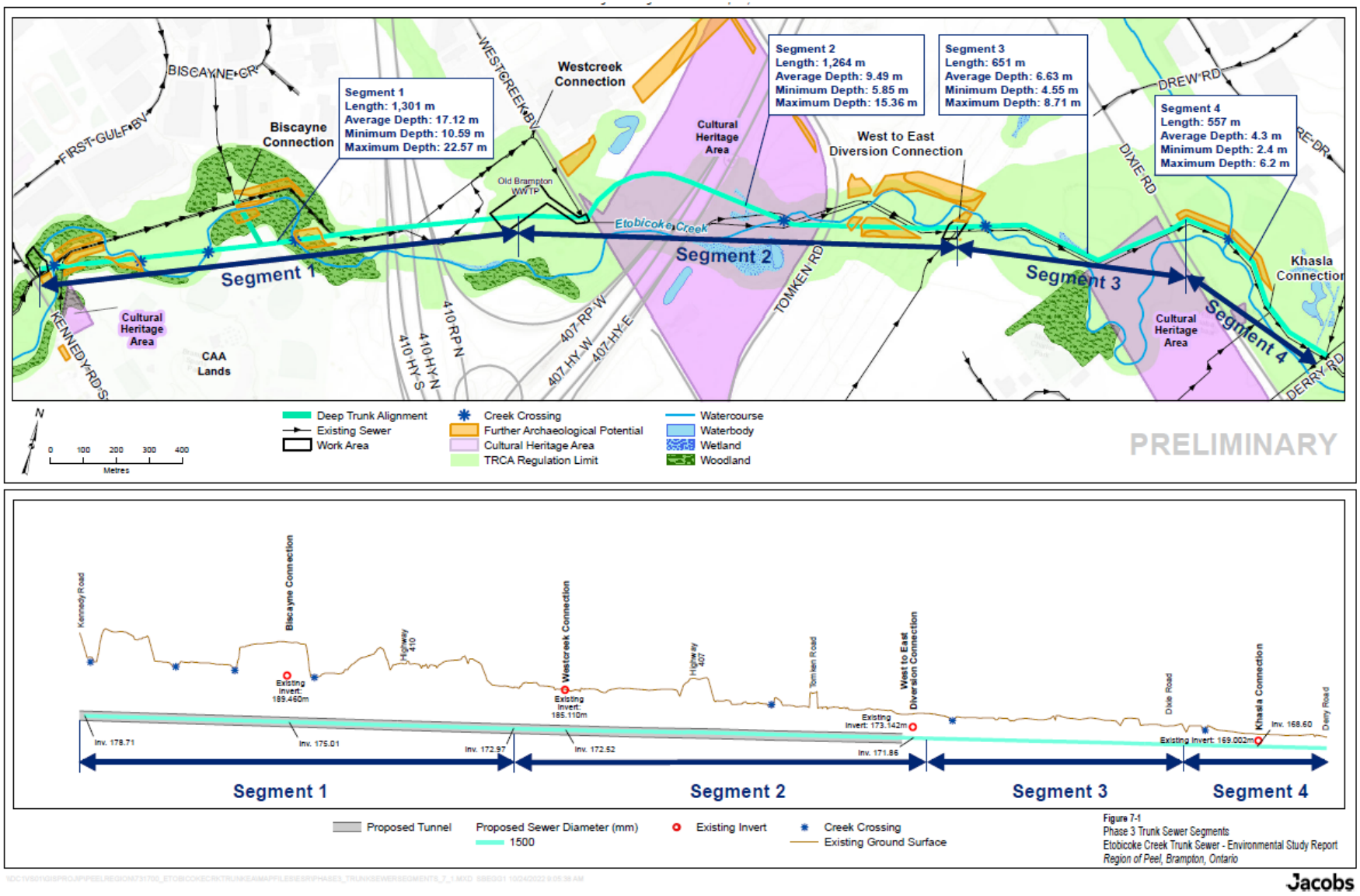
7.1.1 Segment Definition

Four segments were delineated based on a number of variables, including:

1. Constructability
2. Property availability
3. Existing sanitary sewer configuration
4. Impacts to the community and natural features

The segments described in Section 7.1.1.1 through Section 7.1.1.4 are based on the Phase 2 alignment. The alignment and segment definition were refined during the development of the preferred design concept throughout Phase 3 as further opportunities and constraints were identified. Figure 7-1 shows the segments for the Deep Trunk alignment using the Phase 2 alignment.

Figure 7-1. Phase 3 Trunk Sewer Segments



7.1.1.1 Segment 1: Kennedy Road – Old Brampton WWTP Site

The first segment extends approximately 1.30 km from the upstream connection point of the existing trunks at Kennedy Road to the old Brampton WWTP Site. Most of this segment is within the Etobicoke Creek valley and includes four creek crossings. The nearly linear segment includes the crossing of Highway 410 at an approximate angle of 85 degrees, and a connection to the extended local Biscayne sewer. The average depth of the segment is 17.1 metres (m), with a minimum depth of 10.6 m and a maximum depth of 22.6 m.

A diversion chamber will be needed at the upstream connection point where the existing twin pipes will be connected, so the flows can be split between the two existing pipes and the new trunk. Diversion chamber configurations will be confirmed during preliminary design and detailed design. During Phase 2, it was assumed that the proposed Deep Trunk would receive approximately 80% of the flow at Kennedy Road during the 5-year design storm under future flow projections.

The existing Biscayne Connection currently discharges into the existing (north) twin trunk sewer, but poses operational issues due to its relatively flat slope and frequent surcharging. The proposed Deep Trunk is about 140 m south of the connection point and is about 14.5 m deeper, creating an opportunity to provide an additional connection point to further relieve flows within Biscayne area. The trunk length from the Biscayne Connection to the proposed Deep Trunk will result in an additional creek crossing.

7.1.1.2 Segment 2: Old Brampton WWTP Site – West-to-East Diversion Chamber

The second segment is approximately 1.26 km long. It commences at the old Brampton WWTP site and extends east to the West-to-East Diversion Chamber. This segment includes a single crossing of Etobicoke Creek, a perpendicular crossing of Highway 407, and a crossing of Tomken Road. Perpendicular crossing of Highway 407 is necessary as per operators of Highway 407 (407 ETR) requirements. The average depth of the segment is 9.5 m, with minimum and maximum depths of 5.9 m and 15.4 m, respectively.

The new trunk will connect to the West-to-East Diversion Trunk Sewer and will provide the Region with more flexibility to manage flows if necessary. The proposed Deep Trunk is at lower elevation than the existing West-to East Diversion Trunk Sewer, and a new diversion chamber and connection pipe will be required. Connection details will be determined during preliminary design.

7.1.1.3 Segment 3: West-to-East Diversion Chamber - Eastern side of Dixie Road

The third segment is approximately 0.7 km long and runs mainly along the existing twin trunks. Commencing at the West-to-East Diversion Chamber connection and routing north of Etobicoke Creek, Segment 3 extends to just east of Dixie Road. This segment involves one crossing of Etobicoke Creek, as well as a crossing of Dixie Road. On average, this segment is 6.6 m deep, with a minimum depth of 4.6 m and maximum depth of 8.7 m.

7.1.1.4 Segment 4: Eastern side of Dixie Road - Derry Road

The fourth segment is approximately 0.6 km long. It begins east of Dixie Road and extends southeast to the connection point just north of Derry Road, where the proposed Deep Trunk will drain into the diversion chamber recently built on the East-to-West Diversion Sanitary Trunk Sewer that is currently under construction. Downstream flows will be split between the East-to-West Diversion Sanitary Trunk Sewer and the existing twin Etobicoke Creek Trunk Sewer. A knockout wall has been constructed on the East-to-West Trunk diversion chamber for the future connection of the Deep Trunk sewer.

Segment 4 generally parallels Etobicoke Creek and crosses one of the creek's tributaries. The segment has an average depth of 4.3 m, a minimum depth of 2.4 m, and a maximum depth of 6.2 m.

7.1.2 Stage 1 Evaluation-Open-Cut and Trenchless Construction

The Stage 1 evaluation discusses the practicality of using open-cut versus trenchless technology for each trunk segment, in terms of costs and technical efficiencies. Each methodology has associated opportunities and limitations. The choice of open-cut or trenchless construction depends on the depth of the installation and the nature of the segment alignment.

Open-cut construction allows for an alignment to change direction and orientation as needed, usually with the introduction of a maintenance hole. Open-cut can be achieved by constructing the pipe in stages within approximately 2.7 – to 3-m wide trenches for the 1,500-mm pipe. Trenches deeper than 8 m are generally not practical for the following reasons:

1. A large volume of soil must be managed.
2. Excess soil standards must be complied to for excavated soil stockpiles.
3. Larger digging equipment is required.

Figure 7-2 depicts the open-cut construction method.

Figure 7-2. Open-Cut Construction

During trenchless construction a tunnel is bored for pipe installation, commonly using a tunnel-boring machine (TBM) or microtunnel-boring machine (MTBM). A MTBM is a type of TBM but has a smaller diameter and shorter drive lengths compared to TBM. Specifics regarding TBM and MTBM are presented in Section 7.1.3 For trenchless construction, it is necessary to place the starting shaft where the tunnel-

boring machine (TBM) or microtunnel-boring machine (MTBM) is launched and to place a retrieval shaft where it is retrieved. Figure 7-3 shows a TBM within a launching shaft.

Figure 7-3. Launching Shaft Example

For trenchless construction, it is necessary to place the starting shaft where the tunnel-boring machine (TBM) or microtunnel-boring machine (MTBM) is launched and to place a retrieval shaft where it is retrieved. Although trenchless construction usually has a less impact, because it requires a much smaller surface area for launching and retrieval shaft installation, it can only accommodate abrupt directional changes in alignment at maintenance holes where the machine is launched or retrieved, and usually bears greater costs than open-cut construction. In general, and depending on soil conditions, a minimum cover of twice the size of the tunnel is typically needed to create an arch of material over the tunnel and limit ground deformations and frac-outs when using a pressurized face in soft ground. Frac-outs occur when water travels through the ground from the tunnel to the surface. A 1,500-mm pipe will need a tunnel with a minimum diameter of 2,150 mm, resulting in more than 4 m of ground cover above the tunnel. The minimum depth to pipe invert will need to be 6.5 m, taking into account the cover, tunnel liner thickness (if required), and pipe external diameter.

Table 7-1 compares the practicality of using open-cut and trenchless methods for the four proposed sewer segments.

Table 7-1. Stage 1 Evaluation – Open-Cut vs. Trenchless Construction

Segment	Segment Summary	Practicality Based on Depth of Pipe Invert - Trenchless	Practicality Based on Depth of Pipe Invert - Open-Cut	Practicality Based on Alignment - Trenchless	Practicality Based on Alignment - Open-Cut	Preferred Construction Methodology
1	Average: 17.1 m Minimum: 10.6 m Maximum: 22.6 m Straight segment Length: 1,301 m	Practical	Not Practical	Practical	Practical	**Trenchless construction** ▪ Based on pipe invert, open-cut construction is not practical as the depth is much greater than 8 m, while trenchless is more cost-effective. ▪ In terms of alignment, both open-cut and trenchless construction are feasible.
2	Average: 9.49 m Minimum: 5.9 m Maximum: 15.4 m Straight segment Length: 1,264 m	Practical	Not Practical	Practical	Practical	**Trenchless construction** ▪ Based on pipe invert, open-cut construction is not practical as the depth is much greater than 8 m, while trenchless is more cost-effective. ▪ In terms of alignment, both open-cut and trenchless construction are practical using large radius curves on the tunneled segment.

Segment	Segment Summary	Practicality Based on Depth of Pipe Invert - Trenchless	Practicality Based on Depth of Pipe Invert - Open-Cut	Practicality Based on Alignment - Trenchless	Practicality Based on Alignment - Open-Cut	Preferred Construction Methodology
3	Average: 6.6 m Minimum: 4.6 m Maximum: 8.7 m Some changes in direction Length: 651 m	Practical	Practical	Practical	Practical	**Open-cut/Trenchless construction** ▪ In terms of alignment, both open-cut and trenchless construction are practical. ▪ Both open-cut and trenchless construction methodology are practical with the depths required. ▪ Trenchless requires an intermediary shaft when the alignment has a sharp change in direction or when the tunnel drive is long.
4	Average: 4.3 m Minimum: 2.4 m Maximum: 6.2 m Many small segments with significant changes in direction Length: 557	Not Practical	Practical	Not Practical	Practical	**Open-cut construction** ▪ In terms of alignment, open-cut construction is practical due to the several directional changes. ▪ Based on pipe invert, trenchless is not practical due to insufficient cover.

Notes:

The depth to pipe invert is based on the Deep Trunk Alternative from Phase 2. Additionally, the depths are generated from an interpolation of contour lines.

Based on the Stage 1 evaluation, trenchless construction is recommended for Segments 1 or 2 because of their proposed depths. The appropriate trenchless design concepts for Segments 1 and 2 will be defined, evaluated, and selected as part of the Stage 2 Evaluation described in Section 7.1.3.

Both open-cut and trenchless construction are practical for Segment 3. Section 7.1.3 further evaluates the Segment 3 preferred construction methodology and design concept.

Open-cut construction is preferred for Segment 4 because there is insufficient cover to undertake tunnelling. There is no opportunity to lower the vertical alignment along Segment 4 because of constraints associated with the connection to the existing twin trunk sewers on Derry Road with fixed invert elevation. In addition, the alignment follows the existing sewer easement and therefore has multiple direction changes, which are difficult to achieve with trenchless methods. Open-cut will be carried forward for Segment 4. As there are not multiple types of open-cut methods, Segment 4 was not carried through to the Stage 2 evaluation.

7.1.3 Stage 2 Evaluation -Trenchless Construction Methodologies

As Section 7.1.2 noted, trenchless construction is a viable option for Segments 1, 2, and 3. The various methods of trenchless construction are pre-screened for practicality, in terms of cost and technical efficiencies, and the results are presented in Table 7-2. It should be noted that Rock TBM and MTBM are each type of TBM, and were the most applicable for this project.

Table 7-2. Trenchless Construction Methodologies

Segment	Hand Mining	Drill and Blast	Rock TBM	MTBM
Segment 1	Not Feasible	Not Feasible	Feasible	Feasible
Segment 2	Not Feasible	Not Feasible	Feasible	Feasible
Segment 3	Not Feasible	Not Feasible	Not Feasible	Feasible

As Table 7-2 shows, the two feasible options for a project of this magnitude and nature are Rock TBM and MTBM. Hand mining and drill and blast technologies were eliminated from further analysis due to length of segments, slow progress, health and safety concerns, geotechnical conditions, and the disruptive nature of those methods. The initial assessment of trenchless construction technologies for Segment 3 eliminated the use of a Rock TBM since geotechnical investigations indicated rock was not found at the required sewer elevation. Further geotechnical and hydrogeological investigations will be completed during preliminary design and detailed design.

7.1.3.1 Design Concepts for Segments Proposed with Trenchless Technologies

During the Stage 2 evaluation, the design concepts for trenchless technologies were developed based on the initial alignments considered in Phase 3. To develop design concepts for rock TBM and MTBM construction, the three segments proceeding to Stage 2 evaluation were further evaluated as follows:

- **Segment 1: Kennedy Road – Old Brampton WWTP Site**
  - Based on preliminary discussions with the Ministry of Transportation Ontario (MTO), the Highway 410 can be crossed in a tunnel with an angle close to 90 degrees.
  - The old Brampton WWTP site is located at the northeastern corner of Highway 410 and Highway 407, and offers a large potential staging area, because the Region owns it, and it is available for use for the duration of the project.
  - There may be low points within the valley areas; a topographical survey will be needed to confirm this.

- **Segment 2: Old Brampton WWTP Site – West-to-East Diversion Chamber**
  - The operators of Highway 407 (407 ETR) require that the tunnel crossing of Highway 407 be close to a 90-degree angle and that no shafts be located within the highway's right-of-way. The bridge over the Etobicoke Creek Trail should also be avoided.
  - The old Brampton WWTP site is located at the northeastern corner of Highway 410 and Highway 407, and offers a large potential staging area, because the Region owns it, and it is available for use for the duration of the project.
  - There may be low points within the valley areas; a topographical survey will be needed to confirm this.
- **Segment 3: West-to-East Diversion Chamber - Eastern side of Dixie Road**
  - Due to recent road reconstruction on Dixie Road, the Region's Transportation Division would like to avoid further road reconstruction that would result from open-cut construction. Dixie Road is also heavily travelled and is a major arterial road so open-cut construction would present additional traffic management concerns.
  - There may be low points within the valley areas; a topographical survey will be needed to confirm this.

The design concepts presented in Section 7.1.3.1.1 and Section 7.1.3.1.1 were developed during the Stage 2 evaluation of the design concepts. Following the Stage 2 evaluation, the alignment is refined. The final sewer alignment is discussed in Section 7.3.

7.1.3.1.1 Design Concept Based on Rock TBM

General Considerations

Table 7-3 provides general pipe and tunnel sizes needed to implement the proposed Deep Trunk alignment by using a rock TBM. When using a rock TBM, the carrier pipe for the sewer is installed after the tunnel is excavated and supported. Therefore, the TBM has to excavate with a cross-section large enough to accommodate the carrier pipe afterward. When tunnel drives are longer than 1,000 m, a larger tunnel diameter may be required to allow for the ventilation duct that conveys fresh air to the TBM. The outer diameter of a 1,500-mm pipe is around 1,800 mm. Because the excavation support can be approximately 150 mm thick, a TBM capable of excavating a tunnel of around 2700 mm would be sufficient to install the target pipe.

Table 7-3. Pipe Size, Tunnel Size and Depth of Cover Needed for TBM

Element	Inner Diameter (mm)	Outer Diameter (mm)	Required Depth of Cover (m)	Minimum Depth of Invert (m)
Pipe	1500	1770	Not Applicable	Not Applicable
Tunnel	2400	2700	5.4	8.1

Segment 1: Kennedy Road – Old Brampton WWTP Site

This segment would include two shafts for the launching and retrieval of the TBM:

1. Shaft 1 is at the upstream connection point (east of Kennedy Road, just north of Etobicoke Creek).
2. Shaft 2 is within the old Brampton WWTP site boundaries.

Tunnelling would not require intermediate shafts between Shaft 1 and 2 because it can be completed in a single drive, but the current alignment would require an intermediate shaft to accommodate the Biscayne Connection. Shaft 1 is assumed to be the launching shaft because it is near Kennedy Road. The TBM would be retrieved at Shaft 2, and the TBM would tunnel downhill to facilitate a smaller retrieval shaft within the

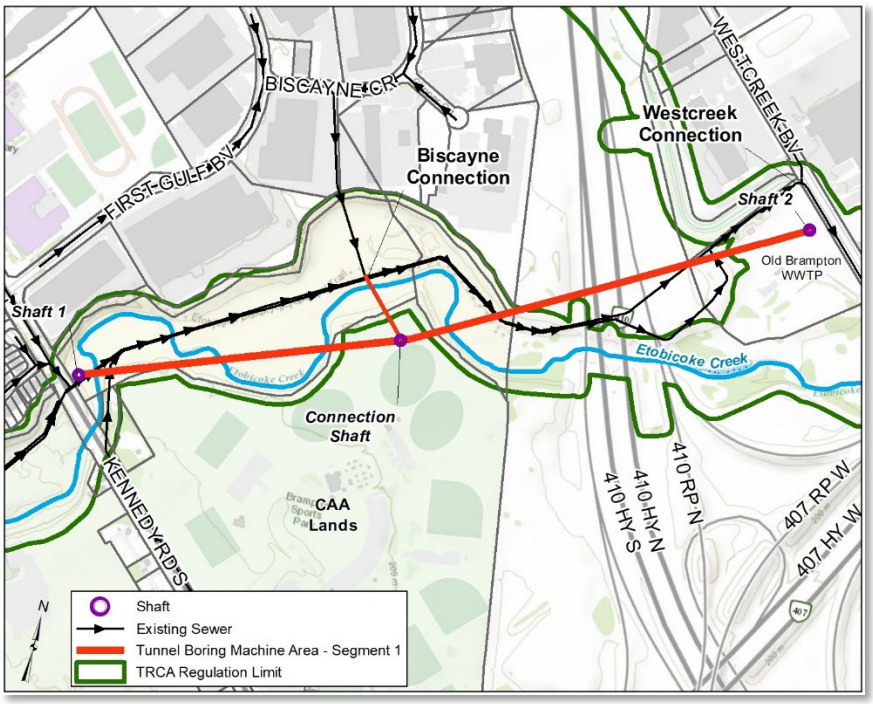
natural environment at Shaft 2. The downhill approach presents challenges because water will infiltrate through the rock and accumulate. To address this challenge, the TBM contractors will need to estimate the size of pumps needed to manage the additional water and maintain safe working conditions. Alternatively, because of the restricted access conditions at Shaft 1, Shaft 1 could be designated as the receiving shaft and Shaft 2 could be assumed to be the launching shaft. A diversion chamber would be constructed within Shaft 1, where the existing twin pipes could be diverted into the proposed Deep Trunk sewer or flows could be split between the two existing pipes and the proposed Deep Trunk sewer.

Based on the initial segmental analysis, the proposed Deep Trunk is about 140 m south of the Biscayne Connection point and about 14.5 m deeper than the existing Biscayne sewer. The connection between the Biscayne sewer and the proposed new trunk sewer would need to be deep enough to cross under Etobicoke Creek and limit potential disruption. A separate MTBM would likely be needed to tunnel the connection to the existing Biscayne sewer, with a connection shaft between Shafts 1 and 2. This structure would accommodate a vortex chamber to dissipate energy from the significant drop. Note that following the Stage 2 evaluation, the location of the Biscayne connection and intermediary connection shaft is refined (refer to Section 7.3.1) to further address surcharging issues and eliminate a creek crossing.

Access roads would be needed to access Shaft 1 and the Biscayne Connection shaft. A short access road would be needed to access Shaft 1 (located in the valley land), whereas a longer access road would be needed for the Biscayne Connection shaft. Shaft 2 could make use of some of the paved roads on the old Brampton WWTP site. Access to Shaft 1 is challenging because of existing site conditions. The site has steep slopes that will require grading and access will require the removal of a number of trees.

Figure 7-4 shows the Segment 1 alignment using TBM for construction.

Figure 7-4. TBM Segment 1



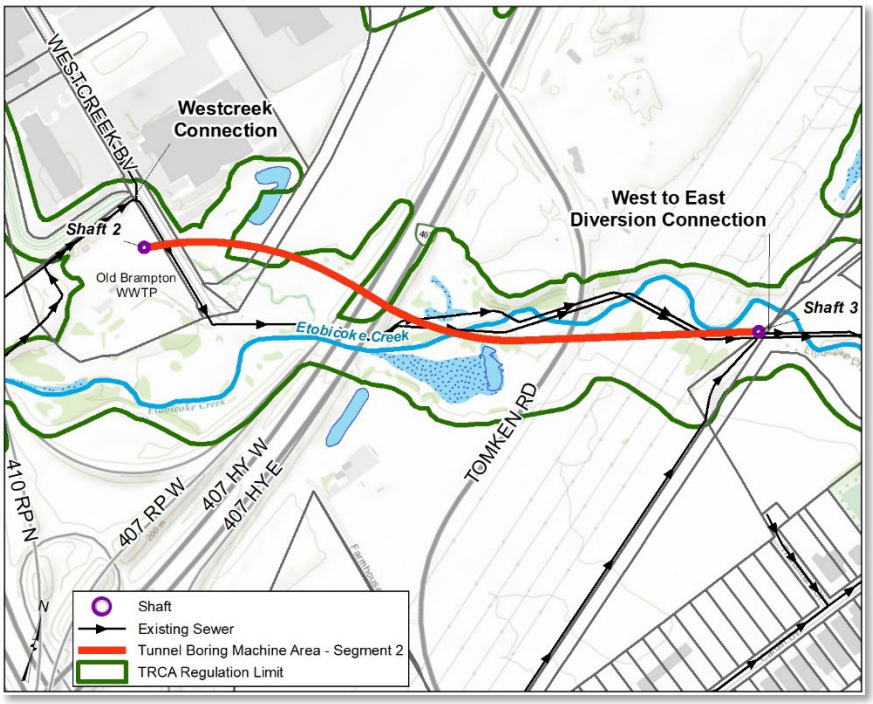
Segment 2: Old Brampton WWTP Site – West-to-East Diversion Chamber

Segment 2 would require two shafts, starting at Shaft 2 (at the old Brampton WWTP site), and tunnelling downhill to Shaft 3 (the West-to-East Connection point). In this case, Shaft 2 would be used to launch the TBM toward Shaft 3, where the TBM would be retrieved. No intermediate shafts would be required, because a TBM could tunnel the 1,300-m length in a single drive. The alignment for this segment would

have two 500-m-radii curves to allow for the perpendicular crossing of Highway 407, as shown in Figure 7-5.

Shaft 3 would facilitate a connection to the West-to-East Diversion Trunk Sewer, allowing flexibility to divert flow. A diversion chamber would be required at Shaft 3. Note that these lands are owned by Infrastructure Ontario and necessary permits and agreements will be required to be obtained prior to infrastructure installation. Shaft 2 is accessible through an existing paved road. Shaft 3 would be located within the valley lands and would need an access road off Tomken Road.

Figure 7-5. TBM Segment 2



7.1.3.1.2 Design Concepts Based on MTBM

General Considerations

Table 7-4 lists the general pipe and tunnel sizes needed to construct the Deep Trunk using a MTBM. A MTBM machine can excavate in rock or overburden, and the jacking pipe can be used to push the MTBM forward in the excavation support of the tunnel; this becomes the carrier pipe when the tunnel is finished.

A jacking pipe with an internal diameter of 1,500 mm has an outside diameter of approximately 1,900 mm. To install this size of pipe, the MTBM would have an excavation diameter of roughly 2,100 mm.

Table 7-4. Pipe Size, Tunnel Size and Depth of Cover Needed for MTBM

Element	Inner Diameter (mm)	Outer Diameter (mm)	Required Depth of Cover (m)	Minimum Depth of Invert (m)
Pipe	1,500	1,890	Not Applicable	Not Applicable
Tunnel	2,150		4.3	6.5

Segment 1: Kennedy Road – Old Brampton WWTP Site

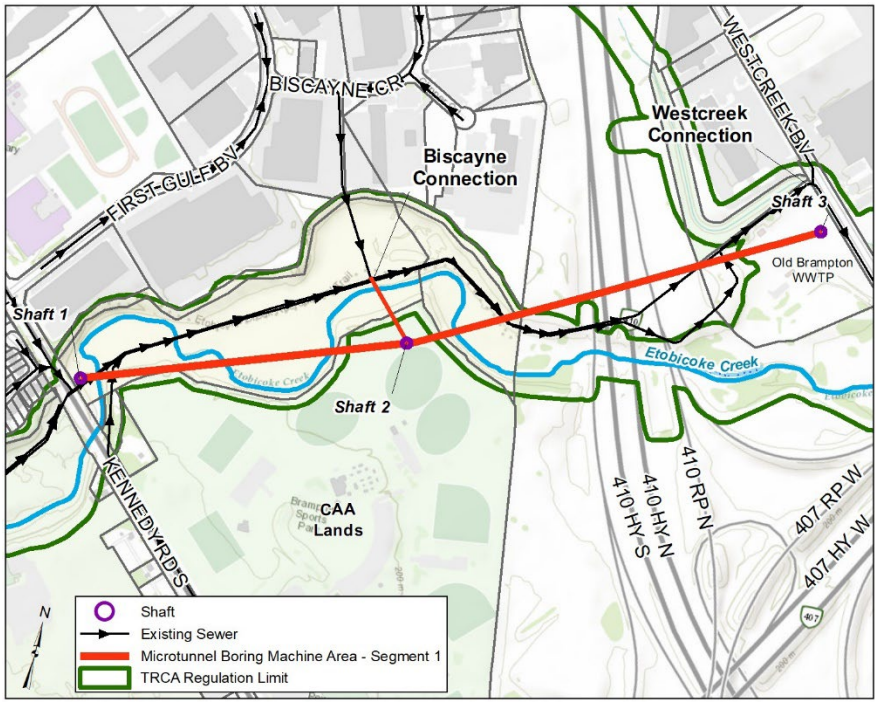
Based on the length of this segment, two drives are required through three shafts. Shaft 1 would be at the upstream connection point (east of Kennedy Road, just north of Etobicoke Creek). Shaft 2 would be placed in an intermediate location to help facilitate the Biscayne Connection. Shaft 3 would be located at the old Brampton WWTP site. Shafts 1 and 3 would be launching shafts, because they are more accessible than Shaft 2, and Shaft 2 would be the receiving shaft. The MTBM would tunnel downhill from Shaft 1 to 2, and would then be moved to Shaft 3 to tunnel uphill to Shaft 2. Shaft 1 would likely be converted into a diversion chamber where the existing twin pipes entered, and the flows would be split between the two existing pipes and the proposed Deep Trunk.

The proposed Deep Trunk is located about 140 m south of the Biscayne Connection point and is about 14.5 m deeper than the existing Biscayne Connection. To achieve this extension, the connection would need to be deep enough to cross under Etobicoke Creek to minimize disruptions. Shaft 2 would be used to connect the Biscayne sewer to the Deep Trunk sewer. A vortex chamber would be needed here because there is a significant drop between the Biscayne and Deep Trunk sewers. Note that following the Stage 2 evaluation, the location of the Biscayne connection and Shaft 2 is refined (refer to Section 7.3.1) to further address surcharging issues and eliminate a creek crossing.

Access roads are needed to access Shafts 1 and 2. A short access road would be needed to Shaft 1 (located in the Etobicoke valley), whereas a longer access road would be needed for Shaft 2. Shaft 3 could use some of the paved roads on the old Brampton WWTP site.

Figure 7-6 shows the Segment 1 alignment using an MTBM.

Figure 7-6. MTBM Segment 1



Segment 2: Old Brampton WWTP Site – West-to-East Diversion Chamber

The second segment would also need two drives through three shafts:

1. Shaft 3 at the old Brampton WWTP Site
2. Shaft 4 north of Tomken Road
3. Shaft 5 at the West-to-East Connection point

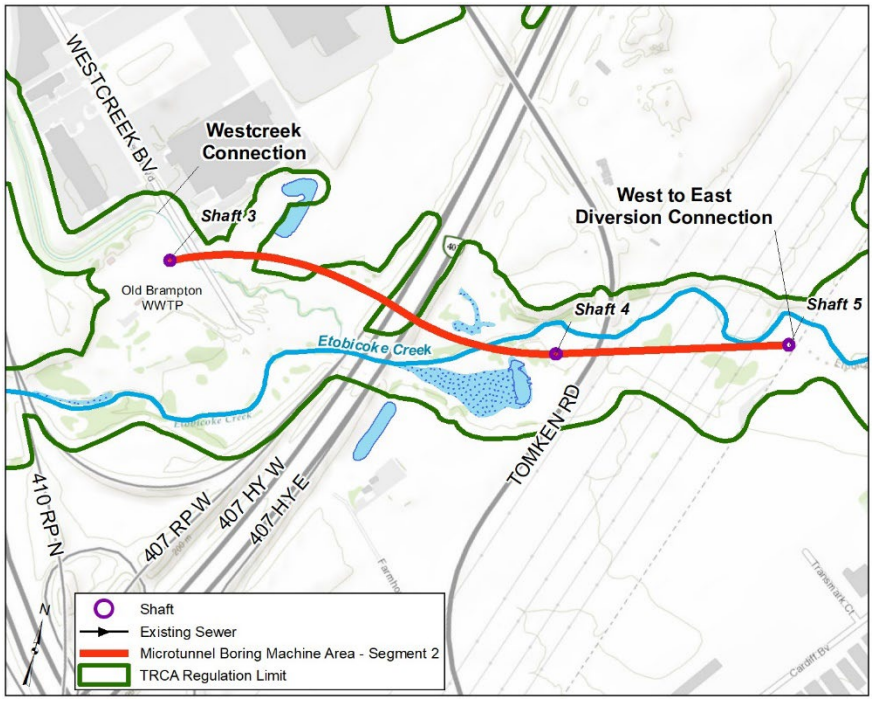
Shafts 3 and 5 would be launching shafts, whereas Shaft 4 would be a retrieval shaft. The MTBM would tunnel downhill from Shaft 3 to 4, and would then be moved to Shaft 5, where it would tunnel uphill to Shaft 4. The alignment would be designed with two 500-m-radii curves to allow for the perpendicular crossing of Highway 407.

Shaft 3 would facilitate a connection to the West-to-East Trunk Sewer, allowing flexibility to divert flows; a diversion chamber would also be required here.

Shaft 3 is accessible through existing paved road. However, because they are within Etobicoke valley lands, Shafts 4 and 5 would need access roads from Tomken Road. The access road to Shaft 4 would be shorter than the access road to Shaft 5. Access to Shaft 5 may be difficult and could use the existing hydro corridor access on the southern side of the creek and an access road along Etobicoke Creek Trail.

Figure 7-7 shows the Segment 2 alignment using a MTBM.

Figure 7-7. MTBM Segment 2



Segment 3: West-to-East Diversion Chamber - Eastern side of Dixie Road

Segment 3 would need two drives through three shafts

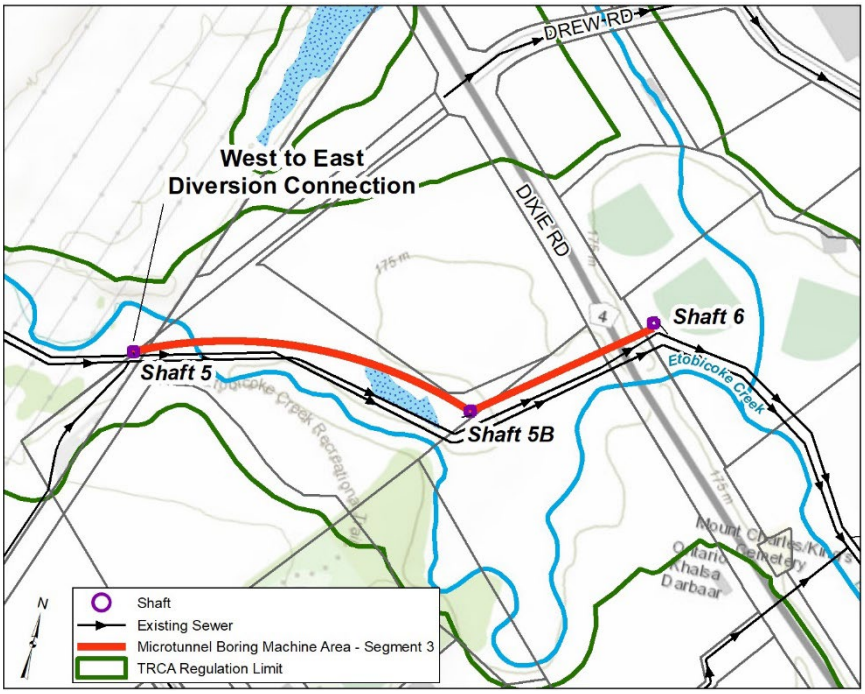
1. Shaft 5 at the West-to-East Connection point
2. An intermediary Shaft 5B
3. Shaft 6 east of Dixie Road and north of Etobicoke Creek

Shafts 5 and 6 would be launching shafts, whereas Shaft 5B would be a retrieval shaft. The MTBM would tunnel downhill from Shaft 5 to 5B, and would then be moved to Shaft 6, where it would tunnel uphill to Shaft 5B.

Access to Shaft 5 may be difficult and could be achieved from Tomken Road using the existing hydro corridor access on the south side of the creek and an access road along Etobicoke Creek Trail. Shafts 5B and 6 could be accessed with an access road off Dixie Road. Shaft 5, Shaft 5B, and Shaft 6 are located within IO lands, private property, and City of Mississauga lands, and as such required permits and agreements will need to be in place prior to project implementation.

Figure 7-8 shows the Segment 3 alignment using an MTBM.

Figure 7-8. MTBM Segment 3



7.2 Evaluation of Tunnelling Methodologies

7.2.1 Evaluation Criteria

Evaluation of the tunnel methodologies was completed based on a similar triple-bottom-line-plus approach as that used to evaluate the short-listed alternatives in Phase 2. Four criteria types were identified to satisfy the evaluation requirements of the MEA's Class EA Process: Technical Considerations, Natural Environment, Socio-Cultural Environment, and Economic Factors. Study-specific criteria were then determined under each of the four criteria type as presented in Table 7-5.

Table 7-5. Evaluation Criteria Type and Comparative Criteria

Type	Comparative Criteria	Description	Main Consideration
Technical Considerations	Tunneling Considerations	▪ Tunnel diameter ▪ Tunnel Drive ▪ Number of shafts needed ▪ Size of shafts ▪ Presence of gases	▪ A tunnel size closer to the pipe size is preferred (TBM needs 2700 mm OD tunnel and MTBM needs 2150 mm OD tunnel); reduces amount of grouting required ▪ Single drive to tunnel each section is preferred (TBM can bore up to 3 km and MTBM can bore typically up to 800 m) ▪ Fewer number of shafts preferred (longer drives eliminate need for intermediate shafts) ▪ Smaller shaft area is preferred (TBM needs minimum shaft size of 10 m for launching and 7 m for receiving while MTBM requires minimum 6.5 m for launching and 5 m for receiving) ▪ Gases (like methane, hydrogen sulphide and others common in the rock and found in overburden in southern Ontario) have been detected in shale in nearby projects; lower risk in the event that gas is encountered is preferred (higher risk if workers are present) as it could trigger explosions
Technical Considerations	Geotechnical and Hydrogeological Conditions	▪ Versatility ▪ Groundwater	▪ Versatility to tunneling in different ground conditions (overburden and bedrock) is preferred ▪ Preference for a TBM is to excavate upward to allow groundwater infiltration to run towards the launching shaft and minimize pumping requirements; no preference for MTBM

Type	Comparative Criteria	Description	Main Consideration
Technical Considerations	Property Requirements	▪ Space for work compounds ▪ Area needed for permanent easements ▪ Impact on private property ▪ Encroachment permit needs for Hwy 410/407 ETR/ Hydro One Lands	▪ Smaller work compounds needed for staging the launching and retrieving shafts are preferred as it will mean a smaller temporary easement (TBM 4500 m^2 and 3000 m^2 respectively and MTBM 2000 m^2 and 800 m^2 respectively) ▪ Smaller permanent easement area is preferred to facilitate property negotiations ▪ Least impact on private property is preferred to facilitate property negotiations ▪ Smaller area within Hwy 410/407 ETR/ Hydro One Lands
Technical Considerations	Accessibility	▪ Construction access	▪ Ease of accessing shaft locations is important
Technical Considerations	Maintainability	▪ Ease of maintenance ▪ Operation access ▪ Maintenance needs	▪ More opportunities to use shaft locations for maintenance holes is preferred ▪ Ease of accessing the maintenance holes and diversion chambers is important ▪ Longer distances between maintenance holes may require specialized and costly inspection and repair equipment; lower need for specialized equipment is preferred
Technical Considerations	Schedule	▪ Duration of project	▪ Shorter time duration for completion of work is preferred

Type	Comparative Criteria	Description	Main Consideration
Natural Environment	Terrestrial Environment	▪ Area within natural environment ▪ Crossing of the natural system	▪ Smaller area of work area within the natural environment is preferred; presents less disturbance to the natural environment, habitats and ultimately species that use the area ▪ Perpendicular crossing of the Natural System at its most narrow point
Natural Environment	Aquatic Environment	▪ Impact to aquifers and surface water receptors (e.g., watercourses, wetlands, and woodlands)	▪ Fewer number of shafts/work area close to the Etobicoke Creek is preferred to minimize impact on aquifers and surface water receptors
Natural Environment	Groundwater Impacts	▪ Groundwater levels	▪ Less impact to groundwater levels is preferred; can be impacted by tunnelling in rock
Natural Environment	Contaminated Lands	▪ Proximity of contaminated lands	▪ Fewer number of work compounds and shafts within Areas of Potential Environmental Concern (APEC) is preferred to reduce the potential for groundwater contamination during construction
Natural Environment	Soil Management	▪ Quantity of excavated	▪ Less soil needing to be hauled after excavation is preferred
Socio-Cultural Environment	Built Heritage Resources and Cultural Heritage Landscapes	▪ Proximity to cultural heritage sites	▪ Fewer number of Cultural Heritage Resources (CHR) in close proximity of work compounds, shafts and alignment is preferred
Socio-Cultural Environment	Archaeological Potential	▪ Impact to archaeological potential	▪ Preference is for work compounds and shafts to be outside of areas requiring archaeological assessment
Socio-Cultural Environment	Impact to Recreation	▪ Impact to recreational trails/ facilities	▪ Minimal temporary disruption to access recreational trails and facilities preferred

Type	Comparative Criteria	Description	Main Consideration
Economic Factors	Cost of Tunneling and Infrastructure	▪ Equipment cost ▪ Cost of shaft excavation and work compound preparation ▪ Cost of material ▪ Cost of hauling material ▪ Cost of pipe	▪ Lower equipment cost is preferred (including cost of tunnel) ▪ Lower cost for shafts and work compounds is preferred ▪ Lower cost for material (i.e., backfill grout to fill in annular space) is preferred ▪ Lower cost for material to be hauled from site is preferred ▪ Lower cost of pipe is preferred

The tunneling design concepts were evaluated against each of the comparative criteria and a score shown in Table 7-6 was assigned.

Table 7-6. Scoring for the Evaluation of the Tunneling Design Concepts

Score	Definition
● Most Preferred	Least Impacts/Most Benefits
◐ Moderately Preferred	Moderate Impacts/Moderate Benefits
○ Least Preferred	Most Impacts/Least Benefits

For each criteria, an average score was determined for each construction methodology. The design concept with the most criteria types where it scored Most Preferred was selected as the preferred design concept for the tunneled segments. Section 7.2.2 describes the scoring results.

7.2.2 Evaluation of Tunneling Design Concepts

The construction methodologies were evaluated for Segment 1 to 3 using the evaluation criteria and scoring definitions provided in Section 7.2.1. The results of the evaluation are summarized in Table 7-7 and provided in detail in Appendix G.

Table 7-7. Construction Methodology Evaluation Summary

Criteria Type	Segment 1 Rock TBM	Segment 1 MTBM	Segment 2 Rock TBM	Segment 2 MTBM	Segment 3 Trenched	Segment 3 MTBM
Technical Considerations	◐ Moderately Preferred	● Most Preferred	◐ Moderately Preferred	◐ Moderately Preferred	○ Least Preferred	◐ Moderately Preferred
Natural Environment	◐ Moderately Preferred	● Most Preferred	◐ Moderately Preferred	◐ Moderately Preferred	○ Least Preferred	● Most Preferred

Criteria Type	Segment 1 Rock TBM	Segment 1 MTBM	Segment 2 Rock TBM	Segment 2 MTBM	Segment 3 Trenched	Segment 3 MTBM
Socio-Cultural Environment	◐ Moderately Preferred	◐ Moderately Preferred	◐ Moderately Preferred	○ Least Preferred	○ Least Preferred	◐ Moderately Preferred
Economic Factors	○ Least Preferred	● Most Preferred	○ Least Preferred	◐ Moderately Preferred	○ Least Preferred	● Most Preferred
Concept Selection		**Preferred**		**Preferred**		**Preferred**

7.2.2.1 Segment 1

Both the rock TBM and MTBM are technically feasible for Segment 1. Ultimately, MTBM scored higher for technical, natural environment, and economic considerations. A main factor for preference of MTBM is the diameter of the MTBM is closer to the proposed pipe diameter of the proposed Deep Trunk than the rock TBM diameter, reducing the amount of grouting required. Three shafts are required for both the MTBM and rock TBM; however, the shaft areas and compound areas are smaller for the MTBM than for the rock TBM, resulting in less disturbance to the natural environment. Additionally, MTBM does not impact the groundwater table during tunnelling and results in less excavated material than the TBM. Although speed of tunnelling is slower, pipe installation using MTBM is combined with tunnelling, resulting in an overall shorter expected schedule and duration than the TBM. Overall, the cost of the MTBM is expected to be less than that of the rock TBM.

7.2.2.2 Segment 2

Both the rock TBM and MTBM are technically feasible for Segment 2, and these received equal overall scores. Although there are fewer shaft compounds required for the TBM due to an intermediate shaft being required for the MTBM, both alternatives have similar impacts on the natural environment due to the larger work area required for the TBM. The MTBM scored slightly lower than the rock TBM under socio-cultural environment considerations. This is because the MTBM option may result in an additional shaft that is near trails, in a previously unassessed area of archaeological potential, and in an area that may impact one Cultural Heritage Resource (CHR). Assuming equal availability of equipment, the capital cost for an MTBM will be less based on the smaller tunnel diameter, reduced grout requirements, and excavated soils disposal cost.

As reflected in the scoring, there is no clear preference for Segment 2. However, because the MTBM is preferred for Segment 1, implementing a MTBM for Segment 2 would be more cost-effective than mobilizing alternative TBM equipment. Additionally, a MTBM provides more flexibility to accommodate variable ground conditions, which will be confirmed during preliminary design. MTBM technology is therefore recommended for Segment 2.

7.2.2.3 Segment 3

Open-cut excavation and microtunnelling (via a MTBM) were evaluated and compared. From a technical standpoint, both open-cut and MTBM technologies are feasible for Segment 3; however, one of the major constraints is the alignment crossing of the six-lane section of Dixie Road. Substantial challenges will exist related to traffic management and utilities conflicts that are likely to be faced attempting to trench across Dixie Road. Additionally, Dixie Road was recently reconstructed, and it is preferred to avoid further

reconstruction that open-cut would require. The following factors were considered in the evaluation of the two construction methodologies:

- **Excavation Volume.** The open-cut methodology will require a greater excavation, carbon footprint, and materials management volume than the MTBM method because there will be more maintenance holes, soils management, and restorations, as well as the requirement of a full width trench along the entire alignment to lay the pipe.
- **Hydrogeology**. Although additional hydrogeological information will be needed to confirm this, it is expected that significant dewatering will be required when constructing the pipe using open-cut technology near the creek. The construction of the MTBM shafts will also require some groundwater management; however, the open-cut option may require dewatering along the entire length of the alignment, while the MTBM option would only require dewatering at shaft locations.
- **Disturbed Surface**. The open-cut methodology is likely to require approximately 5,600 m^2 of disturbed surface whereas the tunnelling will require 4,800 m^2 during construction. Toronto and Region Conservation Authority (TRCA) permits will be required for both options. Although both options will end up having the same permanent easement space, open-cut will require the procurement of a larger temporary easement.
- **Maintenance.** As the open-cut method requires more maintenance holes to accommodate directional changes, from an access and maintainability perspective this method is considered slightly more favourable than the MTBM method. However, the actual maintenance activities anticipated on the asset are minimal and are considered to be similar for both construction methods.
- **Project Duration and Schedule**. Comparing the overall project duration and schedule for the two construction methods, open-cut excavation was considered to have a substantially longer construction period due to the approvals and permits required to cross Dixie Road. Significant planning for traffic management and the management of existing utilities would also be required for this option. However, the actual construction may be a quicker installation for the open-cut construction than for MTBM construction.
- **Cost.** The preparatory costs related to design/investigations involved with open-cut excavation, including the section across Dixie Road, would be substantially greater than for a MTBM. However, the MTBM is likely to have a higher construction cost.
- Based on the analysis, from a technical perspective, Segment 3 is recommended to be constructed using MTBM methodology. A MTBM will result in the least disruption to Dixie Road during construction, will have fewer environmental impacts, and will minimize the construction footprint.

7.3 Refined and Updated Sewer Alignment

Following the selection of the preferred construction methodologies, the Biscayne Connection, Segment 2, Segment 3, and Segment 4 alignments and shaft locations were refined based on the constraints identified in the Stage 2 evaluation process. These locations were also refined to improve the level of confidence in the constructability of the alignments and shafts. This section includes details and rational for refining the sewer alignment and shaft locations.

7.3.1 Alignment from Shaft 1 to Shaft 2

The alignment from Shaft 1 to Shaft 2 was revised due to the relocation of Shaft 2, as well as a change in the location of the proposed Biscayne Connection. The proposed Biscayne Connection to the proposed Deep Trunk moved from the existing Biscayne Connection location at the existing twin trunk sewers to a connection on private property approximately 150 m north of the twin trunk sewers (three pipe segments upstream). The Biscayne Connection location was changed because the existing sewer segments downstream of the proposed Biscayne Connection are prone to surcharging, and diverting the flow upstream should help to alleviate this surcharge.

Four locations were also considered for Shaft 2, which serves as a connecting point for the Biscayne Connection to the proposed Deep Trunk:

- Option 1 -Phase 2 location within the existing cricket pitch
- Option 2 -Outside cricket pitch
- Option 3 -Westerly connection
- Option 4 -Easterly connection

Figure 7-9 shows the locations of these options, and Table 7-8 summarizes the advantages and disadvantages of each location.

Figure 7-9. Biscayne Connection Option

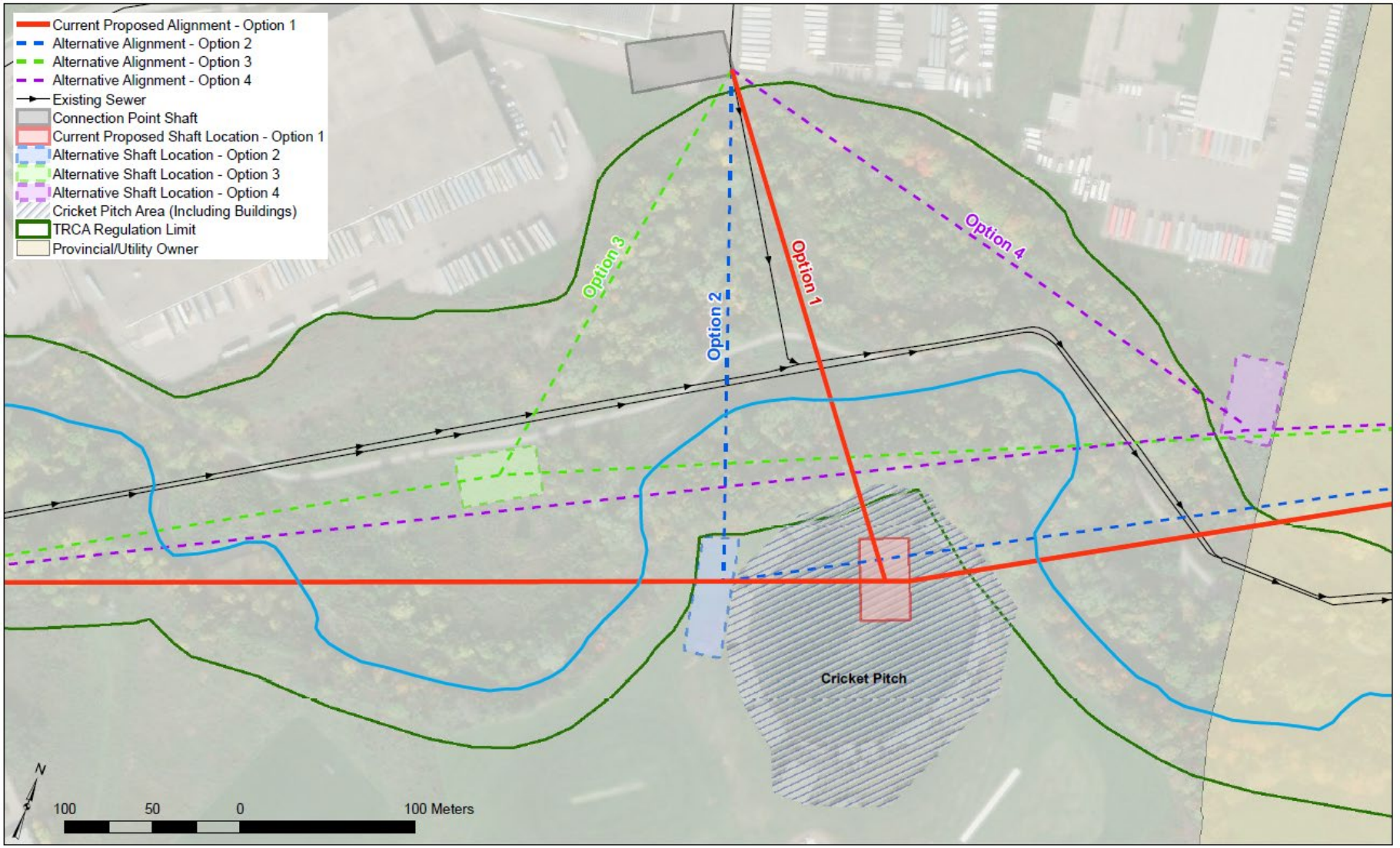


Table 7-8. Biscayne Connection Location Evaluation

Category	Option 1 Phase 2 Location	Option 2 Outside Cricket Pitch	Option 3 Westerly Connection	Option 4 Easterly Connection
Impact to Cricket Pitch and Subsequent Approval from City of Brampton	Within cricket pitch. Will not be approved.	Just outside cricket pitch; construction sequencing may need coordination with cricket season/tournament.	Does not impact cricket pitch. Will be preferred.	Does not impact cricket pitch. Will be preferred.
Impact to Private Property	Does not impact any private properties	Does not impact any private properties	Does not impact any private properties	Requires a shaft compound on outer extent of private property
IO/MTO Right-of-Way	Compound is outside of IO/MTO right-of-way	Compound is outside of IO/MTO right-of-way	Compound is outside of IO/MTO right-of-way	Within close proximity to IO/MTO right-of-way; will likely require the team needing to justify shaft location
Difference from Original Alignment	None	Minor difference	Larger difference	Larger difference
TRCA Regulation Limits	Compound is outside of TRCA Regulation Limits	May be partially within TRCA Regulation Limits	Within TRCA Regulation Limits	Within close proximity to TRCA Regulation Limits
Creek Crossing	Connection crosses the creek	Connection crosses the creek	Connection does not cross the creek	Connection does not cross the creek
Hydraulic Constraints	Connection is toward direction of flow in trunk. Drop structure would be needed here.	Connection is at slight angle against direction of flow in trunk. However, a drop structure is needed, negating acute angle impact.	Connection is at acute angle and a little against the direction of flow in trunk. However, a drop structure is needed, negating acute angle impact.	Connection is toward direction of flow in trunk. Drop structure would be needed here.

Category	Option 1 Phase 2 Location	Option 2 Outside Cricket Pitch	Option 3 Westerly Connection	Option 4 Easterly Connection
Tunnelling Considerations	Relatively similar distance drives leading to (610 m) and from (680 m) the connection shaft for the Deep Trunk.	Shorter distance to (475 m) and longer distance from (810 m) the connection shaft for the Deep Trunk. The longer distance is feasible but not preferred.	Much shorter distance to (335 m) and much longer distance from (945 m) the connection shaft for the Deep Trunk. The longer distance is not recommended by machine manufacturers and it is preferred to be avoided.	Longer distance to (815 m) and shorter distance from (475) the connection shaft for the Deep Trunk. The longer distance is feasible but not preferred.
Accessibility	Will need to be accessed through CAA Lands and directly into cricket pitch. Could impact traffic into/out of community centre.	Will need to be accessed through CAA Lands. Could impact traffic into/out of community centre.	Can be accessed via the trails but will require a section of trail to be closed or re-routed. Some tree clearing may be needed. Trail may not be suitable for heavy construction vehicles.	Not likely to be accessed off Highway 410. Will need to be accessed via the trail, needing a larger section of the trail to be closed or re-routed. Will also need significant tree clearing.

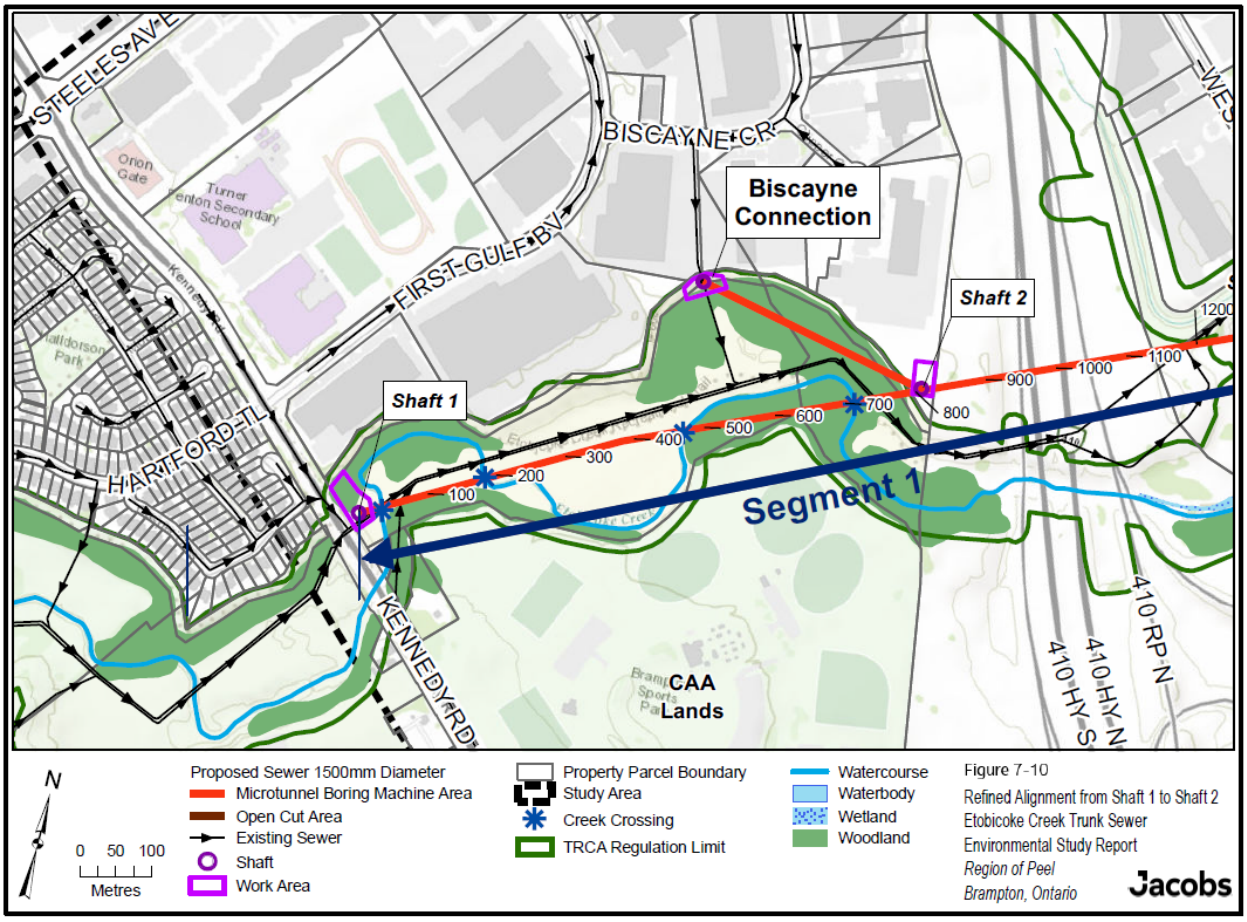
Note:

IO = Infrastructure Ontario

Based on the considerations in Table 7-8, Option 4 (Easterly Connection) is the preferred shaft location for the Biscayne Connection. The Option 4 location is the refined location of Shaft 2.

The refined alignment between Shaft 1 and Shaft 2 is show in Figure 7-10.

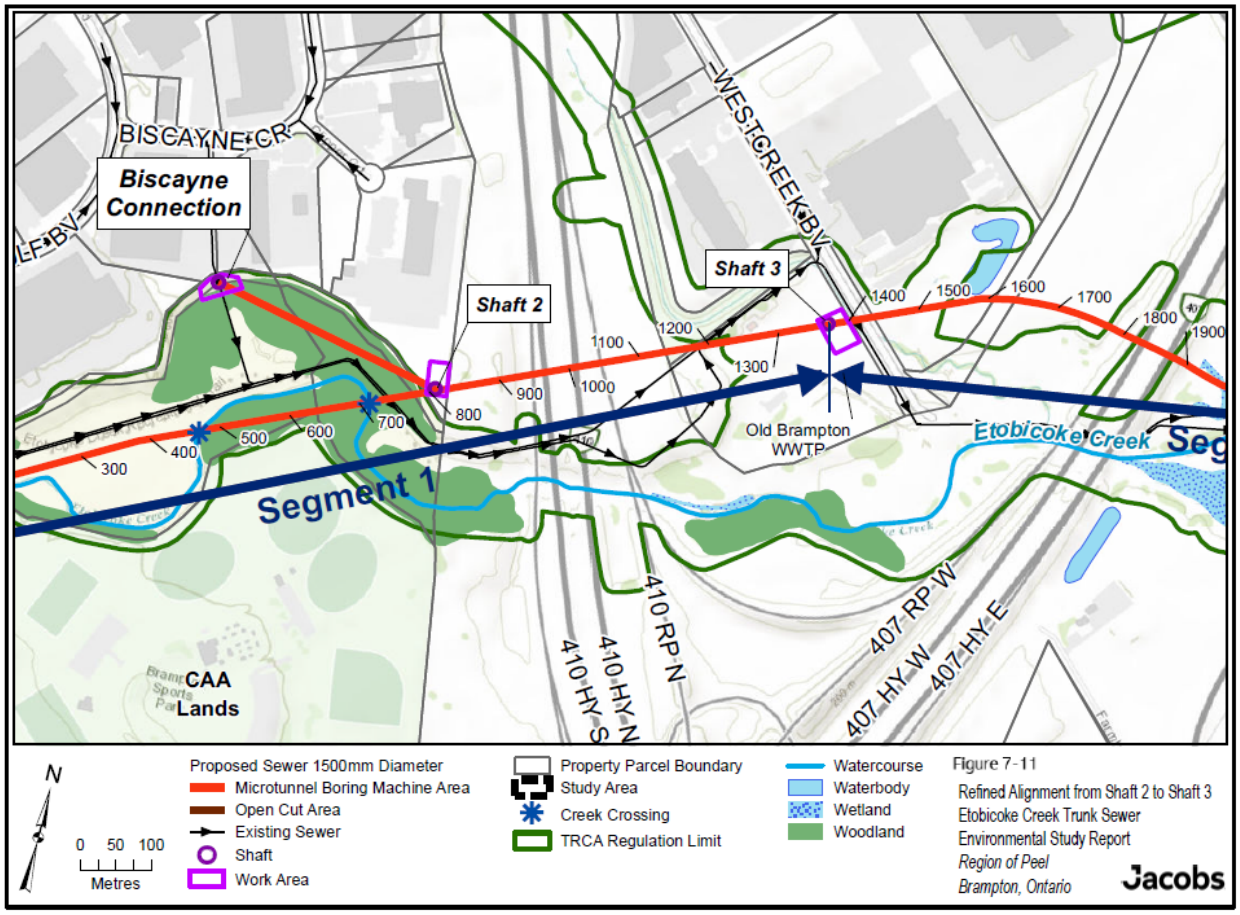
Figure 7-10. Refined Alignment from Shaft 1 to Shaft 2



7.3.2 Alignment from Shaft 2 to Shaft 3

The alignment from Shaft 2 to Shaft 3 altered because the location of Shaft 2 changed, as discussed in Section 7.3.1. Additionally, as reasoned in Section 7.3.3 Shaft 3 was shifted slightly to the east. Figure 7-11 shows the refined alignment from Shaft 2 to Shaft 3.

Figure 7-11. Refined Alignment from Shaft 2 to Shaft 3



7.3.3 Alignment from Shaft 3 to Shaft 4

The original proposed location of Shaft 4, north of Tomken Road, was near a reconstructed wetland. Following the construction methodology evaluation process, Shaft 4 is recommended to be located south of Tomken Road to avoid the wetland.

A minor change to the alignment and a minor move for Shaft 3 was also required to accommodate a new Shaft 4 location because the current drive length between Shafts 3 and 4 (approximately 850 m) was on the higher end of the recommended maximum MTBM drive length. Shaft 3 was shifted to the eastern extent of the Region's old Brampton WWTP site and closer to the road at Westcreek Boulevard.

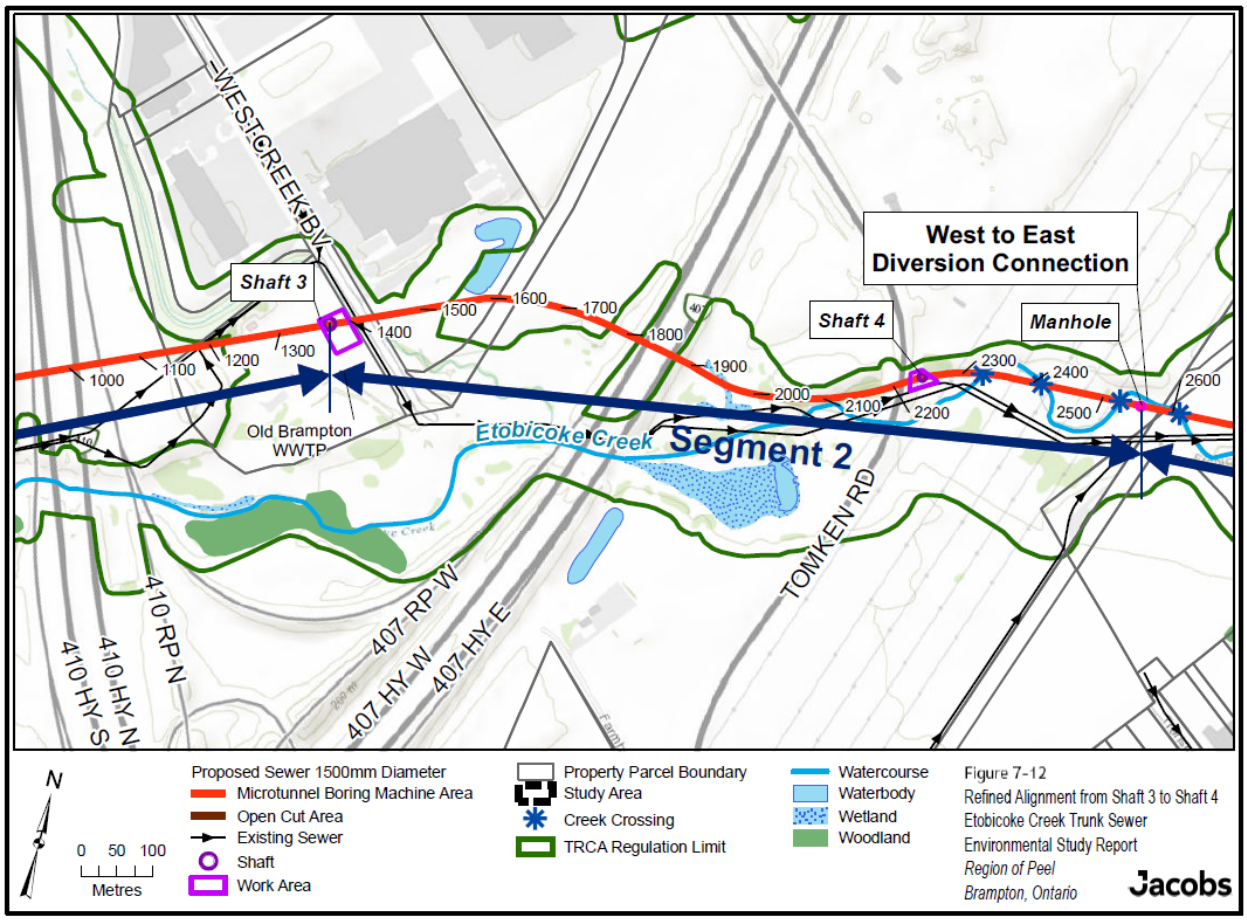
The minor changes required in the alignment were also driven by the following factors:

- **Requirement to cross Highways 410 and 407 at a perpendicular angle.** The radius bends were adjusted so the alignment is constructible and feasible within the recommended parameters.
- **Hydro One permissions.** Hydro One does not typically allow a tunnel to be near any transmission tower. Minor adjustments were made in the alignment to accommodate this constraint.

The revised alignment also eliminated a Segment 2 creek crossing.

Figure 7-12 shows the updated alignment and shaft locations between Shafts 3 and 4.

Figure 7-12. Refined Alignment from Shaft 3 to Shaft 4



7.3.4 Alignment from Shaft 4 to Shaft 5

The easterly shift of Shaft 4 resulted in a shorter sewer length between Shafts 4 and 5. Consequently, the need for an intermediary shaft at the proposed West-to-East Diversion Connection was void. In place of a shaft at the West-to-East Diversion Connection, a new manhole is proposed to be constructed after tunnelling operations to connect to the existing 1,200-mm-diameter trunk sewer.

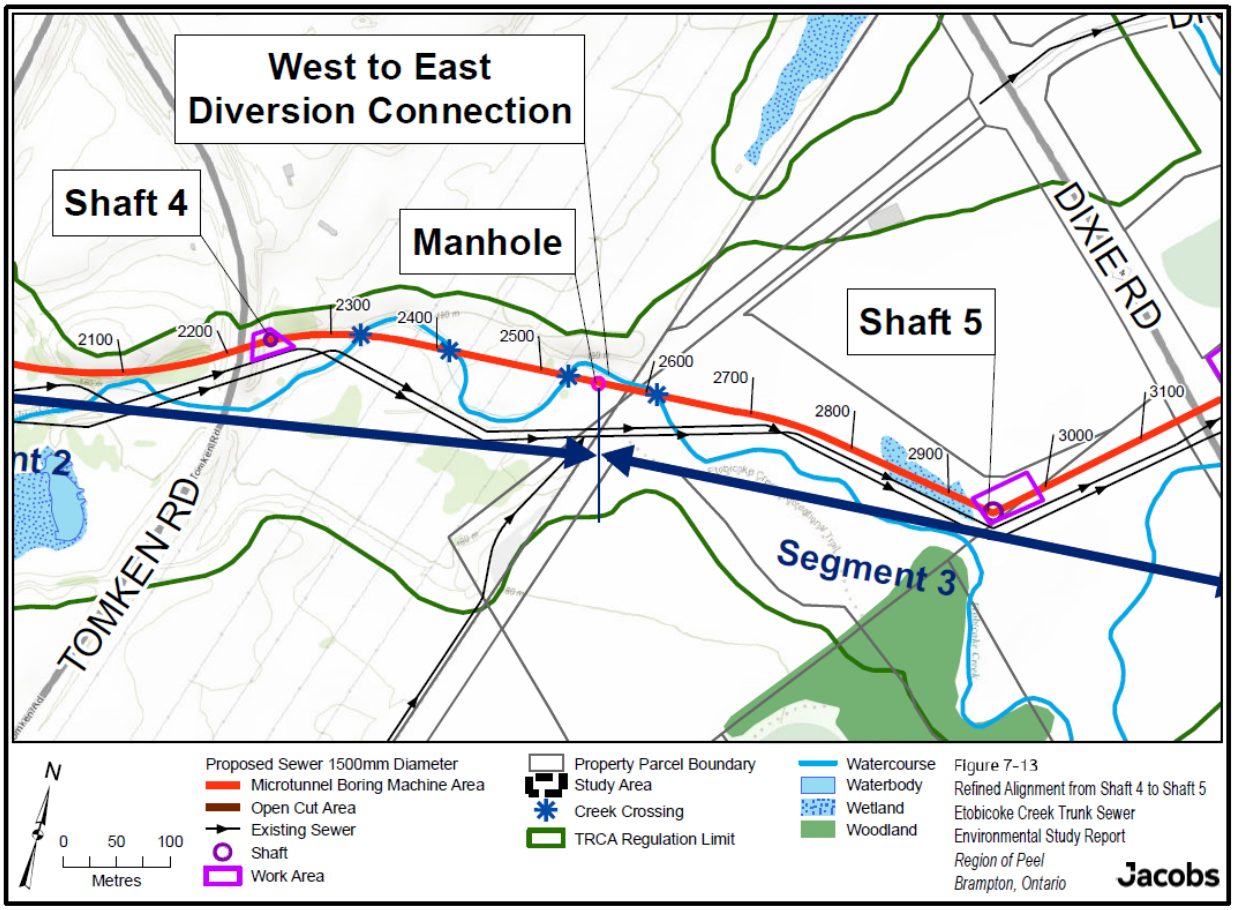
A few options were considered for the alignment between Shafts 4 and 5:

- One option was to curve the alignment south toward Shaft 5, because it would result in only two Etobicoke Creek crossings. However, this option was discounted from further consideration because it encroaches onto private property at Chainage 2600. This option would also require two additional crossings of the existing sewers.
- A second option was to curve the alignment north toward Shaft 5, which would result in only two creek crossings along the main alignment but would require an additional creek crossing to connect the existing West-to-East Trunk Sewer to the proposed Deep Trunk. Alternatively, the existing West-to-East Trunk Sewer would need to be connected at a diversion chamber location at Chainage 2700. However, connecting at Chainage 2700 would result in a connection further downstream than the originally intended connection location.
- A third option was to make this portion of the alignment as direct and straight as possible, accounting for a set clearance between the existing sewer and proposed alignment. This alignment requires Etobicoke Creek to be crossed at four locations. The required clearance has been accounted for, as has

a buffer (approximately 3 m) from the creek bed to the top of the proposed pipe to mitigate potential risks to the creek's geomorphology. However, that depth is based on a geographic information system-derived contour and depth, and the creek profile will be confirmed during preliminary design via topographical surveys. This option is the preferred option between Shafts 4 and 5.

Figure 7-13 shows the selected alignment between Shafts 4 and 5:

Figure 7-13. Refined Alignment from Shaft 4 to Shaft 5

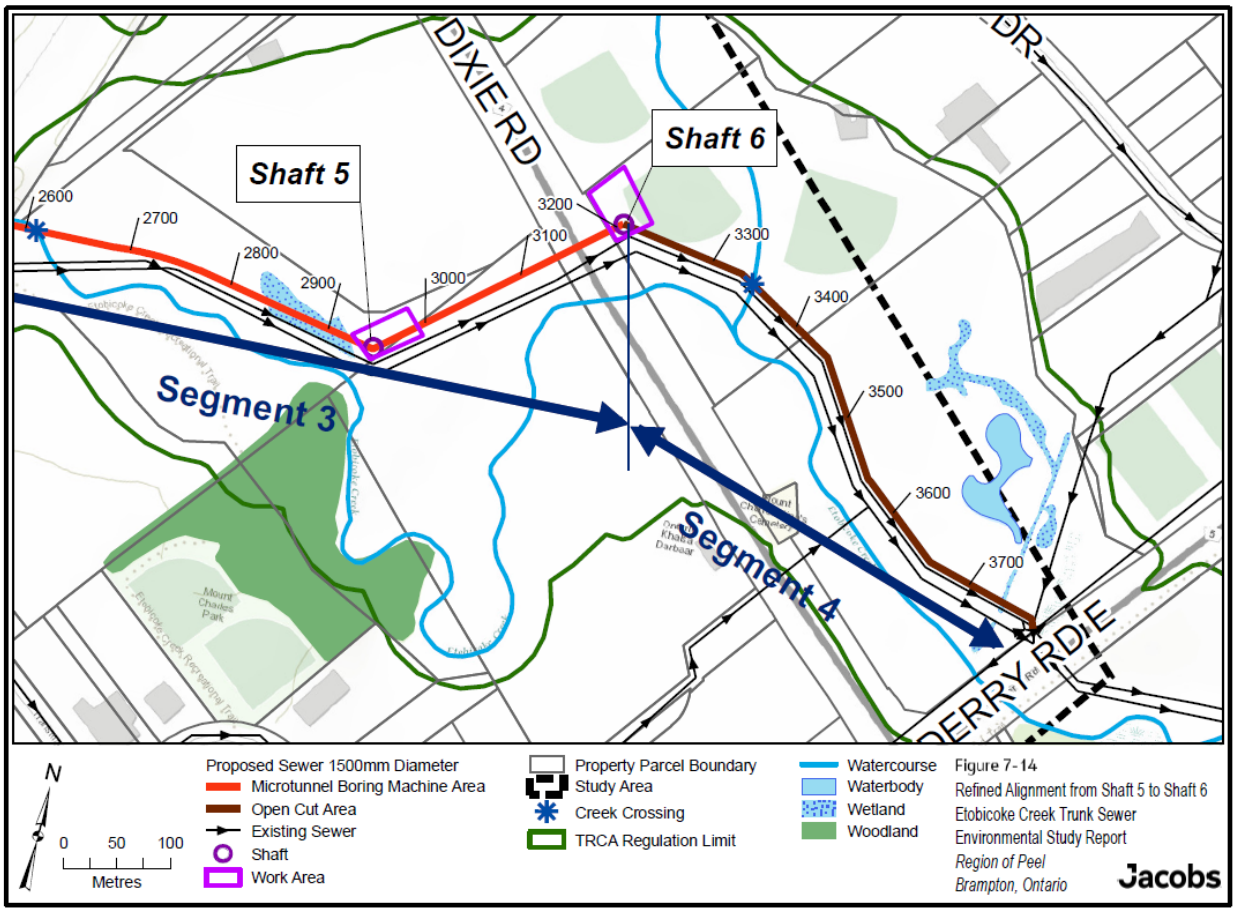


Note that consideration was also given to routing the alignment through a section of the private property north of Shaft 5. However, agreements for accessing the property during the development and implementation of preliminary geotechnical investigations could not be reached with the property owner.

7.3.5 Alignment from Shaft 5 to Shaft 6

The alignment from Shafts 5 to 6 was determined based on the local private property constraints. There is a corridor in between a private property boundary and existing utility easement that is regulated by the TRCA and owned by the City of Mississauga. The alignment is adjacent to but not within an existing easement for the existing twin trunk sewers; therefore, an additional easement will be required. Figure 7-14 shows the refined alignment.

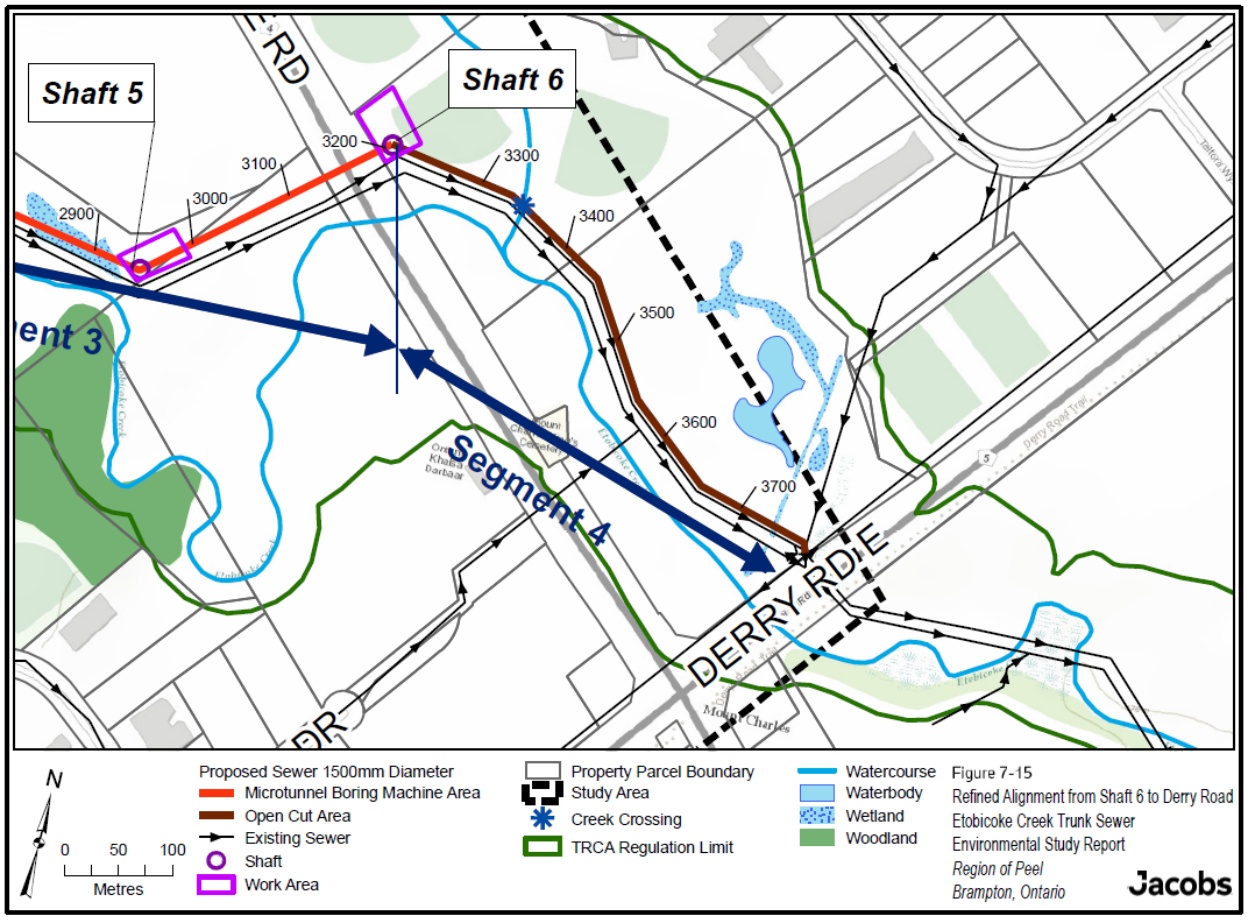
Figure 7-14. Refined Alignment from Shaft 5 to Shaft 6



7.3.6 Alignment from Shaft 6 to Derry Road

The alignment between Shaft 6 and Derry Road was modified slightly from Phase 2 to provide a 5-m clearance between the existing sewer and the proposed alignment. Figure 7-15 shows the location of the refined alignment between Shaft 6 and Derry Road.

Figure 7-15. Refined Alignment from Shaft 6 to Derry Road



7.4 Shaft Compound Area Locations

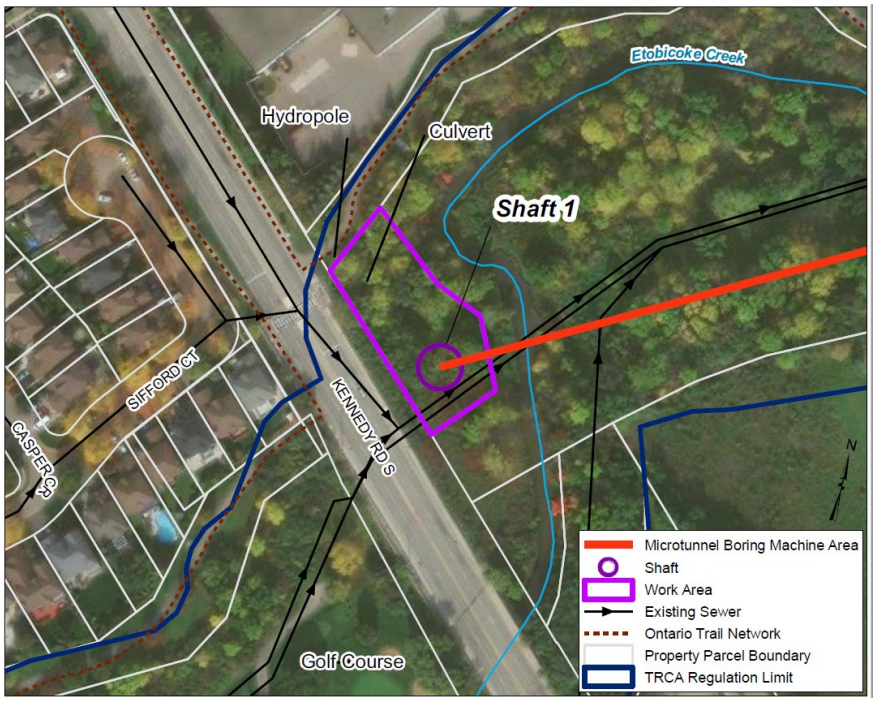
7.4.1 Shaft 1

Shaft 1 is a launching shaft located immediately east of Kennedy Road, west of the Etobicoke Creek, and south of the Etobicoke Creek Trail. The proposed shaft compound area is located within Etobicoke valley lands and near Etobicoke Creek, and within the TRCA regulated area. The site will require a minimum area of 2,400 m^2; within that area, a 7-m-diameter shaft will be needed. This site will include a diversion chamber to facilitate the upstream connection to the existing twin sewers and any other future connections.

The proposed site for Shaft 1 is defined by the required connection to the existing sewers (Figure 7-16). There is a small culvert to the east of the compound area that will need to be protected with a retaining wall. There is also a substantial slope from Kennedy Road to the proposed shaft location, and fill and tree removals will be required to create suitable topography for shaft construction. Accessing this site may be difficult. Access from the trail will require excavation of a small hill (approximately 2m high) that is located at the entrance of the trail off of Kennedy Road. Additionally, a hydro pole (see Figure 7-16) is also located directly at the trail entrance and would need to be relocated.

Alternative options for the shaft location were considered, including a shaft location on Kennedy Road, west of Kennedy Road on the golf course, and a downstream location (east) of the proposed shaft location at the multiuse trail. A shaft location on Kennedy Road would require blocking three lanes of traffic, with no opportunity to widen the road at a location in the vicinity of the existing Etobicoke Creek Trunk Sewers. Additionally, filling outside of the road would likely still be required to provide stable conditions for excavation. There are also steep slope conditions West of Kennedy Road at the golf course, and as such west of Kennedy Road is not an ideal location. The location downstream at the creek trail was discounted as it was not hydraulically feasible.

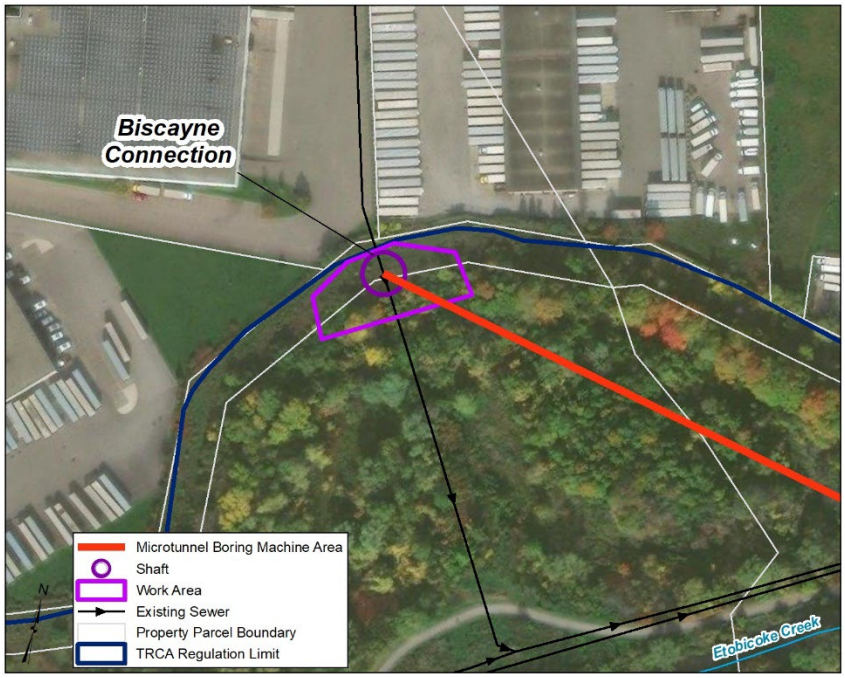
Figure 7-16. Shaft 1 Compound Area



7.4.2 Biscayne Connection

The Biscayne Connection is a launching shaft located north of Etobicoke Creek and south of Biscayne Crescent (Figure 7-17). The 1500 m diameter sewer connection to the proposed Deep Trunk will be constructed via MTBM. The compound requires an area of 1,320 m^2; within that, a 7-m-diameter shaft will be needed. This shaft location is within a TRCA regulated area.

Figure 7-17. Biscayne Connection Compound Area

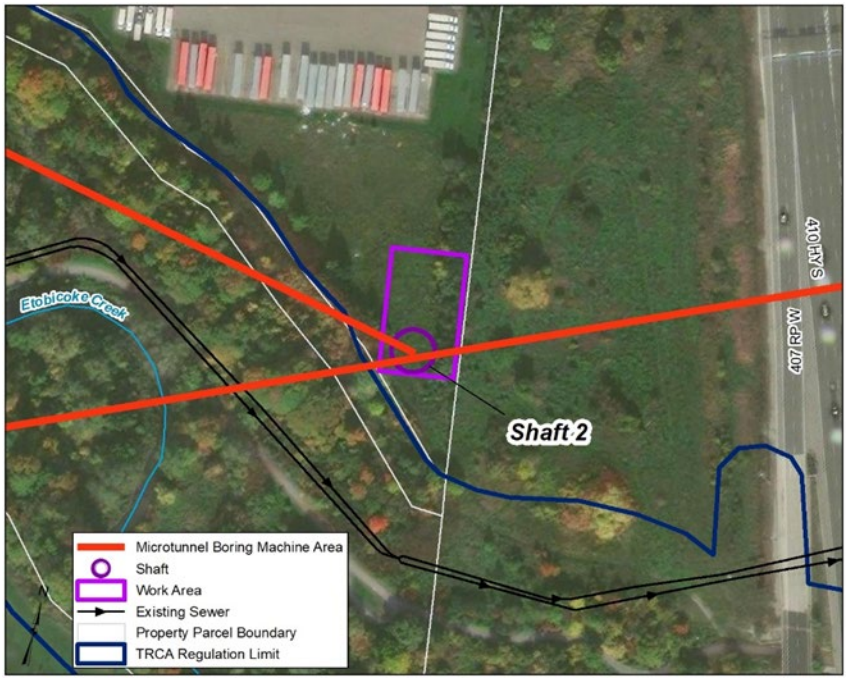


As discussed in Section 7.3.1, the shaft location is proposed at the location shown on Figure 7-17 and not further downstream to help alleviate surcharging.

7.4.3 Shaft 2

Shaft 2 is a receiving shaft for the MTBMs launched from Shafts 1 and 3 on the proposed Deep Trunk and will also be used as a receiving shaft to connect the Biscayne sewer to the proposed Deep Trunk sewer, as discussed in Section 7.3.1. Its site is southeast of Biscayne Crescent and west of Highway 410 (Figure 7-18). As presented in Section 7.3.1, this location avoids the City of Brampton's cricket pitch, avoids a creek crossing, and the pipe connection is in the direction of flow in the trunk. The construction site will require an area of 1,320 m^2; within that area, a 5-m-diameter shaft will be needed.

Figure 7-18. Shaft 2 Compound Area



7.4.4 Shaft 3

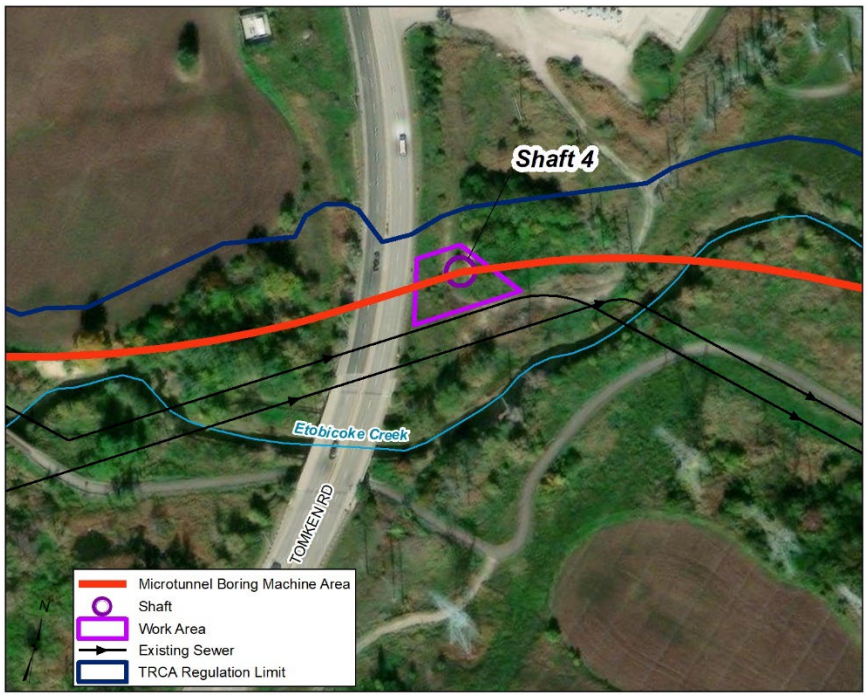
Shaft 3 is a launching shaft in both directions (to the east and the west). It will be located within the Region-owned Old Brampton WWTP site, west of Westcreek Boulevard (Figure 7-19). As Section 7.3.3 discussed, this location was driven by the opportunity to use the Region's property and the opportunity for upstream and downstream MTBM drives to be within typical ranges. This shaft is within a TRCA regulated area and within the natural environment. The compound will require an area of 1,990 m^2; within that, a 7-m-diameter shaft will be needed.

Figure 7-19. Shaft 3 Compound Area

7.4.5 Shaft 4

Shaft 4 is a receiving shaft located just east of Tomken Road and north of Etobicoke Creek (Figure 7-20). This location was selected because it avoids the wetland north of Tomken Road, as well as the hydro towers, allows for typical MTBM drive lengths, and to make sure Highway 407 and Highway 410 were crossed at a perpendicular angle. The few constraints of this location include its location within the natural environment, is near the creek, is within TRCA regulated area, and is within the hydro corridor owned by IO, the MTO, and 407 ETR. The compound requires an area of 660 m^2; within that, a 5-m-diameter shaft will be needed.

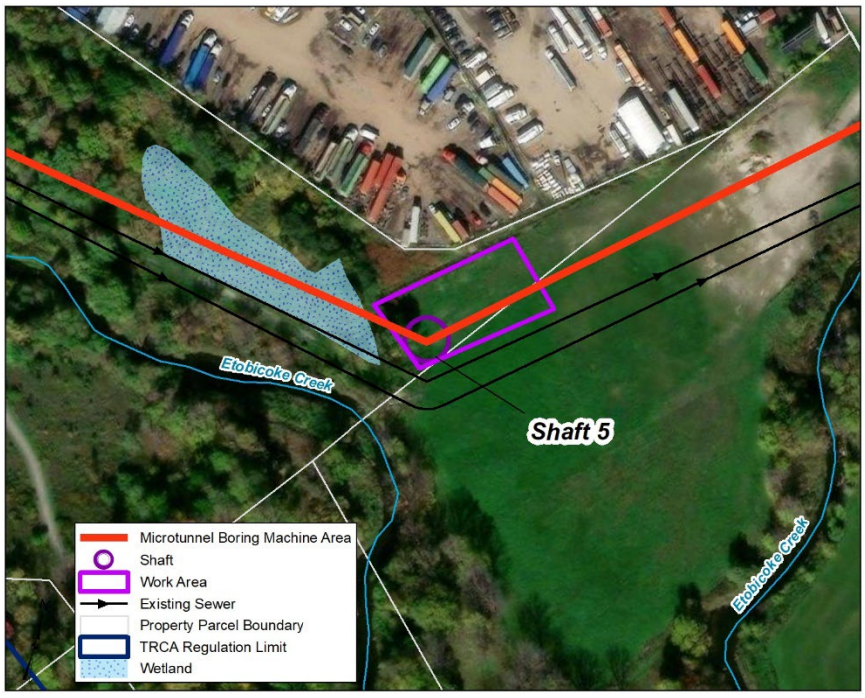
Figure 7-20. Shaft 4 Compound Area



7.4.6 Shaft 5

Defined by the alignment's directional change, Shaft 5 is a launching shaft located approximately 300 m west of Dixie Road and north of Etobicoke Creek (Figure 7-21). This location avoids crossing the existing sewers and avoids the wetland to the west of the shaft compound location. As described in Section 7.3.4, making the portion of the alignment between Shaft 4 and Shaft 5 as direct and straight as possible also dictated the location of Shaft 5. Additionally, this location was further influenced by the property constraints for the portion of sewer connecting to Shaft 6. Although most of this location is within City of Mississauga property, a portion of the shaft compound area is within private property during construction. The compound requires an area of 1,610 m^2; within that, a 7-m-diameter shaft will be needed. This shaft location is within a TRCA regulated area.

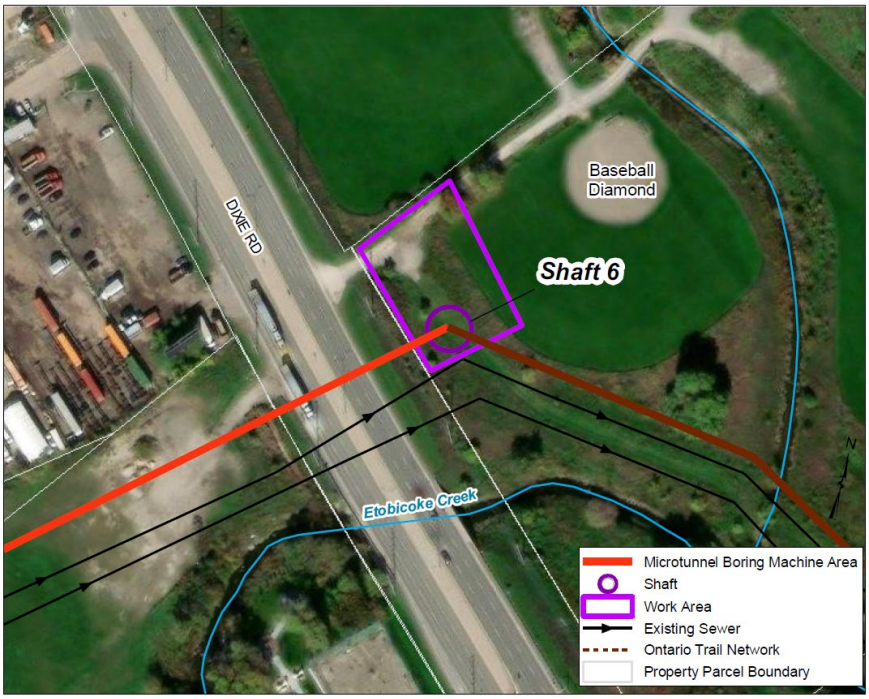
Figure 7-21. Shaft 5 Compound Area



7.4.7 Shaft 6

Shaft 6 is a receiving shaft located immediately east of Dixie Road and less than 50 m north of Etobicoke Creek (Figure 7-22). This location is defined by the preferred method of tunnelling and required clearance under Dixie Road, as well as the extent of the downstream open-cut segment from east of Dixie Road to Derry Road. Shaft 6 is north of the existing sewers, so avoids crossing the existing sewers. This location was also selected to minimize impacts to the baseball diamond as much as is feasible, and further consideration to avoid the baseball diamond will be made during detailed design. The compound requires an area of 2,160 m^2; within that, a 5-m-diameter shaft will be needed. This shaft location is within a TRCA regulated area.

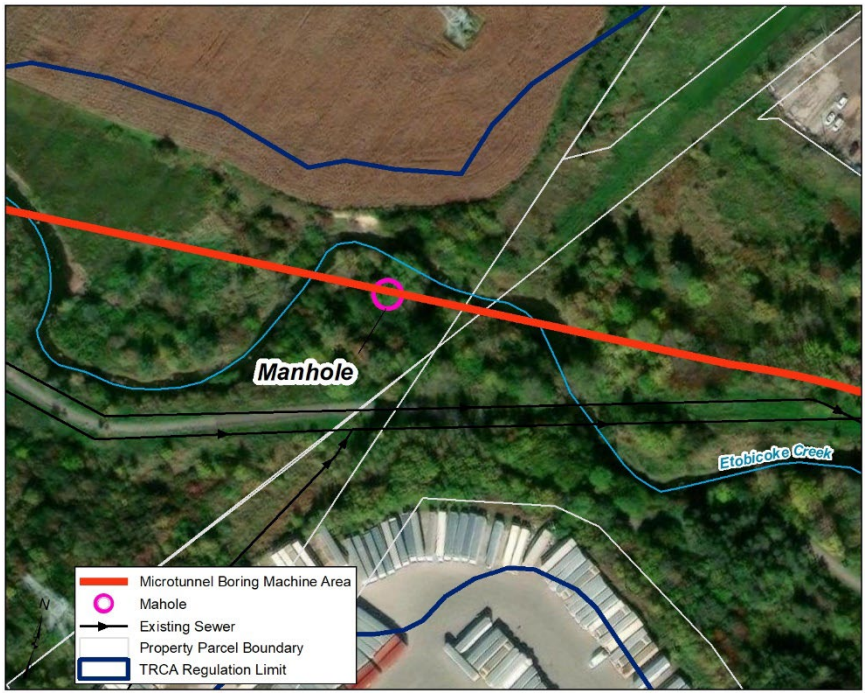
Figure 7-22. Shaft 6 Compound Area



7.4.8 West to East Diversion Connection

This proposed 2.4-m-diameter maintenance hole is located on the southern side of Etobicoke Creek between Shafts 4 and 5, and will serve as the West-to-East Diversion Connection (Figure 7-23). This manhole is close to Etobicoke Creek and is within a TRCA regulated area. A connection sewer will be required from the West-to-East sewer to the proposed Deep Trunk, to enable the proposed Deep Trunk to receive flows from the existing sewer. Details of the diversion and connection will be developed during preliminary design, but the sewer is proposed to be installed via open-cut.

Figure 7-23. West-to-East Diversion Connection



8. Description of Preferred Design Concept

8.1 Overall Design Concept

Flowing west to east, the proposed 1,500 mm diameter Deep Trunk provides future capacity for the study area by diverting flows from the existing twin trunk sewers at Kennedy Road to the downstream end on Derry Road, east of Dixie Road.

Segment 1 of the proposed Deep Trunk extends from Kennedy Road to Shaft 2, west of Highway 410, in a generally eastern direction, and crosses Etobicoke Creek four times. Shaft 2 serves as a connection point to the Biscayne Connection, providing relief in the Biscayne area. The proposed Deep Trunk then stretches east across Highway 410 to Shaft 3, which is at the old Brampton WWTP.

Beginning at Shaft 3, Segment 2 curves slightly southeast across Highway 407 and toward Shaft 4, which is east of Tomken Road and north of Etobicoke Creek. Shaft 4 to the West-to-East Diversion maintenance hole is a straight stretch, crossing Etobicoke Creek three times.

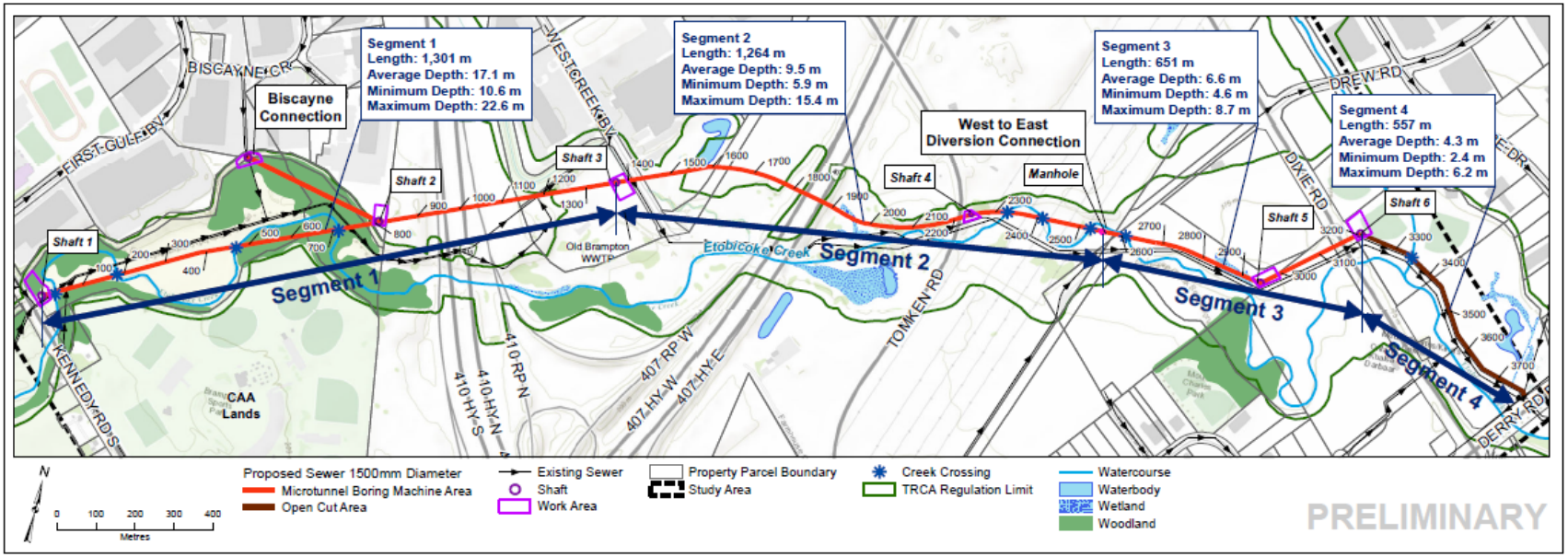
Segment 3 begins at the West-to-East Diversion maintenance hole. It routes southeast to Shaft 5, north of Etobicoke Creek and approximately 300 m west of Dixie Road, and crosses the Etobicoke Creek once. The section of the proposed Deep Trunk between Shaft 5 to Shaft 6 runs parallel to the existing twin trunk sewers (Shaft 6 is immediately east of Dixie Road). Segment 4 begins at Shaft 6 and largely follows the route of the existing twin trunk sewers to the connection to the East-to-West Trunk Sewer and Etobicoke Creek Trunk Sewers at Dixie Road, with one crossing of a tributary to Etobicoke Creek.

The total length of the proposed Deep Trunk is approximately 3.8 km. Table 8-1 summarizes the preferred design concept, including preliminary depths and invert elevations. As Figure 8-1 shows, Segments 1, 2, and 3 are proposed to be constructed using an MTBM. Segment 4 is proposed to be constructed using open-cut methodology.

Table 8-1. Proposed Deep Trunk Summary

Segment	Depth of Invert (m)	Length (m)	ECTS Invert (m)	No. of Creek Crossings	Pipe Diameter (mm)	Construction Method
Segment 1	Average: 17.1 Minimum: 10.6 Maximum: 22.6	1,301	Shaft 1: 176.9 Shaft 2: 174.3 Shaft 3: 172.5	4	1,500	MTBM
Segment 2	Average: 9.5 Minimum: 5.9 Maximum: 15.4	1,264	Shaft 3: 172.5 Shaft 4: 170.6 West-to-East Diversion Connection: 169.9	3	1,500	MTBM
Segment 3	Average: 6.6 Minimum: 4.6 Maximum: 8.7	651	West-to-East Diversion Connection: 169.9 Shaft 5: 169.0 Shaft 6: 168.6	1	1,500	MTBM
Segment 4	Average: 4.3 Minimum: 2.4 Maximum: 6.2	557	Shaft 6: 168.6 East-to-West Connection: 167.1	2	1,500	Open-cut

Figure 8-1. Proposed Deep Trunk Design Concept



The shaft locations are also shown on Figure 8-1 and described in detail in Section 7.4 Table 8-2 summarizes the required shaft locations.

Table 8-2. Summary of Proposed Shafts

Shaft	Launching/Receiving Shaft	Compound Area (m^2)	Shaft Diameter (m)	Shaft Depth (m)
Shaft 1	Launching Shaft	2,400	7	20.7
Shaft 2	Receiving Shaft	1,320	5	26.2
Shaft 3	Launching Shaft	1,990	7	15
Shaft 4	Receiving Shaft	660	5	7.7
Shaft 5	Launching Shaft	1,610	7	7.6
Shaft 6	Receiving Shaft	2,160	5	6
Biscayne Connection	Launching Shaft	1,320	7	12
West-to-East Maintenance Hole	Not Applicable	Not Applicable	2.4	6.6

8.2 Property Requirements

Several permanent and/or temporary easements are anticipated from the City of Mississauga, City of Brampton, MTO, and several private owners. Details surrounding the anticipated easements and permits are listed in the *Property Requirements Report* (Jacobs 2022a) in Appendix C5. Details are summarized for each shaft location in 8.3. The easement locations are to be refined during the preliminary design phase. Negotiations for permanent and temporary easements will be negotiated during detailed design. The Regin of Peel will keep property owners informed of construction plans as the project proceeds. More details are included in the *Property Requirements Report* (Jacobs 2022), including the Property Impact Plan.

8.3 Design and Construction Considerations

8.3.1 Shaft 1

Shaft 1 is located in a heavily treed area with highly variable steep contours. The design of the access and staging area will need to account for this and consider construction feasibility, specifically involving the stability of machinery onsite. Additionally, tree removals and corresponding mitigation measures need to be considered. The multiuse trail north of Etobicoke Creek and accessible off of Kennedy Road can act as an access road to Shaft 1. Access from the trail will require excavation of a small hill (approximately 2m high) that is located at the entrance of the trail off of Kennedy Road. Additionally, a hydro pole is located directly at the trail entrance and would need to be relocated. Access roads into and out of the site will need to be carefully designed, so the turning radii of construction vehicles are considered, along with visibility to local traffic and pedestrians at site entrance and exit. Permanent and temporary easements will be required for construction and maintenance access.

Shaft 1 is constrained in location because of the need to connect to the existing sewers as well as any future connections so flows can be interchanged as needed during operations. The existing twin trunks are not connected to each other at the current location. As such, the design will need to provide a permanent diversion chamber to provide flexibility in diverting flows from either twin into the proposed Deep Trunk. If the existing sewers are to be crossed, the clearance needs to be designed to meet the Region's design

criteria. The proximity of the site to the Etobicoke Creek may also require dewatering; this will be determined once monitoring wells have been installed for hydrogeological fieldwork.

8.3.2 Biscayne Connection

Access to the existing Biscayne sewer through the existing easements to launch the MTBM and tunnel the connection may not be sufficient for construction vehicles, and will need to be considered. Because the existing easement is over the existing Biscayne sewer, the feasibility of driving large equipment over the existing sewer should be considered, especially if the current pavement over it is not meant for heavy vehicle travel. Without entering the private properties, the other access point is via the Etobicoke Creek Trail and through heavily sloped lands. Access to this location will be challenging. Furthermore, because the site is on a slope, design will need to accommodate machine and equipment stability onsite.

The connection to the existing Biscayne sewer will be just upstream of where it currently connects to the existing twin Etobicoke Creek Trunk Sewers. The connection will need to be designed and constructed with a bypass to maintain flows while the new connection is implemented. The connection to the proposed Deep Trunk will be tunneled.

8.3.3 Shaft 2

Shaft 2 is located outside the TRCA regulation limits and on private property, close to a downward slope. Accessibility to the site will need to be considered, along with its slope stability and construction hoarding near the sloped area. The restoration design will need to consider whether a permanent access road is to be left in place for operations and maintenance in the future. Construction access to Shaft 2 will likely be through private property north of the shaft location. Permanent and temporary easements are required for construction and maintenance access.

To accommodate the Biscayne Connection that will tie into the new trunk at this location, the design will need to provide the connection details between the two shafts. The connection details between the two shafts will be provided in the preliminary design. A vortex chamber will be needed at this location to dissipate energy from the significant drop in invert elevation from the Biscayne Connection to proposed Deep Trunk. A maintenance hole will need to be left in place as well.

8.3.4 Shaft 3

This site is located on property owned by the Region. There are no connections at this location; however, a maintenance hole will be needed here for operations and maintenance needs. The Region has plans to develop a vactor dewatering bunker on the property so coordination will be required to determine location.

Access to Shaft 3 location will be from Westcreek Boulevard. Because the southern end of Westcreek Boulevard includes access to the Etobicoke Creek Trail, the design of the construction compound should avoid any impacts the trail's access or use.

8.3.5 Shaft 4

Shaft 4 is located within Crown Lands, specifically, within the hydro corridor. Although access to the site from Tomken Road will need minimal considerations (entrance, exit, and visibility to oncoming traffic) the main design considerations will need to focus on the impact to the hydro transmission towers. Tunnelling projects need cranes and other tall equipment, so discussions with Hydro One will be needed to understand their requirements when working near their infrastructure. Considerations for the access road should include sightlines and turning radii to ensure heavy vehicles can be safely accommodated. Permanent and temporary easements are required for construction and maintenance access.

The site is on fairly sloped lands, and close to the existing trunk sewers. It is imperative that the site be designed to maneuver the sloped lands without any impacts to the existing sewers. There are no concerns about clearance under the existing sewers because the intent is not to cross under them at this location.

Since Shaft 4 is within a TRCA regulated area, there is the potential for extensive dewatering. This will be determined through the hydrogeological and geotechnical investigations.

8.3.6 Shaft 5

Shaft 5 is located on relatively flat lands and will not have much of a concern regarding stability. However, it is relatively close to the existing sewers and it will be necessary to ensure their locations are known before working near them, so they are not accidentally hit during the tunnelling process. The shaft location may impact one Cultural Heritage Resource (CHR), and a Heritage Impact Assessment may be required. Additionally, Shaft 5 is located close to wetlands, and therefore there should be special consideration for dewatering.

The Region currently has a permanent easement for the twin sewers running through the property directly off of Dixie Road, which may be used to access shaft 5 or as part of construction staging. However, the current easement agreement will have to be reviewed to see if that work can be accommodated within the terms of the agreement. There is also the potential to use a side street north of the site to enter through the City of Mississauga property and access the site so there is minimal impact to the private property. Permanent and temporary easements will be required for construction and maintenance access.

8.3.7 Shaft 6

Similar to Shaft 5, Shaft 6 is on relatively flat ground. The stability of the site or equipment is not a concern. The proximity to the existing sewers will need to be considered, and their exact locations will need to be determined before work can begin.

Access to the site will need to be from Dixie Road, and permanent and temporary easements are required for construction and maintenance access. The site entrance may need to be the same entrance used by the public to access King's Park's baseball diamonds. Coordination with the City of Mississauga will be key to ensure that heavy construction vehicles do not impact the use of the baseball diamonds. Additionally, the site encroaches onto the middle baseball diamond. Consideration will need to be given to avoid this if possible; otherwise, the diamond will need to be temporarily closed.

8.3.8 West to East Diversion Connection

Access to the West-to-East Diversion Connection will likely be from Tomken Road via the existing hydro corridor access on the southern side of the creek. The access road will then follow along the Etobicoke Creek Trail to the maintenance hole location. The design of the access road should minimize impacts to accessibility of the trail and to the trail itself where possible. A connection sewer will be required from the West-to-East sewer to the proposed Deep Trunk. Details on the diversion and connection will be developed during preliminary design, as will consideration for temporary trail closure during construction.

8.3.9 Trench Location

As Section 7.3.6 discussed, the open-cut location extends from Shaft 6, east of Dixie Road, to the East-to-West Connection at Derry Road, on the northern side of Derry Road, on the east side of Etobicoke Creek. Due to the proximity to the Etobicoke Creek, dewatering is likely to be needed. The two tributary crossings may require in-water works. A temporary construction access would be required on the east side of Dixie Road and/or north side of Derry Road to provide access to the open cut segment. During construction, there may be need for some tree removal in the area. However, given that a majority of the ground disturbance limits overlaps with the existing easement over the Etobicoke Creek twin sewers, tree removal is likely to be minimal as tree removal is permitted on the existing easements.

The trench width will be around 3.0 m with a depth up to 7 m. During the construction stage of the East-to-West Trunk, the East-to-West Connection was modified to allow for a 1,500-mm stub to accommodate the proposed Deep Trunk sewer. Temporary easement will be required during construction to the extent of ground disturbance, including the access road for construction vehicles. Permanent easement will be required along the infrastructure for future operation and maintenance access needs. Coordination with TRCA and the City of Mississauga may be necessary to ensure compliance with any by-laws or requirements, as per Section 8.5.3 and Section 8.5.10, respectively.

8.4 Environmental Management Plan

8.4.1 Impacts and Mitigation Measures

8.4.1.1 Built Heritage Resources and Cultural Heritage Landscapes Impacts

ASI Heritage (ASI) completed the Cultural Heritage Resource (CHR) Assessment for the study area, which included a background review of historical research and a review of secondary source material (ASI,2019; Appendix C2). Four previously identified CHRs were situated within the study area, one of which was found to no longer have cultural heritage value or interest. The shaft locations of the proposed Deep Trunk alignment generally avoid the CHRs. However, Shaft 5 may impact the residential CHR at 1411 Derry Road East in Mississauga; therefore, a resource-specific Heritage Impact Assessment may be required per the *City of Mississauga Official Plan,* Clause 7.4.1.12 (City of Mississauga 2021). The impact could include potential land disturbance the northern portion of the property; however, any impact is expected to be temporary. Alternative suitable mitigation measures can include fencing around zones that are considered off-limits, and post-construction rehabilitation. Further details are provided in the Cultural Heritage Resource Assessment report (ASI 2019) in Appendix C2.

Although the Cultural Heritage Resource Assessment report (ASI 2019) was based on the proposed alignment developed during Phase 2 and does not reflect the updated shaft locations, the report provides enough detail that the impacts of the revised alignment and shaft locations can be inferred and that no additional impacts are anticipated based on the new alignment and shaft locations.

8.4.1.2 Natural Environmental Impact

LGL Limited (LGL) completed a Natural Sciences Report (NSR) (Appendix C1) for the project study area in May 2021 (LGL 2021). Initially, background information records were reviewed for the study area, where available information was used to identify natural environmental constraints. Field surveys (May 22 and May 27, 2019, and October 16, 2020) were then completed to verify and update the extent of the constraints identified, assess the natural and seminatural vegetation communities, and screen for species at risk (SAR). A roaming breeding bird survey was conducted on May 27, 2019, and June 7, 2019, and additional point count breeding bird investigations were completed on June 29 and July 7, 2020. SAR grassland birds were screened for on May 26, 2020. These findings are detailed in the NSR in Appendix C1.

Since the completion of the NSR, the shaft and alignment locations have been refined. As such, LGL conducted additional field investigations on May 10, 2022, and issued an addendum to the NSR, Natural Heritage Evaluation of Preferred Alternative (LGL 2022). The main findings pertaining to the shaft and open-cut locations are as follows:

- **Shaft 1:** The area is a mix of cultural meadow, deciduous willow swamp, and deciduous forest.
- **Biscayne Connection Shaft:** The area has an old access road that is overgrown with staghorn sumac. Several large trees suitable for bat habitat were identified; however, no suitable habitat trees were identified in the current shaft footprint. During detailed design, LGL recommended that a more detailed survey of the trees be completed and assumed the shaft compound area will be refined to avoid the forest.

- **Shaft 2:** The area is located in a meadow bound by a sumac and spruce trees and surrounded by a chain-link fence. There is evidence of a coyote den at this site.
- **Shaft 3:** The area is within a cultural woodland and is located at the site of the old Brampton WWTP site.
- **Shaft 4:** The area located in a previously disturbed area, with a section of the shaft compound area within a cultural woodland. LGL assumed the shaft work area will be refined during detailed design to minimize impacts to the woodland.
- **Shaft 5:** The area located in a previously disturbed area, with a section of the shaft compound area within a willow lowland deciduous forest. Potential bat maternal roosting habitat was observed within the compound area. Further investigation may be required during detailed design stage and the Endangered Species Act, 2007, must be followed.
- **Shaft 6:** The area located within a parking lot, with portions of manicured lawn.
- **Open-cut Section:** This section extends through a cultural meadow and manicured lawn, with two crossings of Etobicoke Creek tributaries.

The construction of the Deep Trunk poses potential impacts to vegetation and tree removals, wildlife habitat removal, and aquatic habitats.

The preferred alternative and design concept crosses the Etobicoke Creek eight times, and crosses its tributaries four times. The Etobicoke Creek crossings will be completed by an MTBM. The tributary crossings involve two MTBM crossings and two open-cut crossings. Erosion and sedimentation shall be implemented to ensure minimal to no impact to the adjacent habitats and aquatic environment. The additional impacts of creek and tributary crossings will be investigated at the detailed design stage (LGL 2022).

This project is expected to result in approximately 20,000 m^2 of disturbed area. The main type of Ecological Land disturbed is classified as Dry-Moist Old Field Meadow (CUM1-1), followed by Mineral Cultural Wood land (CUW1), Dry-Fresh Deciduous Forest (FOD4), Manicured (M), Sugar Maple Beach Deciduous Forest (FOD5), and others. Impacts to vegetation and vegetation communities are expected and further impacts, such as potential dewatering requirements, as well as restoration plans, will need to be assessed during detailed design (LGL 2022).

Wildlife activity could be affected by equipment and construction access into the Etobicoke Creek valley, vegetation removals, and disturbance from construction. However, because multiuse trails and paved pathways currently reside within the valley and woodland, the additional impacts from construction are expected to be minor (LGL 2022).

LGL (2021) recommended the following mitigation measures to reduce impacts:

- Use existing pathways for construction access where possible.
- Minimize the construction area to the extent possible.
- Minimize vegetation and tree removals.
- Use appropriate tree protection measures for any work around tree resources.
- Locate site maintenance, vehicle washing, and refueling stations where contaminants are handled offsite and at least 30 m away from any watercourses or wetlands.
- Comply with the *Migratory Birds Convention Act*.
- Use previously disturbed areas or areas outside of the Natural Heritage System for construction laydown and staging to the extent possible.
- Ensure a Spills Management Plan is onsite at all times.
- Implement Erosion and Sediment Control (discussed in Section 8.4.1.8).

- Protect trees.
- Comply with the Species Act.
- Compensate for tree loss and restore treed areas.

In terms of tree protection, it is recommended that a Tree Protection Plan be developed during detailed design for trees that are identified as being retained or removed. Tree clearance cannot take place during the *Migratory Bird Conservation Act* breeding season from April 1 to August 30 (unless an appropriate nesting survey is conducted) (LGL 2021). Further details recommended for Tree Protection are listed in the NSR in Appendix C1.

Although there was not suitable habitat for protected SAR birds identified in the study area, Bat Maternal Roosting Habitats were observed. Impacts to bats can be mitigated by following the timing windows for tree-clearing activities (May 1 and August 31). SAR bat impacts may require further consultation or approvals with the Ontario Ministry of Environment, Conservation and Parks (MECP) at the detailed design stage (LGL 2021).

In general, further refinement was recommended for the shafts, such as the Biscayne Connection shaft where the Sugar Maple Beach Deciduous Forest exists, during detailed design to further reduce impacts (LGL 2022).

As part of the detailed design, an Environmental Impact Assessment will be required once shaft locations, grading and access and staging and materials storge areas are finalized. This will include arborists report to categorize trees and determine restoration and compensation requirements for impacted areas.

8.4.1.3 Impacts to Surface and Groundwater

Because the construction of the new trunk sewer will be carried out by a combination of open cut construction and tunnelling methods, there is the potential for impacts to surface water and groundwater. The potential will vary depending on the alignment and shaft locations in relation to Etobicoke Creek and wetland areas within the stream valley. Impacts can result from dewatering activities that occur during construction. These impacts may include changes to groundwater levels that may impact wetlands and surface water levels. There is also the potential for soil settlement depending on the nature of the tunnelling operation and the exiting native soils. Additional geotechnical and hydrogeology information will be collected as part of the preliminary design and final design to determine the potential impacts of construction and the required mitigation steps. However, the tunnelling method (MTBM) does not require implementation of dewatering since the tunnelling machine maintains a pressurized face using slurry to stabilize the excavation. The pipes are jacked behind the machine and the ground is not exposed at any time. There are cost savings resulting from not requiring dewatering and treatment of water for which additional space in the staging area is necessary. These cost savings are offset by using sealed excavation support systems like secant piles or sinking caisson. This method also reduces also potential risks of settlements.

8.4.1.4 Grading and Excavation Impacts

Because the construction of the new trunk sewer will be carried out by tunnelling methods, the majority of any potential impacts due to site grading and construction will be at the shaft locations and along the access routes to the shafts. This activity has the potential to impact the natural environment and flooding potential at the shaft locations. Based on the impacts anticipated during construction on natural features, a restoration and compensation plan will be developed to address areas disturbed during construction.

- **Shaft 1:** The area is a mix of cultural meadow, deciduous willow swamp, and deciduous forest. The final location of the shaft location and the alignment of the access route will be selected to minimize any impacts to the natural features. Shaft 1 is also in close proximity to Etobicoke Creek. Grading of the area to allow for construction, including grading near the multi-use trail to construct the access road as well as within the shaft compound area for shaft stability, will have the potential to cause temporary

changes in the flood potential in the immediate area. Flood potential will be required to be determined as part of the preliminary design and mitigation measures defined that will reduce the potential to acceptable levels. The final shaft configuration after construction is not anticipated to have any substantial impacts on flood potential.

- **Biscayne Connection Shaft:** The area has an old access road that is overgrown with staghorn sumac. Several large trees suitable for bat habitat were identified; however, no suitable habitat trees were identified in the current shaft footprint. During detailed design, a more detailed survey of the trees will be completed and the shaft compound area will be selected to minimize impacts to the natural environment. The Biscayne connection is on the outer limit of the regulated area and is not anticipated to have any substantial impacts on flood potential.
- **Shaft 2:** The area is located in a meadow bound by a sumac and spruce trees and surrounded by a chain-link fence. There is evidence of a coyote den at this site. Shaft 2 is on private lands. During detailed design, the shaft compound area will be selected to minimize impacts to the natural environment. Shaft 2 is outside of the regulated area and is not anticipated to have any impacts on flood potential.
- **Shaft 3:** The area is within a cultural woodland and is located at the site of the old Brampton WWTP site. During detailed design, the shaft compound area will be selected to minimize impacts to the natural environment. Shaft 3 is within the regulated area but it's location on the old Brampton WWTP is not anticipated to have any impacts on flood potential.
- **Shaft 4:** The area located in a previously disturbed area, with a section of the shaft compound area within a cultural woodland. During detailed design, the shaft compound area will be selected to minimize impacts to the natural environment. Shaft 4 is also in close proximity to Etobicoke Creek. Grading of the area to allow for construction will have the potential to cause temporary changes in the flood potential in the immediate area. Flood potential will be required to be determined as part of the preliminary design and mitigation measures defined that will reduce the potential to acceptable levels. The final shaft configuration after construction is not anticipated to have any substantial impacts on flood potential.
- **Shaft 5:** The area located in a previously disturbed area, with a section of the shaft compound area within a willow lowland deciduous forest. Potential bat maternal roosting habitat was observed within the compound area. During detailed design, the shaft compound area will be selected to minimize impacts to the natural environment. Shaft 5 is also in close proximity to Etobicoke Creek. Grading of the area to allow for construction will have the potential to cause temporary changes in the flood potential in the immediate area. Flood potential will be required to be determined as part of the preliminary design and mitigation measures defined that will reduce the potential to acceptable levels. The final shaft configuration after construction is not anticipated to have any substantial impacts on flood potential.
- **Shaft 6:** The area located within a parking lot, with portions of manicured lawn. Because of its location in a parking lot area, the shaft compound area is not anticipated to have any impacts to the natural environment. Shaft 6 is, however, in close proximity to Etobicoke Creek. It is also not anticipated that grading of the area will be required so there are no substantial impacts anticipated to flood elevations. The final shaft configuration after construction is also not anticipated to have any substantial impacts on flood potential.
- **Open-cut Section:** This section extends through a cultural meadow and manicured lawn, with two crossings of Etobicoke Creek tributaries. During detailed design, the open cut construction methods will be required to develop a plan to minimize any potential flooding. The construction methods will also be selected to minimize impacts to the natural environment. Additionally, a review of the two open-cut crossings of the tributaries to Etobicoke Creek will be required by a fluvial geomorphologist during the detailed design phase to provide the recommendations on how to reconstruct the bank and watercourse to avoid triggering erosion.

An initial estimate of fill will be developed during preliminary design and updated during final design.

8.4.1.5 Archeological Impact

Similar to Stage 1 AA, the Stage 2 AA was completed based on the Phase 2 Deep Trunk alignment (ASI 2022b) (Appendix C3). The following areas required Stage 2 AAs:

- Portions along Segment 1 and near the existing Biscayne Connection
- A location near Westcreek connection
- Multiple locations near the West-to-East Diversion Connection
- A stretch adjacent to Segment 4

Approximately 0.5 hectare within the study area required Stage 2 AA:

1. A test pit survey was conducted at 5-m intervals for 0.21 hectare that was found to contain natural topsoil

2. A judgmental test pit survey was conducted at 10-m intervals for 0.29 hectare that was found to not contain natural topsoil to confirm previous disturbance

Appendix C3 provides more details about the Stage 2 AA area.

Overall, the Stage 2 AA concluded there were no archaeological resources encountered for this project based on Phase 2 Deep Trunk alignment. However, due to the shaft location changes that resulted from the refined Deep Trunk alignment during Phase 3, it was determined that there were some additional areas needing Stage 1 and 2 AA.

- Refined Shaft 2
- Refined Biscayne Connection
- Refined Shaft 4
- Refined Shaft 5
- Refined Shaft 6

This additional Stage 1 and 2 AA was undertaken in 2022, except for the Biscayne Connection location, which will be completed during subsequent design stages. No archaeological resources were encountered during this additional Stage 1-2 survey, and no further archaeological assessment is recommended (ASI, 2022a). The Phase 1-2 report was accepted by the MCM on March 5, 2023.

If during construction previously undocumented archaeological resources are discovered, work on the site must stop and procedures in accordance with the Ontario Heritage Act must be followed. Similarly, if a burial site is discovered procedures in accordance to the Funeral, Burial and Cremation Services Act, 2002, must be followed.

8.4.1.6 Traffic Impact

The purpose of the Traffic Impact Assessment report was to review and understand the traffic management constraints and requirements for design and construction of the preferred alternative and design concept.

Table 8-3 summarizes the key traffic considerations at each shaft location. The full Construction Traffic Impact Assessment report is included in Appendix C6.

Table 8-3. Traffic Considerations Summary

Shaft ID	Traffic Considerations
Shaft 1	▪ It is recommended that the multiuse trail, which is accessible off of Kennedy Road, will act as an access road to Shaft 1. However, this will require approval from the City of Brampton ▪ Kennedy Road is a major arterial road and is near the anticipated construction access ▪ Short-duration, temporary lane closures of Kennedy Road may be required, and such works should be completed during night-time or weekends to avoid impacts to peak-hour traffic flows ▪ During the detailed design stage, considerations for the access road should include sightlines and turning radii to ensure heavy vehicles can be safely accommodated
Shaft 2	▪ Access to Shaft 2 will be routed through private property north of the shaft location ▪ Coordination between the contractor and the property owner will be required to limit conflicts between truck movements and periods of higher activity for the impacted businesses
Shaft 3	▪ Access to Shaft 3 will be off of Westcreek Boulevard ▪ Westcreek Boulevard is two-lane road that serves a small industrial area just west of Tomken Road ▪ Westcreek Boulevard already serves heavy vehicles and should have no issues accommodating construction vehicles ▪ No impacts are expected to traffic operations
Shaft 4	▪ Access to Shaft 4 is recommended to be off of Tomken Road. However, further discussion with IO is required ▪ Minimal traffic impacts are expected ▪ During the detailed design stage, considerations for the access road should include sightlines and turning radii to ensure heavy vehicles can be safely accommodated
Shaft 5	▪ A temporary construction access would be required on the western side of Dixie Road to provide access to Shaft 5 ▪ Dixie Road is a major six-lane arterial road and would have no issues providing allowing for minor increase in traffic volumes due to construction ▪ Turning restrictions (right-in right-out only) will be required for the access due to the centre median along Dixie Road, and turning radii onto Dixie Road will need to be considered during the detailed design stage
Shaft 6	▪ A temporary construction access would be required on the eastern side of Dixie Road to provide access to the shaft location ▪ Dixie Road is a major six-lane arterial road and would have no issues providing allowing for minor increase in traffic volumes due to construction ▪ Turning restrictions (right-in right-out only) will be required for the access due to the centre median along Dixie Road, and turning radii onto Dixie Road will need to be considered during the detailed design stage

Shaft ID	Traffic Considerations
Biscayne Connection	▪ It is recommended that access to the Biscayne Connection shaft is via private property off of Biscayne Crescent. Property owners will need to be confirmed ▪ Coordination between the contractor and the property owner will be required to limit conflicts between truck movements and periods of higher activity for the impacted businesses
W-E Manhole	▪ Access will likely be from Tomken Road via the existing hydro corridor access on the southern side of Etobicoke Creek ▪ The design of the access road should minimize impacts to the trail where possible
Open-Cut Section	▪ Limited traffic impacts ▪ A temporary construction access would be required on the east side of Dixie Road and/or north side of Derry Road to provide access to the open cut segment. ▪ Turning restrictions (right-in right-out only) will be required for the accesses due to the centre median along Dixie Road and Derry Road

The proposed construction tunnel shafts are all expected to be off-road, and construction activity traffic is expected to be low and have minimal impacts on the adjacent road network and the Etobicoke Creek Trail. Where short-duration activities that encroach upon major arterials are required for the shaft compound construction, work will be completed during evening or weekend hours to avoid impacting peak-hour traffic flows.

Minimal traffic impacts are anticipated to Derry Road from the Segment 4 open-cut construction.

8.4.1.7 Noise and Vibration Impact

The noise and vibration associated with the construction can be addressed by the following measures:

- Working within City of Brampton and City of Mississauga noise bylaws
- Working within the MECP's Environmental Noise Guideline - Stationary and Transportation Sources - Approval and Planning
- Minimizing construction traffic in local residential streets

8.4.1.8 Erosion and Sedimentation Impact

Erosion and sediment control can help mitigate construction related impacts to the natural environment. Details regarding controls to mitigate erosion and sedimentation will be prepared during detailed design, and can include:

- Install sediment trap and catch-basin protection, where appropriate, during construction to prevent sediments entering the storm sewers.
- Install sediment control fences along the extent of the construction sites, where appropriate.
- Cover exposed excavated material.
- Prevent storing material within the flood plain
- Install silt fences, siltsoxx, and check dams as needed to prevent sediments from reaching Etobicoke Creek

In general, the TRCA's E*rosion and Sediment Control Guide for Urban Construction* (TRCA 2019) will be followed.

8.4.2 Environmental Site Assessment

Jacobs completed a Phase One Environmental Site Assessment (ESA) for the study area, which addressed the proposed tunnel, shaft locations, and open-cut area (Jacobs 2022) (Appendix C4). The ESA identified 7 potentially contaminating activities (PCAs) in the study area and 5 PCAs offsite with the potential to impact the study area. These resulted in the identification of 14 Areas of Environmental Concern (APECs). These APECs are in the following locations:

- At all proposed shaft locations
- Between Shaft 1 and Shaft 2
- Between the Biscayne Connection and Shaft 2
- Portions between Shaft 2 and Shaft 3
- Two relatively short segments between Shaft 3 and Shaft 4
- Between Shaft 5 and Shaft 6

The identified APECs result from activities such as old pesticide use, use of salt on roadways, industrial and manufacturing activities, chemical manufacturing, processing and bulk storage, gasoline, and associated products storage in fixed tanks, etc. Refer to Appendix C4 for further details.

Because PCAs and APECs have been identified, a Phase Two ESA will be required. Depending on the findings of the Phase Two ESA, an additional subsurface ESA, risk assessment, risk management, or remedial work, or some combination thereof, may also be necessary.

8.4.3 Relevant Policies and Plans

The following should be considered during subsequent project stages:

- **Official Plans:** The following plans are summarized in Appendix B.
  - City of Brampton Official Plan
  - City of Brampton 2040 Vision
  - Region of Peel Official Plan
  - Parkway Belt West Plan
- **Growth Plan for the Greater Golden Horseshoe**: Under the *Places to Grow Act ,2005,* the Ministry of Municipal Affairs and Housing (MMAH) developed *A Place to Grow: Growth Plan for the Greater Golden Horseshoe (2019)*. This document is a provincial growth plan and guides government investments and municipalities on their own long-term growth plans.
- **Greenbelt Plan**: The Greenbelt is permanently protected land. The purpose of the Greenbelt Plan is to inform planning by presenting policies and discussion that protect the Greenbelt.
- **Region of Peel Climate Change Master Plan (CCMP):** The CCMP is the Region's response to address climate change. The key outcomes of the CCMP include building capacity for climate change, reducing greenhouse gas emissions, incorporating resiliency into services and assets, investing in and financing actions on climate change, and monitoring and reporting progress on work on climate change.
- **The Planning Act:** This act guides land use planning in Ontario.
  - **Provincial Policy Statement**: Ontario's MMAH issues the Provincial Policy Statement (PPS) under Section 3 of the *Planning Act*, whichstates the provincial government's policies and provides guidance on land use planning. The PPS enables municipalities to develop their official plans and make planning-related decisions. Relevant policies include Policy 1.6.1, Policy 1.6.3, and Policy 1.6.6.1.
- **Clean Water Act and Safe Drinking Water Act:** The Clean Water Act and Safe Drinking Water Act relate to protecting water at its source and specifying requirements to keep drinking water safe, respectively. These acts are directly related to Source Water Protection, as described in Section 8.4.4.

- **Conservation Authorities**: Conservation authorities are governed by the Conservation Authorities Act, which is administered by the MECP. The TRCA is the governing conservation authority for the study area. The TRCA manages the lands within the Etobicoke Creek regulation limit. Several permits and approvals will be required by the TRCA (refer to Section 8.5).

8.4.4 Source Water Protection

To protect drinking water sources, surface water intakes and wellheads in source protection areas have been identified as vulnerable areas as per the Clean Water Act, 2006 and as amended. Drinking water sources can potentially be impacted by projects if work is being completed in designated vulnerable areas.

The source protection plan that includes the study area was updated in 2022 (CTC Source Protection Region, 2022), and includes policies that protect water sources. According to the source protection plan, the Region of Peel has 14 Wellhead Protection Areas (WHPAs), which are all located within Caledon and outside of the study area. The Region of Peel has two Intake Protection Zones (IPZs), including one IPZ at Lorne Park Water Treatment Plant (WTP) and one IPZ at A.P. Kennedy WTP (CTC Source Protection Region, 2022). However, there are no IPZ's within the study area, as per MECP's Source Protection Information Atlas (MECP, 2022).

One identified drinking water threat activity includes "the establishment, operation, or maintenance of a system that collects, stores, transmits, treats, or disposes of sewage" (CTC Source Protection Region, 2022). Since the proposed Deep Trunk collects and transmits sewage, it is included under this drinking water threat. The project area is also upstream of an Event Based Area, as identified on MECP's Source Protection Information Atlas (MECP, 2022). Potential risks to the impact zones include potential spills to Etobicoke Creek that could end up flowing downstream to the IPZs. This threat could occur during construction, operation, or if erosion at watercourses exposes the sewer.

Additionally, according to MECP's Source Protection Information Atlas, there are Highly Vulnerable Aquifers (HVA) within the study area. An HVA is an aquifer that is susceptible to contamination, either because it is located close to ground surface or the ground materials around the aquifer are highly permeable.

To mitigate adverse impacts to the Event Based Area and the HVAs, it is recommended that the mitigation measures identified in Section 8.4.1 are implemented. These mitigation measures include the following:

- Locate site maintenance, vehicle washing, and refueling stations where contaminants are handled offsite and at least 30 m away from any watercourses or wetlands
- Ensure a Spills Management Plan is onsite at all times
- Implement Erosion and Sediment Control (as outlined Section 8.4.1.8)

For the open-cut section and shaft locations requiring dewatering, dewatering should be minimized where feasible to reduce any impact on HVAs. The proposed Deep Trunk sewer will also be sized and constructed according to typical standards and codes to mitigate the occurrence wastewater leakage into the creek.

9. Implementation Plan

9.1 Future Approvals/Permits Required

9.1.1 Ministry of Environment, Conservation and Parks (MECP)

The following MECP permits/approvals will be required before the construction of the preferred design concept:

- **Ontario Environmental Assessment Act Approval.** An ESR must be completed, reviewed, and approved under the Ontario Environmental Assessment Act.
- **Environmental Compliance Approvals (ECAs).** A MECP ECA for wastewater will be required for all new sewer tunnels.
- **Permit to Take Water.** A Permit to Take Water is required if it is necessary to take more than 50,000 litres of water in a day from the environment.
- **Endangered Species Act.** Timing windows for any required tree removals should be followed to avoid the maternal roosting period for SAR bats. As Section 8.4.1.2 discussed, this timing window is May 1 and August 31. Consultation with the MECP during the detailed design stage is recommended, and an Information Gathering Form must be completed to determine whether a permit is required.

Additionally, consultation with MECP is recommended prior to removal of any protected SAR bat habitat within the study area.

9.1.2 Environment and Climate Change Canada

The removal of bird nests or eggs from trees and nesting sites are regulated under the Fish and Wildlife Conservation Act (see Section 8.5.4). However, certain rules apply to migratory birds, which are protected under the federal Migratory Birds Convention Act. Environment Canada provides guidance regarding tree removal and construction timing windows to avoid impacting migratory bird species

9.1.3 Toronto and Region Conservation Authority (TRCA)

The following permits and consultations will be required from the TRCA before construction:

- A permit for the Development Interference with Wetlands and Alteration to Watercourse and Shoreline Regulation (Ontario Regulation 166/06) will be required.
- Erosion and sediment control plans, geotechnical and hydrogeological information, natural heritage information, and protection plans/compensation strategies may need to be reviewed.
- Consultations are recommended during detailed design.

9.1.4 Fisheries and Oceans Canada

If aquatic species or their habitats are at risk, a self-assessment will be necessary to determine if the project needs to undergo review by the Department of Fisheries and Oceans Canada (DFO). According to the Natural Heritage Evaluation of Preferred Alternative report in Appendix C1 (LGL 2022), no aquatic SAR were found in the permanent watercourse that requires an open-cut crossing. However, if new information arises that indicates aquatic species or their habitats are at risk, a Request for Review will be necessary to determine whether the project needs to undergo review by Fisheries and Oceans Canada during detailed design.

9.1.5 Ministry of Natural Resources and Forestry (MNRF)

- **Fish and Wildlife Conservation Act**. A License to Collect Fish for Scientific Purposes is required if fish must be relocated to outside the work area is required. A Wildlife Collector's Authorization will be required if wildlife must be relocated to outside of the work area.
- **Public Lands Act & Lakes and Rivers Improvements Act.** The project may require land tenure under the *Public Lands Act*. Consultation with the Aurora District MNRF is required during detailed design.

9.1.6 Ministry of Transportation (MTO)

Permits will be required for works within MTO jurisdiction and to cross Highways 407 and 410. License agreement or permanent easement agreements will be required for the portion of the lands where the trunk sewer alignment is proposed. Communication and consultation with MTO are recommended during detailed design.

9.1.7 Ministry of Citizenship and Multiculturalism (MCM)

Further Stage 1 and 2 AA remain outstanding for a few locations. This additional AA is currently ongoing. A review letter from the MCM indicating that the archaeological assessment reports, recommending no further assessment, have been entered into the Ontario Public Register of Archaeological Reports is required before construction.

9.1.8 Region of Peel

Proposed permenant or temporary construction accesses need to be in compliance with the Region of Peel Access Control By-law and as well as the Region's spacing requirements.

9.1.9 City of Brampton

It will be necessary to obtain permits from the City of Brampton:

- Permit for tree removal under Tree Preservation By-law 317-2012 and potentially under Woodlot Conservation By-law 316-2012
- Topsoil Removal Permit under By-law 30-92

Consultation and notification will also be required before the use or closure of multiuse trails, parks, or sidewalks required for construction.

9.1.10 City of Mississauga

It will be necessary to obtain permits from the City of Mississauga:

- Erosion and Sediment Control Permit under Erosion and Sediment control By-law 0512-1991
- Potentially, a permit under the Public Tree Protection By-law (0020 2022) and Private Tree Protection By-law (0021 2022)
- Park Access Permit under By-law 0149-2015

Consultation and notification will also be required before the use or closure of multiuse trails, parks, or sidewalks required for construction.

A Heritage Impact Assessment may be required for 1411 Derry Road East; this will be confirmed during preliminary design.

9.1.11 Utilities

Utility infrastructure such as that belonging to Hydro One, Bell Canada, Telus, Rogers, and Enbridge must be confirmed during preliminary design to confirm there are no conflicts with the preferred design concept. Review and approval must be received.

9.1.12 Easements

The easements discussed in Section 8.2 will need approvals. Refer to the property impact plan in Appendix C5 for more details related to easements.

9.2 Cost Estimates

An Association for the Advancement of Cost Engineering (AACE) International Class 4 cost estimate was prepared for the overall design concept. Table 9-1 summarizes the estimate, and Appendix H provides details.

Table 9-1. Cost Estimate

Description	Contractor's Total Bid
Sanitary Sewer	68,502,000
Restoration	4,150,000
Miscellaneous Items	6,840,000
Contingency	3,470,000
Provision Items	546,000
Cash and Contingency Allowance	10,254,000
Contractor's Subtotal	**93,762,000**
Design Contingency (20%)	18,753,000
Contractor's Subtotal, including Contingencies	**112,515,000**
Escalation	22,996,000
Total Amount of Tender	**135,511,000**

As Table 9-1 shows, the estimated contractor's subtotal for the preferred design concept is $93,762,000. A 20% design contingency was applied. A construction contingency was included in the cash and contingency allowance. An escalation of 4.5% was assumed per year from November to June 2025 with 32 months construction, resulting in an escalation of 20.44% at the midpoint of construction. The estimated total amount of the tender is approximately $136 million, with an upper +50% estimate of $203 million and a lower -30% estimate of $95 million.

9.3 Plan and Profile Drawings

Appendix I provides plan and profile drawings depicting the proposed Deep Trunk in relation to the existing trunk sewers.

9.4 Phasing Considerations

The Class EA and preliminary design are expected to be complete in early 2023. The Region will need to procure another contract for the detailed design, tendering, and construction services.

It is anticipated that the detail design process will start by middle of 2023 and the project will be ready for tendering in 2025. The successful contractor can start procuring the tunnelling equipment and pipes, thereafter, pending property acquisition, with construction estimated to start early in 2026 for a duration of 3 years. The project would then be expected to be commissioned in 2029. Table 9-2 provides preliminary implementation timelines.

Table 9-2. Implementation Timeline

Project Milestone	Year
Design	2023
Tendering	2025
Construction	2026
Project Completion	2028-2029

The Deep Trunk sewer will be connected to the East-to-West Trunk Sewer that is currently under construction and is expected to be commissioned by 2026.

The construction of the access roads, staging areas, and open-cut sections can proceed upon the award of the tender. This will allow some time to procure the MTBM.

The expected phases are as follows:

- Phase 1: East of Dixie Road to north of Derry Road, including connections to the East-to-West Trunk Sewer and the existing Etobicoke Creek Trunk Sewers:
  - 0.6 km of open-cut section (Segment 4)
  - Connection to the East-to-West Trunk Sewer
- Phase 2: From east of Dixie Road to Kennedy Road
  - 3.2 km of tunnelled sections (Segments 1, 2, and 3)
  - Construction of six shafts (Shaft 1 through 6)
  - Connection to West-to-East Trunk Sewer
  - Connection to existing trunk sewer on Kennedy Road
- Phase 3: Biscayne Connection
  - Biscayne diversion and shaft
  - Tunnelled section from Biscayne Connection to Shaft 2

Consideration should be given to avoid impacting the baseball diamond east of Dixie Road in the summer months during Phase 1 construction.

9.5 Next Steps

9.5.1 Additional Comments and Considerations

The following should be considered during future design stages:

- Review of design and construction considerations outlined in Section 8.3
- Confirmation of geotechnical and hydrogeological conditions for tunneled and open-cut segments
- Confirmation of flow split between the existing trunk sewers and the proposed Deep Trunk, and design of the diversion chamber on Kennedy Road
- Design of the connection from the existing trunk sewers to the West-to-East Diversion Connection

- Design of the connection to the East-to-West Trunk Sewer and the existing twin Etobicoke Creek Trunk Sewers at Derry Road
- Review of watercourse profiles at crossings
- Development and implementation of a Soil Management Plan
- Completion of a topographical survey
- Coordination with the City of Mississauga on the new Drew Road
- Completion of Stage 2 AA the Biscayne Connection
- Review and approval from utilities
- Completion of Stage 2 AA for Shaft 2 and the Biscayne Connection
- Applications for permits and approvals listed in Section 8.5
- Fulfilment to public consultation commitments:
  - Adhere to Ontario Traffic Manual's Book 7, specifically for Shafts 5 and 6.
  - Inform the Region's Transportation Division about the project and respective project impacts. Further details are provided in the communications log in Appendix A3.
  - Identify and mitigate any impacts to the Region's storm infrastructure during detailed design. Further details are provided in Appendix A3.
  - Coordinate with the City of Mississauga's Transportation and Works group on the new four-lane Drew Road (from Dixie Road to Tomken Road). Construction for this road is pending for 2029.

9.5.2 Preliminary Design

The ESR conceptual design will be used to further develop a design that meets the Region's standards and provides a foundation for detailed design and construction as part of the preliminary design process.

Preliminary design will focus on the following elements:

- Shaft and tunnel design
- Maintenance hole design
- Pipeline design, including diameter and material selection
- Hydraulic design – update to the previous model to confirm flows for current and future conditions
- Connection design into the Derry Road East-to-West Trunk Sewer and the existing twin Etobicoke Creek Trunk Sewers
- Temporary access road design for construction
- Existing utility crossings/conflicts
- Creek crossings

The deliverables for the preliminary design will include a Preliminary Design Report and a Preliminary Design Drawing Set.

9.5.3 Request for Tender

As part of the preliminary design process, the following Requests for Tenders will be required for the subsequent field investigative works:

- Geotechnical and hydrogeological studies

- Subsurface Utility Engineering (SUE) investigations
- Topographical surveys

The results from these field investigations will inform the preliminary design.

9.5.3.1 Geotechnical and Hydrogeology

The work completed to date is based on desktop geotechnical information and will need to be verified in the final design stage through a geotechnical and hydrogeological program. No geotechnical and hydrogeological program has been initiated at this stage. Information for Phase 3 was obtained from the following sources:

- MTO borehole records
- East-to-West Diversion Sanitary Trunk Sewer trunk project on Dixie Road and Derry Road
- Boreholes at Highway 410 bridge (drilled in 2011) and Highway 407 near the Etobicoke Creek (drilled in 1993)
- Seven boreholes, drilled by WSP to confirm Segment 3 construction methodology in February 2022

A substantive borehole and monitoring well plan is part of the geotechnical and hydrological investigations to gather ground condition information for use in the preliminary design.

9.5.3.2 Subsurface Utility Engineering

For preliminary design, SUE mapping investigation will be required. The investigation will be to Quality Level C for the entire alignment and to Quality Level B for the shafts and the open-cut alignment. The purpose of this SUE investigation will be to check for any conflicts and develop relocation/protection measures of the existing utilities.

9.5.3.3 Topographical Survey

To date, 1-m contour lines obtained from the Region have been used for topographical elevations. During preliminary design, a topographical survey of the features of the site, ground services, and spot elevations of the areas of interest of the study area will be required. Key areas of interest for the topographical survey will include the shaft locations, access road locations, creek crossings, and open-cut segment of the alignment.

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Appendix A
Public Consultation

Appendix A1
Public Agency Consultation Plan

Appendix A2
Stakeholder Contact List

Appendix A3
Correspondence Log and Communications

Appendix A4
Notices and Public Information Centres

Appendix B
Baseline Features and Servicing Conditions

Appendix C
Technical Reports

Appendix C1
Natural Environment Reports

Appendix C2
Cultural Heritage Reports

Appendix C3
Archaeological Reports

Appendix C4
Environmental Site Assessment (ESA) Reports

Appendix C5
Property Requirements Report

Appendix C6
Traffic Impact Assessment

Appendix D
Phase 2 Cost Estimates

Appendix E
Hydraulic Analysis

Appendix F
Phase 2 Evaluation

Appendix G
Phase 3 Evaluation

Appendix H
Phase 3 Cost Estimate

Appendix I
Plan and Profile Drawings