Environmental Study Report (ESR)

DRAFT

City of Kitchener

Biehn Drive Municipal Class Environmental Assessment

January 2023

Submitted by:

BT Engineering Inc.

509 Talbot Street

London, ON N6A 2S5

Prepared By:
BT Engineering Inc.
509 Talbot Street
London, ON N6A 2S5
519-672-2222

January 2023

____

Steve Taylor, P.Eng., Consultant Project Manager
BT Engineering Inc.

Table of Contents

List of Figures

List of Tables

Technical Appendices

EXECUTIVE SUMMARY

ES.1 EA PROJECT

The City of Kitchener (City) has undertaken a Schedule C Class Environmental Assessment (EA) Study to develop a transportation plan for the extension of Biehn Drive westerly to the Robert Ferrie Drive extension in the City of Kitchener. The Biehn Drive extension will include municipal services including a trunk sanitary sewer, storm sewer/ditches and watermain. The Study has developed and evaluated alternatives for the alignment of the Biehn Drive extension, intersection locations/type and municipal services while minimizing environmental, social, and cultural impacts of the project. Biehn Drive is a Major Collector Road in the City of Kitchener Official Plan. The previous sanitary sewer network has been constructed to accommodate the future service areas to connect directly to Biehn Drive. No other alternative exists for the sanitary sewer network other than to connect to Biehn Drive.

Problem Statement

Future development within the Doon South and Brigadoon communities requires a defined alignment for the extension of Biehn Drive to Robert Ferrie Drive as part of the area road network and to accommodate municipal services. The sanitary sewer network must connect to Biehn Drive.

To determine the road alignment, this Study has considered the natural, social environments and the future land use in the Study Area. The extension of Biehn Drive and the associated municipal servicing has been a longstanding part of the integrated plan for the Brigadoon neighbourhood. The planned extension will improve local access to Strasburg Road to safely and reliably accommodate all modes of transportation including vehicular, pedestrians, and cyclists, and provide access to potential future transit. Defining the future road and municipal servicing plans concurrently allows subsequent land use plans to be completed by developers by providing certainty in the horizontal and vertical alignment of the municipal street right-of-way.

The EA Study provides the opportunity to: improve accessibility to the local community by providing additional network links; define a multi-modal transportation plan to support travel within the local neighbourhoods; accommodate the required and previously planned sanitary sewer extension; and allow development to proceed on lands that currently require the roadway ROW plan to be defined prior to developing the land use plan.

Study Area

The study area is illustrated in Error! Reference source not found.. The “Local Study Area” extends from the current terminus of Biehn Drive, approximately 60 m west of Spencer Court, southerly to the future Robert Ferrie Drive Extension. The “Broader Study Area” includes the surrounding areas to consider traffic effects in adjacent neighbourhoods as well as broader alternatives through adjacent neighbourhoods.

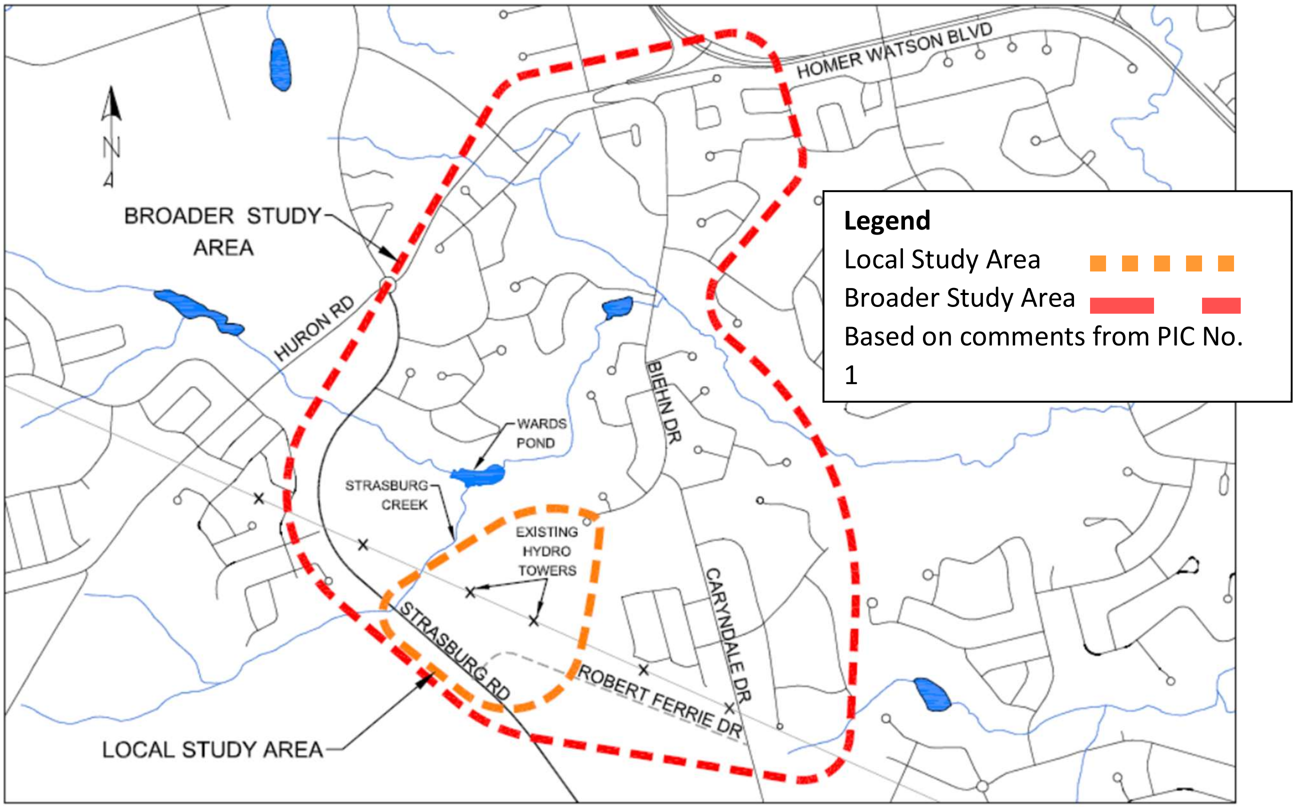


Figure E- 1: Study Area

ES.2 MUNICIPAL CLASS EA PROCESS

This project was undertaken to satisfy the Provincial EA Act following the "Municipal Class Environmental Assessment" process for a Schedule C project as amended by the Municipal Class EA 2015. This document specifies the procedures required to plan specific road projects according to an approved planning process.

The Class EA process was undertaken in a series of phases commencing with problem identification and culminating in the filing of this ESR.

The Class EA process includes an evaluation of all reasonable alternatives and the selection of a preferred alternative(s) with acceptable effects (including avoidance and mitigation of any residual adverse effects) on the natural and social/cultural environments. The Municipal Class EA process entails five phases:

Phase 1: Identify the Problem
Phase 2: Alternative Solutions
Phase 3: Alternative Design Concepts for the Preferred Solution
Phase 4: Environmental Study Report (ESR)
Phase 5: Implementation

ES.3 CONSULTATION

The public consultation approach used several techniques to proactively involve the public. The study was carried out in consultation with staff from the City of Kitchener, external agencies, stakeholders and the public.

The EA process included circulating a draft Study Design describing the proposed methodology for the Class EA at the start of the study. The draft Study Design was circulated to external agencies and was available to the general public through posting on the City website. The final Study Design is included in **Appendix A**. The Study Design circulation was completed as a discretionary public consultation, Step 1.2 of the Municipal Class EA Planning and Design Process.

A combined Community Café/Public Information Centre Event and a Public Information Centre were held during the study to present the project, the assessment of alternatives and the Technically Preferred Plan. These meetings were an integral component of the study – seeking input and comments from the local community/stakeholders. As a result, the following two major community issues were raised during the Study.

1) Community disruption (vehicular traffic) to existing residents.

   Based on community input, an additional alternative using Caryndale Drive was added and carried forward through the evaluation. The study has evaluated the effect of community traffic accessing the arterial road network using either the Biehn Drive or the Caryndale Drive route. Based on the Caryndale Drive route being designated a minor collector and having an elementary school along this route, the study recommendation is to maintain the Official Plan transportation system and utilize Biehn Drive (Major Collector) for the link to the arterial road network for the community. There will be minor effects for residents currently living at the end of Biehn Drive; however, these residents previously purchased properties on a designated Major Collector that was illustrated in the City's Official Plan.

2) Environmental effects to the Provincially Significant Wetland (PSW).

The EA has documented the need for an infrastructure link across the PSW. The length of the crossing has been minimized in the selection of the corridor and the cross section and right-of-way width have been reduced to minimize the environmental effects of the project. The EA commits to these measures when the project is implemented through Detail Design and Construction.

Indigenous Peoples engagement was undertaken as part of the study. The extensive Indigenous consultation between the Study Team and the respective individual indigenous communities and their responses/ requests have been tracked by means of an Excel spreadsheet. A separate spreadsheet has been created for field visits involving Indigenous communities requesting to be involved. The engagement included sharing archaeological studies and a field review of the final Recommended Plan with Six Nations of the Grand River. The City respects that this consultation is a Nation-to-Nation contact with the City representing the Crown. The First Nations are Rights Holders and are separate and distinct from Public Stakeholders.

All Indigenous communities listed in the previously mentioned spreadsheet will be sent notification of the Notice of Study Completion and the 30-day review period. The contact and any response will be used to update the spreadsheet. The spreadsheet will continue to be updated into and during the next phases of Detail Design and construction regarding their notification of future permits that have the potential to affect their interests. The City commits to continued liaison with the Six Nations Grand River which has identified an interest in the project and the environmental mitigation plan. No other community identified themselves during the consultation to date.

Council Resolution

ES.4 ANALYSIS AND EVALUATION

Environmental Study Report - Post Environmental Clearance and Detail Design

Any future major changes from the preliminary design documented in the ESR will be dealt with in an Addendum. The Addendum will be communicated to the contact list of the study and follow the requirements of the Municipal Class EA. A major change would be a design that requires a footprint beyond the right-of-way identified in the ESR. Any minor changes will be addressed through permitting with the Grand River Conservation Authority.

The evaluation of alternatives was completed in a two-step process. The initial step was to consider and validate previous decisions of the Transportation Master Plan as alternative planning solutions. For this study, the alternative planning solutions included:

- Alternative 1 – Do Nothing
- Alternative 2 – Transportation Demand Management (TDM)
- Alternative 3 – Use of Existing Local Roads
- Alternative 4 – Limit Land Use Development
- Alternative 5 – Extend Biehn Drive

Based on the preliminary review of Alternative Planning Solutions, Use of Existing Local Roads and Extend Biehn Drive were recommended for further evaluation. Transportation Demand Management was not carried forward as a standalone solution but will be incorporated with the preferred alternative as part of the recommended plan.

Generation of Preliminary Design Alternatives

A "long list" of preliminary design alternatives was generated, based on identified needs, to ensure consideration of a wide range of transportation alternatives (i.e. all reasonable alternatives are considered). The preliminary alternatives were categorized under 3 groups:

a. Alignment Alternatives (road and sanitary sewer and municipal services)
b. Cross Section Alternatives
c. Intersection Alternatives

Preliminary design alternatives were developed for each group of alternatives. These alternatives were presented to the public at the PIC's and was expanded based on comments received from the public. Alternatives are described in **Section 4.0**.

Analysis and Evaluation

The Project Team participated in and reviewed the analysis and evaluation for all alternatives. The Technically Preferred Alternative (TPA) was presented to the public at the second PIC.

ES.5 RECOMMENDED PLAN

After PIC No.2, the TPA was subject to refinements based on community input as described in **Section 8.1**.

The Biehn Drive Extension Recommended Plan includes:

- New 2-lane road connecting the current Biehn Drive terminus to the future Robert Ferrie Drive

  - Alignment will be east of the Hydro Tower
  - Cross section will include 3.3 m lanes with curb/gutter (0.5 m)
- Active transportation improvements will include:
  - 3.0 m MUT on the east side and a 1.5 m sidewalk on the west of the road from Robert Ferrie Drive to Biehn Drive.
  -
  - Boulevard (varying width, minimum 1.0 m)
  - Potential pedestrian crossing at:
    - The hydro corridor north of Biehn Drive/Robert Ferrie Drive roundabout.
    - The south edge of the wetland.
- Roundabout at the intersection of Biehn Drive and Robert Ferrie Drive (per the recommendations of the Robert Ferrie Drive Environmental Assessment)
- Installation of municipal services beneath the road alignment including:
  - Sanitary trunk sewer (525 mm diameter)
  - Storm sewer
  - Watermain
- Natural environment mitigation including:
  - Construction of one or more concrete box culverts with a 1.0 m span and 1.0 m rise for the provision of wildlife passage under the Biehn Drive extension in the area of the Strasburg Creek PSW (final sizing, design and number of crossings to be defined in detail design). The Biehn Drive Wildlife Crossing Technical Memorandum is included in **Appendix I.**
  - Implementation of permanent wildlife fencing
  - Stormwater quality control of northern outlet to the PSW (oil grit separator)
  - Target desirable compensation for wetland loss including:
    - 10:1 tree replacement
    - 1:1 wetland replacement (on-site)
    - 2:1 wetland replacement (off-site)
    - The feasibility for compensation to be reviewed with the future determination of the offsets from the PSW to development lands as an opportunity for naturalization and well as the re-naturalization of the removal of the existing cul-de-sac on Biehn Drive.

The Recommended Plan is illustrated in **Figure E2.** It incorporates Preliminary Design mitigation measures for the project which are described in **Section 10.0**. Detail Design and Construction mitigation measure commitments are described in **Section 11.0.**

The timeline for implementation of the project is expected to be within the 5-year capital program.

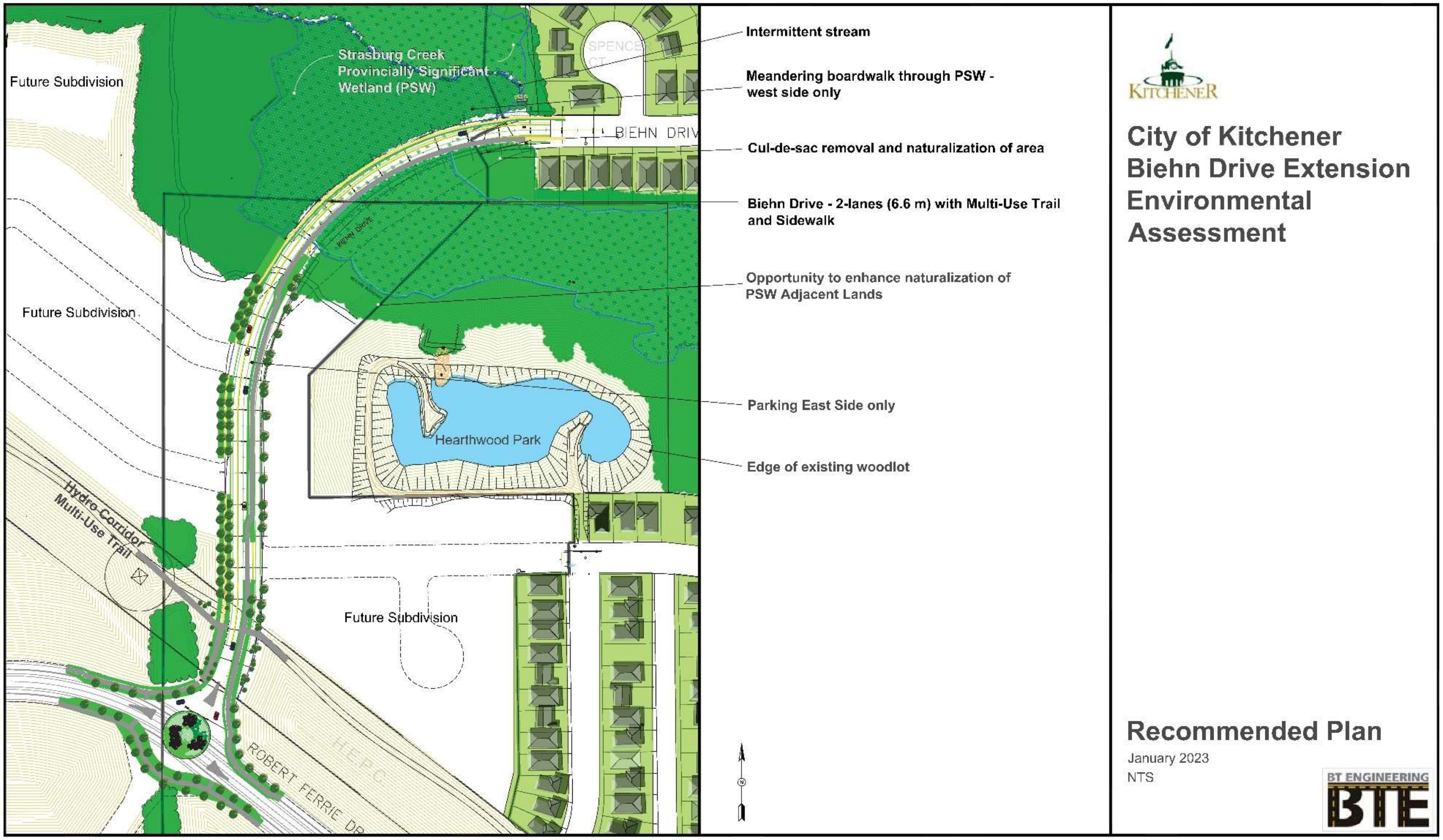


Figure E- 2: Recommended Plan

1.0 INTRODUCTION

The City of Kitchener (City) has undertaken a Schedule C Class Environmental Assessment (EA) Study to develop a transportation plan for the extension of Biehn Drive westerly to the Robert Ferrie Drive extension in the City of Kitchener. The Biehn Drive extension will include municipal services including a trunk sanitary sewer, storm sewer/ditches and watermain. The Study has developed and evaluated alternatives for the alignment of the Biehn Drive extension, intersection locations/type and municipal services while minimizing environmental, social, and cultural impacts of the project. Biehn Drive is a Major Collector Road in the City of Kitchener Official Plan. The previous sanitary sewer network has been constructed to accommodate the future service areas to connect directly to Biehn Drive. No other alternative exists for the sanitary sewer network other than to connect to Biehn Drive.

This Environmental Study Report (ESR) documents the transportation/servicing need and the Recommended Plan to address current and future operational needs, considering all modes of travel and incorporating environmental mitigation measures as required. The road extension will be a key link in the Brigadoon community transportation/servicing network and will provide all users (pedestrians, bicycles, and vehicular traffic) with a safe and efficient route to travel from neighbourhoods to the arterial road network now that Strasburg Road has been constructed to the planned extension of Robert Ferrie Drive.

1.1 Study Area

The Study Area is located in the City of Kitchener and is illustrated on **Figure 1**. The Local Study Area extends from the current terminus of Biehn Drive, approximately 60 m west of Spencer Court, southerly to the future Robert Ferrie Drive Extension. Following the Community Café and Public Information Centre No. 1, the Study Area was expanded to a Broader Study Area to consider traffic effects in adjacent neighbourhoods as well as broader alternatives that had not been originally considered in the Draft Study Design.

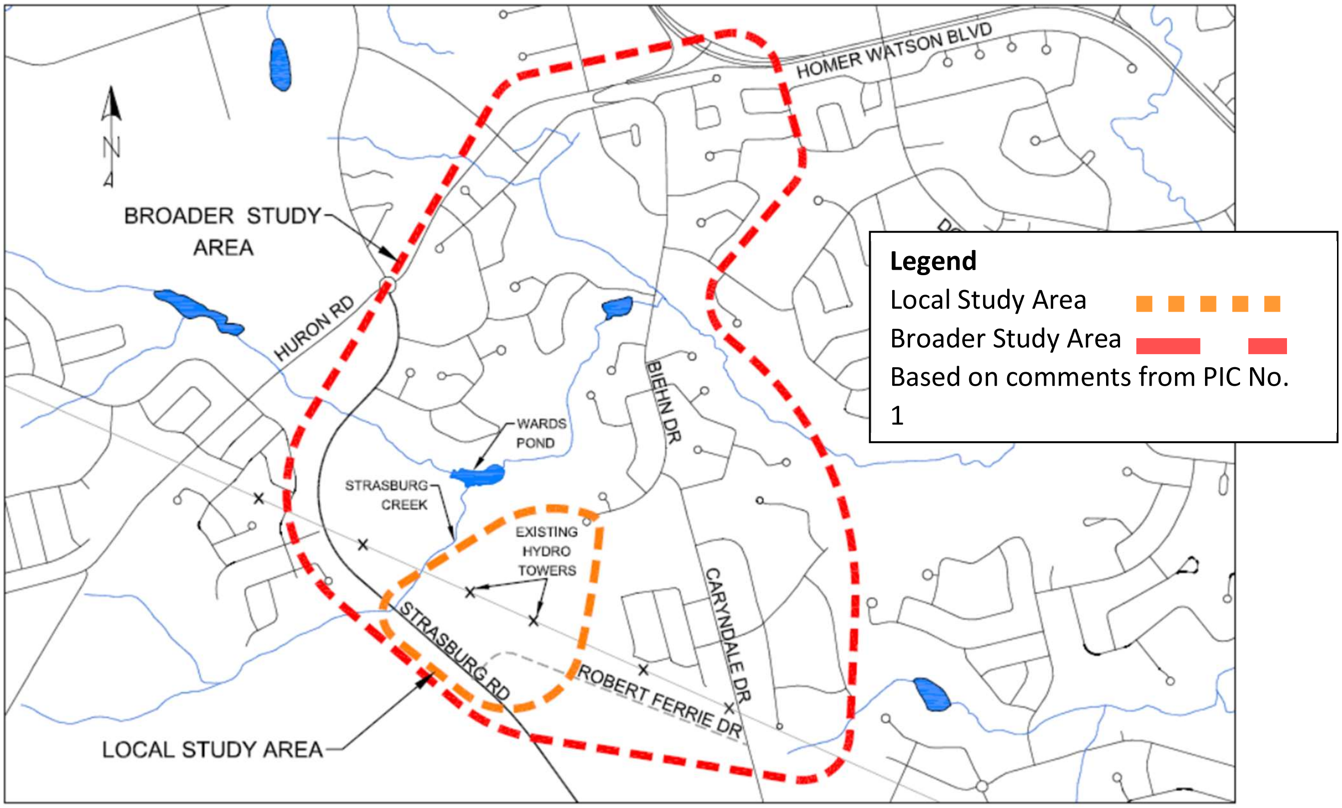


Figure 1: Study Area

1.2 Background

Since the mid-2000's the road network and municipal servicing for the Doon South and Brigadoon areas in the City of Kitchener have planned for area development and evolving transportation and municipal servicing needs. Several planning documents including the Official Plan and Transportation Master Plan (TMP) have identified the need to extend Biehn Drive southerly to the Robert Ferrie Drive extension and ultimately to Strasburg Road for use as both a collector road and for municipal services. The Biehn Drive Extension would be a major collector road, as identified in Schedule B of the City of Kitchener's Official Plan. This link would accommodate vehicles to and from the Brigadoon community and would help reduce traffic on other local streets within the community (Caryndale Drive and the northern section of Biehn Drive). A separate Biehn Drive Traffic Calming Study is proceeding concurrently with this EA Study for the northern section of Biehn Drive.

A collector road collects traffic from local streets within the community and provides connectivity to high tier arterial roads including Strasburg Road.

Background studies have previously been completed within the Study Area to document the proposed land uses, planned transportation networks, municipal servicing plans and existing issues. These reports are summarized in the following sections.

1.2.1 Official Plan and Land Use

The City of Kitchener Official Plan (2014) documents the policies for growth, development, and land use within the City. Map 3 of the Official Plan identifies the land in the Study Area as Natural Heritage Conservation and Low-Rise Residential:

- Natural Heritage Conservation: This land use designation is used to protect and/or conserve natural heritage features and their ecological functions. This designation includes Provincially Significant Wetlands (PSW).
- Low-Rise Residential: This land use designation accommodates a range of low-density housing types including single detached dwellings, semi-detached dwellings, townhouses, low-rise multiple dwellings etc.

In addition to the general land use classifications, there is a Specific Policy Area (SPA) along the hydro corridor in the Brigadoon subdivision (SPA 45). This SPA states:

> *"Notwithstanding the Open Space land use designation and policies on the Hydro Corridor in the Brigadoon Subdivision (30T-88006) shared uses on hydro rights-of-way including open space links, parking lots or other uses accessory to adjacent land uses in accordance with Policy 14.C.1.37 and Policy 15.D.10.1 i) will be permitted."*

1.2.2 City of Kitchener Transportation Master Plan

The Kitchener Integrated Transportation Master Plan (TMP) (2013, IBI Group) identifies the need to extend Biehn Drive from its current terminus. The TMP recommended that Biehn Drive be extended westerly to Strasburg Road. This recommendation was modified in subsequent planning documents and EAs to recommend connection to the Robert Ferrie Drive extension instead, with the final determination to be defined by an EA (the current Study).

1.2.3 Region of Waterloo Transportation Master Plan

The Region of Waterloo's Moving Forward 2018 Master Plan (IBI Group, 2019) outlines the needs for active transportation, transit and Regional roads. This report identifies Biehn Drive as an Existing Local Route for Grand River Transit; however, the 2021 GRT System Transit Map no longer includes this link (Route 16 Strasburg-Belmont follows Biehn Drive from Old Huron Road to Black Walnut Drive).

1.2.4 Kitchener Growth Management Plan (KGMP)

The Kitchener Growth Management Plan (KGMP) (2019) provides a framework to ensure that the City has "direct, proper and orderly development within the boundary". The Plan prioritizes areas for development based on the supply of developable lands and existing infrastructure.

The extension of Biehn Drive, including a sanitary sewer, is identified in the Plan as a major remaining initiative for the Brigadoon community. There are two developments planned/proposed within this area (see **Figure 2**). A requirement for development of the lands, labelled 33 and 34 on **Figure 2,** is the extension of sanitary services and the Biehn Drive connection.

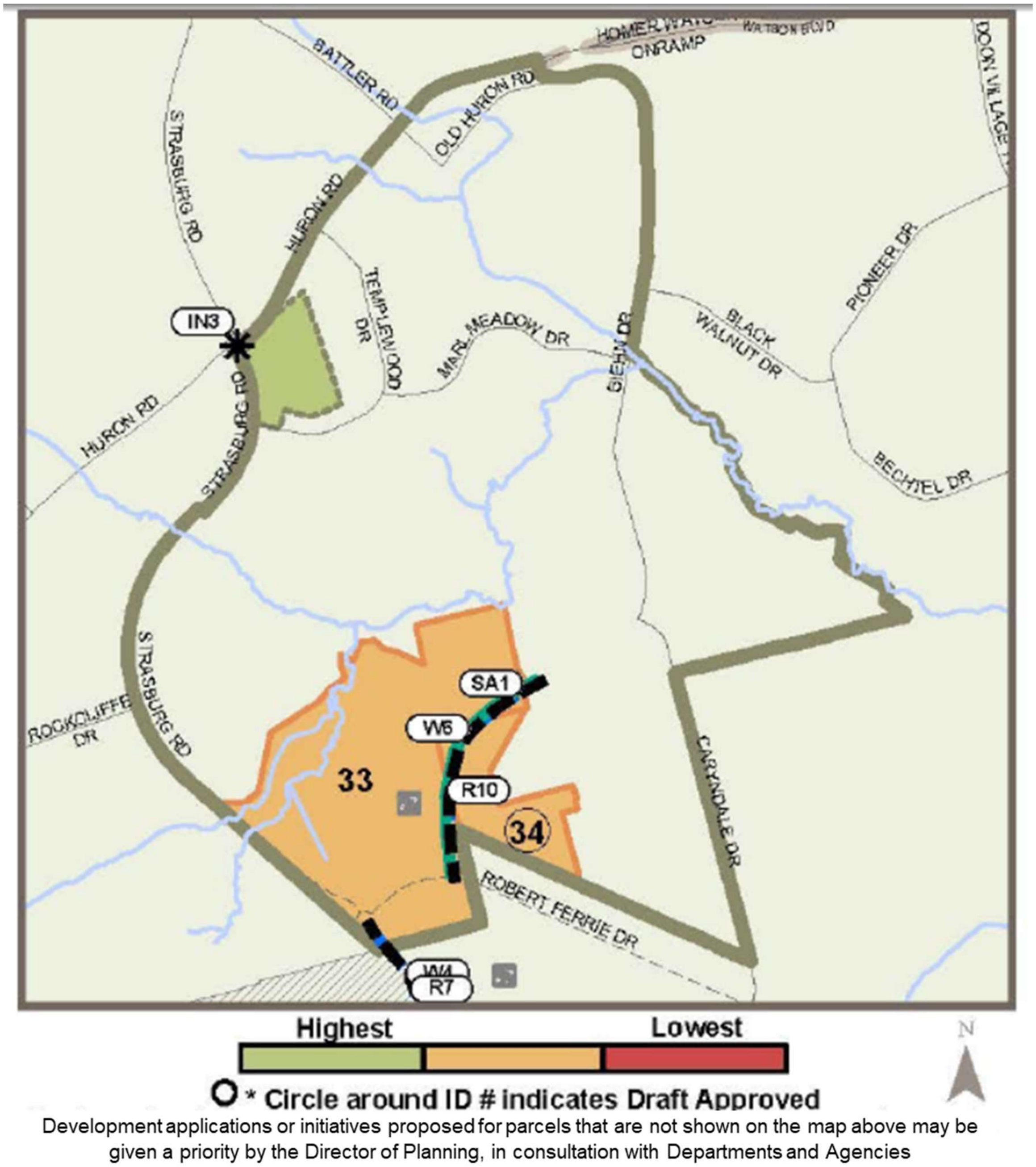


Figure 2: Growth Area Subplan for Brigadoon (Kitchener Growth Management Plan, 2019)

1.2.5 Brigadoon Community Plan

The Brigadoon Community Plan (2004) documents the principles for the development of the Brigadoon Community. This plan identifies that the development of lands east and west of the future Biehn Drive extension "shall require the construction of Strasburg Road and the Biehn Drive extension".

1.2.6 Integrated Sanitary Master Plan (ISAN-MP)

The City of Kitchener is currently completing an Integrated Sanitary Master Plan. All previous construction of the sanitary network has been built to accommodate the future services areas to connect directly to Biehn Drive. No other alternative exists for the sanitary network other than to connect to Biehn Drive.

1.2.7 Integrated Stormwater Management Master Plan (ISWM-MP)

The City of Kitchener's Integrated Stormwater Management Master Plan (ISWM-MP) (Aquafor Beach, 2016) identifies the prioritization of works for the City's overall Stormwater Master Plan. This report indicates that the Study Area is located within the Strasburg Creek subwatershed. This was identified as a Priority 4 subwatershed, which is an area where intensification should provide sufficient buffers to maintain the natural hydrologic cycle.

1.2.8 Provincial Policy Statements

The Kitchener Official Plan and subsequent planning studies have been carried out in accordance with the Provincial Policy Statement (PPS) at the time of their creation. Within this Report, Section 3.2.4 Proposed /Approved Development outlines the undertaking's compliance with the "*A Place to Grow: Growth Plan for the Greater Golden Horseshoe* (2020)". In addition, Section 3.1.1 Terrestrial and Aquatic acknowledges the Strasburg Creek Provincially Significant Wetland (PSW) complex and the design efforts to minimize the footprint and long-term impact on this PSW complex. Finally, the evaluation process considered the impact on the PSW complex of the various alternatives in arriving at the Recommended Plan.

The Study recommendations are consistent with the PPS which allows infrastructure works within a PSW when there is a demonstrated need for a project following an Environmental Assessment. With the exception of the Do Nothing Alternative, all alternatives require crossing the PSW. The planned sanitary system for all future planned development (south of the PSW) has been planned to outlet on the north side of the PSW at Biehn Drive. The need for the development areas to the south is consistent with the Province's Places to Grow legislation defining growth targets to 2050. The land use plan is documented in the City and Region's Official Plans.

The following insert is the reference from the PPS defining infrastructure as separate and distinct from other forms of development:

> **Development:** means the creation of a new lot, a change in land use, or the construction of buildings and structures requiring approval under the *Planning Act*, but does not include:
> a) activities that create or maintain *infrastructure* authorized under an environmental assessment process;
> b) works subject to the *Drainage Act*; or
> c) for the purposes of policy 2.1.4(a), underground or surface mining of *minerals* or advanced exploration on mining lands in *significant areas of mineral potential* in Ecoregion 5E, where advanced exploration has the same meaning as under the *Mining Act*. Instead, those matters shall be subject to policy 2.1.5(a).

Below is the definition of “infrastructure” in the Provincial Policy Statement:

> **Infrastructure:** means physical structures (facilities and corridors) that form the foundation for development. *Infrastructure* includes: sewage and water systems, septage treatment systems, stormwater management systems, waste management systems, electricity generation facilities, electricity transmission and distribution systems, communications/telecommunications, transit and transportation corridors and facilities, oil and gas pipelines and associated facilities.

The project includes the construction of sewage works (sanitary sewer) and surface transportation access for the community. The project recommendations are to cross the PSW utilizing a reduced cross section and context sensitive design to minimize the residual effects of the project on the PSW.

1.2.9 Additional Reports

Additional background reports that were reviewed as part of the Study include:

- City of Kitchener Standard Specifications
- City of Kitchener Standard Drawings
- Region of Waterloo and Area Municipalities Design Guidelines and Supplemental Specifications for Municipal Services
- Strasburg Road Extension Environmental Study Report
- South Strasburg Gravity Trunk Sanitary Sewer Project File
- East Side Lands Sanitary Servicing Environmental Study Report
- Doon South Pumping Station Draft Environmental Study Report
- Robert Ferrie Drive Extension Environmental Study Report
- Biehn Drive Extension and Need Justification Review
- Doon South Community Plan
- Huron Community Plan
- Southwest Kitchener Urban Area Studies - Community Master Plan
- Doon South - Brigadoon Transportation Network and Corridor Study
- Doon South Community and Broader Study Area Traffic Impact Study
- City of Kitchener Cycling and Trails Master Plan
- Huron Industrial Development Transportation Planning and Engineering Study
- Strasburg Creek Flood Control Environmental Study Report
- State of the Watershed (SOW) Report Upper Blair Creek
- Cumulative Effects Monitoring – Blair Creek Case Study
- Revised Final Stormwater Management Report Doon Creek – Robert Ferrie Drive Extension
- City of Kitchener Stormwater Management Facility Retrofit, Class EA and Preliminary Design Brief
- Upper Blair Creek (Kitchener) Functional Drainage Study Final Report

1.3 Problem Statement

Future development within the Doon South and Brigadoon communities requires a defined alignment for the extension of Biehn Drive to Robert Ferrie Drive as part of the area road network and to accommodate municipal services. The sanitary sewer network must connect to Biehn Drive.

To determine the road alignment, this Study has considered the natural, social environments and the future land use in the Study Area. The extension of Biehn Drive and the associated municipal servicing has been a longstanding part of the integrated plan for the Brigadoon neighbourhood. The planned extension will improve local access to Strasburg Road to safely and reliably accommodate all modes of transportation including vehicular, pedestrians, and cyclists, and provide access to potential future transit. Defining the future road and municipal servicing plans concurrently allows subsequent land use plans to be completed by developers by providing certainty in the horizontal and vertical alignment of the municipal street ROW.

The EA Study provides the opportunity to: improve accessibility to the local community by providing additional network links; define a multi-modal transportation plan to support travel within the local neighbourhoods; accommodate the required and previously planned sanitary sewer extension; and allow development to proceed on lands that currently require the roadway ROW plan to be defined prior to developing the land use plan.

2.0 STUDY PROCESS

The *Environmental Assessment Act* of Ontario (EA Act) provides for "the protection, conservation and wise management in Ontario of the environment"[1]. Municipal infrastructure projects, including road projects, within the Province of Ontario must follow the process prescribed by the EA Act. The EA process includes: the identification of the problem/opportunity; evaluation and selection of the preferred alternative while minimizing environmental effects; and consultation with stakeholders in the decision-making process. This is a self-assessment process that includes mandatory public consultation.

The environmental impacts of municipal projects are varied. Therefore, projects are classified into Schedules based on the scope and complexity of the project as well as the estimated capital cost. This Study was completed to satisfy the Municipal Class EA process for a Schedule C Study. It builds on the previous completion of Phases 1 and 2 of the Class EA process that were completed as part of the Transportation Master Plan. Schedule C projects generally include the construction or new facilities and major expansions to existing facilities with the potential for significant environmental effects.

At the start of the Study, a Study Design document was prepared that described the previous Master Plan phases, the proposed work plan, public consultation and process to be followed to complete the remaining phases of the Class Environmental Assessment. The Final Study Design report, included in **Appendix A,** was initially circulated in draft form for public and agency comment and revised based on input received.

2.1 Class Environmental Assessment Process

The Class EA document specifies the procedures required to plan specific transportation projects according to an approved planning process. The Study approach included the Ministry of the Environment, Conservation and Parks (MECP) five guiding principles for EA studies, namely:

- Consider all reasonable alternatives;
- Provide a comprehensive assessment of the environment;
- Utilize a systematic and traceable evaluation of net effects;
- Undertake a comprehensive public consultation program; and
- Provide clear and concise documentation of the decision-making process and public consultation program.

The Class EA Process was undertaken in a series of phases commencing with problem identification and culminating in the filing of an Environmental Study Report.

The Planning and Design Process for the Municipal Class EA is illustrated in Error! Reference source not found.. The Class EA process includes an evaluation of all reasonable alternatives and the selection of a preferred alternative(s) with acceptable effects (including avoidance and mitigation of any residual

[1] Municipal Class Environmental Assessment, Municipal Engineers Association (2015)

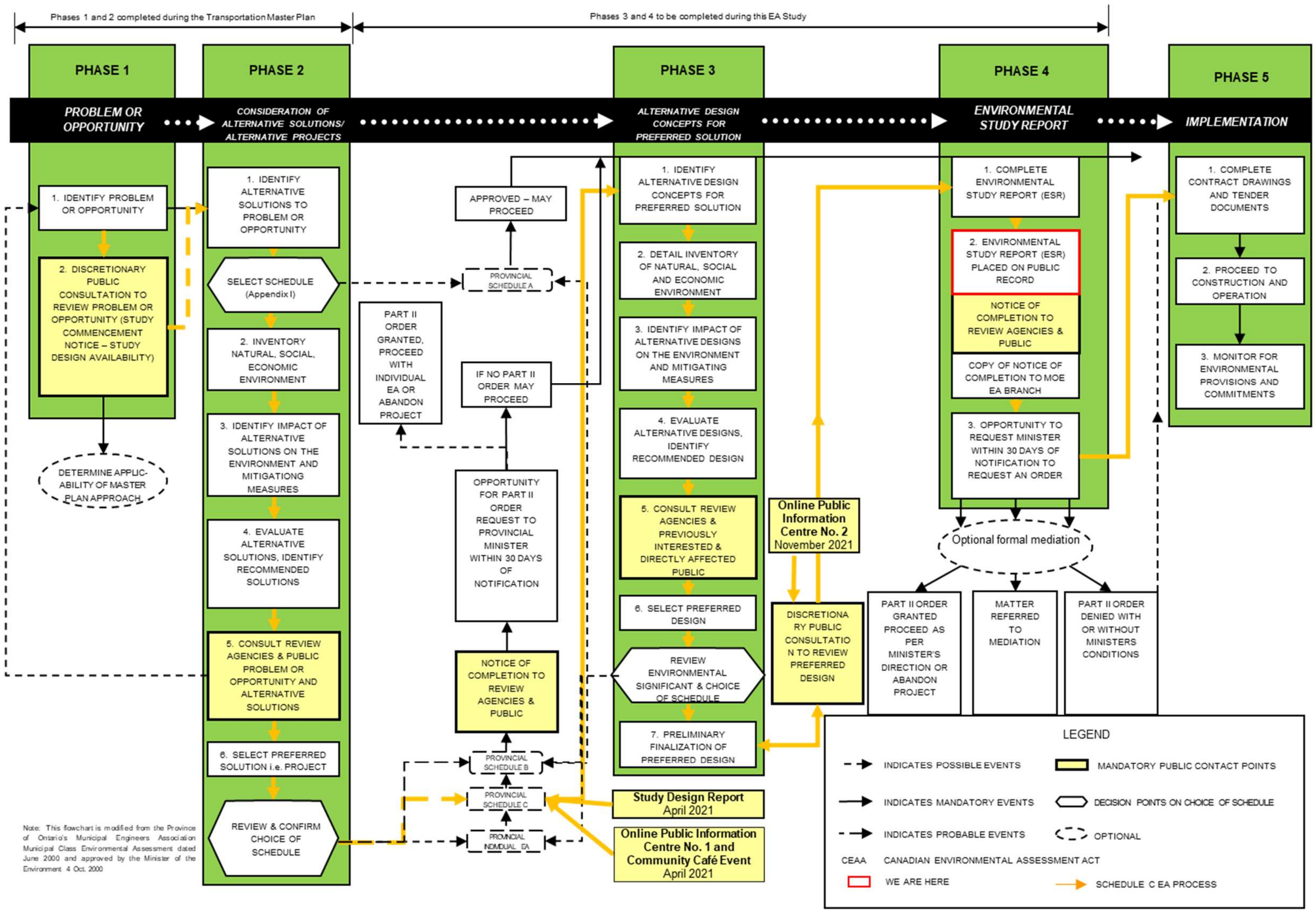


Figure 3: Municipal Class EA Process

effects) on the natural and social/cultural environments. The Municipal Class EA process entails five phases.

The following is the specific breakdown of tasks by phase for a Class EA project.

Phase 1: Identify the Problem (completed as part of the City's TMP)

Step 1: Identification and description of the problem or opportunity.

Step 2: Discretionary public consultation.

Phase 2: Alternative Solutions (Steps 1 to 8 completed as part of the City's TMP)

Step 1: Identification of all alternative solutions to the problem.

Step 2: Identify the Study Area and a general inventory of the natural, social and cultural environments.

Step 3: Identification of the net positive and negative effects of each alternative solution.

Step 4: Review and validation oof alternative solutions.

Step 5: Identification of reasonable design alternatives for the preferred solution

Step 6: Public consultation

Step 7: Confirmation of design alternatives, finalization of Draft Study Design Report for work program, and refinements to or addition of design alternatives to be carried forward to Phase 3.

Step 8: Selection of the preferred solution.

Step 9: Draft Study Design available on the City's website – added activity to initiate this Study.

Step 10: Initial Community Café'/PIC No. 1 added activity under this Study to review/validate previous TMP recommendations and present preliminary design alternatives for public and agency comment before Phase 3 activities are initiated. Draft Study Design Report finalized after PIC No. 1.

Phase 3: Alternative Design Concepts for the Preferred Solution

Step 1: Identification of alternative designs.

Step 2: Preparation of a detailed inventory of the natural, social and economic environments.

Step 3: Identification of the potential impacts of the alternative designs.

Step 4: Evaluation of the alternative designs.

Step 5: Selection of preferred design.

Step 6: Public consultation at PIC No. 2.

Phase 4: Alternative Design Concepts for the Preferred Solution

Step 1: Completion of the ESR.

Step 2: 30-day public review period.

Step 3: Filing of the ESR and Notice of Completion.

Phase 5: Implementation

Future phase, after this Study.

The Municipal Class EA process is illustrated in **Figure 3**. This Study has been completed to the end of Phase 4 of the Municipal Class EA process. The project will be approved for design and construction if no written concerns are submitted during the 30-day public review period. Construction will be subject to obtaining permits and approvals during the future Detail Design Phase 5 of the project.

2.2 Alternative Planning Solutions from Previous Planning Studies

The analysis and evaluation of alternatives involves a two-step process for decision-making. The first step is the analysis and evaluation of Planning Solutions, which considers different broad approaches to address the problem. The second step, as described in **Section 4.0**, is the generation and evaluation of preliminary design alternatives which are determined based on the selected Planning Solution.

In determining the preferred undertaking for the City, the following Planning Solutions were considered previously:

- Alternative 1 – Do Nothing. This alternative would maintain the existing road network and would not extend Biehn Drive.
- Alternative 2 – Transportation Demand Management (TDM). This strategy would reduce vehicular demand and encourages alternative work hours, work at home and more active modes of transportation.
- Alternative 3 – Use of Existing Local Roads. This strategy would encourage the use of local roads to reduce the need to extend Biehn Drive. Local roads are generally not designed or maintained to accommodate high traffic volumes.
- Alternative 4 – Limit Land Use Development. This strategy would limit any new residential, commercial or industrial development and therefore reduce the generation of new trips.
- Alternative 5 – Extend Biehn Drive. Construction of Biehn Drive extension would provide a long-term solution for improved traffic capacity, operations and safety.

Based on the preliminary review of Alternative Planning Solutions, Use of Existing Local Roads and Extend Biehn Drive were recommended for further evaluation. Transportation Demand Management was not carried forward as a standalone solution but will be incorporated with the preferred alternative as part of the recommended plan.

The evaluation of the Alternatives to the Undertaking (Planning Alternatives) for this Study is shown in **Table 1.**

Table 1: Planning Alternatives

Screening Criteria	Alternative 1: Do Nothing	Alternative 2: TDM	Alternative 3: Use of Existing Local Roads	Alternative 4: Limit Development	Alternative 5: Extend Biehn Drive
Transportation	Does not address forecast traffic demand. Results in increased volumes on local roads.	May reduce vehicular demand by mode shift or work at home but will not eliminate need for new or improved infrastructure.	Local roads not designed to accommodate increased volumes.	May reduce vehicular demand by reducing the number of trips generated by development but does not address existing demands and/or background growth.	Accommodates all modes of transportation.
Environmental	No impacts.	No or low impacts. Low impacts may be associated with active transportation projects/ improvements (i.e. sidewalks, bike lanes).	Low impacts. Creates disruption to properties on local roads that would experience an increase in traffic.	No impacts.	Medium to High impacts. Environmental effect associated with the new corridor. Magnitude of effects is subject to environmental mitigation.
City Planning Objectives	Does not meet objectives/ recommendations in City Planning documents.	Supports objective to encourage active transportation and alternate modes.	Does not meet objectives/ recommendations in City Planning documents.	Does not meet objectives/ recommendations in City Planning documents.	Supports the recommendations for the extension of Biehn Drive in the City's Official Plan and TMP.

Screening Criteria	Alternative 1: Do Nothing	Alternative 2: TDM	Alternative 3: Use of Existing Local Roads	Alternative 4: Limit Development	Alternative 5: Extend Biehn Drive
Recommendations	Not recommended to be carried forward.	Recommended as a complementary solution.	Following PIC No. 1 there was public support to carry forward this alternative.	Not recommended.	Recommended to be carried forward.

2.3 Consultation Program

Over the course of the Study, input was solicited from the public, stakeholders, agencies and Rights Holders (Indigenous Communities). Input was collected through meetings, the project website, and discussions/communication with interested parties. The Study approach was to work collaboratively with interested parties to address issues and reach a consensus on the preferred design.

The following sections provide a summary of the consultation activities held during the Study.

2.4 Notices

Notices for the Study were advertised on the City's website, mailed/emailed to the project contact list, and published as follows:

- Study Commencement and Community Café/Public Information Centre No. 1 – The Waterloo Region Record on March 26, 2021
- Public Information Centre No. 2 – The Waterloo Region Record on October 29, 2021
- Notice of Study Completion - <<DATE>>

In addition, a newsletter was distributed to all properties within the Broader Study Area to present background information and respond to frequently asked questions following the Community Café/PIC No. 1.

See **Appendix B** for copies of the study notices and newsletter. **Appendix C** includes select correspondence received from interested individuals, ministries, agencies, and Indigenous Peoples.

2.4.1 Contact List

A public/agency mailing list was developed at the start of the Study and was updated throughout the duration. The following Sections identify the stakeholders, agencies and communities contacted.

2.4.2 Stakeholder Consultation

All agencies of groups that may have had an interest in the project or any documentation to contribute to the Study were contacted at the start of the Class EA for their input. The following ministries, agencies and stakeholders were invited to attend the public meetings:

- Ministry of the Environment, Conservation and Parks (MECP)
- Ministry of Northern Development, Mines, Natural Resources and Forestry (NDMNRF)
- Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI)
- Ministry of Municipal Affairs and Housing (MMAH)
- Infrastructure Ontario (IO)
- Transport Canada (TC)
- Ministry of Indigenous Affairs
- Grand River Conservation Authority (GRCA)
- Emergency Services

- Utilities
- School Boards/Bus Services
- Other Stakeholders (as identified)

2.4.3 Indigenous Peoples Consultation

The City of Kitchener has a constitutional duty to consult with Indigenous Communities with traditional land use or interests within the Study Area. Notices were sent to the Indigenous Communities within the vicinity of the Study Area notifying them of the Study start-up and key milestones. Those contacted included:

- Six Nations of the Grand River (SNGR)
- Metis Nation of Ontario
- Mississaugas of the Credit First Nation
- Haudenausaunee Chiefs Confederacy Council (HCCC) represented by Haudenosaunee Development Institute (HDI)
- Huron Wendat Nation

A meeting (January 5, 2022) and a separate site visit at the Study conclusion (February 18, 2022) was held with Six Nations of the Grand River (SNGR) during the EA.

The City of Kitchener has committed to keeping all Indigenous Communities updated on the progress of the projects and will invite Indigenous field monitors to participate during future environmental fieldwork. The final archaeological report, which provided clearance of the project limits, was submitted both to the Ministry Sport, Tourism and Culture Industries and SNGR, HCCC (represented by HDI) and Mississaugas of the Credit First Nation.

2.5 Public Meetings

A combined Community Café Event/Public Information Centre (PIC) and a second Public Information Centre were held online during the Study to present the project, the assessment of alternatives and the Technically Preferred Plan. These meetings were an integral component of the Study – seeking input and comments from the local community/stakeholders. Public and agency representatives were encouraged to provide input/feedback. City of Kitchener and consultant staff were available to respond to any verbal comments/questions at the online events and during the subsequent 2-week comment period.

See **Appendix B** for the Community Café and Public Information Centre Summary Reports.

2.5.1 Community Café Event/ PIC No. 1

A combined Community Café and PIC was held virtually (by video webinar) on April 20, 2021 from 6:30 to 8:00 pm. The Community Café was an informal event for the public and stakeholders to facilitate conversation about issues that matter to the community. Four topics were chosen as discussion points to consider the concerns of the public including: traffic operation, pedestrians/cyclists, intersection design and neighbourhood concerns.

The Community Café process followed the principles of the 'World Café' philosophy; namely that people want to talk together about issues that matter and secondly, that as they talk together, they can collectively achieve greater wisdom. The Community Café is an effective conversational method for fostering dialogue, accessing collective intelligence and creating innovative possibilities for action. Discussion from the event was recorded and used an input for subsequent steps in the EA Study.

Based on input from the Community Café and PIC No.1, the Study Area was expanded to a Broader Study Area to consider traffic effects in adjacent neighbourhoods and to consider a new transportation alternative, Caryndale Drive.

2.5.2 Public Information Centre No. 2

The second PIC was held virtually (by video webinar) on November 17, 2021 from 6:30 to 8:00 pm. The PIC presented information on the Municipal Class EA Process, traffic, preliminary design alternatives, effects and mitigation, the Technically Preferred Alternative, and next steps.

Nine comment sheets/emails were received following the PIC.

2.5.3 Council Resolution

3.0 EXISTING CONDITIONS

The existing conditions of the natural and built environment, land use and property, and socio-economic environment are described in this Section.

3.1 Natural Environment

3.1.1 Terrestrial and Aquatic

The north section of the Study Area (adjacent to the current terminus of Biehn Drive) is located within the Strasburg Creek Provincially Significant Wetland (PSW) Complex. The Strasburg Creek PSW unit at Biehn Drive is a wooded swamp dominated by mature hardwoods. A desktop background information review did not identify the presence of any terrestrial or aquatic Species at Risk (SAR); however, the site reviews did identify suitable habitat conditions for bats within the swamp (roosting trees throughout) and for a variety of SAR songbirds on the lands currently under cultivation to the south.

No open bodies of water were in the vicinity that would indicate turtle presence in the area and their presence would likely be only transitory due to the closed canopy and lack of basking areas. Other reptiles and amphibians (frogs, salamanders, snakes, etc.) would be expected to be common. Yellow Birch (*Betula alleghaniensis*), now an uncommon tree species in many parts of southern Ontario, is well represented in the wetland and surrounding woodlands, as are Eastern Hemlock (*Tsuga canadensis*), Black Ash (*Fraxinus nigra*) and White Pine (*Pinus strobus*), all of which include large specimens. A grouping of mature Aspen Poplars (*Populus spp*.) occurs at the south boundary of the woodlot where the roadway extension will exit the PSW.

The Natural Environment Site Overview Technical Memorandum is provided in **Appendix D**.

3.1.2 Cultural Heritage

The MHTSCI Checklist to screen Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes was completed and determined that no properties within the Study Area are recognized as a heritage property or to have cultural heritage value. The completed checklist is provided in **Appendix E.**

3.1.3 Archaeology

The Study Area for the proposed Biehn Drive extension and sanitary trunk sewer extension in the City of Kitchener was subject to previous Stage 1 and 2 archaeological assessments conducted prior to the current project. The eastern portion was assessed by AAL in 2009 (P013-519-2009) and the western portion was assessed by ARA in 2021 (P007-1187-2021). Both of these assessments identified several archaeological sites, but none of them met the MHSTCI criteria for requiring any additional archaeological assessment. The 2021 report was completed with the participation of the HCCC (represented by HDI), the Six Nations of the Grand River

Elected Council, and the Mississauga of the Credit First Nation, and all three communities reviewed the report and had no concerns with the recommendations made.

Based on the previous work completed, there are no outstanding archaeological concerns for the current project.

3.1.4 Sourcewater Protection

The Study Area is located within the Grand River Source Protection Area and is subject to the Grand River Source Protection Plan. Parts of the Study are located within:

- Wellhead protection area B (WHPA-B) with a vulnerability score of 8;
- Wellhead protection area C (WHPA-C) with a vulnerability score of 6;
- Wellhead protection area D (WHPA-D) with a vulnerability score of 4;
- Significant Groundwater Recharge Area with a vulnerability score of 2; and
- Significant Groundwater Recharge Area with a vulnerability score of 4.

These areas are illustrated on **Figure 4**. The Grand River Source Protection Plan identifies policies to protect municipal drinking water against existing and future threats in compliance with the *Clean Water Act, 2006* (Ontario Regulation 287/07). The *Clean Water Act* requires municipalities to notify Source Protection Authorities and Committees when the municipalities receive applications that could create or modify a transport pathway.

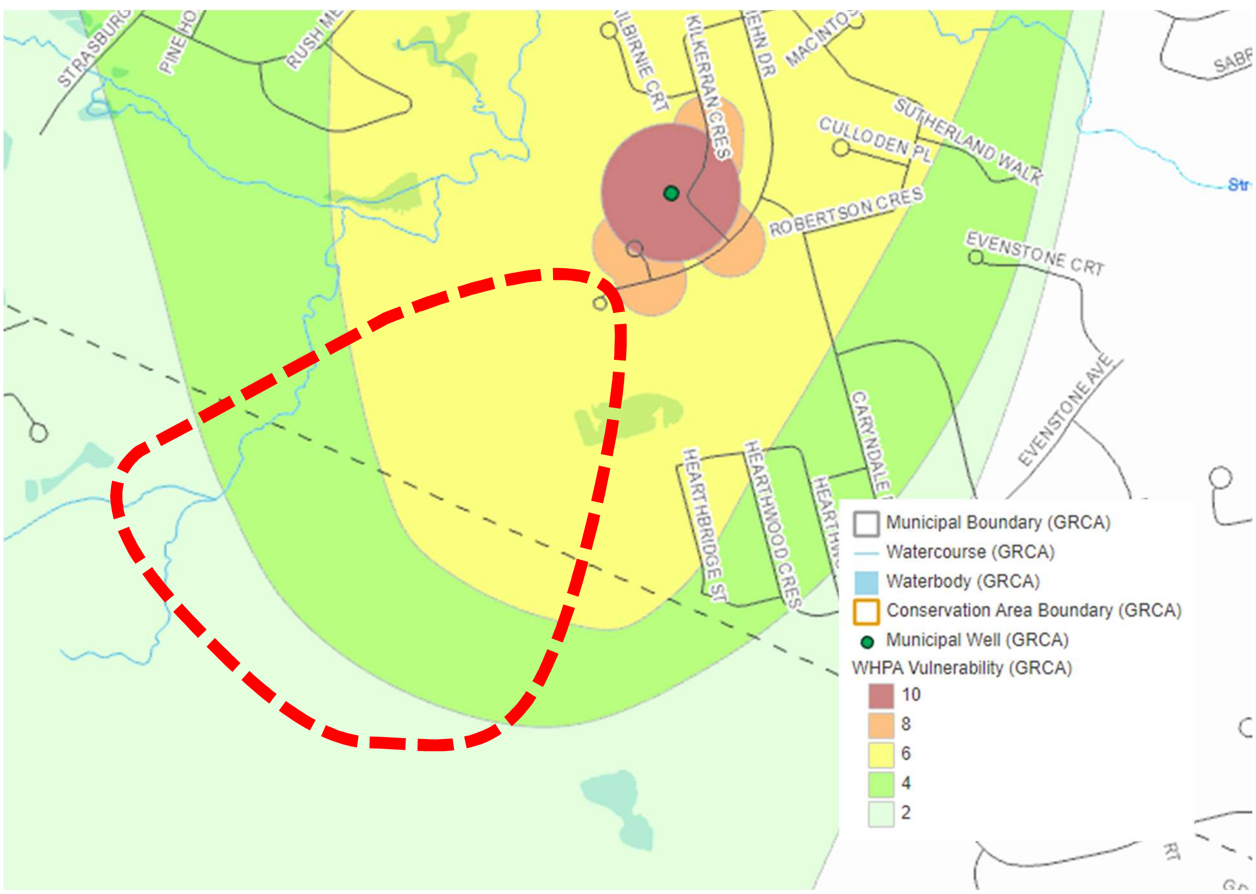


Figure 4: Wellhead Protection Areas (WHPA)

The City is required to protect against source water threats. Source protection policies which apply to this Study are summarized in the Grand River Source Protection Plan (Chapter 10 – Region of Waterloo). All applicable policies identified in the Grand River Source Protection Plan need to be followed during and post construction.

3.1.5 Climate Change

The recommendations of the ESR considered the impacts of climate change and the effectiveness of adaptation strategies to reduce the City's vulnerability. Strategies being implemented as part of or in conjunction with this ESR include:

- The expansion of cycling infrastructure to encourage active transportation;
- Improved access to transit services and the potential to provide transit services along the corridor in the future; and
- Low impact design to meet the City's water retention target and mitigate increased precipitation due to climate change.

The extension of Biehn Drive is not anticipated to produce an increase or decrease in greenhouse gas emissions based on the following:

- Vehicle trips along the corridor will be generated by: a redistribution of cars from existing roads (the extension has the potential to shorten vehicle trips by providing a more direct route to/from destinations); and new trips generated by future development in Kitchener (these trips would be added to the transportation network regardless of the Biehn Drive extension).
- The construction will not be a significant source of greenhouse gasses.
- The addition of multi-use trails/boardwalks will encourage more active transportation along the corridor and will have a beneficial long-term effect on greenhouse gas emissions.

3.2 Technical Investigations

3.2.1 Drainage

Groundwater monitoring wells from earlier investigations are located near the current southwest terminus of Biehn Drive on the edge of the PSW unit. A concrete headwall with twin 1.2 m culvert inlets in the wetland boundary at the south end of the roadway directs wetland drainage and local storm sewer flows from Biehn Drive to an outlet pipe 25 m north of the road, where it becomes a permanently flowing tributary connecting with Strasburg Creek. The floor of the wetland in the immediate vicinity of the culvert entrance was wet with scattered ephemeral pools extending south. Several seasonal channels could be made out within the wetland approaching the culverts from the southwest and southeast.

3.2.2 Utilities

A Hydro One transmission corridor, including a transmission tower, is located within the Study Area. A 15 m offset area around the Hydro One transmission tower is required for Hydro One maintenance and access roads.

3.2.3 Noise

A Noise Assessment was completed utilizing the STAMSON 5.04 noise software program to determine 16-hour and 8-hour nighttime equivalent sound levels (Leq) for the roadway traffic. The assessment was performed in accordance with the MECP's Noise Assessment Criteria (NPC-300) and MTO's Environmental Guide for Noise. The noise assessment was completed using three representative receiver sites, as shown in **Figure 5.** The receiver sites were located in an Outdoor Living Area (OLA) in the backyard during the day and the plane of the window of a bedroom for nighttime assessments.

It is projected that no receiver sites (residential properties) will experience sound level changes greater than 5 dBA and no receiver site will have a total sound level of over 65 dBA. The forecast sound levels for daytime and nighttime meets the objective of 55 dBA and no mitigation is required.

See **Appendix F** for the Noise Assessment Report.

Figure 5: Representative Receiver Sites

3.2.4 Proposed / Approved Development

Future growth is occurring within the Kitchener area, and the lands adjacent to the Study Area. This growth is identified within the Official Plan, Kitchener Growth Management Plan and as approved in the Province of Ontario's *A Place to Grow: Growth Plan for the Greater Golden Horseshoe (August 2020)*. The Growth Plan for the Greater Golden Horseshoe was prepared and approved under the *Places to Grow Act*, 2005 and Amendment 1 took effect on August 28, 2020.

The successful realization of this vision centres on effective collaboration between the Province, other levels of government, Indigenous Peoples, residents, private and non-profit sectors across all industries, and other stakeholders. The policies of this Plan regarding how land is invested are based on the following principles:

- Support the achievement of complete communities that are designed to support healthy and active living and meet people's needs for daily living throughout an entire lifetime.
- Prioritize intensification and higher densities to make efficient use of land and infrastructure and support transit viability.

The Places to Grow Plan targets the Region of Waterloo to achieve a population threshold of 923,000 and an employment threshold of 470,000 by 2051.

4.0 GENERATION OF PRELIMINARY DESIGN ALTERNATIVES

The analysis and evaluation process is a central requirement of the Class EA process. In adhering to this process, several alternatives were generated for consideration which would improve traffic operations through the broader Study Area to meet existing and future traffic and active transportation demands.

A "long list" of alternatives was generated, based on identified needs, to ensure consideration of a wide range of transportation alternatives (i.e. all reasonable alternatives are considered). The preliminary design alternatives were categorized under 3 groups:

1. Alignment Alternatives (road and sanitary sewer and municipal services)
2. Cross Section Alternatives
3. Intersection Alternatives

5.0 TRAFFIC

The extension of Biehn Drive has been part of the integrated land use and transportation plan for the larger community for decades.

The new street is needed to evenly distribute traffic movements into and out of neighbourhoods to the arterial road network. Multiple connections from the arterial road network are desirable to reduce the traffic volumes on any one street, reduce the travel distance from any house to the arterial road network, and provide multiple access points for emergency services to each neighbourhood. If Biehn Drive is not extended, there will be increased traffic on adjacent streets (i.e. Caryndale Drive, Templewood Drive, and Biehn Drive northeast of the Study Area). Diversion of traffic from a neighborhood to go through other neighbourhoods is not desirable because of the disruption to other communities.

The extension of Biehn Drive is now possible because the Strasburg Road arterial has been constructed and is now available to provide a western arterial street to service neighbourhoods to the east. The construction of Strasburg Road and the new Biehn Drive link will mean that traffic will no longer need to travel a longer distance on circuitous routes through adjacent neighbourhoods to reach an arterial road network. The new link will reduce traffic volumes in other neighbourhoods and provide a new route to serve the neighbourhood currently near the termination of Biehn Drive.

5.1 Previous Studies

The Biehn Drive extension has been included in the City's planning documents since the late 1980's. The extension is part of the integrated land use and transportation plan for the Brigadoon community that will provide for convenient travel from neighbourhoods to the arterial road network. The transportation and land use studies that have led to this plan have included (chronologically):

1. Brigadoon Community Plan (1989);
2. Official Plan Amendment No. 98 (1991);
3. Doon South – Brigadoon Transportation Network and Corridor Study (McCormick Rankin, 1994);
4. Kitchener Planning and Development Staff Report PD95/51 (1994);
5. Updated Brigadoon Community Plan (2005);
6. Kitchener Integrated Transportation Master Plan (2013);
7. Robert Ferrie Drive Extension Environmental Assessment (2014); and
8. Official Plan Amendment No. 103 (March 21, 2019).

These previous studies have developed an integrated land use and transportation plan that provides a reasonable distribution of traffic volumes on collector streets into and out of neighbourhoods and considers all modes of transportation (vehicular, pedestrian and cyclists).

5.1.1 Previous Need and Justification Review (2014)

The Biehn Drive Extension Need and Justification Report was completed by Paradigm Transportation Solutions in June 2014. This Report identified that eliminating the Biehn Drive extension would result in:

- Inefficiencies in the road network and backtracking/out-of-way travel for residents in the Doon South/Brigadoon communities;
- Insufficient capacity to accommodate the forecast traffic demands at the 2031 planning horizon; and
- Increased traffic on adjacent streets (i.e. Caryndale Road, Templewood Drive, and Biehn Drive (northeast of the Study Area)). These roads would be operating at traffic levels above their road classifications.

The Report concluded that eliminating Biehn Drive would be a fundamental design change to the Doon South/Brigadoon communities and would result in significant impacts to adjacent roads and other neighbourhoods, and that the Biehn Drive extension is therefore required.

5.2 Road Classification

Road networks are categorized into four levels based on their function and capacity as a hierarchy with increasing design standards:

- Local streets - function to provide access to land/driveways (shown as grey in **Figure 6)**. These are typically low speed and accommodate pedestrians and parking on-street. Examples of these types of streets in the community include McLeod Court and Kilkerran Crescent.
- Collector streets - function to collect traffic from several local streets and provide access to arterial streets (shown as orange and brown in **Figure 6**). These streets typically separate pedestrians and vehicles and have moderate traffic volumes. Examples of these types of streets in the community include Caryndale Drive and Biehn Drive.
- Arterial streets - carry higher volumes of traffic and truck traffic (shown as purple in **Figure 6**). Examples of these types of streets in the community include Huron Road and Strasburg Road.
- Highways and freeways - provide linkages between communities (shown in blue in **Figure 6**). Highways and freeways are high speed and accommodate inter-regional trips.

The City's Official Plan (November 2014) identifies Biehn Drive as a Major Community Collector Street.

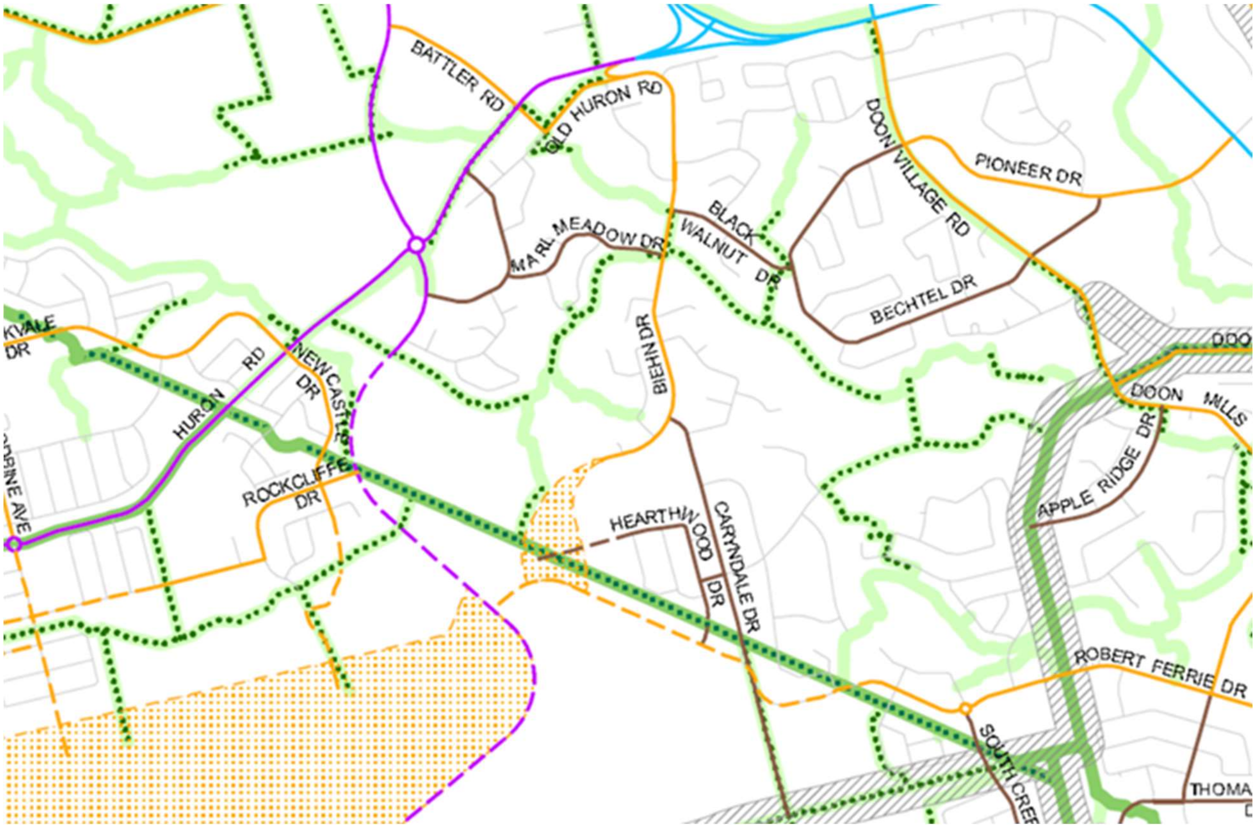


Figure 6: Road Network

5.3 Projected Traffic Volumes

The Broader Study Area (bound by Strasburg Road and Huron Road) includes 4 community neighbourhoods (see **Figure 7)**. Each of these neighbourhoods, with exception of the Biehn Drive South neighbourhood (Neighbourhood 3) has a collector road to provide them a direct link to the arterial road system. If the new Biehn Drive link is not constructed, traffic from Neighbourhood 3 will continue to go through adjacent neighbourhoods. This was never intended as part of the land use plan for the broader residential area.

5.3.1 Trip Generation

Traffic volumes along the Biehn Drive extension were forecast based on existing traffic volumes and the daily traffic generated by the 4 existing adjacent neighbourhoods. Daily trip generation rates developed by the Institute of Transportation Engineers Trip Generation Manual (11th Edition) were utilized. Trip generation for the existing neighbourhoods is summarized in **Table 2**.

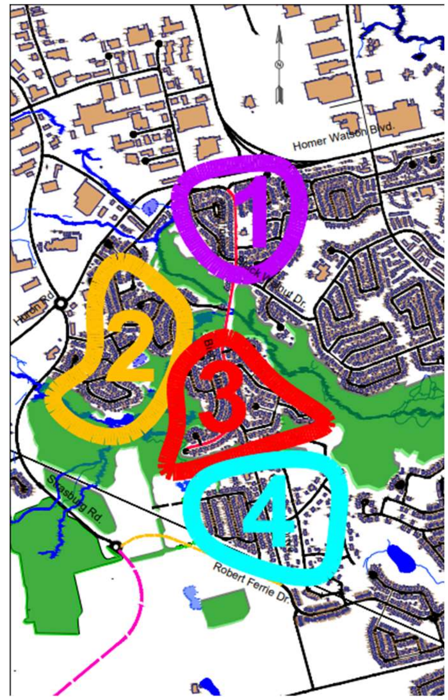


Figure 7: Existing Neighbourhood Areas

Table 2: Trip Generation Rates of Existing Neighbourhoods

Neighbourhood	Approximate Number of Dwelling Units	ITE Trip Generation Rate	Total Daily Vehicle Trips
Neighbourhood 1 (Biehn Drive North Neighbourhood)	260	Single-Family Detached Housing 9.43 Daily Trip Generation Rate/Dwelling Unit	2452
Neighbourhood 2 (Marl Meadow Neighbourhood)	475		4480
Neighbourhood 3 (Biehn Drive South Neighborhood)	265		2490
Neighbourhood 4 (Caryndale Neighbourhood)	225		2122

Alignment alternatives for Biehn Drive include two scenarios:

- Scenario 1 includes an extension of Biehn Drive for vehicular traffic; and
- Scenario 2 does not include the extension of Biehn Drive beyond an extension for the sanitary sewer, associated servicing and a multi-use trail (vehicle trips would continue to use existing roads including Caryndale Drive).

The primary travel routes to the arterial road network are shown in **Figure 8**.

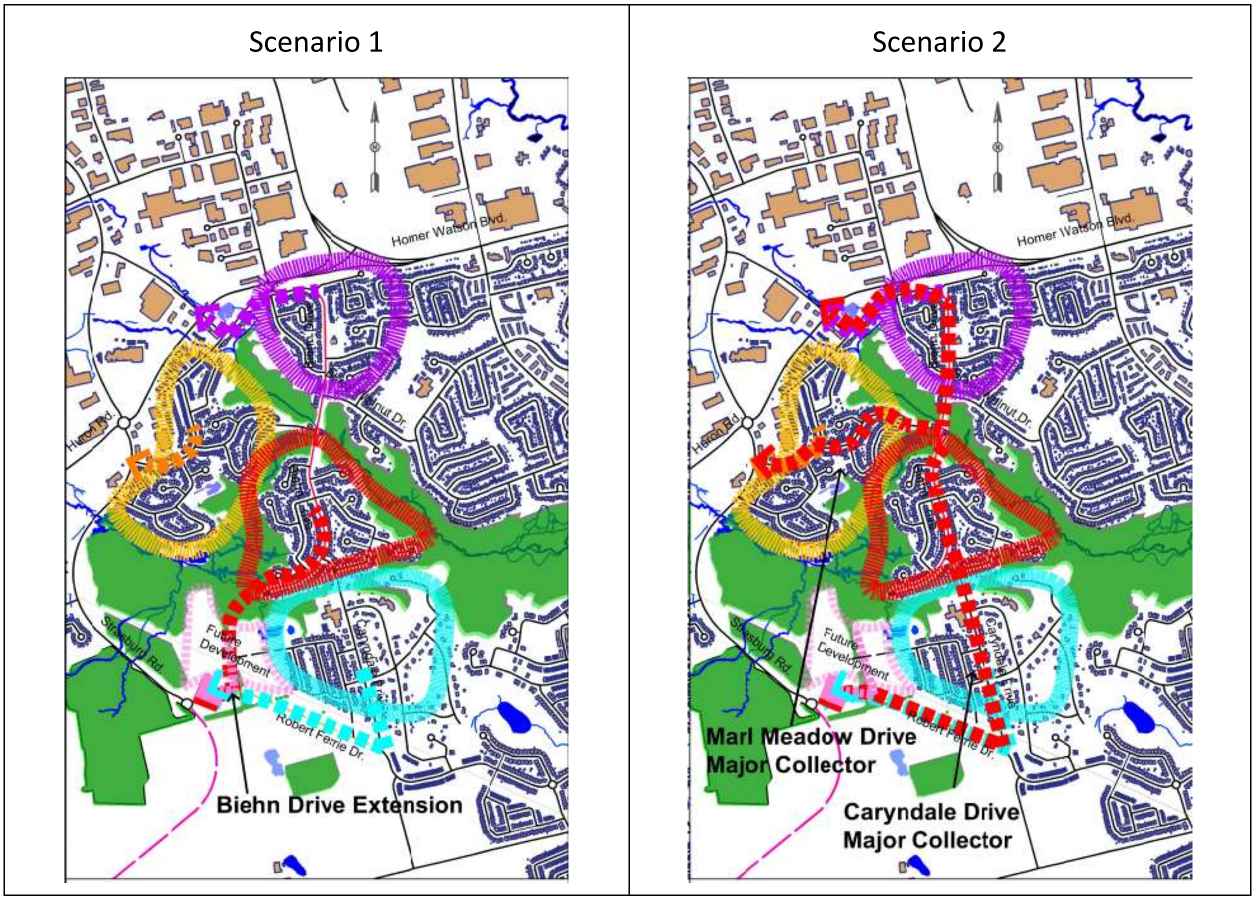


Figure 8: Primary Neighbourhood Access Routes

The trip distribution and assignment of traffic to Biehn Drive under Scenario 1 and Caryndale Drive under Scenario 2 are summarized in **Table 3**. The projected trip distribution is based on future travel patterns based on proposed improvements to the road network (i.e. Robert Ferrie Drive extension and opening and extension of Strasburg Road). When the Strasburg Road and Robert Ferrie Drive extensions are constructed and opened, drivers will select the shortest route to their destinations utilizing the arterial road network.

Table 3: Trip Distribution and Assignment

Scenario	Origin / Destination Neighbourhood	Distribution		Number of Vehicle Trips
Scenario 1 – Extension of Biehn Drive **(Location – Current Biehn Drive Terminus)**	Neighbourhood 2 (Marl Meadow Neighbourhood)	Trips to/from the south via Robert Ferrie Drive	5%	224
	Neighbourhood 3 (Biehn Drive South Neighborhood)	Trips to/from the south Robert Ferrie Drive	90%	2,258
			Total=	2,482
Scenario 2 – Without Biehn Drive Extension **(Location – Caryndale Drive north of Robert Ferrie Drive)**	Neighbourhood 2 (Marl Meadow Neighbourhood)	Trips to/from the south via Caryndale Drive	5%	224
	Neighbourhood 3 (Biehn Drive South Neighborhood)	Trips to/from the south via Caryndale Drive	50%	1,250
	Neighbourhood 4 (Caryndale Neighbourhood)	Trips to/from Robert Ferrie Drive	90%	1,909
			Total=	3,383

Under Scenario 1 (extension of Biehn Drive), Biehn Drive is projected to have a daily traffic volume between 2,500 to 3,000 vehicles/day (at the current terminus (cul-de-sac)) with an allowance for potential daily variation in traffic flows. To the south of the Provincially Significant Wetland, traffic volumes will increase as Biehn Drive will then include additional traffic from the future development lands north of Robert Ferrie Drive. These volumes are within the acceptable range of a major collector roadway in the City's TMP.

Under Scenario 2 (no extension of Biehn Drive), Caryndale Drive will have a daily traffic volume of approximately 3,500 vehicles/day (north of Robert Ferrie Drive). Caryndale Drive currently carries increased traffic as it is used by motorists on Robert Ferrie Drive to access the arterial road network along Biehn Drive North. The extension of Robert Ferrie Drive to Strasburg Road, without an extension of Biehn Drive, would reverse the flow of that current traffic demand on Caryndale Drive, as residents in the area of Biehn Drive would use Caryndale Drive (a minor collector street which includes an elementary school) to access Robert Ferrie Drive and Strasburg Road.

From a traffic operation and safety perspective, Scenario 1 is preferred.

6.0 SANITARY SEWER

A Technical Memorandum was prepared to present the definition of the sanitary drainage area and the estimated peak flow at the proposed connection to the existing sanitary trunk sewer on Biehn Drive. This is included in **Appendix G.**

The sanitary drainage area/tributary area includes the lands designated for urban development (see **Figure 9**) and excludes the lands designated as Rural and Agricultural. The sanitary trunk sewer drainage area includes 64.0 ha. The design criteria for sanitary servicing meets the requirements of the City of Kitchener's Development Manual.

The sanitary sewer extension will follow the alignment of the Biehn Drive extension. The required sanitary sewer pipe size is 525 mm diameter. No other alternative is available for the sanitary sewer alignment.

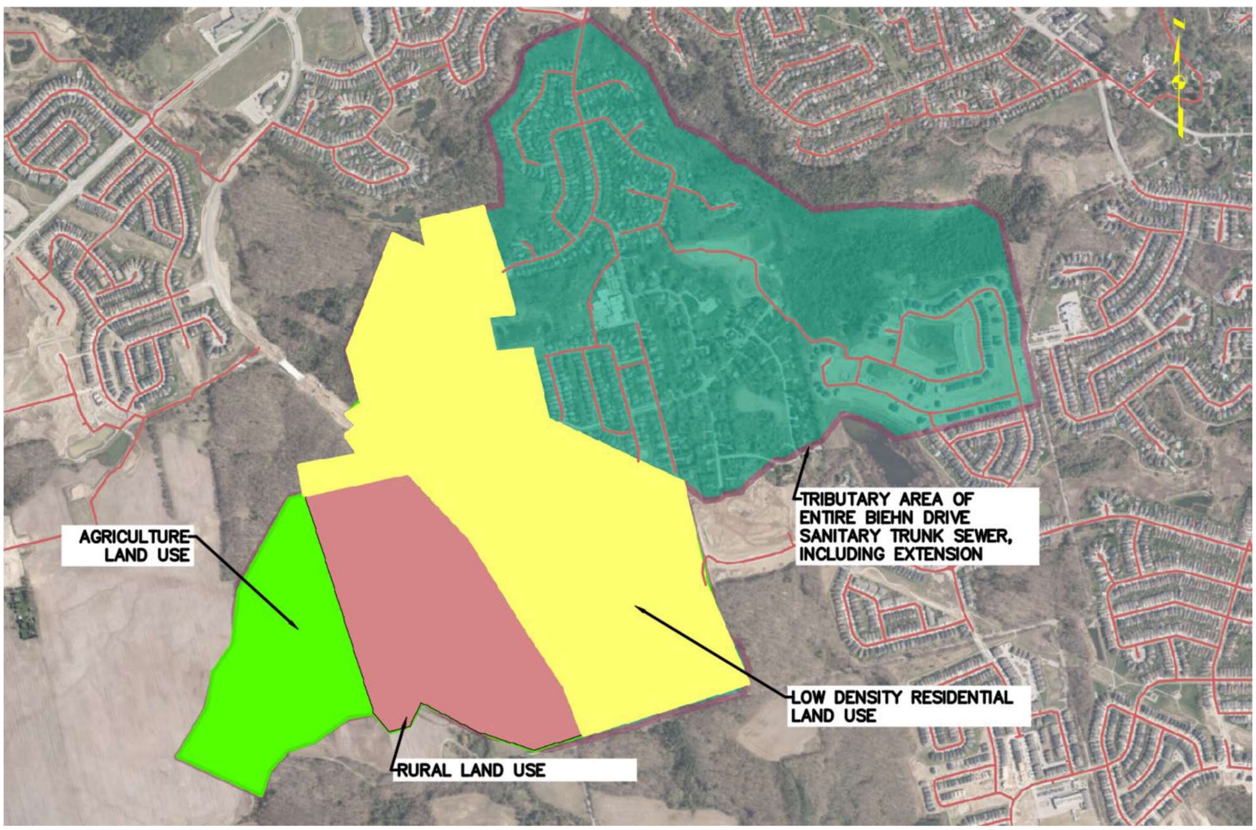


Figure 9: Tributary Area Based on Land Uses per the Official Plan

7.0 EVALUATION OF ALTERNATIVES

The evaluation of alternatives was completed using both quantitative and qualitative assessments to compare the net effects and performance of the alternatives.

The quantitative assessment used various global factors and a weighted additive score methodology to mathematically evaluate the alternatives being considered. The methodology is referred to as the Multi Attribute Trade-off System (MATS).

The qualitative evaluation method measured the relative differences and compared the advantages and disadvantages of each alternative using evaluation criteria. The evaluation criteria looked at the effects each alternative had on the natural, social/cultural, economic and physical elements in the Study Area.

The Analysis and Evaluation Report detailing the evaluations for each alternative is included in **Appendix H** and is summarized in this section.

7.1 Evaluation of Alignment Alternatives

7.1.1 Coarse Screening of Alternatives

Alignment Alternatives 1, 2 and 3 for the Biehn Drive extension were generated by the Project Team and presented to the public at PIC No. 1 (see **Figure 10**). Following PIC No. 1, Alignment Alternative 4 (using existing roadways) was added based on public input. All the alternatives carried forward to the detailed evaluation were considered by the Project Team to be reasonable alternatives to the Planning Solution:

- Alternative 1 – Connect Biehn Drive to Robert Ferrie Drive – East Alignment
- Alternative 2 - Connect Biehn Drive to Robert Ferrie Drive – Central Alignment
- Alternative 3 - Connect Biehn Drive to Strasburg Road – West Alignment
- Alternative 4 - Connect Biehn Drive to Robert Ferrie Drive – Via Caryndale Drive

The coarse screening of Alignment Alternatives is shown in **Table 4.**

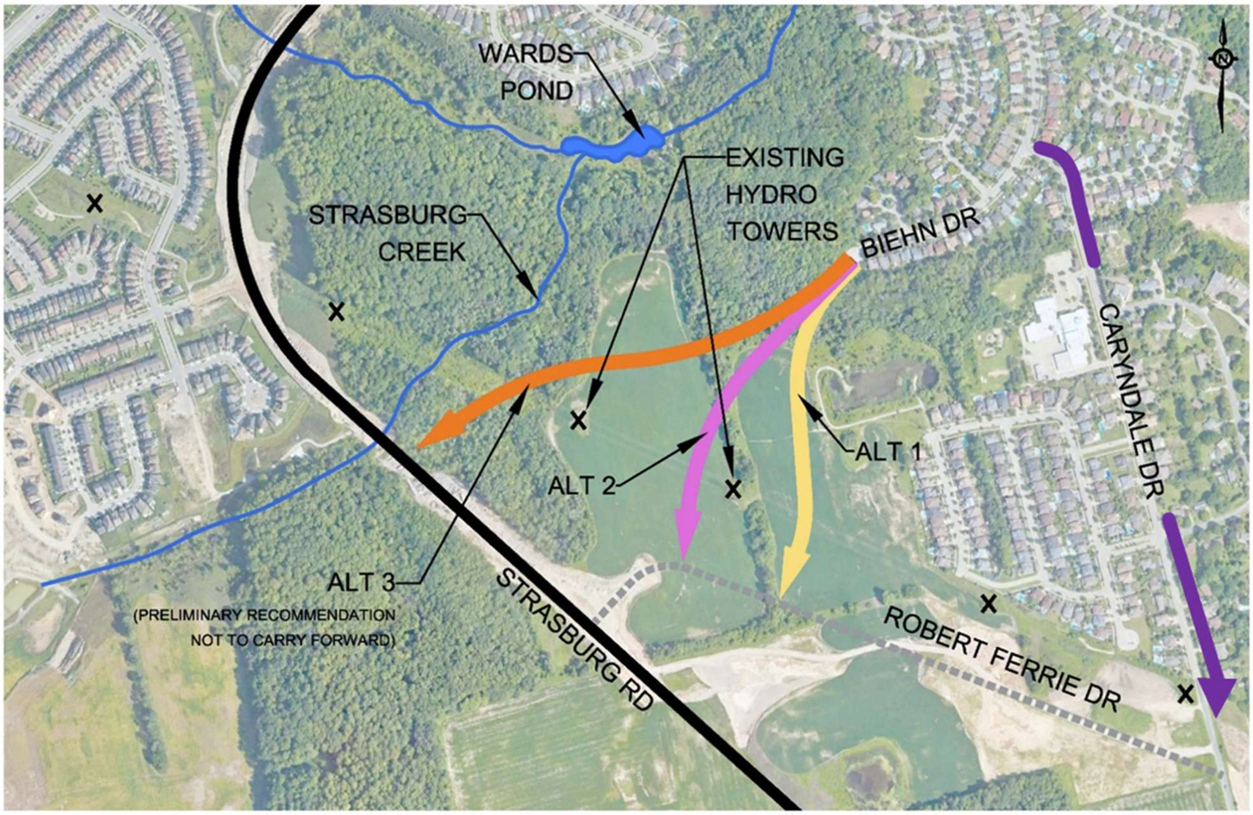


Figure 10: Preliminary Alignment Alternatives

Table 4: Coarse Screening of Alignment Alternatives

Screening Criteria	Alternative 1: East Alignment	Alternative 2: Central Alignment	Alternative 3: West Alignment	Alternative 4: Via Caryndale Drive
Does this alternative satisfy forecast traffic demand, improve safety, and address all modes of transportation?	Provides a north-south connection to Robert Ferrie Drive. Accommodates all modes. Reduces cut-through traffic on Biehn Drive.	Provides a north-south connection to Robert Ferrie Drive. Accommodates all modes. Reduces cut-through traffic on Biehn Drive.	Provides a north-south connection to Strasburg Road. Accommodates all modes.	Provides a north-south connection to Strasburg Road. Accommodates all modes. However, there are increased levels of traffic on local roads.
Does the approach result in significant impacts to the natural environment?	Minor impacts to the woodlot/PSW (~0.3 ha).	Minor impacts to the woodlot/PSW (~0.3 ha).	Significant impacts to the woodlot/wetland (~1.3 ha).	Minor impacts (construction of sanitary sewer).
Is the approach affordable for the City to implement?	No significant difference.	No significant difference.	Higher cost - requires an intersection onto Strasburg Road (arterial).	Affordable alternative.
Does this alternative comply with the recommendations of the City's planning documents (i.e., TMP, OP, KGMP)	This alternative complies with the recommendations of the City's planning documents.	This alternative complies with the recommendations of the City's planning documents.	Does not comply with the recommendations of the Official Plan or Growth Management Plan. Based on the previous design and construction of the Strasburg Road and roundabout within the Study Area, this previous	This alternative does not comply with the recommendations of the City's planning documents.

Table 4: Coarse Screening of Alignment Alternatives

Screening Criteria	Alternative 1: East Alignment	Alternative 2: Central Alignment	Alternative 3: West Alignment	Alternative 4: Via Caryndale Drive
			alternative is no longer considered feasible.	
Recommendation:	Carry forward for further evaluation	Carry forward for further evaluation	Do not carry forward	Carry forward for further evaluation

7.1.2 Quantitative Evaluation

This section describes the formal quantitative evaluation approach used in this Study for evaluating alignment alternatives for Biehn Drive. This evaluation was presented to the public/stakeholders at PIC No. 2.

7.1.2.1 Multi Attribute Trade-off System (MATS)

The quantitative approach is based on the “Weighted Additive Method” which focuses on the differences between the alternatives, addressing the complexity of the base data collected and providing a traceable decision-making process. Sensitivity tests are also performed to determine the impact of the alternatives and the trade-offs between each alternative.

Overall scores are assigned to each alternative and the alternative with the highest score is selected as the preferred alternative. The initial task in the evaluation is to develop criteria from which alternatives will be evaluated and assessed. This process includes the identification of “global” groups of factors followed by the selection of a number of “local” sub-factors (sub-factors) under these global groups.

The evaluation criteria are grouped into broad categories (global factors) to describe the Study specific engineering and environmental concerns. The global factors for the evaluation of the alignment alternatives included: Transportation; Natural Environment; Cultural Environment; Socio-Economic Environment; Land Use and Property; Cost; and Engineering.

Under each of the global factors, several sub-factors are selected under which measurements could be made. These sub-factors are the individual descriptors for the evaluation. Each sub-factor must adequately describe the issue or aspect of the environment to be evaluated and the unique features of each alternative. A long list of potential sub-factors is generated based on discussions with the Project Team, stakeholders, the public and Rights Holders (Indigenous Peoples). Each sub-factor is then reviewed, and the sub-factors considered equal or not applicable are screened out. The long list of sub-factors and short list screening is in **Appendix H**.

To evaluate the alternatives using the short-listed criteria, the Evaluation Team members rated each global factor and sub-factor based on their opinion. It is noted that every person assigning weights has a personal bias and understanding of the scope of the project, with various life experiences (i.e. the Evaluation Team consists of a diversified team of professionals with varied backgrounds).

Each member of the Evaluation Team assigns percentage weights to each global factor and sub-factor based on their opinion of the relative importance of each. Their individual weights are then averaged to determine the Evaluation Team weight for each global factor and sub-factor.

Sensitivity Tests

Sensitivity testing is an essential component in the analysis and evaluation process. It evaluates whether the average weighting of the factors was the sole reason for the results of the evaluation. Since each specialist assigns weights based on their professional opinion, there is a spread of values for the selection of weights. The range is dependent on the value judgements of the individuals and specialists. Using the average of the group does not necessarily capture what the standard deviation was among the individual scores. Therefore, sensitivity testing is conducted to test a range of weights either higher or lower than the group's average.

7.1.2.2 Alignment Alternatives

As described in **Section 7.1.1**, three alignment alternatives were carried forward for the quantitative evaluation of the extension of Biehn Drive, including:

- Alternative 1: East Alignment - Connect to Robert Ferrie Drive east of Hydro Tower, see **Figure 11**;
- Alternative 2: Central Alignment - Connect to Robert Ferrie Drive west of Hydro Tower, see **Figure 12**;
- Alternative 4: Existing Roads - Connect Biehn Drive to Robert Ferrie Drive via Caryndale Drive with a Maintenance Road/MUT connecting from the Biehn Drive Terminus to Robert Ferrie Drive see **Figure 13**;

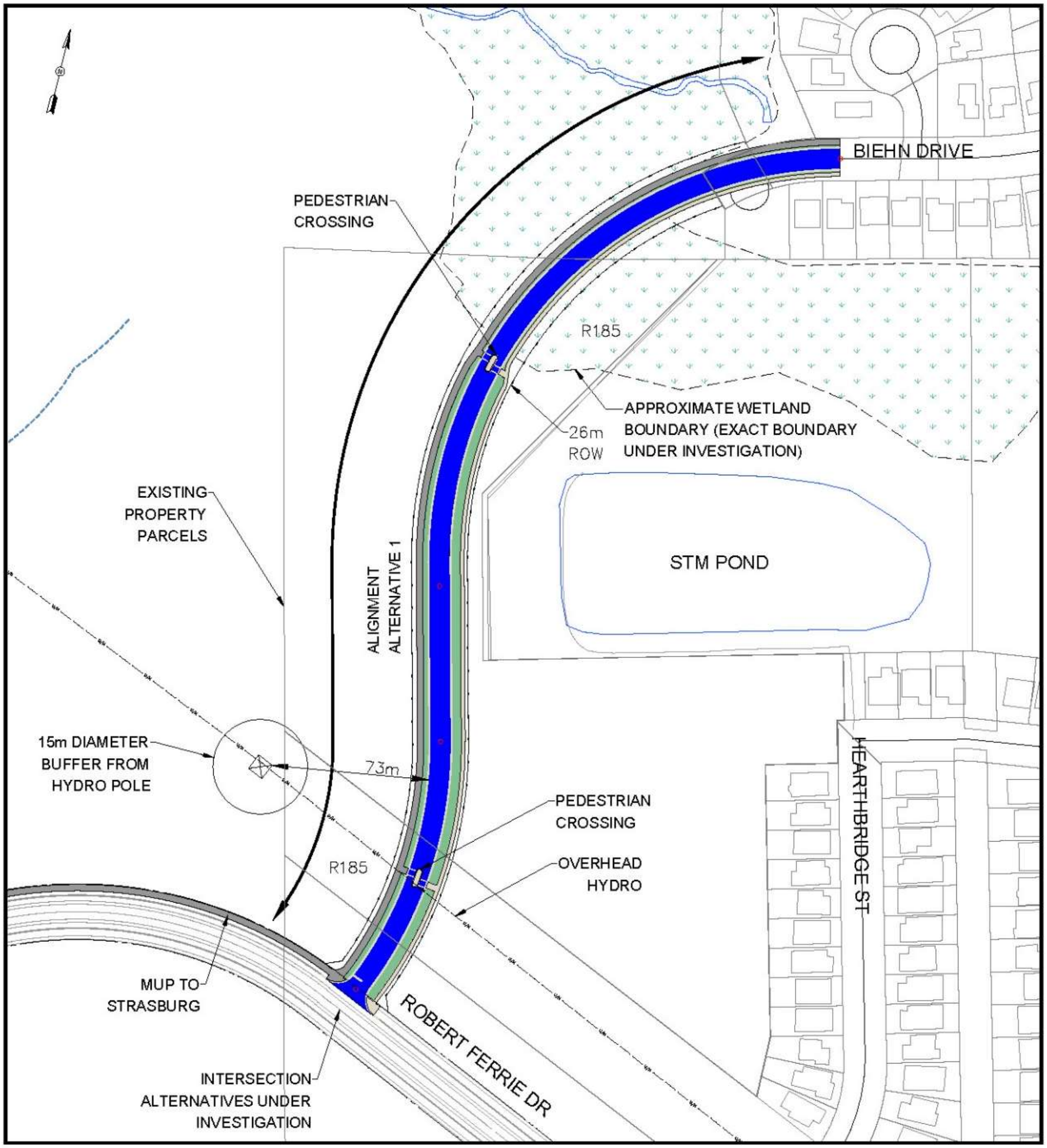


Figure 11: Alignment Alternative 1

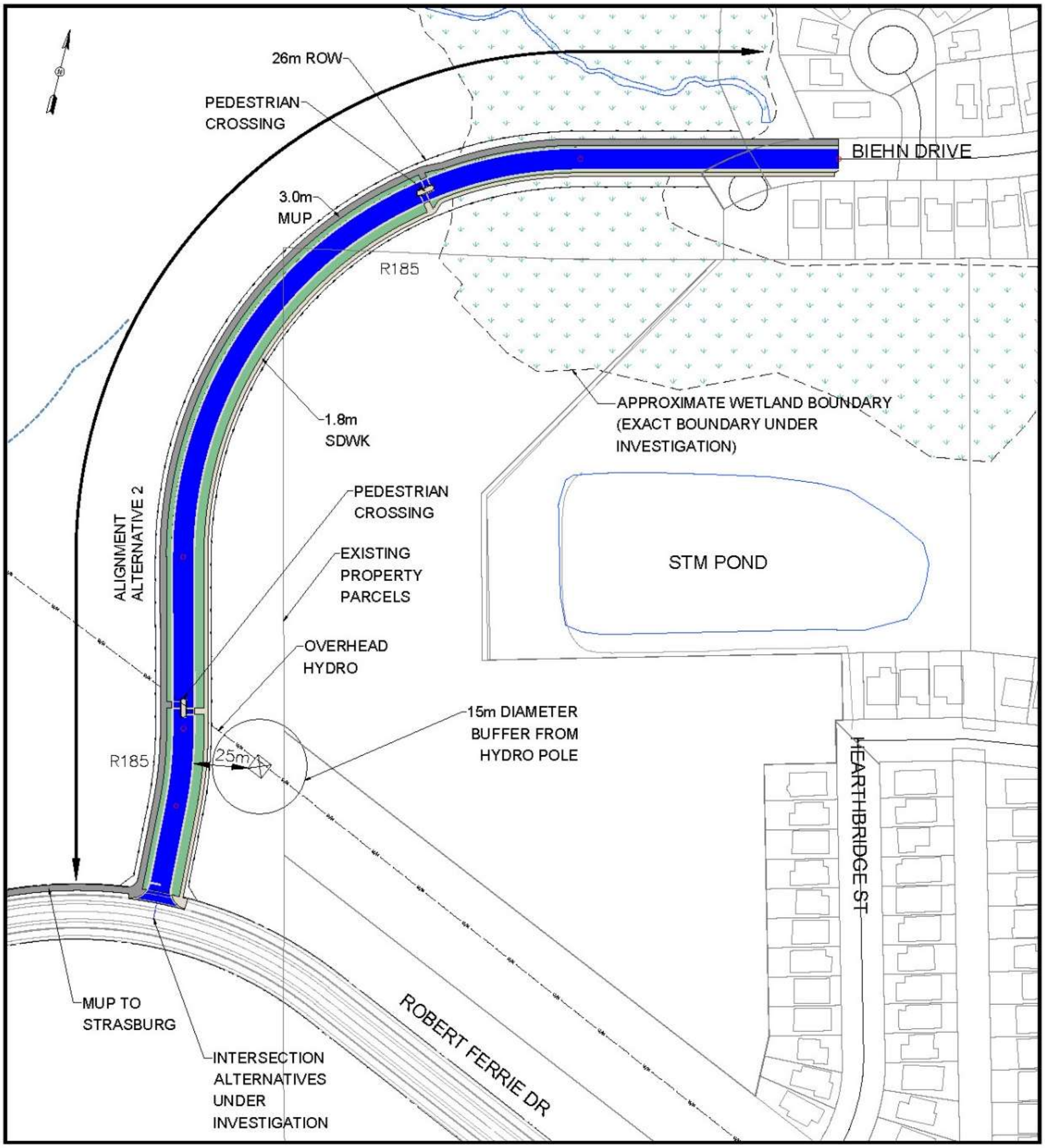


Figure 12: Alignment Alternative 2

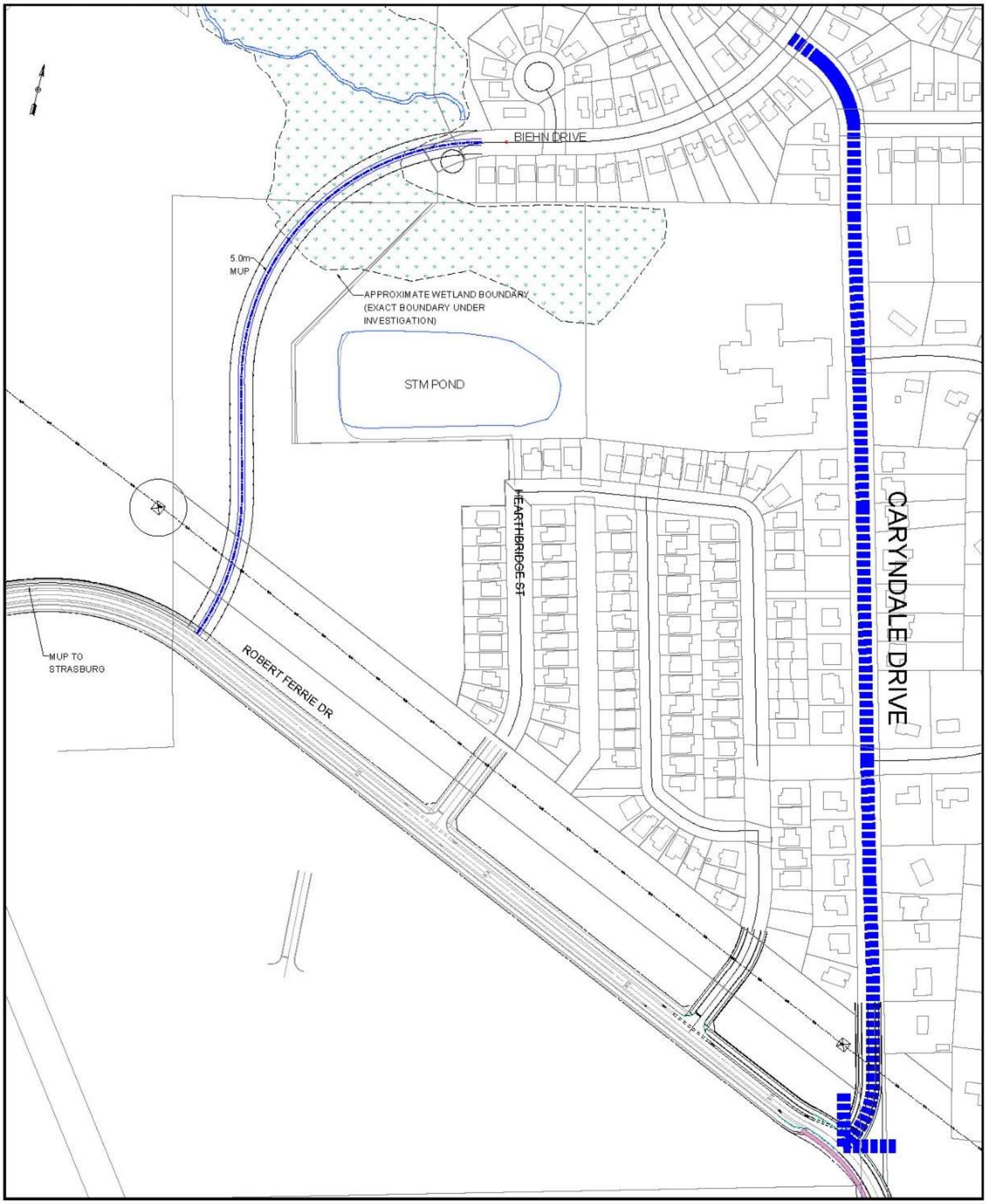


Figure 13: Alignment Alternative 4

7.1.2.3 Evaluation Results

The results of the weights and rankings of the alignment alternatives are illustrated on **Figure 15** and **Figure 14**, respectively. The technically recommended alternative was Alternative 1 - connect Biehn Drive to Robert Ferrie Drive east of Hydro Tower.

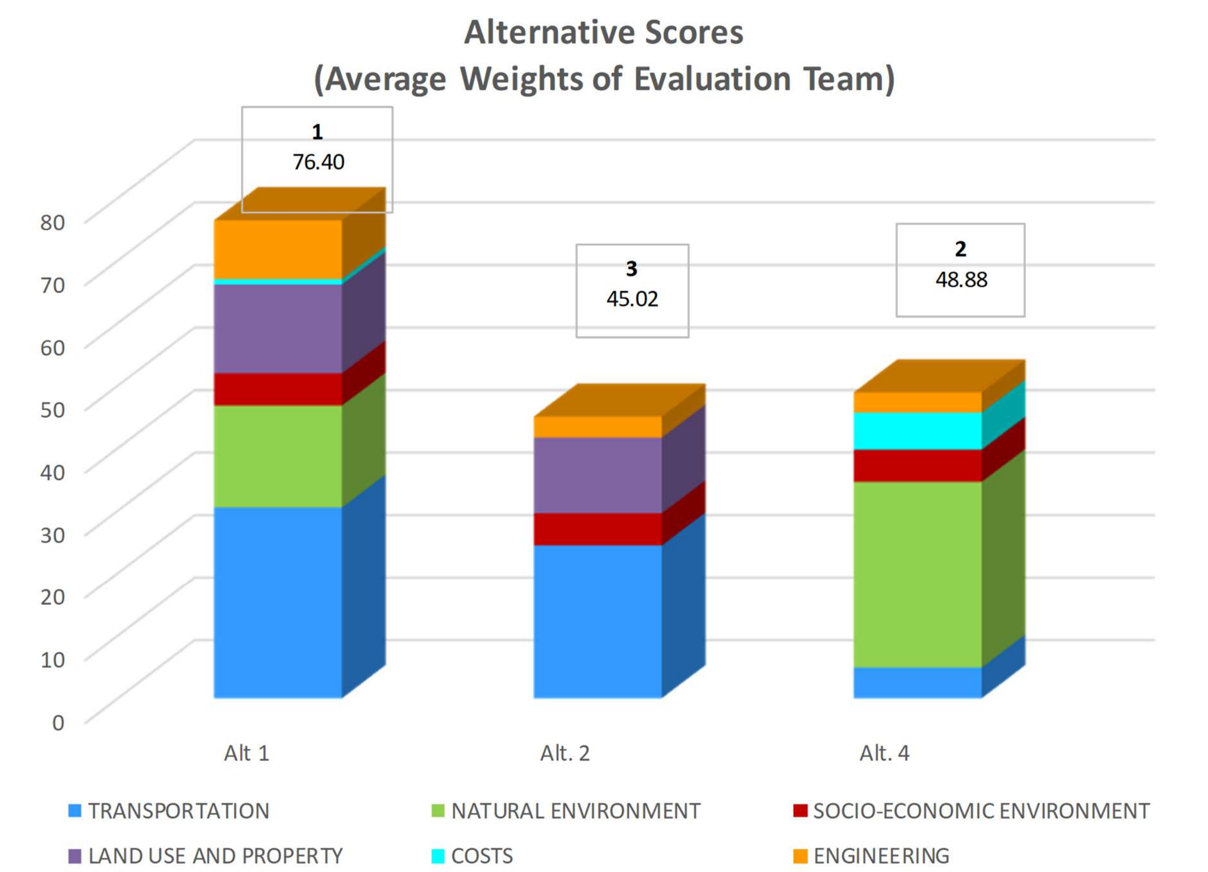


Figure 14: MATS Evaluation Ranking Results

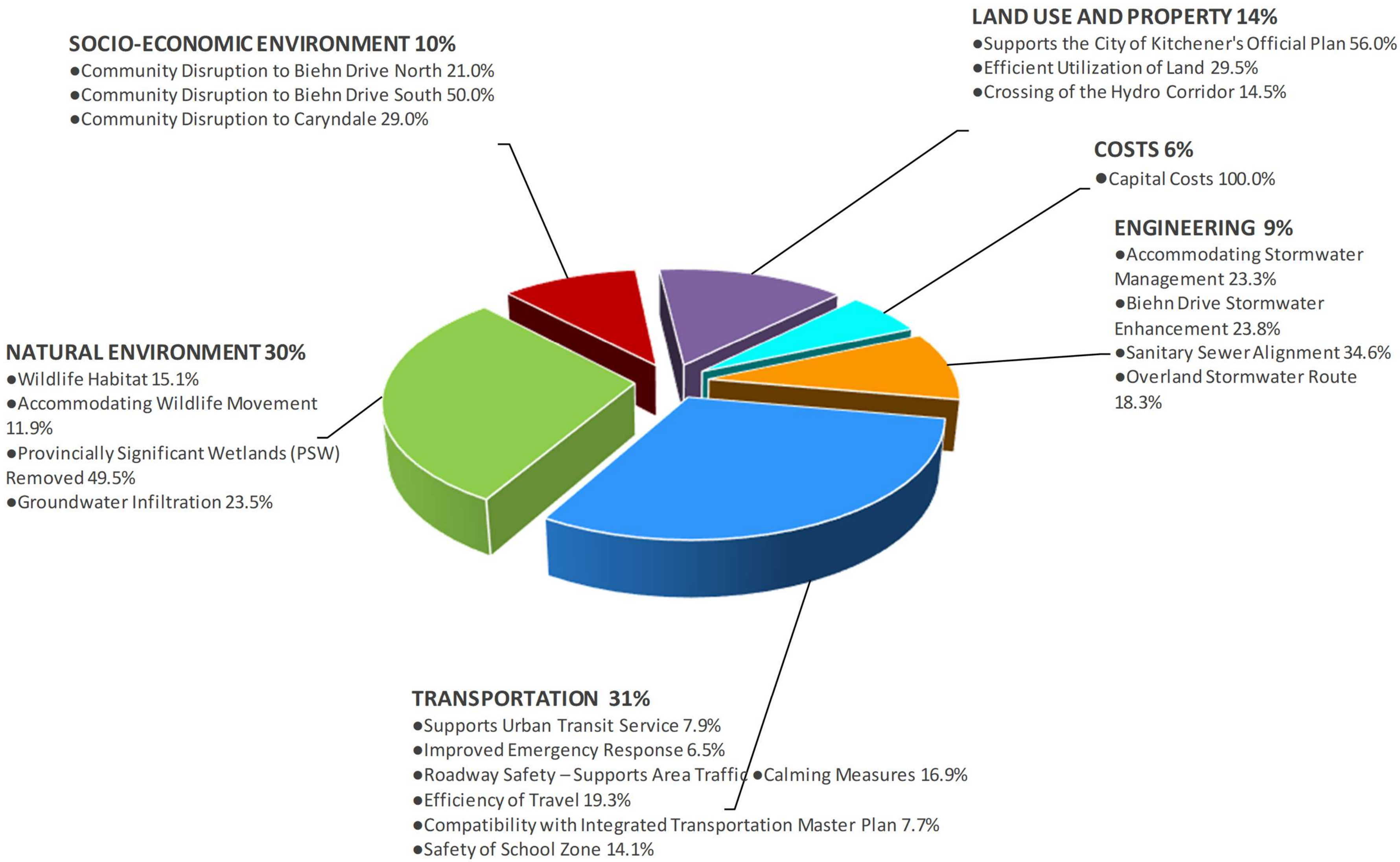


Figure 15: MATS Weighting Results

Sensitivity Tests

To validate the weighting exercise, a sensitivity testing program was undertaken to determine whether the Technically Preferred Alternative (TPA) would have changed if a particular factor group was assigned a higher or lower importance than the group average. This ensures greater confidence in the selection process. The three tests included:

- Average Evaluation Team weight
- Highest weight in a factor group by any Evaluation Team member
- Lowest weight in a factor group by any Evaluation Team member

The results of these tests are shown in **Table 5**. The green box shows the first rated alternative.

Table 5: Sensitivity Testing Results for Alignment Alternatives

Alternatives			**Alt. 1**	**Alt. 2**	**Alt. 4**
Ranking			**1**	**3**	**2**
Transportation	High	45%	1	2	3
	Low	20%	1	3	2
Natural Environment	High	40%	1	3	2
	Low	20%	1	2	3
Socio-Economic Environment	High	15%	1	3	2
	Low	10%	1	3	2
Land Use and Property	High	20%	1	2	3
	Low	10%	1	3	2
Cost	High	10%	1	3	2
	Low	2%	1	2	3
Engineering	High	15%	1	3	2
	Low	5%	1	3	2

The sensitivity test results showed that there were no trade-offs between the alternatives. **Alternative 1**: **Connect to Robert Ferrie Drive east of Hydro Tower**, was determined to be the preferred alignment alternative.

7.2 Evaluation of Cross Section Alternatives

Two (2) cross section alternatives were considered for Biehn Drive outside the limits of the wetland, including:

- Alternative 1 – 26 m Major Collector with In-boulevard Cycling Facilities (see **Figure 16**); and
- Alternative 2 - 26 m Major Collector with Bike Lanes (see **Figure 17**).

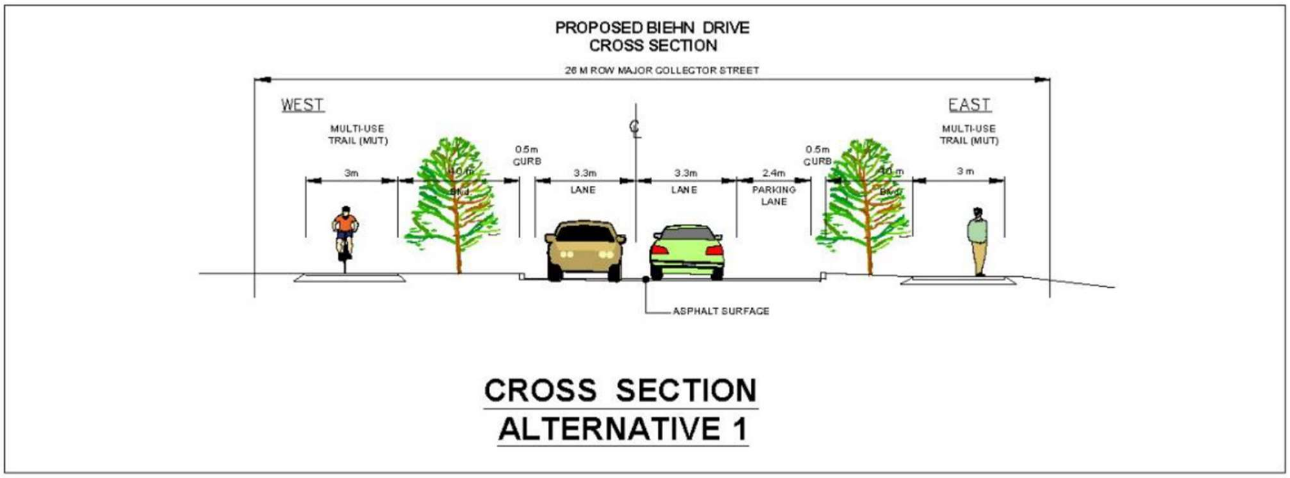


Figure 16: Cross Section Alternative 1 (Beyond the Wetland)

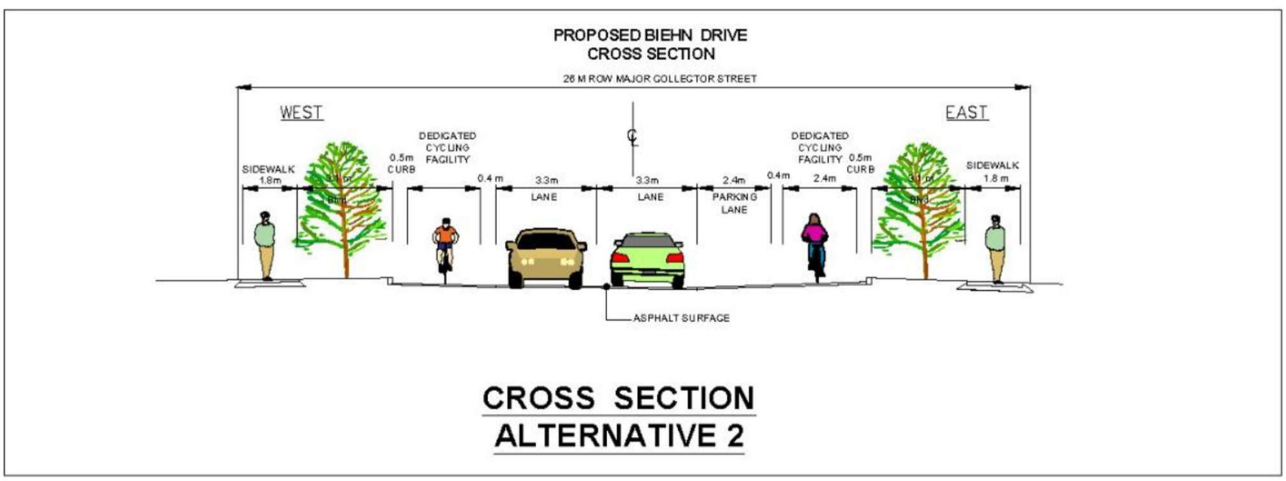


Figure 17: Cross Section Alternative 2 (Beyond the Wetland)

The preliminary evaluation of the cross section alternatives is shown in **Table 6**. Alternatives were developed to reflect the City of Kitchener's Complete Streets guidelines. The recommended cross section is Alternative 1 with multi-use trails.

Table 6: Cross Section Evaluation

Evaluation Criteria	Alternative 1 – 26 m ROW with Multi-use Trail	Alternative 2 – 26 m ROW with Bike Lanes
Active Transportation	MUTs are preferred by the greatest proportion of cyclists (interested but concerned). Greater network continuity for cyclists with the future MUT along the Hydro corridor and potential to connect to the MUTs along Strasburg Road.	Better accommodates pedestrians by separating pedestrians and cyclists. Increased conflict between cyclists and access to/from parked vehicles.
Traffic Calming	The reduced pavement width would better promote lower travel speeds.	Wider asphalt surface would be less effective in reducing travel speeds.
Impacts to Natural Environment / Storm Water Quality	All alternatives considered equal.	All alternatives considered equal.
Impacts to Developable Lands	All alternatives considered equal.	All alternatives considered equal.
Cost	MUTs are more cost effective to construct with reduced pavement thickness and granulars.	Wider roadway pavement structure increases construction cost.
Recommendation:	Carry Forward **Alternative 1**	

7.3 Intersection Alternatives

A roundabout is proposed at the intersection of Biehn Drive and Robert Ferrie Drive. This recommendation is consistent with the approved plan identified in the Robert Ferrie Drive Class Environmental Assessment. Additional justification for the preferred alignment and the recommendation of a roundabout at this location includes:

- To limit queuing (due to the proximity to Strasburg Road) and to accommodate pedestrian crossings.
- To accommodate access to future development south of Robert Ferrie Drive.
- At Black Walnut Drive, Biehn Drive traffic volumes would be reduced by an average of approximately 2,500 vehicles/day.

- On Caryndale Drive, south of Biehn Drive, traffic volumes would be reduced by an average of approximately 500 to 1,000 vehicles/day.
- The houses along Biehn Drive, between Caryndale and the existing cul-de-sac will experience an increase in traffic ranging from 2,000 to 3,000 vehicles/day.
- Strasburg Road has been constructed and will provide a western arterial road to service the community.
- With implementation of the proposed Biehn Drive extension, traffic will not have to take a circuitous route through neighbourhoods to reach the arterial road network.

8.0 TECHNICALLY PREFERRED ALTERNATIVE

The Technically Recommended Alternative is shown in **Figure 19**. This recommendation conforms to the City of Kitchener's Official Plan and Integrated Transportation Master Plan and accommodates the associated municipal servicing. It minimizes the impacts to the Provincially Significant Wetland by eliminating the on-street parking and provides a high level of land use planning efficiency to the lands available for development. In addition, this alternative redistributes vehicles travelling to Robert Ferrie Drive from Caryndale Drive and Brigadoon Public School to Biehn Drive, a designated Major Collector in the City of Kitchener.

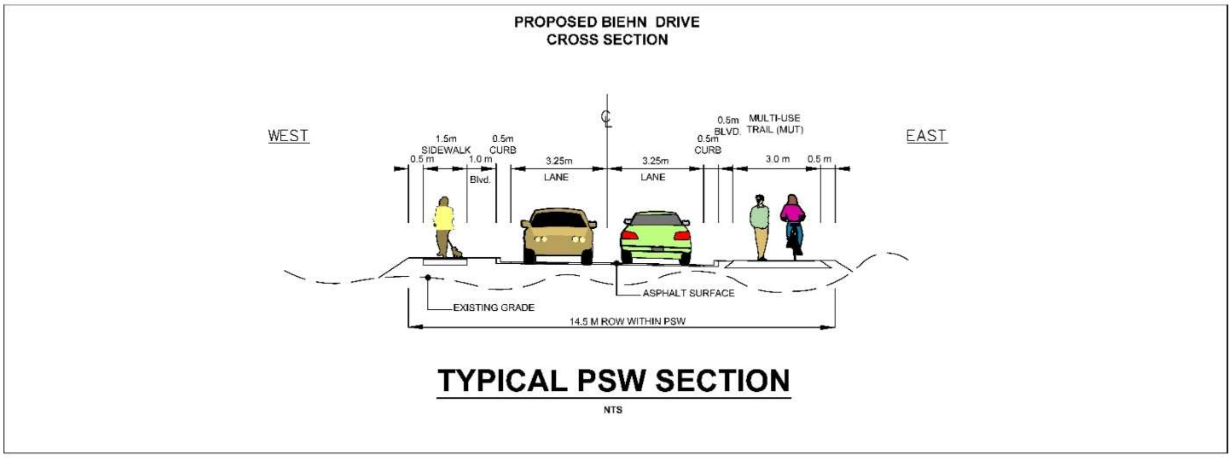
A multi-use trail (MUT) on the north side of Robert Ferrie Drive was not identified in the previous EA but is recommended as part of this EA to provide for active transportation along the short section of Robert Ferrie Drive in place of a sidewalk, noting:

- MUT's have already been placed on the portion of the east leg of the Strasburg Road roundabout which has been constructed.
- It would provide better network continuity (providing a MUT connection between the MUTs on Strasburg Road and the MUTs on Biehn Drive).
- At the time the Robert Ferrie Drive EA was being completed, MUTs on Biehn Drive had not been identified.

8.1 Refinements to Technically Preferred Alternative

The Technically Preferred Alternative (TPA) described in **Section 7.2**, was presented at PIC No. 2. Following the PIC, the TPA was subject to refinements based on input from the public, stakeholders and Indigenous Communities. These include:

- Through the wetland, the cross section (see **Figure 18**) will be identical to the cross section beyond the PSW, except that it will be revised to:
  - Remove the MUTs from the north (west) side of the road and replace with a sidewalk on the west side of the road.
  - Allow for a 14 m ROW through the wetland.
  - Provision for a wildlife passage culvert within the PSW
  - No Parking within the PSW
  - Lighting with full cut off fixtures
- Opportunity to enhance naturalization of PSW Adjacent Lands
- Outside the wetland, the cross section (see **Figure 18**) will be reduced to 23.5 m through the subdivision, reducing the width of the boulevard on the east side to accommodate the MUT.



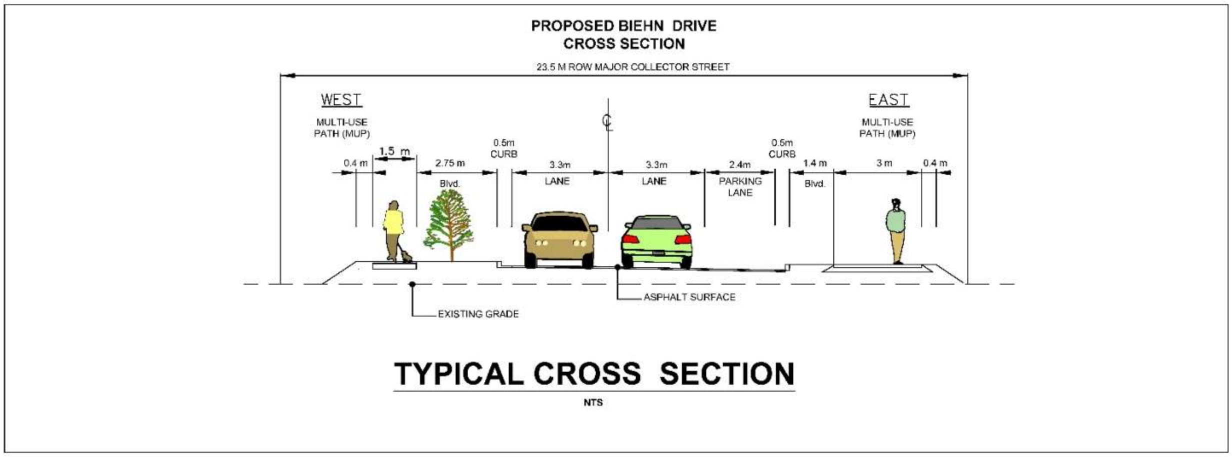


Figure 18: Typical Cross Section Through Wetland and Outside the Wetland

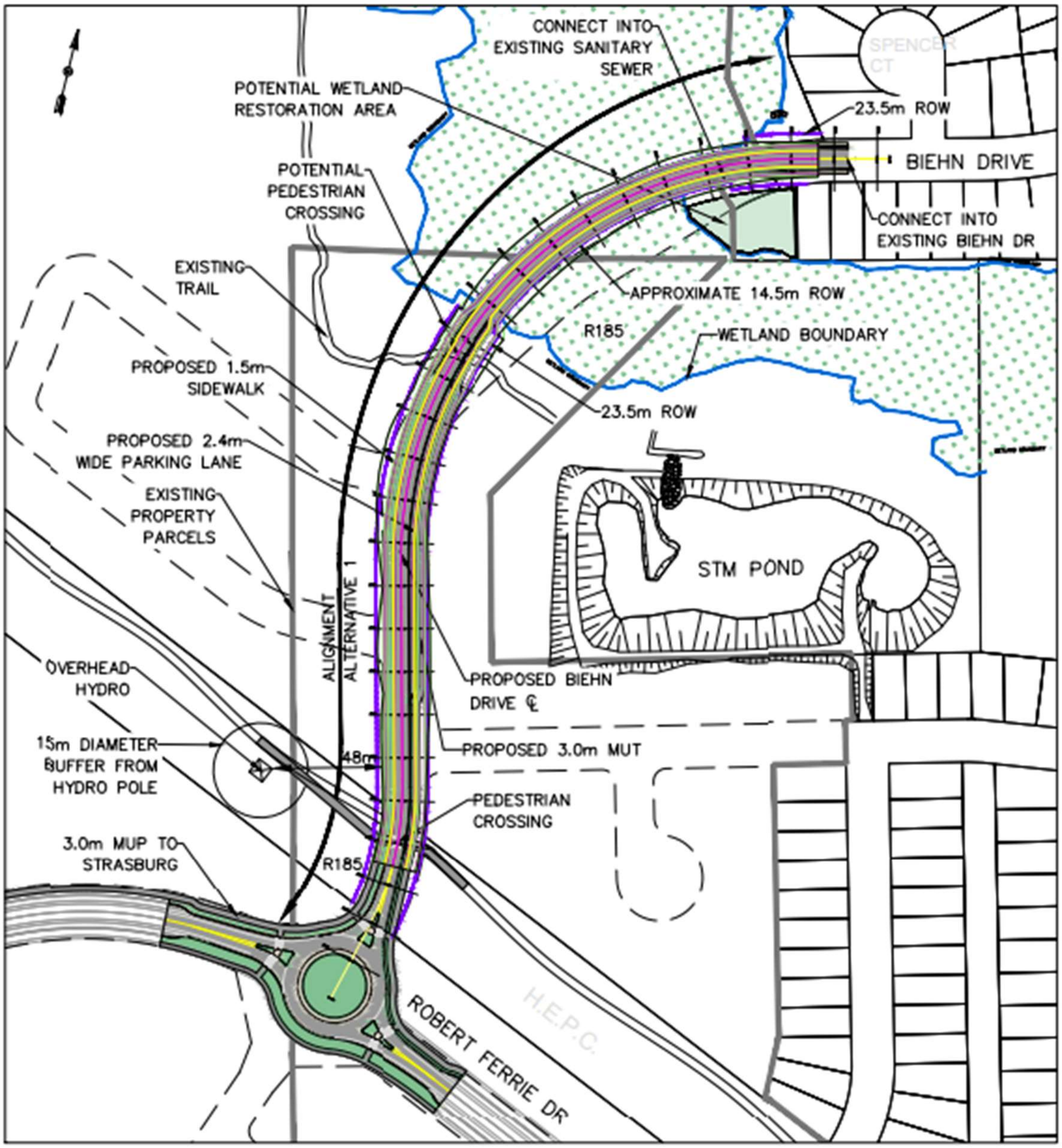


Figure 19: Technically Preferred Alternative

9.0 RECOMMENDED PLAN

The Biehn Drive Recommended Plan includes:

- New 2-lane road connecting the current Biehn Drive terminus to the future Robert Ferrie Drive
  - Alignment will be east of the Hydro Tower
  - Cross section will include 3.3 m lanes with curb/gutter (0.5 m)
- Active transportation improvements will include:
  - 3.0 m MUT on the east side of the road from Robert Ferrie Drive to the wetland (see Statement of Flexibility Section 9.1)
  - 1.5 m sidewalk on the west side from the Hydro Easement to Biehn Drive.
  - Boulevard (varying width, minimum 1.0 m)
  - Potential pedestrian crossings at:
    - The Hydro Easement.
    - The south edge of the wetland
- Roundabout at the intersection of Biehn Drive and Robert Ferrie Drive (per the recommendations of the Robert Ferrie Drive Environmental Assessment)
- Installation of municipal services beneath the road alignment including:
  - Sanitary trunk sewer (525 mm diameter)
  - Storm sewer
  - Watermain
- Natural environment mitigation including:
  - Construction of one or more concrete box culvert with a 1.0 m span and 1.0 m rise for the provision of wildlife passage under the Biehn Drive extension in the area of the Strasburg Creek PSW (final sizing, design and number of crossings to be defined in detail design). The Biehn Drive Wildlife Crossing Technical Memorandum is included in **Appendix I.**
  - Implementation of permanent wildlife fencing
  - Stormwater quality control of northern outlet to the PSW (oil grit separator)
  - Target desirable compensation for wetland loss including:
    - 10:1 tree replacement
    - 1:1 wetland replacement (on-site)
    - 2:1 wetland replacement (off-site)
    - The feasibility for compensation to be reviewed with the future determination of the offsets from the PSW to development lands as an opportunity for naturalization and well as the re-naturalization of the removal of the existing cul-de-sac on Biehn Drive.

The Recommended Plan is illustrated on the Plates in **Section 13.0**.

9.1 Statement of Flexibility

The Recommended Plan contains key features with flexibility for refinements during detail design including:

- Minor adjustments to the vertical profile and cross section through the development lands during detail design.
- Minor adjustments to the sidewalk and MUT through the PSW to minimize impacts to the natural environment and include input from the EIS to be completed during detail design.
- Selection of the surface type/material of the sidewalk and MUT through the wetland. This will be determined during detail design.
- Modifications to the size, location and number of wildlife passages based on consultation with Indigenous Peoples and GRCA during detail design.

10.0 RECOMMENDED PLAN PRELIMINARY DESIGN EFFECTS, MITIGATION MEASURES ANDFUTURE RECOMMENDATIONS

Key issues and Preliminary Design features and associated mitigation measures have been identified and are summarized in **Table 7**.

Identified Preliminary Design mitigation measures reflect commitments by the City of Kitchener to mitigate environmental effects. Effects on the environment were considered in accordance with the Municipal Class EA process.

Table 7: Summary of Preliminary Design Potential Impacts, Proposed Preliminary Design Mitigation

No.	Factor	Environmental Issues and Potential Effects	Proposed Preliminary Design Mitigation Measures
1.0	**Transportation**		
1.1	Traffic Calming	Increase in traffic speeds at the current Biehn Drive terminus.	To control traffic speeds and provide a more pedestrian friendly environment: • Lane widths have been reduced to 3.3 m – identified as the City's new preferred standard for major collector street • A centre pedestrian refuge island and crosswalk at the south end of existing Biehn Drive as a traffic calming measure and to transition to the narrower lane widths on the proposed extension
2.0	**Natural, Social and Cultural Environment**		
2.1	Species at Risk	Impacts to Species at Risk and loss of habitat.	No SAR have been confirmed in the Study Area based on field investigations completed by BTE and the developer's consultants.

Table 7: Summary of Preliminary Design Potential Impacts, Proposed Preliminary Design Mitigation

No.	Factor	Environmental Issues and Potential Effects	Proposed Preliminary Design Mitigation Measures
2.2	Significant Woodlands and Specimen Trees	Loss of Significant Woodlands and Specimen Trees.	Alternative 1 has been selected in part because it has a reduced impact on Significant Woodlands in comparison to the other alternatives.
2.3	Fish Habitat	Downstream impacts to Strasburg Creek cold water fish habitat and impacts to ephemeral/intermittent features in the PSW.	No direct impacts to fish or fish habitat are anticipated to occur as result of the selection of Alternative 1.
2.4	Water Quality	Decrease in water quality in Strasburg Creek from stormwater runoff.	Detail Design Recommendation: A stormwater management plan is being developed to reduce chloride loading into the watercourse and to cool stormwater prior to its outlet into this cold-water system. Direction of stormwater from the new roadway to the existing stormwater pond (drainage area from the pond southerly). Inclusion of an oil grit separator at the northern/eastern outlet to the PSW.
2.5	Wildlife Habitat	Loss of wildlife habitat including removal of vegetation and tree canopy.	The roadway corridor through the PSW and Significant Woodlands has been narrowed to limit the removal of wildlife habitat.
2.6	Accommodating Wildlife Movement	Reduced ability of animals to cross from one portion of the	Detail Design Recommendation: Permanent exclusion fencing and one or more associated wildlife passages under the road are to be considered during Detail Design. Wildlife

Table 7: Summary of Preliminary Design Potential Impacts, Proposed Preliminary Design Mitigation			
No.	**Factor**	**Environmental Issues and Potential Effects**	**Proposed Preliminary Design Mitigation Measures**
		wetland/woodland to another due to the new road construction.	passages should take into consideration a suitable Openness Ratio for the target species/wildlife type (i.e. amphibians and small mammals) as described in Appendix I.
2.7	Migratory Bird Nesting	Disturbances to birds during the nesting season.	Detail Design and Construction Recommendation: Any clearing and grubbing should be completed outside of the active breeding bird season of April 1 to August 31. If this is not possible, clearing and grubbing should occur under the supervision of an environmental professional, and only after the specific trees and vegetation needing removal have been screened for nesting birds or roosting bats.
2.8	Provincially Significant Wetlands	Loss of Provincially Significant Wetland.	Alternative 1 has been selected in part because it has reduced impact on the Provincially Significant Wetland in comparison to the other alternatives.
2.9	Groundwater – Wellhead Protection Sensitivity Areas Groundwater – Infiltration		The City will protect against sourcewater threats including: • Salt impact assessment to design roads and sidewalks to minimize the need for repeat application of road salts, and to ensure the handling and storage of road salts doesn't become a significant drinking water threat • Reducing roadway platform requiring salt (reduced lane widths, eliminating shoulders by inclusion of urban curbs and elimination of east MUT)

Table 7: Summary of Preliminary Design Potential Impacts, Proposed Preliminary Design Mitigation

No.	Factor	Environmental Issues and Potential Effects	Proposed Preliminary Design Mitigation Measures
			• Ensure discharge from a stormwater management facility does not become a significant drinking water threat • Compliance with the Salt Management Plan to reduce potential for salt related surface water run-off and groundwater infiltration
2.10	Floodplain Storage	Loss of floodplain storage.	Reduced footprint in wetland by reducing lane widths, use of urban cross section and elimination of east MUT.
2.11	Permits and Approvals	Requirements for environmental permits and approvals.	See Table 8.
2.12	Air Quality and Greenhouse Gas Emissions	Potential for decreased air quality and negative contribution to greenhouse gas emissions.	The construction of the road extension is not expected to generate additional trips within the City's transportation network and therefore air quality changes and increases in greenhouse gas emissions are not anticipated.
3.0	**Cultural Environment**		
3.1	Archaeological Impacts	Potential for negative impacts on areas of archaeological potential.	A Stage 1 and 2 Archaeological Assessment was completed within the Study Area and identified there are no outstanding archaeological concerns for the current project.
4.0	**Construction**		

Table 7: Summary of Preliminary Design Potential Impacts, Proposed Preliminary Design Mitigation

No.	Factor	Environmental Issues and Potential Effects	Proposed Preliminary Design Mitigation Measures
4.1	Dewatering, Sediment and Erosion Controls	Potential for negative impacts to the surrounding areas resulting from construction dewatering and sediment management.	See **Table 8**.
4.2	Noise and Vibration	Potential for elevated noise levels.	It is projected that no receiver sites will experience sound level changes greater than 5 dBA and no receiver site will have a total sound level of over 65 dBA. The forecast sound levels for daytime and nighttime meets the objective of 55 dBA and no mitigation is required.
4.3	Property Requirements	Need for property acquisition or land dedication for the new road right-of-way.	Property acquisition or a land dedication will be required for the extension of Biehn Drive. This will be coordinated between the property owner (developer) and the City as part of the development planning and approvals process.

11.0 RECOMMENDED PLAN DETAIL DESIGN AND CONSTRUCTION EFFECTS, MITIGATION MEASURES AND COMMITMENTS TO FUTURE WORK

Key issues and Detail Design and Construction commitments to future work have been identified and are summarized in **Table 8**.

Identified mitigation measures reflect commitments by the City of Kitchener to mitigate environmental effects. Effects on the environment were considered in accordance with the Municipal Class EA process.

Table 8: Summary of Potential Impacts and Future Work During Detail Design and Construction

No.	Factor	Environmental Issues and Potential Effects	Proposed Detail Design and Construction Mitigation Measures
1.0	**Transportation**		
1.1	Traffic Calming	Increase in traffic speeds at the current Biehn Drive terminus.	To control traffic speeds and provide a more pedestrian friendly environment: • Additional traffic calming measures could be considered which might include the provision of raised crosswalks at each of the pedestrian crossings
2.0	**Natural, Social and Cultural Environment and Monitoring**		
2.1	Species at Risk	Impacts to Species at Risk and loss of habitat.	An updated assessment for SAR listed in the *Endangered Species Act* (ESA) and *Species at Risk Act* (SARA) will be completed during Detail Design since it is the responsibility of the proponent to ensure that Species at Risk (SAR) are not killed, harmed, or harassed, and that their habitat is not damaged or destroyed through the proposed activities to be carried out on the site. If the proposed activities cannot avoid impacting protected species and their habitats, then

Table 8: Summary of Potential Impacts and Future Work During Detail Design and Construction

No.	Factor	Environmental Issues and Potential Effects	Proposed Detail Design and Construction Mitigation Measures
			the proponent will need to apply for an authorization under the Endangered Species Act (ESA). If the proponent believes that their proposed activities are going to have an impact or are uncertain about the impacts, they should contact SAROntario@ontario.ca to undergo a formal review under the ESA.
2.2	Significant Woodlands and Specimen Trees	Loss of Significant Woodlands and Specimen Trees.	Refinement during Detail Design should consider minor deviations in alignment to avoid specimen trees and limit tree clearing.
2.3	Fish Habitat	Downstream impacts to Strasburg Creek cold water fish habitat and impacts to ephemeral/intermittent features in the PSW.	Erosion and sediment control should be installed to mitigate sediment transport into the downstream Strasburg Creek or the piped stormwater system under and north of Biehn Drive. As indirect fish habitat is present in the Study Area in the form of overland flow, particular attention should be paid to stabilizing erodible soil during construction and associated clearing and grubbing. An erosion and sediment control specialist should be on site during construction to ensure the proper installation of these controls.
2.4	Water Quality	Decrease in water quality in Strasburg Creek from stormwater runoff.	A stormwater management plan is being developed to reduce chloride loading into the watercourse and to cool stormwater prior to its outlet into this cold-water system.

Table 8: Summary of Potential Impacts and Future Work During Detail Design and Construction			
No.	**Factor**	**Environmental Issues and Potential Effects**	**Proposed Detail Design and Construction Mitigation Measures**
			Direction of stormwater from the new roadway to the existing stormwater pond (drainage area from the pond southerly) Inclusion of an oil grit separator at the northern/eastern outlet to the PSW.
2.5	Wildlife Habitat	Loss of wildlife habitat including removal of vegetation and tree canopy.	To reduce impacts to nocturnal wildlife, lighting will be reduced along this portion of the road and will include mitigation measures to limit dispersal into the adjacent wetland and woodland areas (use of cut-off lighting).
2.6	Accommodating Wildlife Movement	Reduced ability of animals to cross from one portion of the wetland/woodland to another due to the new road construction.	It is recommended that permanent exclusion fencing and one or more associated wildlife passages under the road be considered during Detail Design. Wildlife passages should take into consideration a suitable Openness Ratio for the target species/wildlife type (i.e. amphibians and small mammals) as described in Appendix I.
2.7	Migratory Bird Nesting	Disturbances to birds during the nesting season.	Any clearing and grubbing should be completed outside of the active breeding bird season of April 1 to August 31. If this is not possible, clearing and grubbing should occur under the supervision of an environmental professional, and only after the specific trees and vegetation needing removal have been screened for nesting birds or roosting bats.

Table 8: Summary of Potential Impacts and Future Work During Detail Design and Construction

No.	Factor	Environmental Issues and Potential Effects	Proposed Detail Design and Construction Mitigation Measures
2.8	Provincially Significant Wetlands	Loss of Provincially Significant Wetland.	The Detail Design should consider narrowing of the roadway corridor through the wetland area where feasible.
2.9	Groundwater – Wellhead Protection Sensitivity Areas Groundwater – Infiltration		The City will protect against sourcewater threats including: • Salt impact assessment to design roads and sidewalks to minimize the need for repeat application of road salts, and to ensure the handling and storage of road salts doesn't become a significant drinking water threat • Reducing roadway platform requiring salt (reduced lane widths, eliminating shoulders by inclusion of urban curbs and elimination of east MUT) • Ensure that the removal and storage of snow doesn't become a significant drinking water threat • Spill Prevention, contingency plans and emergency response plans during construction • Ensure discharge from a stormwater management facility does not become a significant drinking water threat • Compliance with the Salt Management Plan to reduce potential for salt related surface water run-off and groundwater infiltration
2.10	Floodplain Storage	Loss of floodplain storage.	Reduced footprint in wetland by reducing lane widths and use of urban cross section.

Table 8: Summary of Potential Impacts and Future Work During Detail Design and Construction			
No.	**Factor**	**Environmental Issues and Potential Effects**	**Proposed Detail Design and Construction Mitigation Measures**
2.11	Permits and Approvals	Requirements for environmental permits and approvals.	Environmental Compliance Approval (ECA): Information regarding ECA's can be found on the MECP website: https://www.ontario.ca/page/environmental-compliance-approval. The MECP's "Guide to Applying for an Environmental Compliance Approval" including the application requirements can be found at https://www.ontario.ca/document/guide- applying-environmental-compliance-approval-0. The following link will bring provide a number of questions, offered as a self-assessment to help determine whether an ECA is required: https://www.ontario.ca/page/sewage-self-assessment Environmental Permissions Branch Permits and Approvals: It is recommended that the proponent consult with the Environmental Permissions Branch of the Ministry of the Environment, Conservation and Parks to determine permits and approvals requirements (enviropermissions@ontario.ca). Permits from GRCA and MNRF will be obtained during Detail Design based on the final contract drawings.
2.12	Air Quality - Construction	Potential for temporary decreased air quality during construction.	The construction of the road extension is not expected to generate adverse air quality as the contractor will be

Table 8: Summary of Potential Impacts and Future Work During Detail Design and Construction

No.	Factor	Environmental Issues and Potential Effects	Proposed Detail Design and Construction Mitigation Measures
			required to maintain the construction equipment in good working order. MECP recommends that non-chloride dust suppressants be applied. For a comprehensive list of fugitive dust prevention and control measures, refer to *Cheminfo Services Inc. Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities* report prepared for Environment Canada, March 2005.
2.13	Excess Materials and Waste	New Environment Protection Act Regulation - phased implementation.	In December 2019, MECP released a new regulation under the Environmental Protection Act, titled *On-Site and Excess Soil Management* (O. Reg. 406/19) to support improved management of excess construction soil. The regulation is being phased in over time, with the first phase in effect on January 1, 2021. For more information, please visit www.ontario.ca/page/handling-excess-soil. The Report should reference that activities involving the management of excess soil should be completed in accordance with O. Reg. 406/19 and the ministry's current guidance document titled "Management of Excess Soil – A Guide for Best Management Practices" (2014). All waste generated during construction

Table 8: Summary of Potential Impacts and Future Work During Detail Design and Construction

No.	Factor	Environmental Issues and Potential Effects	Proposed Detail Design and Construction Mitigation Measures
			must be disposed of in accordance with ministry requirements.
3.0	**Consultation**		
3.1	Post 30-Day Public Review Period	Correspondence resulting from Public Review and between Preliminary and Detail Design Stages.	If such correspondence does occur the associated responses will be kept in a Post-ESR Review File to be reviewed as part of Detail Design in the next phase.
3.2	Significant changes in design and commitments	In the event of major changes from the Preliminary Design documented in the ESR.	Any future major changes from the preliminary design documented in the ESR will be dealt with in an Addendum. The Addendum will be communicated to the contact list of the study and follow the requirements of the Municipal Class EA. A major change would be a design that requires a footprint beyond the right-of-way identified in the ESR. Any minor changes will be through permitting with the Grand River Conservation Authority.
4.0	**Construction**		
4.1	Dewatering, Sediment and Erosion Controls	Potential for negative impacts to the surrounding areas resulting from construction dewatering and sediment management.	These plans will be developed during Detail Design, where applicable, in accordance with the *Ontario Water Resources Act* and Ontario Regulation 387-04. The preliminary design recommends that directional drilling of the sanitary sewer be investigated during detail design. The preliminary design has included a vertical alignment to

Table 8: Summary of Potential Impacts and Future Work During Detail Design and Construction			
No.	**Factor**	**Environmental Issues and Potential Effects**	**Proposed Detail Design and Construction Mitigation Measures**
			allow reducing the length of a storm sewer in the PSW and to include use of a geotextile to support the roadway platform and reduce the excavation of the wetland below the water table. The type of MECP approval required for water taking activities during the construction project will depend on how dewatering and other water uses are proposed to be carried out, sources of water and purposes of water takings. The purposes of water takings which are generally seen for such projects include: constructions dewatering to maintain a dry work area, concrete making, dust suppression, etc. The MECP information listed below provides guidance and further direction in determining whether a Permit to Take Water (PTTW) or an Environmental Activities and Sector Registry (EASR) is required, or if activities are exempt. **Permit to Take Water (PTTW):** The category of PTTW that may be required depends on the level of risk associated with the proposed water taking, source of water, rate/volume of water to be taken, purpose, etc. Further details can be found on the MECP website: https://www.ontario.ca/page/permits-take-water. In addition, the “Guide to Permit to Take Water Application Form” outlines procedures for applying to the MECP’s Permit to Take Water (PTTW) including the approach for

Table 8: Summary of Potential Impacts and Future Work During Detail Design and Construction			
No.	**Factor**	**Environmental Issues and Potential Effects**	**Proposed Detail Design and Construction Mitigation Measures**
			filling in the required application form and the type of supporting documentation/studies to be submitted: https://www.ontario.ca/page/guide-permit-take-water-application-form. The Water Taking and Transfer regulation O. Reg. 387/04 can also provide further guidance: https://www.ontario.ca/laws/regulation/040387. **Environmental Activity and Sector Registry (EASR):** The guide provides information on EASR as it pertains to water takings for eligible highway projects and transit projects, construction site dewatering and pumping tests: https://www.ontario.ca/page/water-taking-user-guide-environmental-activity-and- sector-registry. For the proposed water taking activity to be eligible to register on EASR, it must meet the criteria set out in O.Reg. 63/16: https://www.ontario.ca/laws/regulation/160063
4.2	Noise and Vibration	Potential for elevated long and short-term noise levels.	**Long Term**: The City commits to monitor noise complaints with the opening of Biehn Drive. If the noise complaints last beyond the initial experience of the road opening, then traffic counts will be undertaken to compare with the ESR noise calculation traffic projections. Based on the comparison, the City will assess if any noise mitigation

Table 8: Summary of Potential Impacts and Future Work During Detail Design and Construction			
No.	**Factor**	**Environmental Issues and Potential Effects**	**Proposed Detail Design and Construction Mitigation Measures**
			measures are required, technically feasible and cost effective. **Short Term**: The construction contract will include restrictions on construction activities for night-time works and heavy vehicles will be restricted to accessing from Strasburg Road.
4.3	Property Requirements	Need for property acquisition or land dedication for the new road right-of-way.	Property acquisition or a land dedication will be required for the extension of Biehn Drive. This will be coordinated between the property owner (developer) and the City as part of the development planning and approvals process.
4.4	Monitoring	Monitoring is a requirement of the Municipal Class E A – Section A 4.2.1	As the proponent, the City of Kitchener will commit to a Monitoring Program for this project as part of the Detail Design and Construction phases. An environmental firm specializing in monitoring programs will be part of the Detail Design team and Construction team to ensure the continuity of the environmental measures outlined in Table 8. The Monitoring Program will address the Class Document requirements as set out in Section A.4.2.1 including: • Key impacts to be monitored. • Monitoring requirements during detail design, construction and during the operation of Biehn Drive. • The period during which monitoring will be necessary.

Table 8: Summary of Potential Impacts and Future Work During Detail Design and Construction			
No.	**Factor**	**Environmental Issues and Potential Effects**	**Proposed Detail Design and Construction Mitigation Measures**
			• Frequency and timing of surveys, the location of monitoring sites and the methods of data collection, analysis and evaluation. • The content, manner and form in which records of monitoring data are to be prepared and retained. • Where and for how long monitoring records and documentation will be on file, specific requirements for monitoring appropriate to the particular circumstances and conditions under which the project will be implemented. • How unexpected environmental effects identified during monitoring will be addressed. Table 8 will serve as a checklist for the environmental monitoring firm.

12.0 FUTURE ACTIVITIES

Following Class EA clearance and a 30-day public review period, if there are no objections, this project, or any individual element of this project, may proceed to Detail Design and Construction after obtaining the necessary environmental permits and approvals, and subject to availability of funding and construction priorities. Mitigation measures listed in **Section 10.0** and **Section 11.0** are to be incorporated during Detail Design and Construction, as appropriate. The timeline for implementation is expected to be within the 5-year capital program.

13.0 RECOMMENDED PLAN PLATE

Appendix A

Study Design

Study Design Report, Revision 1

Biehn Drive Municipal Class Environmental Assessment

November 2021

Submitted by:
BT Engineering Inc.
509 Talbot Street
London, ON N6A 2S5

Table of Revisions

No.	Date	Revision
1	April 30, 2021	Section 4.3.2.1.7 Cultural Environment revised to: Potential Built Heritage Resources and Cultural Heritage Landscapes will be evaluated for the entire study area prior to the selection of preferred alternatives and summarized in the ESR. This review will identify all known or potential built heritage resources and cultural heritage landscapes (BHR/CHLs). If resources are present, a cultural heritage assessment report will be completed with the potential project impacts to BHR/CHLs identified and strategies will be provided to mitigate identified impacts. These mitigation measures will inform project planning and design. An Archaeological assessment (AA) will be undertaken by an archaeologist licenced under the *Ontario Heritage Act*, who is responsible for submitting the report directly to the Ministry of Heritage Sport, Tourism and Culture Industries (MHSTCI). A Stage 1 AA consists of a review of geographic, land use and historical information for the property and the relevant surrounding area, a property visit to inspect its current condition, and contacting MHSTCI to find out whether there are any known archaeological sites on or near the property. Its purpose is to identify areas of archaeological potential and determine whether additional archaeological assessment is necessary (e.g. Stages 2, 3, and 4).
2	June 7, 2021	Section 5.0 and 5.1 to add Alternative 4.
3	June 7, 2021	Section 1.1 revised to include a local and broader Study Area.
4	June 7, 2021	Section 2.1 revised to: Future development within the Doon South and Brigadoon communities requires a defined alignment for the extension of Biehn Drive to Robert Ferrie Drive as part of the area road network. In order to determine the road alignment, this Study will consider the natural, social environments and the future land use in the Study Area. The extension of Biehn Drive and the associated municipal servicing has been a longstanding part of the integrated plan for the Brigadoon neighbourhood. The planned extension will improve local access to Strasburg Road to safely and reliably accommodate all modes of transportation including vehicular, pedestrians, and cyclists, and provide access to potential future transit. By defining the future road and municipal servicing plans, the subsequent land use plans can be completed by developers.
5	June 7, 2021	Section 2.2 revised to: … The extension of Biehn Drive, in conjunction with the extensions

		of Robert Ferrie Drive and Strasburg Road, will result in a more balanced distribution of the existing neighbourhood traffic, increasing the traffic volumes along a short section of Biehn Drive while reducing the volumes that are currently using other neighbourhood streets. The EA will undertake community consultation and mitigating measures will be developed to reduce the impacts on the community and control traffic speeds…
6	June 7, 2021	Section 2.3 revised to: • Reduced traffic demand on other neighbourhood streets including Biehn Drive (to the north), Caryndale Drive and Marl Meadow Drive/ Teeplewood Drive resulting in reduced community disruption and improved road safety;
7	July 11, 2021	Section 4.2.3.1.6 Natural Environment revised to include a detailed Terms of Reference (TOR).
8	November 2, 2021	Section 6.0 Schedule updated.

Table of Contents

List of Figures

List of Tables

1.0 Introduction

The City of Kitchener (City) has initiated a Class Environmental Assessment (EA) Study to develop a transportation plan for the extension of Biehn Drive westerly to the Robert Ferrie Drive extension. The Biehn Drive extension will include municipal services including a trunk sanitary sewer, storm sewer/ditches and watermain. The focus of the Study will be to consider alternatives for the alignment of the Biehn Drive extension, intersection locations and designs and municipal services while minimizing environmental, social, and cultural impacts of the project.

This report, the initial public document for the Municipal Class Environmental Assessment, presents a description of the work plan, preliminary alternatives, consultation plan and overall study process. It outlines the EA planning process and describes the key activities required to complete the Study. The Study Design will be circulated to various agencies and the Study's Technical Advisory Committee (TAC) and is available to the public on the City's website for review and comment.

Note: At the time of release of the Study Design Report, the Province of Ontario has implemented restrictions on public gatherings to deal with the COVID-19 pandemic, and as such the distribution of materials is relying on web-based communications with the public. Subsequent stages of the study may revert to conventional public events to review the sequential planning decisions of the study.

1.1 Study Area

The Study Area is located in the City of Kitchener and is illustrated on **Figure 1**.

The Local Study Area extends from the current terminus of Biehn Drive, approximately 60 m west of Spencer Court, southerly to the future Robert Ferrie Drive Extension.

Based on comments from the public at the Community Café and Public Information Centre No. 1, the Study Area was expanded to a Broader Study Area to consider traffic effects in adjacent neighbourhoods.

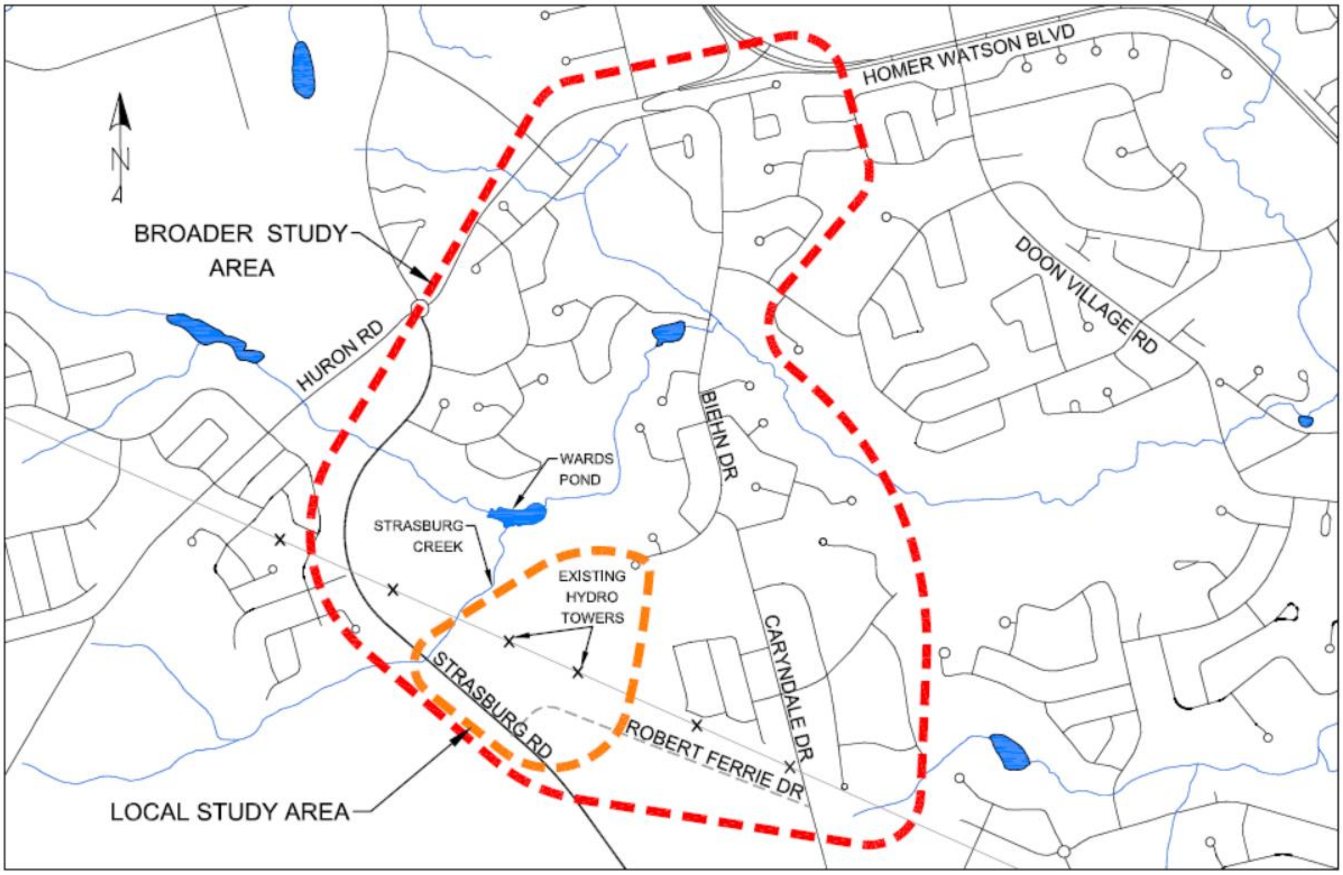


Figure 1: Study Area

1.2 Study Background

Since the mid-2000's the road network and municipal servicing for the Doon South and Brigadoon areas in the City of Kitchener have planned for area development and evolving transportation needs. Several planning documents including the Official Plan and Transportation Master Plan (TMP) have identified the need to extend Biehn Drive westerly to the Robert Ferrie Drive extension and ultimately to Strasburg Road. The Biehn Drive Extension would be a major collector road, as identified in Schedule B of the City of Kitchener's Official Plan Amendment. This link would accommodate vehicles to and from the Brigadoon community, and would help mitigate cut-through traffic on local streets within the community. A collector road collects traffic from local roads within the community and provides connectivity to high tier arterial roads including Strasburg Road.

1.2.1 Background Studies

Background Studies have been completed within the Study Area to document the proposed land uses, transportation networks and existing issues. These reports are summarized in the following sections.

1.2.1.1 Official Plan and Land Use

The City of Kitchener Official Plan (2014) documents the policies for growth, development, and land use within the City. Map 3 of the Official Plan identifies the land in the Study Area as Natural Heritage Conservation and Low-Rise Residential:

- Natural Heritage Conservation: This land use designation is used to protect and/or conserve natural heritage features and their ecological functions. This designation includes Provincially Significant Wetlands.
- Low-Rise Residential: This land use designation accommodates a range of low-density housing types including single detached dwellings, semi-detached dwellings, townhouses, low-rise multiple dwellings etc.

In addition to the general land use classifications, there is a Specific Policy Area (SPA) along the hydro corridor in the Brigadoon subdivision (SPA 45). This SPA states:

> *"Notwithstanding the Open Space land use designation and policies on the Hydro Corridor in the Brigadoon Subdivision (30T-88006) shared uses on hydro rights-of-way including open space links, parking lots or other uses accessory to adjacent land uses in accordance with Policy 14.C.1.37 and Policy 15.D.10.1 i) will be permitted."*

1.2.1.2 City of Kitchener Transportation Master Plan

The Kitchener Integrated TMP (2013, IBI Group) identifies the need to extend Biehn Drive from its current terminus. The TMP recommended that Biehn Drive be extended westerly to Strasburg Road. This recommendation was modified in subsequent planning documents and EAs to recommend connection to the Robert Ferrie Drive extension instead, with the final determination to be defined by an EA (the current study).

1.2.1.3 Region of Waterloo Transportation Master Plan

The Region of Waterloo's Moving Forward 2018 Master Plan (IBI Group, 2019) outlines the needs for active transportation, transit and Regional roads. This report identifies Biehn Drive as an Existing Local Route for Grand River Transit; however, the 2021 GRT System Transit Map no longer includes this link (Route 16 Stasburg-Belmont follows Biehn Drive from Old Huron Road to Black Walnut Drive).

1.2.1.4 Kitchener Growth Management Plan (KGMP)

The Kitchener Growth Management Plan (KGMP) (2019) provides a framework to ensure that the City has “direct proper and orderly development within the boundary”. The Plan prioritizes areas for development based on the supply of developable lands and existing infrastructure.

The extension of Biehn Drive, including a sanitary sewer, is identified in the Plan as a major remaining initiative for the Brigadoon community. There are two developments planned/proposed within this area (see **Figure 2**). A requirement for development of the lands, labelled 33 and 34 on **Figure 2,** is the extension of sanitary services and the Biehn Drive connection.

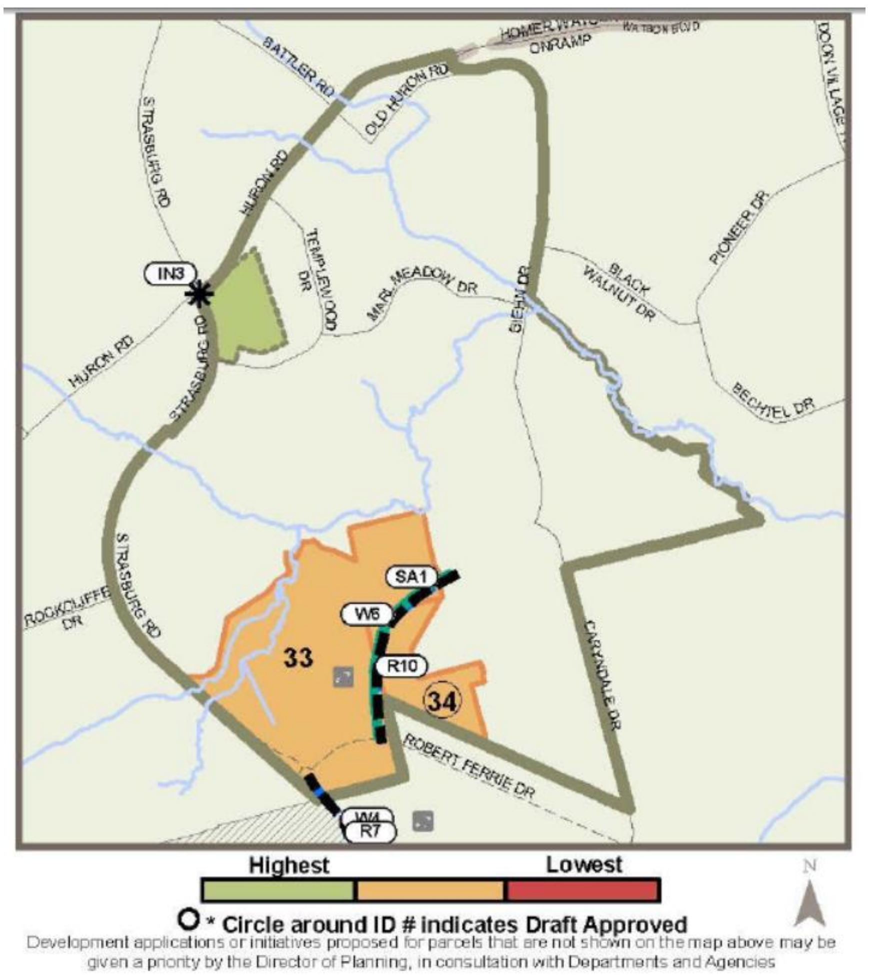


Figure 2: Growth Area Subplan for Brigadoon (Kitchener Growth Management Plan, 2019)

1.2.1.5 Brigadoon Community Plan

The Brigadoon Community Plan (2004) documents the principles for the development of the Brigadoon Community. This plan identifies that the development of lands east and west of the future Biehn Drive extension "shall require the construction of Strasburg Road and the Biehn Drive extension".

1.2.1.6 Sanitary Sewer Master Plan

The City of Kitchener is currently completing a Sanitary Sewer Master Plan.

1.2.1.7 Integrated Stormwater Management Master Plan (ISWM-MP)

The City of Kitchener's Integrated Stormwater Management Master Plan (ISWM-MP) (Aquafor Beach, 2016) identifies the prioritization of works for the City's overall stormwater master plan. This report identifies that the Study Area is located within the Strasburg Creek subwatershed. This was identified as a Priority 4 subwatershed, which is an area where intensification should provide sufficient buffers to maintain the natural hydrologic cycle.

1.2.1.8 Additional Reports

Additional background reports that will be reviewed as part of the study will include, as a minimum:

- City of Kitchener Standard Specifications
- City of Kitchener Standard Drawings
- Region of Waterloo and Area Municipalities Design Guidelines and Supplemental Specifications for Municipal Services
- Strasburg Road Extension Environmental Study Report
- South Strasburg Gravity Trunk Sanitary Sewer Project File
- East Side Lands Sanitary Servicing Environmental Study Report
- Doon South Pumping Station Draft Environmental Study Report
- Robert Ferrie Drive Extension Environmental Study Report
- Biehn Drive Extension and Need Justification Review
- Doon South Community Plan
- Huron Community Plan
- Southwest Kitchener Urban Area Studies - Community Master Plan
- Doon South - Brigadoon Transportation Network and Corridor Study
- Doon South Community and Broader Study Area Traffic Impact Study
- City of Kitchener Cycling and Trails Master Plan
- Huron Industrial Development Transportation Planning and Engineering Study
- Strasburg Creek Flood Control Environmental Study Report
- State of the Watershed (SOW) Report Upper Blair Creek
- Cumulative Effects Monitoring – Blair Creek Case Study
- Revised Final Stormwater Management Report Doon Creek – Robert Ferrie Drive Extension
- City of Kitchener Stormwater Management Facility Retrofit, Class EA and Preliminary Design Brief
- Upper Blair Creek (Kitchener) Functional Drainage Study Final Report

2.0 Need and Justification

2.1 Problem and Opportunity Statement

Future development within the Doon South and Brigadoon communities requires a defined alignment for the extension of Biehn Drive to Robert Ferrie Drive as part of the area road network. In order to determine the road alignment, this Study will consider the natural, social environments and the future land use in the Study Area. The extension of Biehn Drive and the associated municipal servicing has been a longstanding part of the integrated plan for the Brigadoon neighbourhood. The planned extension will improve local access to Strasburg Road to safely and reliably accommodate all modes of transportation including vehicular, pedestrians, and cyclists, and provide access to potential future transit. By defining the future road and municipal servicing plans, the subsequent land use plans can be completed by developers.

The Study will provide the opportunity to: improve accessibility to the local community by providing additional network links; define a multi-modal transportation plan to support travel within the local neighbourhoods and; allow development to proceed on lands that currently require the roadway plan to be defined prior to developing the land use plan.

2.2 Key Issues and Constraints

Key issues and constraints that will be addressed as part of this study include:

- **Impacts on the Existing Community:** The existing Brigadoon community is an established residential area with low ambient sound levels and low traffic volumes on Biehn Drive. The extension of Biehn Drive, in conjunction with the extensions of Robert Ferrie Drive and Strasburg Road, will result in a more balanced distribution of the existing neighbourhood traffic, increasing the traffic volumes along a short section of Biehn Drive while reducing the volumes that are currently using other neighbourhood streets. The EA will undertake community consultation and mitigating measures will be developed to reduce the impacts on the community and control traffic speeds. Measures may include traffic calming measures, pedestrians/cyclist facilities, and mitigation for noise impacts.
- **Natural Environment:** The EA will investigate the protection of surrounding terrestrial and aquatic habitat and will establish mitigation for any potential impacts to the natural environment. There is potential for Species at Risk (SAR) to be present in the adjacent woodlots and the Strasburg Creek Provincially Significant Wetland (PSW). Additionally, two cold-water systems (Strasburg Creek and Blair Creek) flow to the north of south of the Study limits. The provision of wildlife passage will be a key consideration for this work, as will mitigation of potential stormwater impacts to the Strasburg Creek system.

- **Transportation**: The EA will determine a preferred road corridor that will address long-term municipal infrastructure requirements and safely accommodate road users. In addition, the EA will need to consider the proximity to adjacent intersections on Robert Ferrie Drive and the need to accommodate trucks through the roundabout.
- **Active Transportation:** Active modes of transportation will need to be accommodated with separate facilities to provide the highest level of service and safety (multi use pathways, sidewalks, bicycle lanes and/or raised cycle tracks).
- **Planned/Proposed Development:** The extension of Biehn Drive will need to consider any proposed plans of subdivision and the potential network of future local streets.

2.3 Opportunities

The benefits from the completion of the EA study will include:

- Improved emergency service access to local community;
- Reduced traffic demand on other neighbourhood streets including Biehn Drive (to the north), Caryndale Drive and Marl Meadow Drive/ Teeplewood Drive resulting in reduced community disruption and improved road safety;
- Provision of active transportation linkages; and
- Establish the future road location which will allow planning and approvals for subdivisions.

3.0 Study Process

This Study will complete the remaining phases of the Municipal Schedule C Class EA Study which was initiated by the TMP. The Study will meet all requirements of the Municipal Class EA by establishing the need and justification for the project, considering all reasonable alternatives with acceptable effects on the natural, social and cultural environments, and proactively involving the public in defining a Recommended Plan. The study will culminate in the filing of an Environmental Study Report (ESR) and provide environmental clearance to the City to proceed with the project, subject to permits and approvals that will occur during the future detail design stage of the project.

3.1 Guiding Principles

The study approach reflects the following the Ministry of the Environment, Conservation and Parks (MECP) five guiding principles for EA studies, namely:

- Consider all reasonable alternatives;
- Provide a comprehensive assessment of the environment;
- Utilize a systematic and traceable evaluation of net effects;
- Undertake a comprehensive public consultation program; and

- Provide a clear and concise documentation of the decision-making process and the public consultation program.

3.2 Environmental Assessment Act Requirements

The Environmental Assessment will follow the Class EA process, thereby meeting the requirements of the Municipal Class Environmental Assessment (2000 as amended in 2007, 2011 and 2015). The Study is being initiated as a Municipal Schedule C project based on the range on anticipated effects and capital cost of the project.

The Schedule C project will include two public meetings (a combined Community Café Event/Public Information Centre (PIC No. 1 and a second PIC) and conclude with the preparation of an ESR. The public will be provided with a 30-day ESR review period at the Study conclusion.

As the initial step in the Class EA process, this Study Design Report is being made available to the public. This is a discretionary Step of the Municipal Class EA process, as illustrated in **Figure 3** following Phase 2 of the Class EA process. This additional step is similar to the Step 1.2 activity in that it provides the context for a project where there has been a lag in time since the TMP was completed. The public and agencies will have this initial opportunity to comment on the proposed approach and previous TMP recommendations. The Class EA process does not have a public review period for TMP's following Phase 2, and this current study provides an opportunity for project specific comments.

3.3 EA Phases

The Municipal Class EA Process is illustrated in **Figure 3**. The following is the breakdown of tasks, by phase, for a Municipal Schedule C project:

Phase 1: Identify the Problem (completed as part of the City's TMP)

- Step 1: Identification and description of the problem or opportunity.
- Step 2: Discretionary public consultation.

Phase 2: Alternative Solutions (Steps 1 to 8 completed as part of the City's TMP)

- Step 1: Identification of alternative solutions to the problem.
- Step 2: Identify the study area and a general inventory of the natural, social and cultural environments.
- Step 3: Identification of the net positive and negative effects of each alternative solution.
- Step 4: Review and validation of alternative solutions.
- Step 5: Identification of reasonable design alternatives for the preferred solution.
- Step 6: Public consultation

- Step 7: Confirmation of design alternatives, finalization of Study Design for work program, and refinements to or addition of design alternatives to be carried forward to Phase 3.
- Step 8: Selection of the preferred solution
- Step 9: Study Design available on the City's website – added activity to initiate this current study.
- Step 10: Initial Community Café/PIC No. 1 added activity under this study to review/validate previous TMP recommendations and present preliminary design alternatives for public and agency comment before Phase 3 activities are initiated.

Phase 3: Alternative Design Concepts for the Preferred Solution

- Step 1: Identification of alternative designs.
- Step 2: Preparation of a detailed inventory of the natural, social and economic environments.
- Step 3: Identification of the potential impacts of the alternative designs.
- Step 4: Evaluation of the alternative designs.
- Step 5: Selection of preferred design.
- Step 6: Public consultation at PIC No. 2.

Phase 4: Environmental Study Report (ESR)

- Step 1: Completion of the ESR.
- Step 2: 30-day public review period.
- Step 3: Filing of the ESR and Notice of Completion.

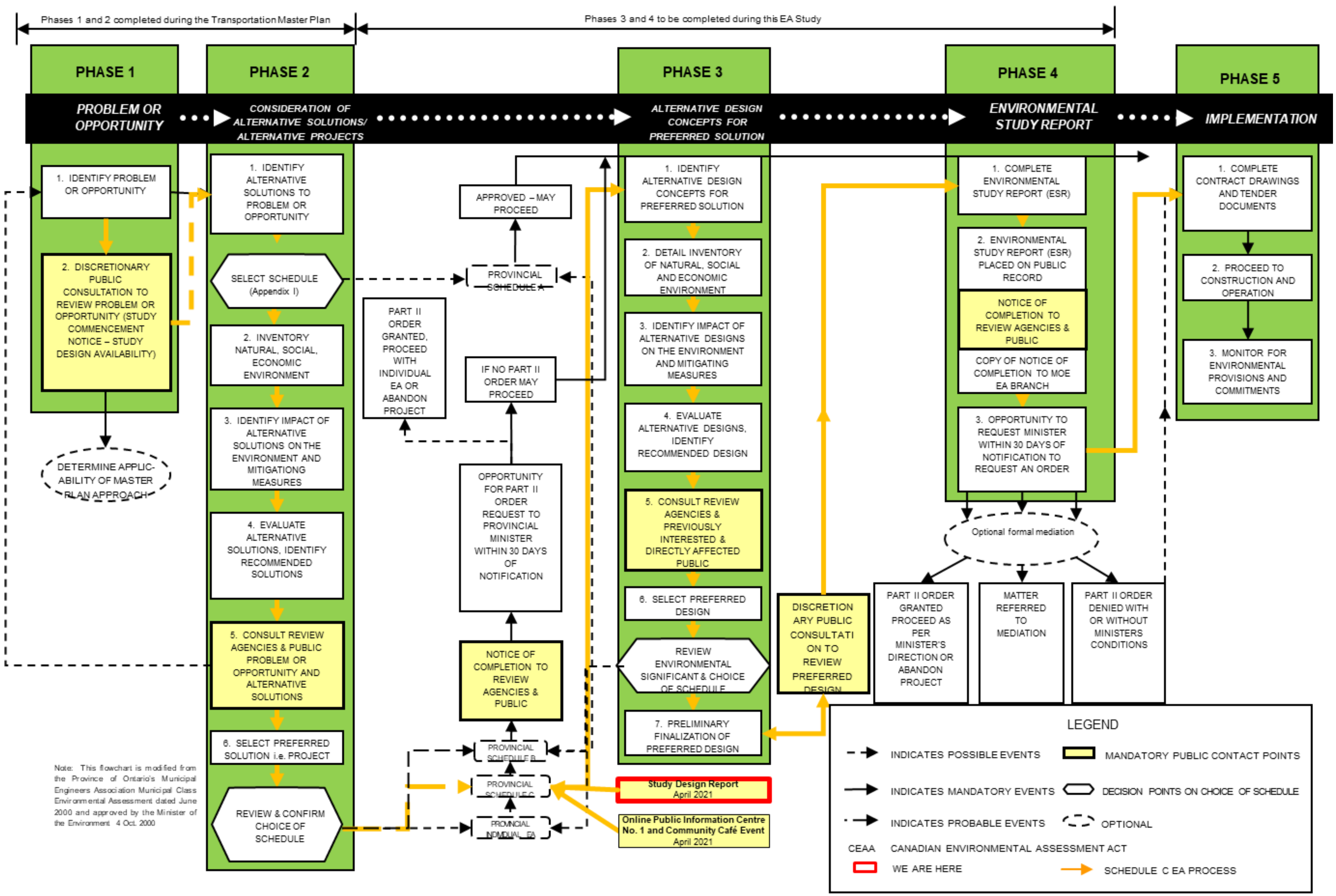


Figure 3: Municipal Class EA Process

4.0 Study Approach

Over the course of the study, input will be solicited from the public, stakeholders, agencies and Indigenous Communities. Input will be gathered through meetings, the project website, and discussions/communication with interested parties. The approach is to work collaboratively with interested parties to address issues and reach a consensus on the Recommended Plan.

4.1 Consultation Program

The Consultation Program identifies the opportunities for the Technical Advisory Committee (TAC) to discuss the Study with the public/stakeholders, agencies and Indigenous Communities. This Study will use several processes to engage with interested parties and provide an opportunity for input. The Consultation Program will include:

- Notices published in local newspapers, issued as media releases and directly mailed/emailed to the study mailing list at key points over the course of the study including:
  - Notice of Study Commencement at the study start-up
  - PIC No. 1/Community Café and PIC No. 2
  - Notice of Study Completion to announce the start of the 30-day public review period
- Communication and coordination with agencies/consultants to obtain background information for input into the study and to obtain required approvals/permits
- Study updates on the project webpage located on the City's website
- Project Team Meetings with City staff
- Meetings with affected property owners, local residents, businesses and Indigenous Communities

4.1.1 Public Consultation

The study will use several techniques to proactively involve the public including a Community Café event, PIC and meetings with external stakeholders. Meetings will be organized with the stakeholders and may include adjacent landowners and other affected businesses or associations. These meetings will include representatives from the City and the consultant team.

Two public meetings will be held. The first public meeting will be a combined Community Café event and PIC No. 1. This event will follow the principles of the World Café philosophy and will engage the public and stakeholders in discussion on their perspectives and interests in the study. The Community Café is a simple yet effective conversational method for fostering dialogue, accessing collective intelligence, and creating innovative possibilities for action. The

Café will be an informal event facilitating conversation by providing participants with a comfortable and welcoming environment.

The second public meeting will be PIC No. 2, which will present the evaluation of design alternatives and the Technically Preferred Alternative (TPA) for the Study Area. Council members will be provided PIC materials in advance of the meeting and the consultant will be available to present to Council in advance of the public meeting.

The public meetings will be an integral component of the study - seeking input and comments from the public and stakeholders. There will be an opportunity for the public to comment on the study at any time. All information will be collected in accordance with the *Municipal Freedom of Information and Protection of Privacy Act* (2009). Anyone interested in the study will be added to the study mailing list upon request.

4.1.2 Agency Consultation

Agencies/Ministries will be contacted at the start of the study to inform them of Study Commencement and to circulate this Study Design. As the study progresses, meetings will be held with select agencies (as required) to review the study and obtain approvals in accordance with the Municipal Class EA. Agencies will include:

- Ministry of the Environment, Conservation and Parks
- Ministry of Natural Resources and Forestry
- Ministry of Indigenous Relations and Reconciliation
- Ministry of Heritage, Sport, Tourism and Culture Industries
- Infrastructure Ontario
- Department of Fisheries and Oceans
- Grand River Conservation Authority
- Transport Canada
- Emergency Services
- School Boards/Bus Services
- Other Stakeholders (as identified)

4.1.3 Indigenous Peoples Consultation

The City of Kitchener has a constitutional duty to consult with Indigenous Peoples with traditional land use or interests within the Study Area. Clear, effective and timely consultation with Indigenous Peoples is essential to ensure the success of the project. This will include:

- Identification of interested/affected Indigenous Peoples early in the decision-making process;

- Distribution and notification of relevant project-related information, including the Class EA process, environmental inventories and potential alternatives/impacts;
- Early identification of concerns/issues;
- Understanding of potential risk and impacts of the Study on Indigenous Peoples interests;
- Development of mutually acceptable solutions involving Indigenous Peoples; and
- Ensuring regulatory compliance throughout the Class EA process.

Indigenous Peoples will be consulted throughout the duration of the Study.

4.2 Work Program

The major elements of the work program are described in the following sections.

4.2.1 Phase 1: Identify the Problem

This phase of the Study will include: establishing the Study scope, schedule and approach with the Project Team and agencies; issuing the Notice of Study Commencement; the collection and organization of background information; reviewing and documenting existing conditions; and the transportation analysis to identify operational, safety and traffic concerns.

In addition, the following Community Engagement tools will be undertaken to proactively engage stakeholders early in the Study:

- **Study Design**: This Study Design presents: the Problem/Opportunity Statement; the consultation plan; project schedule; and identifies the scope of the Study's technical requirements, design standards and proposed evaluation criteria. This document is available for public/agency review and will help establish the foundation for all remaining environmental planning and public consultation processes.

  After the first PIC and based on comments received, the draft Study Design Report will be finalized and placed on the City's website as the Final Study Design Report.

- **Community Café/ PIC No. 1**: This event will be a collaborative community involvement tool that goes beyond the conventional information exchange at public meetings. The event will focus on listening to the community in small group discussions (without the study team in the dialogue) to build consensus on the issues and desires of the community.

4.2.2 Phase 2: Alternative Planning Solutions

The consideration of all reasonable alternatives is a guiding principle for EA studies. The Biehn Drive extension, sanitary sewer alignment, cross section, and intersection alternatives will be generated through discussions with the City, agencies and the general public.

The analysis and evaluation process involves a 2-step decision-making process. Initially the study documents the analysis and evaluation of Alternatives to the Undertaking (alternative project types or alternative strategies to address the problem) followed by the subsequent assessment of preliminary design alternatives.

The City of Kitchener TMP previously identified the extension of Biehn Drive as a City Street Capacity Improvement. This TMP completed Phase 1 and 2 of the Class EA process, including the evaluation of Alternative Planning Solutions. The TMP recommended this project as the "implementation of new streets in southwest Kitchener Urban Areas Study Community Master Plan, including extension of Biehn Drive between Biehn Drive and Robert Ferrie Drive".

4.2.3 Phase 3: Alternative Design Concepts for the Preferred Planning Solution

Preliminary Design Alternatives will be generated for the Preferred Alternative Planning Solution (Biehn Drive Extension) based on an inventory of the natural, social and cultural environment and results of technical investigations.

4.2.3.1 Environmental Inventories and Technical Investigations

Environmental inventories and technical investigations will be completed to assess the impacts of alternative design concepts. These investigations are described in **Sections 4.2.3.1.1** to **Section 4.2.3.1.7**.

4.2.3.1.1 Transportation and Traffic

Transportation/traffic analysis will be completed using a Complete Streets approach considering the needs of pedestrians, cyclists, motorists, goods movement including farm vehicles (if applicable) and transit services. The traffic analysis will assess existing and future traffic demand to the end of the Official Plan horizon. The study will provide recommendations for: intersection control (roundabout vs. signalized), pedestrian crossings, spacing of intersections with local streets and roadway cross section requirements (lane requirements, sidewalks and/or multi-use paths, continuation of existing bicycle lanes or transition to raised cycle tracks and potential traffic calming measures).

The traffic report will also provide recommendations on the timing of the improvements. This analysis will be used to identify the preliminary design level of geometric needs of the various alternatives (i.e. storage lengths, auxiliary lanes, signal/traffic controls, etc.) and in addition, will be used to evaluate the impacts/benefits of the various competing alternatives for the horizon years.

4.2.3.1.2 Sanitary Sewer

The Project Team will develop the design of the trunk sanitary sewer in conjunction with the alternative road extension alternatives. It is noted that some of the alternative alignments for the trunk sewer may diverge from the road alignment alternatives. The Class EA process for extension of the sanitary sewer is a Schedule B process. However, the EA for the road and sanitary sewer will be combined into a single document and will be documented in an ESR. This EA is being undertaken concurrently with the Sanitary Sewer Master Plan.

The preliminary design tasks will include preliminary design of the trunk sanitary sewer, including confirmation of drainage areas and design flows; drainage design, including hydraulic design of the crossings; and stormwater management design, including 30% design of stormwater management facilities and Low Impact Development measures.

4.2.3.1.3 Stormwater Management and Municipal Servicing

The Project Team will undertake a Stormwater Management (SWM) Plan and Report taking into consideration previously completed studies including the Strasburg Creek Flood Control Environmental Study Report and the Upper Blair Creek Functional Drainage Study. The work will include preliminary hydrologic and hydraulic modelling of the existing and proposed conditions and development of a SWM strategy in sufficient detail to satisfy regulatory concerns and obtain approvals in concept.

The preliminary design tasks will include: drainage design, including hydraulic design of the crossings; and stormwater management design, including 30% design of stormwater management facilities and Low Impact Development measures.

4.2.3.1.4 Geotechnical and Hydrogeological

Geotechnical information and published geological data from the area will be reviewed. In addition, three boreholes will be advanced along the proposed extension alignment. A soil investigation program will be completed to determine a soil characterization.

Geotechnical information and published geological data from the area will be reviewed. A geotechnical assessment of the alternatives will be completed.

4.2.3.1.5 Social Environment

An inventory of existing land uses within the Study Area will be undertaken. This will include documentation of agricultural/residential development (access, emergency services, trails, etc.) and utility corridor land uses. The inventory will also include consideration and identification of future land uses such as developments, right-of-way requirements, future transit and transportation facilities and development that could be implemented complying with existing planning documents. Any land use changes that have occurred will be documented.

In addition, an acoustical assessment for this project will be completed to determine the effects of the project beyond the local Study Area and will reflect traffic volume increases forecast along the existing Biehn Drive corridor. The assessment will determine existing daytime and nighttime sound level contours and future sound levels associated with the road extension for areas within existing residential (noise sensitive) land uses.

4.2.3.1.6 Natural Environment

The natural environmental team will review desktop/background information to identify any known natural features and complete field investigations in the spring and summer of 2021 to document existing conditions in the Study Area. A detailed Terms of Reference (TOR) is described below and will be submitted to the Grand River Conservation Authority for their review and comment. These TOR are based on a preliminary field visit conducted with the landowner.

A field visit was completed in the spring of 2021 with the landowner's environmental consultant (WSP) to determine what environmental inventories have been completed for the Study Area and to walk the proposed alignments for the Biehn Drive extension. Comprehensive surveys have been conducted over a number of years and the following information will be made available to BTE in support of the MCEA process:

- Wetland delineation GPS coordinates/shapefiles;
- Significant Wildlife Habitat (SWH) identified in the study area;
- Species at Risk (SAR) habitats and screening; and
- Ecological Land Classification (ELC) mapping.

Based on conversations with WSP and GRCA, the wetland delineation has not been field verified by GRCA staff. As such, a site visit will be scheduled for the summer of 2021 to stake the portion of wetland within the Biehn Drive extension Study Area in cooperation with WSP and GRCA. A digital file showing the approved wetland limits will be provided to GRCA and will form the basis for comparison of alternatives from a natural environmental perspective. Field work conducted in the summer of 2021 will also document the locations of Black Ash (*Fraxinus nigra*), a species soon to be listed under the *Endangered Species Act* (ESA) and identify future requirements for surveys during Detailed Design.

A Terrestrial and Aquatic Existing Conditions report will be prepared based on the 2021 field investigations and work previously completed by WSP in the Study Area. In addition to describing existing conditions, the report will quantify the anticipated extent of disturbance to the surrounding Provincially Significant Wetland (PSW) based on each alternative alignment of the roadway and/or sewer.

4.2.3.1.7 Cultural Environment

Potential Built Heritage Resources and Cultural Heritage Landscapes will be evaluated for the entire study area prior to the selection of preferred alternatives and summarized in the ESR.

This review will identify all known or potential built heritage resources and cultural heritage landscapes (BHR/CHLs). If resources are present, a cultural heritage assessment report will be completed with the potential project impacts to BHR/CHLs identified and strategies will be provided to mitigate identified impacts. These mitigation measures will inform project planning and design.

An Archaeological assessment (AA) will be undertaken by an archaeologist licenced under the *Ontario Heritage Act*, who is responsible for submitting the report directly to the Ministry of Heritage Sport, Tourism and Culture Industries (MHSTCI). A Stage 1 AA consists of a review of geographic, land use and historical information for the property and the relevant surrounding area, a property visit to inspect its current condition, and contacting MHSTCI to find out whether there are any known archaeological sites on or near the property. Its purpose is to identify areas of archaeological potential and determine whether additional archaeological assessment is necessary (e.g. Stages 2, 3, and 4).

4.2.3.2 Evaluation of Alternatives

Preliminary Design Alternatives will be evaluated using a qualitative evaluation process. Through this process, evaluation criteria will be identified including potential factors such as roadway level of service, traffic safety, accessibility, property impacts, socio-economic environment, natural environment, cultural heritage, technical aspects/construction complexity and implementation.

The evaluation and analysis will identify all improvement alternatives and associated cost estimates including lifecycle costs, alternative construction/material options, proposed timeline and innovative solutions. This document will be presented to the public for input at PIC No. 2. Following the PIC, refinements will be made to the Technically Preferred Alternative (TPA) (if applicable) and the refined alternative will become the Recommended Plan.

4.2.4 Phase 4: Environmental Study Report (ESR)

The preparation of the draft and final EA report will follow the format and content for an ESR as required by the Municipal Class EA document. The ESR will document the study methodology, findings, public involvement and recommendations. The report will provide recommendations on the phasing of the proposed works and preliminary cost estimates. The public will be notified of the availability of the ESR for a 30-day public review period.

5.0 Preliminary Design Alternatives

This Section describes Preliminary Design Alternatives for the extension of Biehn Drive. As an initial step in the generation of alternatives this Study has identified the groups of alternatives below.

Three alternatives were presented at Public Information Centre (PIC) No. 1 and to residents at the Community Café event. Based on comments received from attendees at the Community Café, a fourth alternative has been added for the subsequent evaluation. Alternative 4 will use existing collector roads to move vehicular traffic within the Doon South and Brigadoon communities. The project will include an extension of Biehn Drive for a maintenance road for the new sanitary sewer extension and an active transportation link as per the Official Plan.

- Road Alignments (see **Figure 4**)
    - Alternative 1: Connect to Robert Ferrie Drive east of Hydro One transmission tower
    - Alternative 2: Connect to Robert Ferrie Drive west of Hydro One transmission tower
    - Alternative 3: Connect directly westerly to Strasburg Road
    - Alternative 4: Use Existing Collector Roads
- Sanitary Sewer Alignments
    - Following the future Biehn Drive alignment
    - Following a separate alignment
- Intersection Type:
    - Conventional signalized
    - Unsignalized
    - Roundabout control
- Cross Section:
    - Urban cross section with sidewalk/multi-use trail (MUT)
    - Semi-urban cross section with MUT
- Traffic Calming Measures
    - Chicanes
    - Medians
    - Narrower driving lanes
    - Median bulb-outs

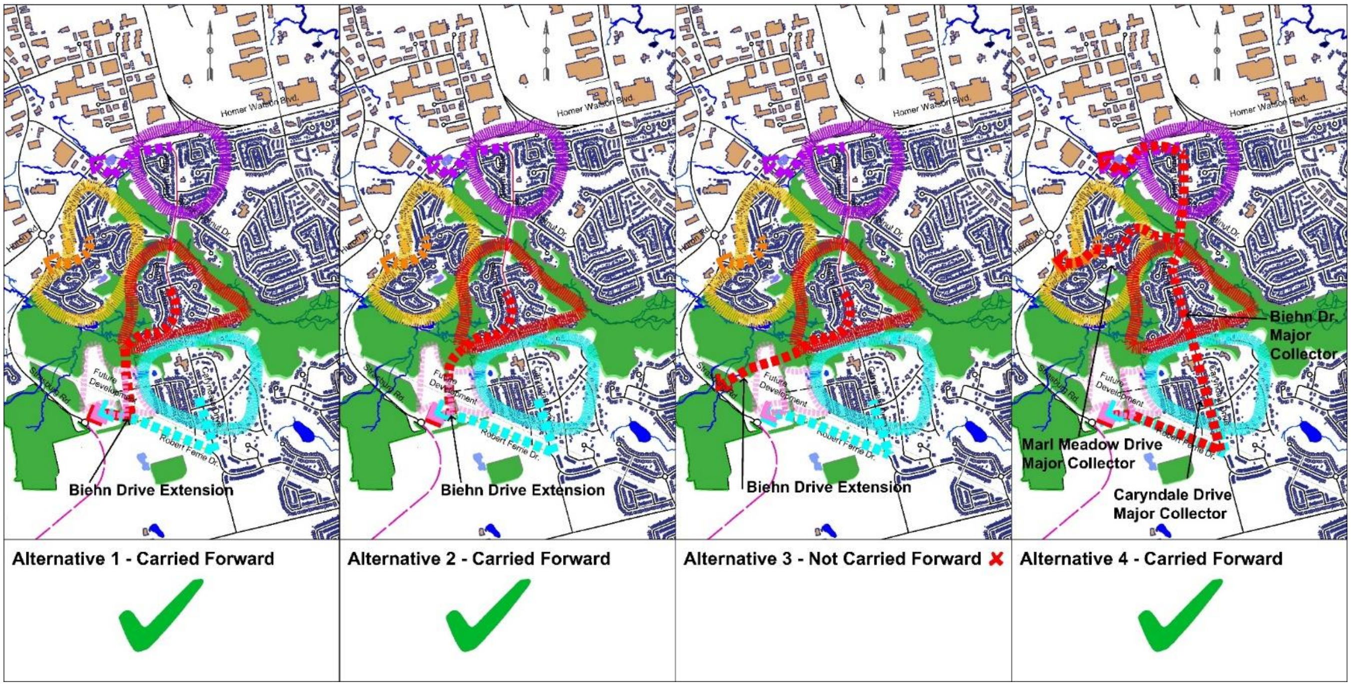


Figure 4: Preliminary Design Alternatives

5.1 Preliminary Coarse Screening of Alignment Alternatives

A coarse screening evaluation of the Preliminary Design Alternatives for the extension of Biehn Drive has been completed to compare the performance, effects and compliance with the City's planning documents, and screen out alternatives which do not address the objectives of the study or are significantly inferior to other competing alternatives.

The evaluation criteria ranking legend is provided below. The evaluation of alternatives is provided in **Table 1**.

✘	-	✓
Poor	**Fair**	**Good**

Table 1: Evaluation of Preliminary Alignment Alternatives

	Alternative 1: Connect to Robert Ferrie Drive east of Hydro Tower	**Alternative 2: Connect to Robert Ferrie Drive west of Hydro Tower**		**Alternative 3: Connect to Strasburg Road**		**Alternative 4: Use of Existing Collector Roads**
Transportation						
Does this alternative satisfy forecast traffic demand, improve safety, and address all modes of transportation?	✓ This alternative would provide a north-south connection to Robert Ferrie Drive to accommodate all modes. This alternative will accommodate vehicles to/from the Brigadoon community and will reduce cut-through traffic on local roads.	✓ This alternative would provide a north-south connection to Robert Ferrie Drive to accommodate all modes. This alternative will accommodate vehicles to/from the Brigadoon community and will reduce cut-through traffic on local roads.	-	This alternative would provide an east-west connection to Strasburg Road to accommodate all modes. This alternative will accommodate vehicles to/from the Brigadoon community.	✗	This alternative does not provide an east-west connection to Strasburg Road to accommodate vehicular traffic. This alternative will accommodate pedestrians/cyclists to/from the Brigadoon community. A maintenance road will also be constructed to provide access to the municipal services.
Environment						
Does the approach result in significant impacts to the natural environment?	- This alternative will result in minor impacts to the woodlot/wetland.	- This alternative will result in minor impacts to the woodlot/wetland.	✗	This alternative will result in significant impacts to the woodlot/wetland.	✓	This alternative will have the smallest footprint in the woodlot/wetland.
Affordability						
Is the approach affordable to the City to implement?	- No significant difference.	- No significant difference.	-	No significant difference.	✓	This alternative eliminates the collector road resulting in lower capital and maintenance/operation costs.
Compliance with City Planning						

Documents						
Does this alternative comply with the recommendations of the City's planning documents (i.e., TMP, OP, KGMP)	✓ This alternative complies with the recommendations of the City's planning documents.	✓ This alternative complies with the recommendations of the City's planning documents.	✗	This alternative does not address the recommendations of the Official Plan or Growth Management Plan. This alternative was originally recommended in the City's Transportation Master Plan; however, this recommendation was modified in the Official Plan. Based on the previous design and construction of the Strasburg Road and roundabout within the Study Area, this previous alternative is no longer considered feasible.	✗	This alternative does not address the recommendations of the Official Plan or Growth Management Plan. This alternative is being considered based on public input provided at Community Café / PIC No. 1.
Recommendation:	✓ Carry forward for further evaluation	✓ Carry forward for further evaluation			✓	Carry forward for further evaluation

Based on the preliminary coarse screening of alternatives, it is recommended that Alternative 3: Connect to Strasburg Road not be carried forward. This alternative would have significant environmental impacts and does not comply with the recommendations of the City's Official Plan or Growth Management Plan. It is recommended that the extension of Biehn Drive only consider connections to the extension of Robert Ferrie Drive.

6.0 Study Schedule

A schedule for this Study is shown below in **Table 2**.

Table 2: Study Schedule

Task	Date
Project Start-Up Meeting	January 2021
Study Commencement Notice	Winter 2021
Information Gathering	Winter 2021
Environmental Review	Winter/Spring 2021
Study Design	March 2021
Public Information Centre No. 1/ Community Café	Spring 2021
Analysis and Evaluation of Alternatives	Summer/Fall 2021
Public Information Centre No. 2	November 2021
Preparation of ESR	Fall/Winter 2021
Municipality Review of ESR	Winter/Spring 2021/2022
30-day Public Review Period	Spring 2022

Glossary of Terms

• **AADT**	Annual Average Daily Traffic – the average 24-hour, two-way traffic per day for the period from January 1st to December 31st.
• **Alignment**	The vertical and horizontal position of a road.
• **Alternative**	Well-defined and distinct course of action that fulfils a given set of requirements. The EA Act distinguishes between alternatives to the undertaking and alternative methods of carrying out the undertaking.
• **Alternative Project**	Alternative Planning Solutions, see above.
• **Bump-Up**	The act of requesting that an environmental assessment initiated as a class EA be required to follow the individual EA process. The change is a result of a decision by the proponent or by the Minister of Environment to require that an individual environmental assessment be conducted.
• **Canadian Environmental Assessment Act (CEAA)**	The CEAA applies to projects for which the federal government holds decision-making authority. It is legislation that identifies the responsibilities and procedures for the environmental assessment.
• **Class Environmental Assessment Document**	An individual environmental report documenting a planning process which is formally submitted under the EA Act. Once the Class EA document is approved, projects covered by the class can be implemented without having to seek further approvals under the EA Act provided the Class EA process is followed.
• **Class Environmental Assessment Process**	A planning process established for a group of projects to ensure compliance with the Environmental Assessment (EA) Act. The EA Act, in Section 13 makes provision for the establishment of Class Environmental Assessments.
• **Corridor**	A band of variable width between two locations. In transportation studies a corridor is a defined area

	where a new or improved transportation facility might be located.
• **Criterion**	Explicit feature or consideration used for comparison of alternatives.
• **Cumulative Effects Assessment**	Cumulative Effects Assessment assesses the interaction and combination of the residual environmental effects of the project during its construction and operational phases on measures to prevent or lessen the predicted impacts with the same environmental effects from other past, present, and reasonably foreseeable future projects and activities.
• **Detail Design**	The final stage in the design process in which the engineering and environmental components of preliminary design are refined and details concerning, for example, property, drainage, utility relocations and quantity estimate requirements are prepared, and contract documents and drawings are produced.
• **DFO**	Department of Fisheries and Oceans.
• **EA**	Environmental Assessment
• **EA Act**	Ontario Environmental Assessment Act, RSO 1990 c. E.18 (as amended July 21, 2020).
• **Environment**	• Air, land or water, • Plant and animal life, including human life, • The social, economic and cultural conditions that influence the life of humans or a community, • Any building structure, machine or other device or thing made by humans, • Any solid, liquid, gas, odour, heat, sound, vibration, or radiation resulting directly or indirectly from human activities, or • Any part or combination of the foregoing and the interrelationships between any two or more of them, in or of Ontario.

• **Environmental Effect**	A change in the existing conditions of the environment which may have either beneficial (positive) or detrimental (negative) effects.
• **ESR**	Environmental Study Report. The final documentation for a Schedule C project, defining the project, consultation process, preferred solution, and mitigation measures.
• **Evaluation**	The outcome of a process that appraises the advantages and disadvantages of alternatives.
• **Evaluation Process**	The process involving the identification of criteria, rating of predicted impacts, assignment of weights to criteria, and aggregation of weights, rates, and criteria to produce an ordering of alternatives.
• **External Agencies**	Include Federal departments and agencies, Provincial ministries and agencies, conservation authorities, municipalities, Crown corporations or other agencies other than MTO.
• **Factor**	A category of sub-factors.
• **General Arrangement**	Structural plan of the bridge and proposed works including elevations and cross-sectional views of the bridge.
• **GRCA**	Grand River Conservation Authority
• **Individual Environmental Assessment**	An environmental Assessment requiring the submission of a document for approval by the Minister, pursuant to the EA Act and which is neither exempt from the EA Act nor covered by a Class EA approval.
• **MECP**	Ministry of the Environment, Conservation and Parks.
• **MHSTCI**	Ministry of Heritage, Sport, Tourism and Culture Industries.
• **Mitigating Measure**	A measure that is incorporated into a project to reduce, eliminate, or ameliorate detrimental

	environmental effects.
• **Mitigation**	Taking actions that either remove or alleviate to some degree the negative impacts associated with the implementation of alternatives.
• **MNRF**	Ministry of Natural Resources and Forestry.
• **MTO**	Ministry of Transportation Ontario.
• **NSA**	Noise Sensitive Areas
• **OP**	Official Plan
• **PIC**	Public Information Centre
• **Planning Alternatives**	Planning alternatives are "alternative planning solutions" under the EA Act. Identification of significantly different transportation engineering opportunities while protecting significant environmental features as much as possible.
• **Preliminary Design Alternatives**	Preliminary Design Alternatives are "alternative methods " of carrying out the selected planning solution while maximizing social and transportation benefits while protecting significant environmental features as much as possible.
• **Project**	A specific undertaking planned and implemented in accordance with the Class EA including all those activities necessary to solve a specific problem.
• **Proponent**	A person or agency that carries or proposes to carry out an undertaking, or is the owner or person having charge, management, or control of an undertaking.
• **Public**	Includes the public, interest groups, associates, community groups, and individuals, including property owners.
• **Realignment**	Replacement or upgrading of an existing roadway on a new or revised alignment.
• **Recommended Plan**	That part of the planning and design process, during

	which various alternative solutions are examined and evaluated including consideration of environmental effects and mitigation; the recommended design solution is then developed in sufficient detail to ensure that the horizontal and vertical controls are physically compatible with the proposed site, that the requirements of lands and rights-of-way are satisfactorily identified, and that the basic design criteria or features to be contained in the design, have been fully recognized and documented in sufficient graphic detail to ensure their feasibility.
• **SAR**	Species at Risk
• **Screening**	Process of eliminating alternatives from further consideration, which do not meet minimum conditions or categorical requirements.
• **SDR**	Study Design Report.
• **Sub-factor**	A single criterion used for the evaluation. Each sub-factor is grouped under one of the global factors.
• **TAC**	Technical Advisory Committee. The TAC will include the approving agencies and Consultant. It will act as the decision-making body for the study recommendations.
• **TIS**	Traffic Impact Study
• **TMP**	Transportation Master Plan
• **TPA**	Technically Preferred Alternative
• **TPP**	Technically Preferred Plan
• **Traceability**	Characteristics of an evaluation process which enables its development and implementation to be followed with ease.

Appendix B

Record of Consultation

BT ENGINEERING

Community Café Summary Report

Biehn Drive Municipal Class Environmental Assessment

May 2021

Submitted by:
BT Engineering Inc.
509 Talbot Street
London, ON N6A 2S5
519-672-2222

Table of Contents

List of Figures

List of Tables

List of Appendices

1.0 INTRODUCTION

This report summarizes the results of the comments received at the online Community Café carried out by BT Engineering Inc. (BTE) in support of the Municipal Class Environmental Assessment (EA) Study for the extension of Biehn Drive in the City of Kitchener.

At the time of the Community Café, the Province of Ontario implemented restrictions on public gatherings to deal with the COVID-19 pandemic, and as such the meeting relied on web-based communications.

The Environmental Assessment (EA) and land use planning for this road link have been ongoing for several decades, and the previous Transportation Master Plan and current Official Plan have identified this project. The TMP completed Phases 1 and 2 of the Municipal Class EA. The current study is completing the subsequent Phases 3 to 5 of the Municipal Class EA and has been initiated by the City of Kitchener to develop a transportation plan for the extension of Biehn Drive westerly to the Robert Ferrie Drive extension. The Biehn Drive extension will include municipal services including a trunk sanitary sewer, storm sewer/ditches and watermain. The Study will evaluate alternatives for the alignment of the Biehn Drive extension, intersection locations and designs, and municipal services while minimizing the environmental, social, and cultural impacts of the project.

The Study Area is located in the City of Kitchener and is illustrated on **Figure 1**.

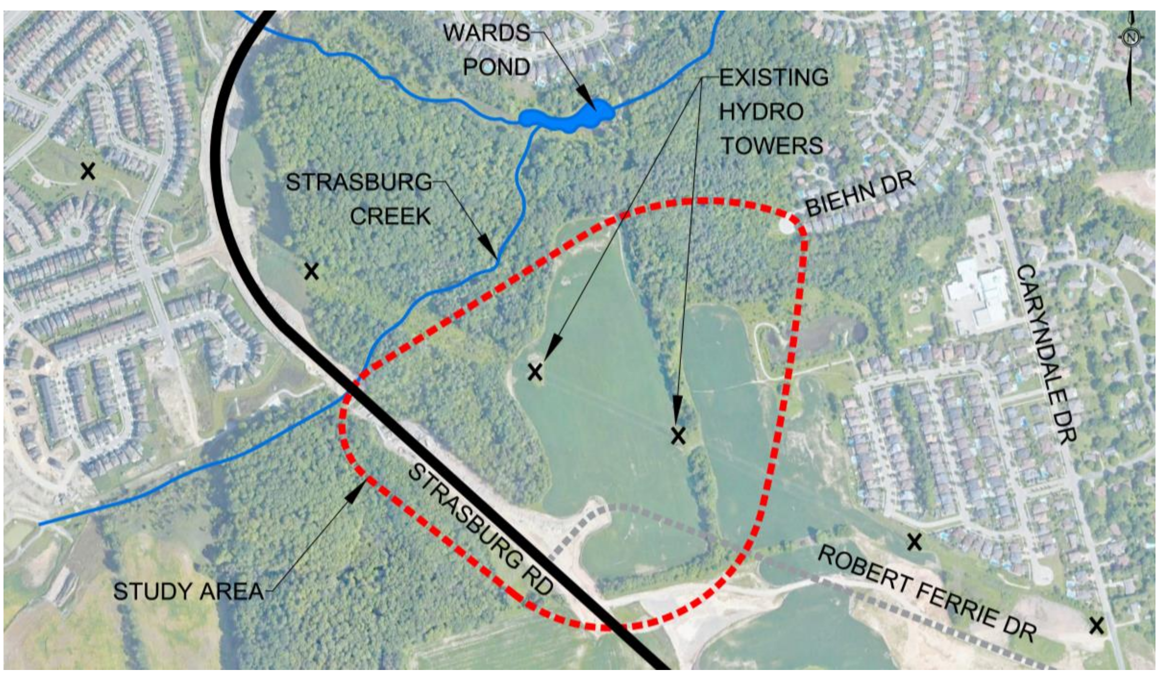


Figure 1: Study Area

The online Community Café event was held on April 20, 2021. Notices and invitations were sent out prior to the event and copies are included in **Appendix A**. The Community Café was conducted with key stakeholders and the public as part of the Environmental Assessment process. Thirty-two (32) people attended the Community Café event.

1.1 History of the Biehn Drive Extension

The Biehn Drive extension has been included in City planning documents since the late 1980's. It first appeared in the Brigadoon Community Plan in 1989 and was identified as a necessary connection between the Brigadoon Community and Strasburg Road.

Following this Community Plan, the road link was adopted into the City's Official Plan as Amendment No. 98 in 1991. The extension has been identified in every subsequent Official Plan, Transportation Master Plan and area planning study including:

- Doon South – Brigadoon Transportation Network and Corridor Study (McCormick Rankin, 1994)
- Kitchener Planning and Development Staff Report PD95/51 (1994)
- Updated Brigadoon Community Plan (2005)
- Kitchener Integrated Transportation Master Plan (2013)

In recent years, the extension of Biehn Drive was reviewed as part of the Robert Ferrie Drive Environmental Assessment (EA). A Need and Justification Review was completed in 2014 as part of this EA and concluded that the extension to Robert Ferrie Drive as well as the extension of Biehn drive were both necessary collector roads to accommodate the transportation needs of the Brigadoon/Doon South communities.

This recommendation was included in the Official Plan Amendment No. 103 in March 21, 2019.

2.0 METHODOLOGY

The Community Café process follows the principles of the "World Café" philosophy; namely, that people want to talk together about issues that matter, and that as we talk together we are able to collectively achieve greater wisdom. People have the capacity to work together and can collectively be creative and insightful when actively engaged in meaningful conversations. The Community Café is a simple yet effective conversational method for fostering dialogue, accessing collective intelligence and creating innovative possibilities for action. The seven Café principles are:

1. Set the context
2. Create hospitable space
3. Explore questions that matter
4. Encourage everyone's contributions
5. Connect diverse perspectives
6. Listen together for insights
7. Share collective discoveries

The Community Café was an informal event that facilitated conversation by providing participants with a comfortable and welcoming environment. Informational exhibits were prepared in advance of the Café and were available on the City's website. Copies of the exhibits are provided in **Appendix B**.

The event was organized to create a dialogue about issues that matter to the stakeholders and community. Each conversation was chosen to consider the most important parameters of the project and the desired goals of the participants. Four discussion topics were provided to reflect the concerns of the community. As participants discussed each topic, key ideas and perspectives were exchanged, providing new insights to the project.

A facilitator encouraged all participants to contribute to the conversation and to remain focused on the topic being discussed.

The four topics chosen to be discussed during the event were:

1. Traffic Operations
2. Pedestrians/Cyclists
3. Intersection Design
4. Neighbourhood Concerns

2.1 Opening Presentation

The Community Café event began with an introductory presentation from Mr. Steve Taylor, Consultant Project Manager, (see the Café Presentation in **Appendix C**). Mr. Taylor introduced the project and provided background information including the project issues, approach and process.

Following the project introduction, Mr. Taylor explained the process and objectives of the Community Café event. The participants were then moved to small breakout rooms to begin discussion on the applicable topics.

3.0 TOPIC DISCUSSIONS

In each breakout room, a topic of conversation was provided for discussion. Each topic had several questions associated with the topic; however, the conversation often diverged from the given questions. This allowed for conversation to flow freely and created an encouraging environment for all participants to contribute ideas and perspectives. It also provided the participants an opportunity to direct the conversation to issues that are relevant to their actual concerns.

The following sections summarize the ideas and comments expressed during the event. The comments are listed based on the discussion topic of the table.

3.1 Topic 1: Traffic Operations

Question 1: What intersection/roadway improvements would you like to see with the extension of Biehn Drive?

- General opposition to the extension of Biehn Drive from residents living on Biehn Drive.
    - The proposed extension of Biehn Drive should not be considered as a "done deal".
    - Extension of Biehn Drive will have massive impacts on residents. This has already happened to Caryndale Drive with the extension of Robert Ferrie Drive.
    - The EA should not be initiated until Robert Ferrie Drive extension is constructed. This would allow the City to collect traffic information instead of relying on projections.
    - Consideration should be given to changes in travel patterns with more workers working from home.
    - Road users are already set in their traffic patterns. The extension is not required. Two collector roads in such close proximity are redundant.
- The extension is not considered to be required because the neighbourhood is already connected to Robert Ferrie Drive at Caryndale Drive.
- Participants noted they were aware of the project and want to ensure that the road extension will protect the natural, social and cultural environments.
    - The project has been documented in various City planning documents for approximately 20 years.
    - The proposed extension of Biehn Drive has always been part of planned area development and the plan was in place when many of the area residents purchased their homes.
    - The understanding is that the Biehn Drive and Robert Ferrie Drive Extensions are interconnected projects that would be delivered together, benefiting area traffic.
- The potential for increased traffic volume on Biehn Drive was also a concern; there were conflicting opinions that the traffic volumes on Biehn Drive would increase while

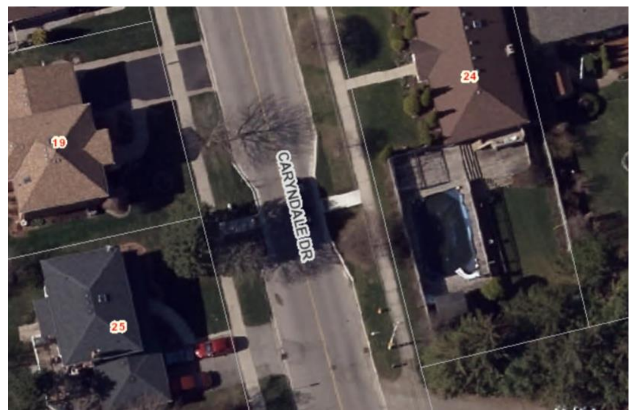
others acknowledged that the traffic volumes on sections of Biehn Drive can be expected to decrease.
    - The planned extensions of Biehn Drive and Robert Ferrie Drive would combine to redirect traffic away from Caryndale Drive and existing Biehn Drive.
- Conflicting opinions were expressed regarding access to the arterial road network:
    - That there is no problem driving north to Huron Road from within the neighbourhood; versus
    - The shorter distance to the Strasburg Road Extension would be a convenient alternative that they would use.
- Preference for Alternative 1; however, participants did not support the road or services extension.
- Consideration should be given to creating a cul-de-sac on the south side of the Provincially Significant Wetland to service the development instead of extending Biehn Drive.
- Consideration should be given to extending Biehn Drive for active transportation uses only. This would limit impacts to the natural environment and improve connectivity of the trail network.
- The opportunity for transit service through the neighbourhood, with the planned extension, would benefit existing area traffic.

Question 2: Do you have any safety concerns related to the future extension of Biehn Drive (i.e. speed, volumes, cut-through traffic)?

- There are existing safety concerns on Caryndale Road and Biehn Drive because of high speeds and traffic volumes.
    - Support for reducing the posted speed on Biehn Drive.
    - Support for making the area a Community Safety Zone or School Safety Zone.
- There are safety concerns at the corner of Biehn Drive and Caryndale Road because approximately 25% of cars at the intersection don’t stop. This a safety issue for the school.
- There is already a high collision rate at Robertson Crescent and Biehn Drive.
- Need to maintain a safe area for vulnerable road users.
    - There are several schools located in close proximity to the Study Area.
    - Neighbourhood children frequently use the current Biehn Drive cul-de-sac for activities. The dead-end creates a safe space for children.
- Concern for increased traffic volumes as a result of the proposed development north of Robert Ferrie Drive on the existing farmland.
    - Would the road alignment alternatives support different development scenarios (i.e. housing, commercial, large apartment buildings, traffic generators)?
- There is a lot of truck traffic on the existing Biehn Drive. Truck traffic should not be allowed on the extension.

Question 3: Should traffic calming features be included (i.e. medians, speed humps)?

- High speeds are an issue on Biehn Drive. Controlling traffic speed on Biehn Drive was noted to be a major concern for many individuals.
- Mitigation with narrowing roads and signs bolted to street create more of a road hazard than slowing people down. More traffic in the neighbourhood increases the chances of an injury/accident. Kids walking to school and people walking in the neighbourhood are at risk already.
- The traffic calming measures constructed on Caryndale Drive are ineffective and create more confusion for drivers (see photos below).
    - Drivers don't know how to navigate the mini roundabout constructed.
    - Drivers don't know if they are required to stop at the crosswalk. Crosswalks should be signed and have flashing lights to alert drivers.



- Centre medians are more cosmetically appealing and reflect the neighbourhood character, additional green space/grassed area.
- Narrowing roads/chicanes/medians are road hazards. Narrowing lanes forces traffic together. Chicanes would be difficult for snow removal and aren't aesthetically appealing.
- Speed humps work to slow down traffic, but drivers weave around them creating a safety concern.
- Any traffic calming measure implemented must ensure it will not impact emergency services operations.
- Support for a curvilinear alignment to slow down drivers.
- Potential to have a 90-degree bend at the existing Biehn Drive cul-de-sac to slow drivers down as they approach the future extension.

3.2 Topic 2: Pedestrians/Cyclists

Question 1: What are the main safety concerns for pedestrians/cyclists along the extension of Biehn Drive?

- Biehn Drive and the future extension are not safe because of traffic volumes and speed.
- Active transportation facilities need to be safe for children and people with disabilities.
  - There are three group homes in this area for people with disabilities.
  - There are multiple schools located in close proximity.
  - There is a day-care close to the Study Area, and they frequently walk to the dead-end.
- Crossings need to be provided to allow kids and vulnerable road users a way to cross the street.
  - Consider installing pedestrian cross-overs.

Question 2: Should active transportation facilities be provided along the Biehn Drive extension, and if so which type (i.e. MUT, sidewalk)?

- A multi-use trail from Robert Ferrie Drive to the existing end of Biehn Drive would be preferred.
  - A MUT provides a safe space for all road users.
  - There are a lot of children with bikes in the area; children's safety is a very important consideration for the project.
- Extending sidewalks along both sides of the proposed extension, as exists along existing Biehn Drive, was also suggested.

Question 3: How should cycling be accommodated in the corridor?

- There are no facilities for cyclists along the existing Biehn Drive.
  - If cycling facilities were built, they wouldn't be continuous.
- A separated cycling lane with dividers looks bad and doesn't create a welcoming environment for all cyclists.
- Pedestrians and cyclists to be separated from vehicular traffic.
- There should be a boulevard/separation between vehicular lanes and active transportation facilities.
- Preference to reduce the width of the boulevard through the wetland to protect the natural environment.

Question 4: How should linkages be made to the existing trail system?

- It was noted that there has already been an increase in the number of pedestrians using area trails.
- It is important to maintain the existing trail system and linkages to parks/schools, natural features etc.
  - Access needs to be maintained between residential areas and public spaces.
- There is an informal trail that exits the Parkwood Estates development. It should be continued. The trail would need to cross Biehn Drive to get to the other side.

3.3 Intersection Design

Question 1: Are there concerns about implementing a roundabout at the new intersection with the future extension of Robert Ferrie Drive?

- Support for a full-size roundabout at the Biehn Drive/Robert Ferrie Drive extension.
  - Allows for continuous traffic flow.
  - A roundabout would reduce traffic speeds.
- Concern for the proximity of the roundabouts on Robert Ferrie Drive at Biehn Drive and Strasburg Road.
- Concern for pedestrian safety at roundabouts

3.4 Neighbourhood Concerns

Question 1: What are the community concerns with respect to the existing neighbourhood (i.e. noise, visual intrusion etc.)?

- Concern for the cost of the project to City taxpayers.
- The majority of impacts will be on residents located west of Caryndale Road. These residents will experience increased traffic volumes, noise and pollution in front of their homes.
- The out-of-way travel to Robert Ferrie Drive is short enough that the extension is not needed.
- Concern for construction traffic in the neighbourhood
- Investigation of the natural environment, cultural heritage significance and archaeological potential of the area is required.
- Parking on the existing Biehn Drive should be maintained.
- Benefits of the proposed extension would include improved Emergency Vehicle Access to the existing neighbourhood.

Question 2: Do you have any environmental concerns for the natural areas being crossed by the project?

- The wetland attracts many visitors. The community doesn't want to lose this asset.
  - The wetland contributes to the mental and physical health of the residents and should be maintained.
  - People move to the area because of the wetland. It is the most important feature of the community.
  - The park area serves the community and should be protected.
  - The increased number of pedestrians already using area trails is already an impact on the environment.
- Concern for impacts to the natural environment and the PSW.

  - How will a road be maintained through a wetland without being washed out/compromised continuously?
  - There are branches of Strasburg Creek that are located beneath the proposed Biehn Drive extension.
    - Construction of a new road and sanitary sewer will impact the flow of water.
    - The water table is already very high and some residents have sump pumps running year round. The water table has been stable (no huge flood events) but does cutting into the environmental area impact the water table? If the water table rises, flooding basements would be inevitable.
    - Concern for sediment contamination in watercourses during construction.
- Developers have historically not protected the environment. They need to follow regulations and protect the natural habitat during construction.
  - Developers should not be allowed to build houses in the wetland.
  - A buffer should be maintained between the development and the wetland.
- The road will interrupt existing wildlife corridors.
  - Deer, foxes, ducks etc. are frequently seen in the wetland. The past winter was the best winter for deer – they follow behind the existing houses and through the environmental areas towards the Grand River.
  - Species at Risk (SAR) need to be identified and protected.
  - A rare salamander was found in the woodlot.
- There is a need to protect existing trees/vegetation.
  - It is Kitchener's policy to not cut trees and encourage tree growth - how is this road extension lining up with that?
    - It was suggested that the proposed extension violates the City of Kitchener's Strategic Plan for the Environment.
  - Any tree removed for this project should be replaced at two or three times the number.
  - Replacement trees should be native species. Avoid Norway maples.
- Concern for the impact to existing wells.
  - The health of the City's water supply should be considered.
- Concern for the increased impermeable area because of increased asphalt.
  - This will result in more salt entering the wetland.
- Support for a wildlife crossing (tunnel under Biehn Drive).

4.0 COMMENT SHEETS

Six comment sheets were received in advance of the Community Café and during the subsequent two-week comment period. These comments are summarized in **Table 1** and, with the exception of personal information, are provided in **Appendix D**.

Table 1: Summary of Written Comments

Comment	Number of Respondents	Comment Sheet No.
Opposition to the extension of Biehn Drive.	3	1, 2, 3
Current cul-de-sac is a quiet, safe spot without heavy traffic	1	1
The natural environment and trails in the Study Area are important features of the area.	3	1, 3, 4
Concern for the impacts to the natural environment as a result of the extension.	5	1, 2, 3, 4, 5
Concern for impacts to the water table.	3	2, 3, 5
Is there a need for the extension once traffic is diverted to Robert Ferrie Drive and Strasburg Road?	2	1, 2
Consider providing only municipal services (i.e. water, storm and sanitary sewer) through the extension (no road).	2	1, 3
Some residents in the area were not aware that the extension was planned.	1	2
Future consultation with residents should clarify that the extension will be built so there isn’t confusion over other alternatives being considered.	1	2
Additional traffic studies should be completed or made available for the Study Area.	1	2
It is discouraging that the City is more focused on serving developers instead or preserving green space/quiet neighbourhoods.	1	2
The City is violating its own strategic plan to protect the natural environment if Biehn Drive is extended.	1	3
More transparency is required regarding the evaluation of alternatives (i.e. environmental impacts). Mitigation measures must also be described in the EA.	1	3
Concern for the cost of the extension.	1	3
Consider providing a road through the development that does not connect to Biehn Drive (cul-de-sac before the wetland).	4	2, 4, 5, 6
Traffic speeds/volumes are already an issue on Biehn Drive. The extension will make this worse.	1	5

5.0 SUMMARY AND NEXT STEPS

The discussion presented in this report represents the opinions and input of the meeting participants. This input reflects perspectives of local residents along Biehn Drive who may not have been unaware or do not support the community planning that was predicated on providing a westerly connection of Biehn Drive to Strasburg Road as part of the transportation and land use plan since the 1980's. The key messages from attendees that were summarized at the end of the meeting include:

- Can earlier decisions be reviewed including not extending Biehn Drive (change the traffic planning to divert this traffic to other communities/streets)?
- Can the link be solely for active transportation?
- Can the need for the street extension be communicated to those living near the extension?
- Create a context sensitive project that recognizes the environmental significance of the Provincially Significant Wetland.
- Traffic calming of any project should achieve a slow and safe road for those living along Biehn Drive.

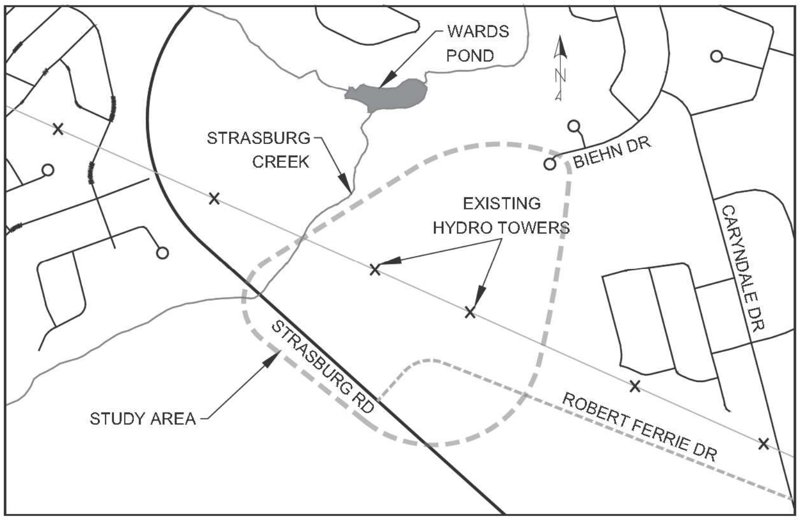
This discussion will be used as input by the Project Team for subsequent steps in the Study. At this stage of the study no decisions have been made.

Readers of the report are cautioned that the recorded ideas and discussions are unsubstantiated, may or may not be feasible, and require development. They do, however, represent an effort for the early identification of the issues and alternatives for the project that are consistent with the values and opinions of the meeting participants.

Appendix A

Notice of Study Commencement and Community Café

Notice of Study Commencement and Community Café
City of Kitchener
Biehn Drive Extension Environmental Assessment



INTRODUCTION

The City of Kitchener has retained BT Engineering Inc. to undertake an Environmental Assessment (EA) Study for the extension of Biehn Drive from the existing terminus 300 m west of Caryndale Drive to the future Robert Ferrie Drive extension. The Study will evaluate alternatives for alignment, cross sections, intersections and active transportation to develop a preferred plan to address the needs of the Study Area and reflect the recommendations in the City of Kitchener Transportation Master Plan.

STUDY PROCESS

The Biehn Drive Extension EA Study is being conducted as a Schedule C EA Study under the Municipal Class Environmental Assessment (MCEA) (2015). The Transportation Master Plan (TMP) has previously completed Phases 1 and 2 of the Class EA; this Study will review the previously completed phases and complete Phases 3 and 4. The Study will consider all reasonable alternatives with acceptable effects on the natural, social and cultural environments, and proactively involve the public, stakeholders and Indigenous Peoples.

PUBLIC CONSULTATION

Study Design Report: A draft Study Design Report has been prepared that describes the study background, approach, process, alternatives and consultation program. The draft Study Design Report is available on the City's website at: https://www.kitchener.ca/en/development-and-construction/infrastructure-projects.aspx

Community Café: An online Community Café event will be held to help define the study scope and issues. The goal of the Community Café event is to engage the public/stakeholders on their perspectives and interests in the Study. **To register for the Community Café, please contact Steve Taylor or Eric Riek.**

The online Community Café will be held as follows:

Date: April 20, 2021
Time: 6:30 to 8:00 pm
Location: Register by email to be sent the Virtual Meeting Room (Zoom) Link

Comments: There is an opportunity at any time during the Class EA process for interested persons to provide comments. Early identification of individual and group concerns greatly aids in addressing these concerns. All information will be collected in accordance with the *Municipal Freedom of Information and Protection of Privacy Act* (2009). With the exception of personal information, all comments will become part of the public record. Persons will be advised of future communication opportunities by electronic notice in addition to newspaper public notices.

For more information, to register for the Community Café, or if you wish to be placed on the study's mailing or emailing list, contact either:

Steve Taylor, P.Eng.
EA Project Manager
BT Engineering Inc.
509 Talbot Street
London, ON N6A 2S5
Tel: 519-672-2222
Email: stevenj.taylor@bteng.ca

Eric Riek, C.E.T.
City Project Manager
City of Kitchener
200 King Street West
Kitchener, ON N2G 4G7
Tel: 519-741-2200 ext. 7330
Email: eric.riek@kitchener.ca

This notice issued on March 26, 2021.

Appendix B

Community Café Exhibits

BT ENGINEERING
BTE

Welcome!
City of Kitchener
Biehn Drive Extension
Class Environmental Assessment

Thank you for participating in the Online Public Information Centre (PIC) for the City of Kitchener's Class Environmental Assessment (EA) for the extension of Biehn Drive and the sanitary trunk sewer.

At the present time, the Province of Ontario has implemented restrictions on public gatherings to deal with the COVID-19 pandemic. As a result, this Public Information Centre is relying on web-based communications. Should you have any questions regarding the study, please contact the City or Consultant Project Managers.

There is an opportunity at any time during the Class EA process for interested persons to provide written input. Any comments received will be collected under the *Environmental Assessment Act* and, with the exception of personal information, will become part of the public record.

Comments can be submitted by emailing stevenj.taylor@bteng.ca and/or eric.riek@kitchener.ca by **May 4, 2021**.

KITCHENER

Introduction

The City of Kitchener has initiated a Class Environmental Assessment (EA) Study for the extension of Biehn Drive and the sanitary trunk sewer from the current terminus of Biehn Drive (approximately 60 m west of Spencer Court) southerly to the future Robert Ferrie Drive Extension.

This Study will complete the planning and preliminary design steps of the Municipal Class EA by conducting a transportation needs assessment, generating and evaluating planning alternatives, and proactively involving the public in defining a recommended plan for improvements.

This Study is being completed as a Municipal Schedule C Class EA undertaking based on the range of anticipated effects. A Draft Study Design Report describing the study process has been made available for agency and public comments and is available on the City's website.

Class Environmental Assessment (Class EA) Process

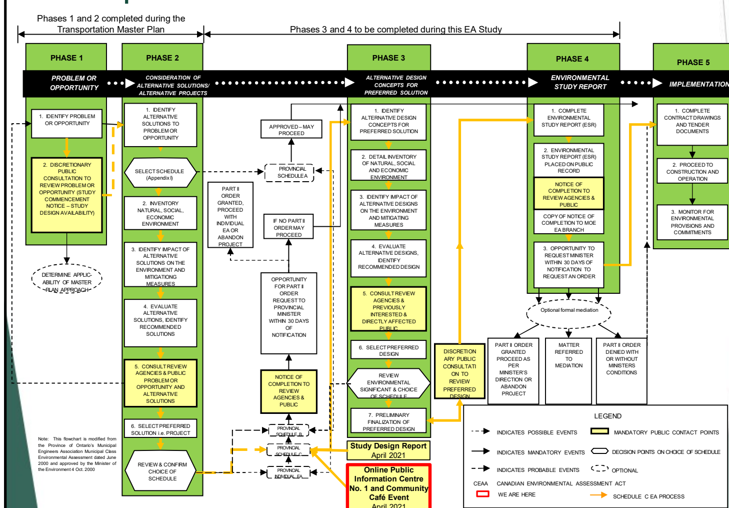
This study is being initiated as a Municipal Schedule C project as defined by the Municipal Class Environmental Assessment (MCEA). Consultation is a key component of the Class EA process. The goal of consultation is to provide stakeholders and affected individuals opportunities to make their interests and concerns known to the project team throughout the EA process. The early identification of issues and concerns allows the project team to investigate with the goal of, if possible, resolving the concern.

At the completion of the EA process, an Environmental Study Report (ESR) will be produced. The Report will document key components of the study: need and justification; the range and types of consultation; natural and socio-economic environmental inventories; evaluation of alternatives; selection of the recommended alternative; and supporting reports produced for the project. Upon the completion of the ESR, the public and interested stakeholders will be made aware of 30-day public review of the Report.

If, after viewing the future ESR and having made your concerns known to the project team, you still have concerns during the 30-day review period, you have rights under the *Environmental Assessment Act.* These rights will be outlined in the public notice advising of the 30-day public review period.

The Municipal Class EA process is illustrated on the following exhibit.

Municipal Class EA Process



Background

Since the mid-2000's, the road network and municipal servicing for the Doon South and Brigadoon areas in the City of Kitchener have been planned to accommodate area development and evolving transportation needs. Several planning documents including the City's Official Plan and Transportation Master Plan (TMP) have identified the need to extend Biehn Drive westerly to the Robert Ferrie Drive extension. The Biehn Drive Extension would be a major collector road, as identified in Schedule B of the City of Kitchener's Official Plan. This link would accommodate vehicles to and from the Brigadoon community, and would help mitigate cut-through traffic on local streets within the community. A collector road collects traffic from local roads within the community and provides connectivity to arterial roads including Strasburg Road.

Biehn Drive Extension as identified in the Official Plan (Integrated Transportation System)

Problem and Opportunity Statement

Future development within the Doon South and Brigadoon communities requires a defined alignment for the extension of Biehn Drive to Robert Ferrie Drive as part of the area road network. In order to determine the road alignment, this Study will consider the natural, social environments and the future land use in the Study Area. The extension of Biehn Drive is required to accommodate municipal servicing, and safely and reliably accommodate all modes of transportation including vehicular, pedestrians, cyclists and trucks. By defining the future road and municipal servicing plans, the subsequent land use plans can be completed by developers.

The Study will provide the opportunity to: improve accessibility to the local community by providing additional network links; define a multi-modal transportation plan to support travel within the local neighbourhoods; and allow development to proceed on lands that currently require the roadway to be defined prior to developing the land use plan.

Study Considerations

- **Existing Community**
  - Changes in sound levels
  - Changes in traffic volumes on Biehn Drive
  - Potential mitigation may include traffic calming measures, pedestrians/cyclist facilities, and mitigation of noise impacts.
- **Natural Environment**
  - Potential for Species at Risk (SAR) in woodlots and the Strasburg Creek Provincially Significant Wetland (PSW)
  - Two cold-water systems: Strasburg Creek (immediately north of the Study Area) and Blair Creek (900 m south of the Study Area).
  - Minimize footprint within, and impacts to, the Strasburg Creek system.
- **Transportation**
  - Improvements are required to address long-term traffic operations.
- **Active Transportation:**
  - Active modes of transportation will require separated facilities to service all ages and abilities as identified in the Cycling and Trails Master Plan.
  - This could include multi-use pathways, sidewalks, buffered bicycle lanes and/or raised cycle tracks.

Assessment of Alternative Planning Solutions

Alternative Planning Solutions (Alternatives to the Undertaking) represent alternative ways or methods of addressing the problem to be solved by the project. In determining the preferred undertaking for the City, the following Planning Solutions were evaluated:

- ✘ Do Nothing: This alternative would maintain the existing road network and would not extend Biehn Drive.
- ✓ Transportation Demand Management (TDM): Reduces vehicular traffic demand (encourages alternative work hours, work at home and active modes of transportation).
- ✘ Greater Use of Local Roads: Encourage the use of local roads to reduce the need to extend Biehn Drive. Local roads are generally not designed or maintained to accommodate high traffic volumes.
- ✘ Limit Land Use Development: Limit any new residential, commercial or industrial development and therefore reduce the generation of new trips.
- ✓ Extend Biehn Drive: Provides a long-term solution for improved traffic capacity, operations and safety.

Based on the preliminary review of Alternative Planning Solutions, "**Transportation Demand Management"** and **"Extend Biehn Drive"** are recommended. This Planning Solution addresses the problem statement by improving transportation service and safety.

The evaluation is documented on the following exhibit for public review and comment. All comments received will be reviewed and considered before proceeding with the Study and the evaluation of TDM (Active Transportation Improvements) and New Infrastructure alternatives.

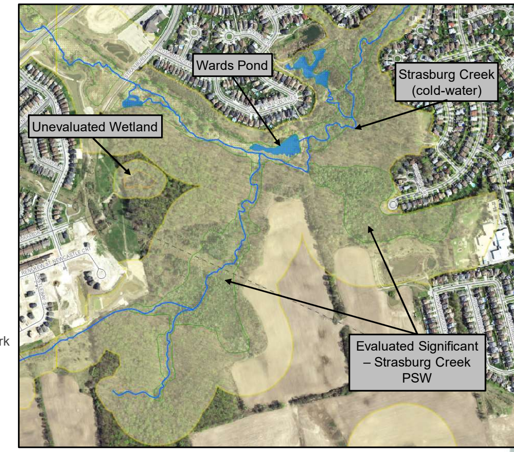
Assessment of Alternative Planning Solutions

Screening Criteria	Alternative 1: Do Nothing	Alternative 2: TDM	Alternative 3: Local Roads	Alternative 4: Limit Development	Alternative 5: Extend Biehn Drive
Transportation	Does not address forecast traffic demand. Results in increased volumes on local roads.	May reduce vehicular demand by mode shift or work at home but will not eliminate need for new or improved infrastructure.	Local roads not designed to accommodate increased volumes.	May reduce vehicular demand by reducing the number of trips generated by development but does not address existing demands and/or background growth.	Accommodates all modes of transportation.
Environmental	No impacts.	No or low impacts. Low impacts may be associated with active transportation projects/ improvements (i.e. sidewalks, bike lanes).	Low impacts. Creates disruption to properties on local roads that would experience an increase in traffic.	No impacts.	Low to medium environmental effect possible with new corridor. Magnitude of effects is subject to environmental mitigation.
City Planning Objectives	Does not meet objectives/ recommendations in City Planning documents.	Supports objective to encourage active transportation and alternate modes.	Does not meet objectives/ recommendations in City Planning documents.	Does not meet objectives/ recommendations in City Planning documents.	Supports the recommendations for the extension of Biehn Drive in OP and TMP.
Recommendations	Not recommended. ✘	Recommended as a complementary solution. ✔	Not recommended. ✘	Not recommended. ✘	Recommended to be carried forward. ✔

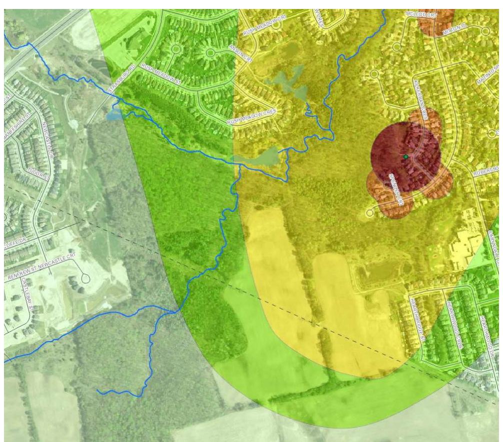
Existing Conditions
Natural Environment

Regulated Watercourse (GRCA)
Regulated Waterbody (GRCA)
Wetland (MNRF)
Provincially Significant
Locally Significant
Unevaluated
Regulation Limit (GRCA)

- Potential SAR:
  - Butternut (Endangered)
  - Snapping Turtle (Special Concern)
  - Eastern Meadowlark (Threatened)
  - Bobolink (Threatened)



Existing Conditions
Well Head Protection Area



Regulated Watercourse (GRCA)
Municipal Well (GRCA)
WHPA Vulnerability (GRCA)
10
8
6
4
2
Regulated Waterbody (GRCA)

https://maps.grandriver.ca/web-gis/public/?theme=MYP&bbox=542091,4802909,545343,4804695

Preliminary Design Alternatives

Preliminary design alternatives for the extension of Biehn Drive were categorized into 5 groups:

Alignment Alternatives	Intersection Alternatives	Sanitary Sewer Alignments	Cross Section Alternatives	Traffic Calming Alternatives
Connect to Robert Ferrie Drive east of Hydro Tower	Signalized	On Road Alignment	Urban Cross Section with sidewalk/ Separated Bike Facilities	Chicanes
Connect to Robert Ferrie Drive west of Hydro Tower	Unsignalized	New Alignment	Semi-Urban Cross Section with Separated Bike Facilities	Median
Connect to Strasburg Road	Roundabout			Narrower Driving Lanes
				Median Bulb-Out

These groups of alternatives are presented on the following exhibits.

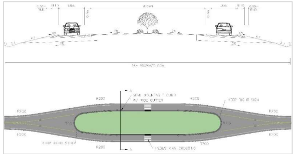
Traffic Calming Alternatives

Traffic calming measures, to control speed and discourage through traffic, will be considered along the extension of Biehn Drive, and will further support future recommendations for the Biehn Drive Traffic Calming Study being completed to the north of the Biehn Drive extension. These may include:

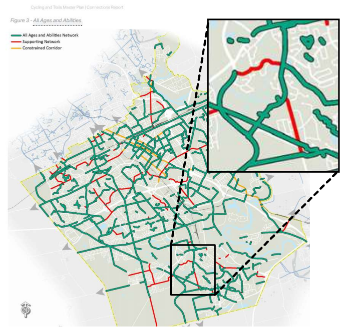

Speed Humps/Cushions or Raised Crosswalks

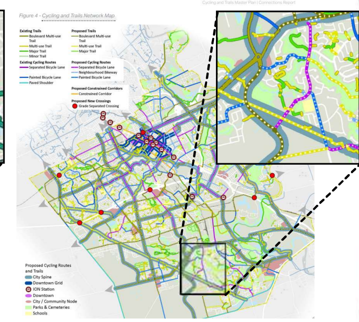

Centre Median


Chicanes


Median Bulb-outs

Cycling and Trails Master Plan





- Identified Cycling Facilities on Biehn Drive to be for all Ages and Abilities.
- Proposed Separated Bicycle Lanes on Biehn Drive with Multi-Use Trails along Strasburg Road and the Hydro Corridor.

Types of Separated Bicycle Facilities

Accommodating all ages and abilities of cyclists along the proposed extension of Biehn Drive could consider a variety of alternatives. These may include:

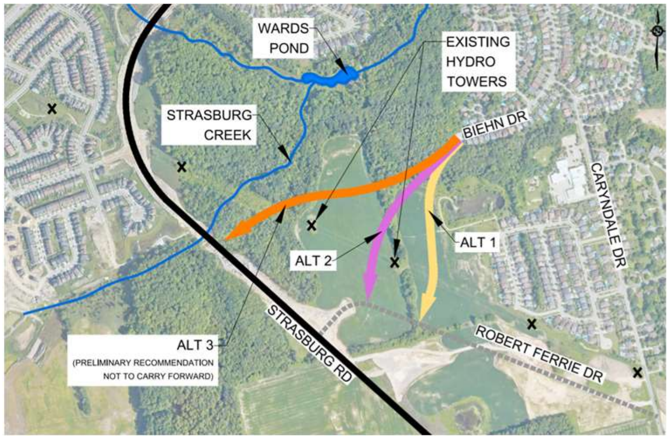

Boulevard Multi-Use Trails


Buffered Bike Lanes


Raised Cycle Tracks

Although Separated Bike lanes/Cycle Tracks were identified in the CTMP, consideration of Boulevard MUTs would be an extension of the facilities on Strasburg Road and along the Hydro Corridor and could transition to another type of future facility along existing Biehn Drive if necessary.

Alignment Alternatives

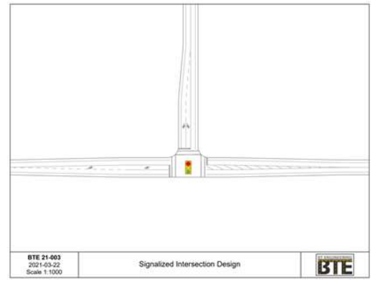


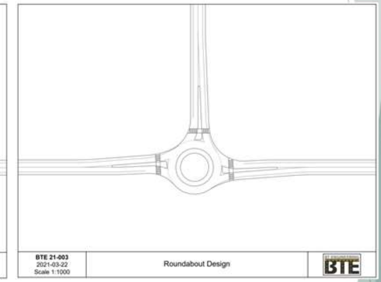
Alignment Alternatives

Coarse Screening

Screening Criteria	Alternative 1: Connect to Robert Ferrie Drive east of Hydro Tower	Alternative 2: Connect to Robert Ferrie Drive west of Hydro Tower	Alternative 3: Strasburg Road Connection
Does this alternative satisfy forecast traffic demand, improve safety, and address all modes of transportation?	Provides a north-south connection to Robert Ferrie Drive. Accommodates all modes. Reduces cut-through traffic on Biehn Drive.	Provides a north-south connection to Robert Ferrie Drive. Accommodates all modes. Reduces cut-through traffic on Biehn Drive.	Provides a north-south connection to Strasburg Road. Accommodates all modes.
Does the approach result in significant impacts to the natural environment?	Minor impacts to the woodlot/PSW (~0.3 ha).	Minor impacts to the woodlot/PSW (~0.3 ha).	Significant impacts to the woodlot/wetland (~1.3 ha).
Is the approach affordable for the City to implement?	No significant difference.	No significant difference.	Higher cost - requires an intersection onto Strasburg Road (arterial).
Does this alternative comply with the recommendations of the City's planning documents (I.e., TMP, OP, KGMP)	This alternative complies with the recommendations of the City's planning documents.	This alternative complies with the recommendations of the City's planning documents.	Does not comply with the recommendations of the Official Plan or Growth Management Plan. Based on the previous design and construction of the Strasburg Road and roundabout within the Study Area, this previous alternative is no longer considered feasible.
Recommendation:	Carry forward for further evaluation ✓	Carry forward for further evaluation ✓	Do not carry forward ✗

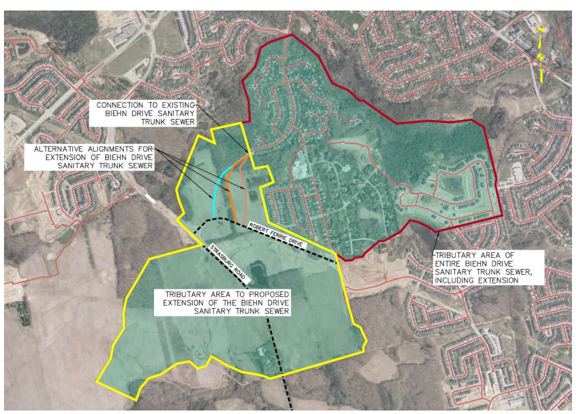
Intersection Alternatives





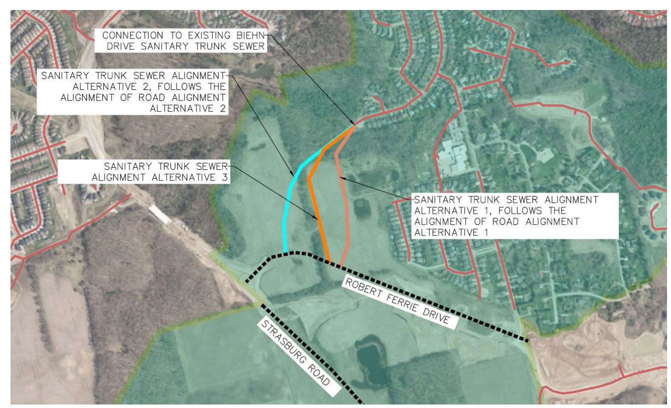
Sanitary Trunk Sewer Extension Alternatives

The trunk sanitary sewer will extend from the existing Biehn Drive cul-de-sac to the future Robert Ferrie Drive Extension. The trunk sewer will serve the area shown.



Sanitary Trunk Sewer Extension Alternatives

Three alternative alignments will be considered. They are shown schematically in the figure.



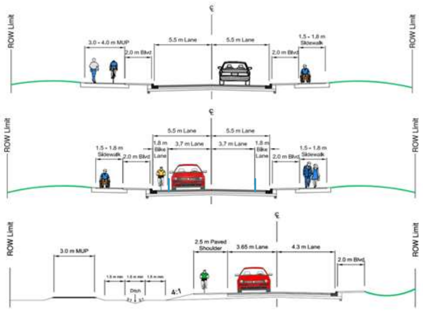
Potential Cross Section Alternatives

Could include but not be limited to:

Urban with multi-use path and sidewalk

Urban with sidewalk and buffered bike lanes

Semi-urban with multi-use path and paved shoulder



The planned extension of Biehn Drive is proposed to:

- Not provide direct driveway access. This will improve safety for cyclists and pedestrians,
- Not permit on-street parking.

Access to residential lots and on-street parking would be provided along local roads within the adjacent community.

The preferred cross section will consider LID measures for stormwater management within the ROW.

Analysis and Evaluation

Alternatives will be evaluated following this Public Information Centre. The following long list of evaluation criteria (factor groups and subfactors) is being considered for the assessment of the alternatives:

Natural Environment
Air quality
Species at Risk (SAR)
Cold / cool / and warmwater fish habitat impacted
Water quality – stormwater runoff
Migratory bird nesting impact/loss of existing vegetated areas
Provincially significant natural areas and habitat (i.e. Provincially Significant Wetlands)
Regionally significant natural areas and wildlife habitat (i.e. woodlots, non provincially significant wetlands, fauna and flora)
Natural habitat impacted (e.g. specimen trees removed)
Groundwater
Climate change
Land Use and Property
Property required (Residential)
Property required (Agricultural)
Property required (Commercial)
Cost
Capital cost
Future life cycle cost
Utility relocation

Social and Cultural Environment
Historic archaeological potential
Prehistoric archaeological potential areas impacted
Built heritage sites impacts
Cultural landscape features
Noise impacts
Vibration impacts
Excess materials management
Water wells impacted
Lighting and visual impacts
Economic environment
Transportation
Traffic operations - delays
Safety - collision potential
Safety – design consistency
Movement of goods
Pedestrian access
Ability to accommodate cyclists
Emergency vehicle access

Next Steps

Following this meeting we will:

- Review all comments
- Carry out environmental inventories and technical investigations
- Complete the analysis and evaluation of alternatives
- Hold Public Information Centre No. 2

We want to hear from you!

- Please provide comments by filling out the comment form or by contacting the City's representative or the consultant below:

Steve Taylor, P.Eng.	**Eric Riek, C.E.T.**
EA Project Manager	City Project Manager
BT Engineering Inc.	City of Kitchener
509 Talbot Street	200 King Street West
London, Ontario N6A 2S5	Kitchener, ON N2G 4G7
Tel: 519-672-2222	Tel: 519-741-2200 ext. 7330
Email: stevenj.taylor@bteng.ca	Email: eric.riek@kitchener.ca

Please provide your comments on or before **May 4, 2021.**

Thank you for your participation in the study.

- To receive updates on the project, request that your name/e-mail be added to the mailing list.
- Your input into this study is valuable and appreciated.

All information is collected in accordance with the *Freedom of Information and Privacy Act.*

Appendix C

Community Café Presentation

Biehn Drive Extension and Sanitary Trunk Sewer Extension

ONLINE COMMUNITY CAFÉ

APRIL 2021

1

Meeting Overview

- Project Introduction
- Community Café Overview
- Café Roundtable Discussions
- Final Wrap-up

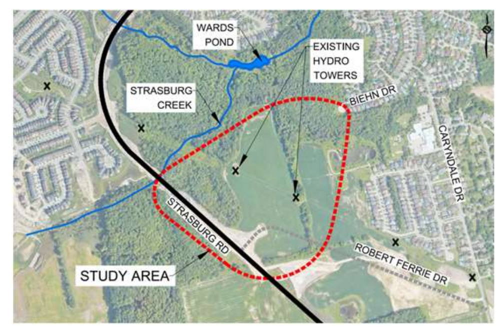
2

Project Introduction

3

Project Introduction

- This Study will be undertaken as a Schedule C Municipal Class Environmental Assessment for the extension of Biehn Drive from its current terminus to the future Robert Ferrie Drive Extension
- The Study will also include the extension of the trunk sanitary sewer, watermain and storm sewers (Schedule B)



4

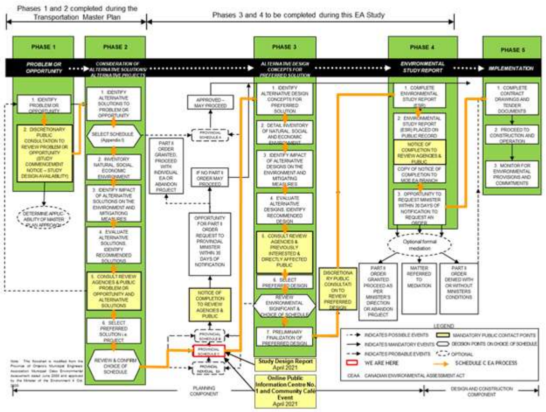
Class EA Process

Biehn Drive Extension

"Construction of new roads or other linear paved facilities (e.g. HOV lanes)" > 2.4 m – Schedule C

Sanitary Sewer Extension:

"Establish, extend or enlarge a sewage collection system and all works necessary to connect the system to an existing sewage outlet where such facilities are not in an existing road allowance or an existing utility corridor." – Schedule B



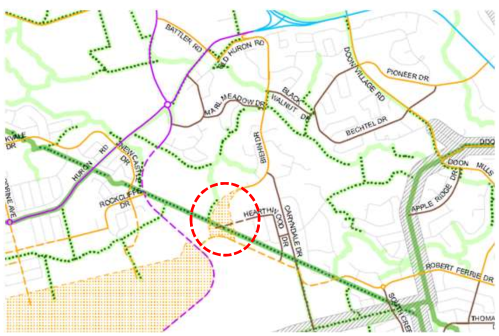
5

Background Information

- Community Plans for the Doon South and Brigadoon areas have established the need for the extension of Biehn Drive
- This has been documented in the Official Plan and Transportation Master Plan
- The new road link will accommodate all modes of transportation (vehicles, trucks, pedestrians and cyclists)

6

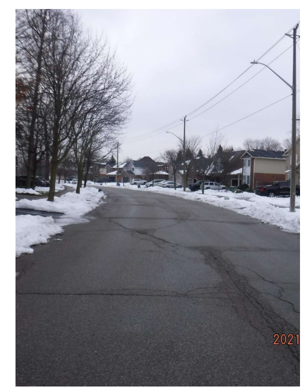
Official Plan – Integrated Transportation System



7

Key Issues

- **Impacts on the Existing Community**: The existing Brigadoon community is an established residential area with low ambient sound levels and low traffic volumes on Biehn Drive
  - Walking, cycling and parking are prevalent along Biehn Drive



8

Key Issues

- **Natural Environment** : The EA will investigate the protection of surrounding terrestrial habitat and will establish mitigation for any potential impacts to the natural environment
  - There is potential for SAR in the woodlots

9

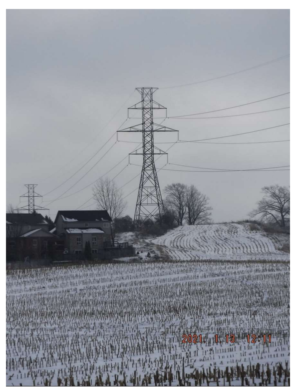
Key Issues

- **Social and Cultural Environment:**
  - Maintain access to adjacent properties
  - Mitigate impacts to property owners and road users during and post construction (i.e. noise, air quality, safety)
  - Consideration of vulnerable road users (i.e. pedestrians, cyclists and transit)
  - Potential property impacts to residential and agricultural lands
  - Archaeological and cultural heritage resources (the Study Area is located within the Haldimand Tract)

10

Key Issues

- Other issues include:
  - Proximity to adjacent intersections on Robert Ferrie Drive and the need to accommodate trucks through the roundabout
  - Consideration of any proposed plans of subdivision/utilization of development land and the potential network of future local streets
  - Potential utility conflicts including the east-west hydro corridor and the vertical clearance to existing aerial lines
  - Consideration and assessment of potential traffic calming measures to assist in controlling traffic speeds



11

Preliminary Design Alternatives

- Several groups of preliminary design alternatives will be developed and evaluated:

Alignment Alternatives
- Connect to Robert Ferrie Drive east of Hydro Tower
- Connect to Robert Ferrie Drive west of Hydro Tower
- Connect to Strasburg Road

Intersection Alternatives
- Signalized
- Unsignalized
- Roundabout

Sanitary Sewer Alignments
- On Road Alignment
- New Alignment

Cross Section Alternatives
- Urban Cross Section with sidewalk/ Separated Bike Facilities
- Semi-Urban Cross Section with Separated Bike Facilities

Traffic Calming Alternatives
- Chicanes
- Median
- Narrower Driving Lanes
- Median Bulb-Out

12

Preliminary Design Alternatives

Alignment Alternatives

13

Preliminary Design Alternatives

Separated Bicycle Facility Alternatives


Boulevard Multi-Use Trails

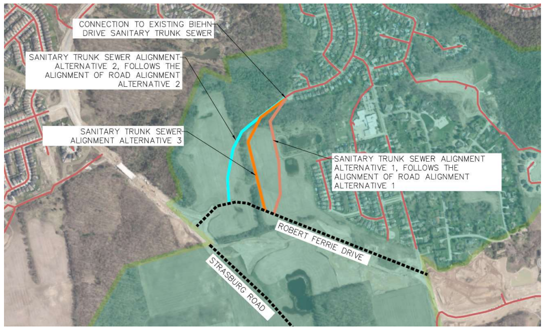

Buffered Bike Lanes


Raised Cycle Tracks

14

Preliminary Design Alternatives

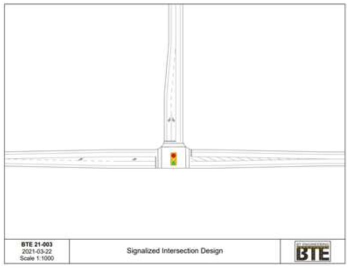
Sanitary Sewer Alignment Alternatives

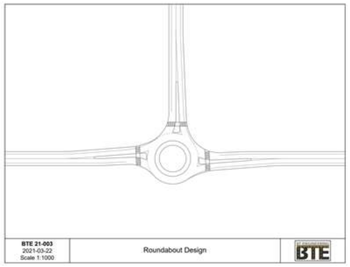


15

Preliminary Design Alternatives

Intersection Alternatives





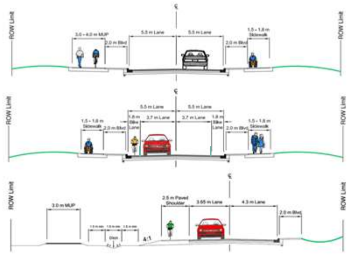
16

Preliminary Design Alternatives
Cross Section Alternatives

Urban with multi-use path and sidewalk

Urban with sidewalk and buffered bike lanes

Semi-urban with multi-use path and paved shoulder



17

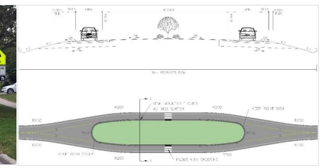
Preliminary Design Alternatives

Traffic Calming Alternatives

Speed Humps/Cushions or Raised Crosswalks

Centre Median

Chicanes



Median Bulb-outs

18

Community Café

19

Community Café Process

- Participants will be divided into small groups to allow conversations and dialogue
- At the conclusion of a discussion period, participants will be asked to change tables and mix between topics
- Participants are free to sit out a session
- A recorder person will make notes of the discussion of problems and potential solutions, and pose questions to generate discussion

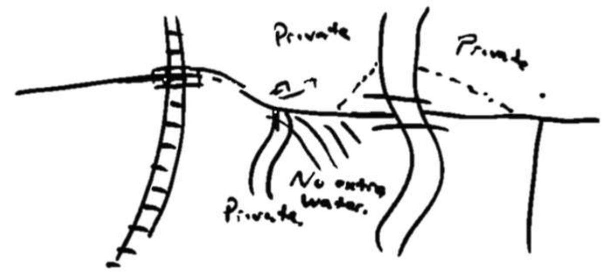
20

Café Approach

- Focus on dialogue between neighbours
- We are here to listen to your values and priorities
- Informal discussion of topics
- Encouraged to doodle sketches
- Build consensus of perspectives
- Records will be kept of discussions

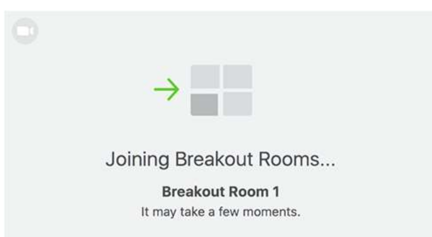
21

Sample Doodle



22

Small Group Discussions



23

Tonight's Café Discussion Topics

- Traffic Operations
- Pedestrians/Cyclists
- Intersection Design
- Impacts to Neighbourhood

24

Schedule and Next Steps

25

Next Steps

1. Needs analysis and presentation of Draft Study Design Report (SDR)
2. Environmental inventories and technical investigations to be used as input for the evaluation
3. Analysis and evaluation of alternatives
4. Selection of Recommended Plan – preferred alignment and consideration of refinements and mitigation for the Recommended Plan
5. Present Preliminary Design of Recommended Plan at PIC No. 2

26

Study Schedule

Task	Date
Project Start-Up Meeting	January 2021
Study Commencement Notice	Winter 2021
Information Gathering	Winter 2021
Environmental Review	Winter/Spring 2021
Study Design	February 2021
Public Information Centre No. 1/ Community Café	Spring 2021
Analysis and Evaluation of Alternatives	May/June 2021
Preparation of ESR	Summer/Fall 2021
Public Information Centre No. 2	Summer/Fall 2021
City Review of ESR	September/November 2021
30-day Public Review Period	October/November 2021

27

Community Café Wrap-up

- Additional information can be found at:

https://www.kitchener.ca/en/development-and-construction/infrastructure-projects.aspx

28

Appendix D

Community Café Comment Sheets

From: [redacted]
Sent: Wednesday, March 31, 2021 7:40 PM
To: Eric Riek <Eric.Riek@kitchener.ca>; stevenj.taylor@bteng.ca
Subject: [EXTERNAL] Biehn Dr extension

Hi Eric and Steve,

Can I please get the link for the virtual discussion regarding this extension?

I know there'll probably be the chance to share opinions but the current cul de sac is a wonderful quiet spot to take kids for a walk and let them run around without the heavy traffic that is near our place on Biehn. Not to mention there is a scattering of great trails through that area that allows us to enjoy the woods.

As is, it will already be a big change when subdivisions inevitably get built in the farm fields to the south west of the end of Biehn, but it would be wonderful if there wasn't also a road directing traffic through this area too.

I'd be interested to first see the numbers on how much traffic will get diverted to the Robert ferrie extension when it meets up with the Strasburg extension, as my gut would be that it would help take some of the traffic away from the north end of biehn. I can't see the cars from the area south of caryndale on Biehn adding that much to the traffic on Biehn, I would assume the majority is the other more dense subdivisions to the north of caryndale and would only get added to with the new houses on Robert ferrie.

So to me the Robert ferrie to Strasburg extension makes sense as it will disturb no more forest than it already has (the section that Strasburg has cut through with the bridge). But I don't see the benefit of extending Biehn Drive as well.

If there is the need to divert or run water and or sewer lines from the end of Biehn to connect to Robert ferrie, perhaps there is a option of just running the lines through without the additional cut needed for a full road plus sidewalks.

[redacted]

Re: Biehn Dr extension

[redacted]
Wed 4/21/2021 11:46 AM

To: Steve Taylor (London) <stevenj.taylor@bteng.ca>
Cc: eric.riek@kitchener.ca <eric.riek@kitchener.ca>; Katherine Scott <katherine.scott@bteng.ca>

Hi all,

Not sure how these community cafes typically go, and how they compare in the Zoom format vs in person, but I think the main takeaway for me was how much of the study group was opposed to the Biehn road extension. I think it's a hard stance to take that the extension will benefit more residents than those that it will hinder/negatively impact.

The concern about affecting the water table is a valid one especially for those that back onto that wetland, and I think the biggest issue for me is how small an area of farmland would actually be accessed by this extension. I don't see the benefit of the access off of Biehn vs directing it all towards Robert Ferrie and Strasburg.

That being said, it sounds like decisions have already been made in the past, though it's definitely interesting to hear how many people on the cafe said they've lived 20+ years in the area and how many were surprised that the extension had already been approved.

I think the descriptions of the paper pamphlet as well as the language used last night by the moderators gave the impression that there was still room for input regarding whether the extension would happen or not. Might have been a bit smoother to say right off the bat, the extension has been approved and is going ahead. This discussion is to get feedback on what that extension would look like.

However, I know from my end being a relatively new resident (5+ years), it is frustrating not having any say in whether the extension happens or not since this discussion has been in the works for so long. And for a project that's been so long in the works, I'm surprised there isn't more data on the existing traffic volumes and the expected volumes when new housing is built and if the extension is built to show what is being used to determine that the extension will in fact cause less traffic on Biehn instead of more.

I find communities like this one where a residential area is almost circled by green space are few and far between and it's pretty discouraging that the city/planners seem more focused on serving new developments vs preserving green space and quiet neighborhoods. I don't think anyone can argue that even the best designed subdivision these days provides a nicer atmosphere than the section of neighborhood at the end of Biehn Dr.

Like I said in the breakout group, I'm not opposed to the development of the farmload beyond the wetland, that is something that we all assume will happen at some point. But there was already a swath of green space that was cut through for the Strasburg extension, and all the new development will already crowd around the greenspace that is left. So I find it hard to justify the Biehn extension for the amount of farmland available for development to the south of the current end of Biehn.

[redacted]

Biehn Drive Extension Class Environmental Assessment and April 20, 2021 Community Café Comments

Land use planning matters.

The Grand River Conservation Authority (GRCA). has confirmed that the area behind our house and the existing Cull de Sac is part of the Provincially Significant Strasburg Creek Wetland Complex. According to the City of Kitchener (C of K) Notice of Study and Community Café, “The study will consider all reasonable alternatives with acceptable effects on the natural, social and cultural environments”. The C of K Strategic Plan for the Environment states “our strategic plan for the environment shows how we will put the environment first, reduce our carbon emissions and preserve our planet. We work to develop and maintain an ecologically diverse open space network that incorporates typical naturally occurring landscapes, significant natural features and the urban forest, all of which embody our natural heritage. We protect our water supply by working with the Region of Waterloo and the Grand River Conservation Authority to replenish and protect our water and wetlands”. If Biehn Drive is extended the C of K is violating its own Strategic Plan for the Environment. It is time for C of K staff and elected officials to lead, not continue as in the past.

Area residents have lived in a wet area for 30 years How is the C of K going to ensure we do not get more water on our properties and in our basements if the wetlands are tampered with? What is the Contingency Plan if this occurs? Documentation of the contingency plan is only fair to existing residents.

Page 9 of the Environmental Assessment (EA)

Alternative 5: Extend Biehn Drive Environmental “Low to medium environmental effect possible with new corridor. Management of effects is subject to environmental mitigation”.

Background data and methodology on how this rating was achieved must be included as part of the EA. As it reads now, the rating is only an opinion of the author(s).

“Magnitude of effects is subject to environmental mitigation.” What does this mean? Environmental mitigation steps must also be documented in the EA.

Page 13 of the EA: Biehn Drive Traffic Calming Study

Please provide the modelling data and any other information for this study as it becomes available.

During the Community Café it was pointed out many times that the proposed extension of Biehn Drive does nothing for the existing residents. We do not want the road extended. Extending Biehn Drive is an unnecessary expense.

It was also pointed out on numerous occasions in the Café that if water and sewer connections are required to the existing infrastructure on Biehn Drive a road is not required to do this. The connections could be done with an easement.

In conclusion the entire EA and Community Café is slanted towards the extension of Biehn Drive. The environment and wishes of existing area residents must be considered. Does the C of K lead and follow its Strategic Plan for the Environment or do mistakes from the past continue?

[redacted]

Biehn Drive City Café and Environmental Assessment Comments

The City of Kitchener invited interested residents to a Community Café Zoom meeting April 20 to discuss the extension of Biehn Drive. Many people talked at the meeting. We ask that you come to a decision with an open mind. Please take into account the comments the people have made.

Kitchener has a decision to make. On one hand the extension of Biehn, which involves plowing through the Provincially Significant Strasburg Creek Wetland Complex. On the other hand, planning a new route through the new subdivision, leaving the wetland alone.

The wetland at the end of Biehn Drive is loved by our family. It is part of our neighbourhood. We have lived here for 31 years and have seen the trees from all our windows. We have seen the forest change through the seasons, seen the mature trees moving in the wind, seen the sunset through their branches. The land behind our house and around the circle is extremely wet. It is a true wetland with its unique and complex biodiversity.

Kitchener can be archaic or Kitchener can be progressive. Archaic-disregard nature. Stick to a plan that was devised 30 years ago. Progressive- see the value of this wetland and change with the times.

Unfortunately, the forest that joins our wetland has already been altered by the removal of trees and the paving of Strasburg Road right through it. The forest was sliced in half.

How many wetlands in the City of Kitchener and Waterloo Region have been lost during all these years of development?

We hope you will save this one. Please do so before it is too late, and all that is left are regrets.

Sincerely,

[redacted]

From: [redacted]
Sent: April 23, 2021 4:28 PM
To: Steve Taylor (London) <stevenj.taylor@bteng.ca>
Cc: eric.riek@kitchener.ca <eric.riek@kitchener.ca>
Subject: Re: Biehn drive extension assessment zoom meeting

Hi Steve
I did not receive a Zoom link for the Community Cafe on April 20.
Even though I was not able to take part in the discussions I am still interested in the plans for the Biehn Extension.
I wonder how much influence local residents actually will have on developing a design.

I have read the draft report on the website and have some thoughts.
-It refers to Biehn as becoming a major collector road - It already is. The speed of the traffic on Biehn has already become dangerous. If the extension is built the problem will increase. It will create the need for added "calming" devices installed to slow drivers down. At the moment cars have to stop to turn onto Caryndale. That slows the raceway down a bit.
- Mention is made of "cut through" traffic. What streets are those? Biehn is the main road through.
- what is going to happen to the wildlife corridor behind Biehn? If it gets disturbed for a road, the wildlife will be cut off from their pond access and roaming areas. Their habitat has already been disturbed by the Strasburg Extension construction.
- How will the swamp recharge area be handled? This is a sensitive area.
- Could the developers not access servicing off Hearthwood or Robert Ferrie?

Please add me to the study's mailing list.
[redacted]

Katherine Scott

From: [redacted]
Sent: April 22, 2021 1:04 PM
To: Katherine Scott
Subject: RE: Biehn Drive | Online Community Cafe (April 20, 2021)

I have one add on suggestion please

Would it be possible to build the road towards Biehn dr. and just stopping short of wetlands? You could build a cul de sac? This would allow development for most of area

Thanks

[redacted]

Sent from Mail for Windows 10

From: Katherine Scott
Sent: April 12, 2021 11:24 AM
Cc: Steve Taylor (London); Eric Riek
Subject: Biehn Drive | Online Community Cafe (April 20, 2021)

Good morning,

Thank you for registering for the Biehn Drive Extension Class Environmental Assessment (EA) Community Cafe Event. The online Community Cafe is scheduled for April 20, 2021 from 6:30 to 8:00 pm. The meeting will be held on Zoom and can be accessed via the following link: https://us02web.zoom.us/j/88151905825

I will also forward a meeting invite to update your calendar.

Please let me know if you have any comments or concerns in advance of the call.

Thanks,

Katherine Scott

BT ENGINEER

509 Talbot Street

London, Ontario N6A 2S5

katherine.scott@bteng.ca

(519) 672-2222

Newsletter

Biehn Drive Extension

1. BIEHN DRIVE EXTENSION CLASS ENVIRONMENTAL ASSESSMENT

The City of Kitchener (City) is conducting a Class Environmental Assessment (EA) Study for the extension of Biehn Drive southerly to the Robert Ferrie Drive. The Biehn Drive extension will include a trunk sanitary sewer, storm sewer/ditches and watermain. The Study is evaluating alternatives for the alignment of the Biehn Drive extension, intersection locations and designs, and municipal services, while minimizing natural, social, cultural and land use impacts. The Study Area is illustrated on the **Figure 1, Study Area**.

Figure 1: Study Area

2. NEED AND JUSTIFICATION

The extension of Biehn Drive has been part of the integrated land use and transportation plan for the larger community. The City of Kitchener Official Plan (November 2014) identifies Biehn Drive as a Major Community Collector Street, shown in yellow. Refer to **Figure 2, Future Road Network**. Collector streets function to collect traffic from several local streets and provide access to arterial streets, shown in purple.

The previous studies that have led to this plan have included:

1) Brigadoon Community Plan (1989);
2) Official Plan Amendment No. 98 (1991);
3) Doon South – Brigadoon Transportation Network and Corridor Study (McCormick Rankin, 1994);
4) Kitchener Planning and Development Staff Report PD95/51 (1994);
5) Updated Brigadoon Community Plan (2005);
6) Kitchener Integrated Transportation Master Plan (2013);
7) Robert Ferrie Drive Extension Environmental Assessment (2014); and
8) Official Plan Amendment No. 103 in March 21, 2019.

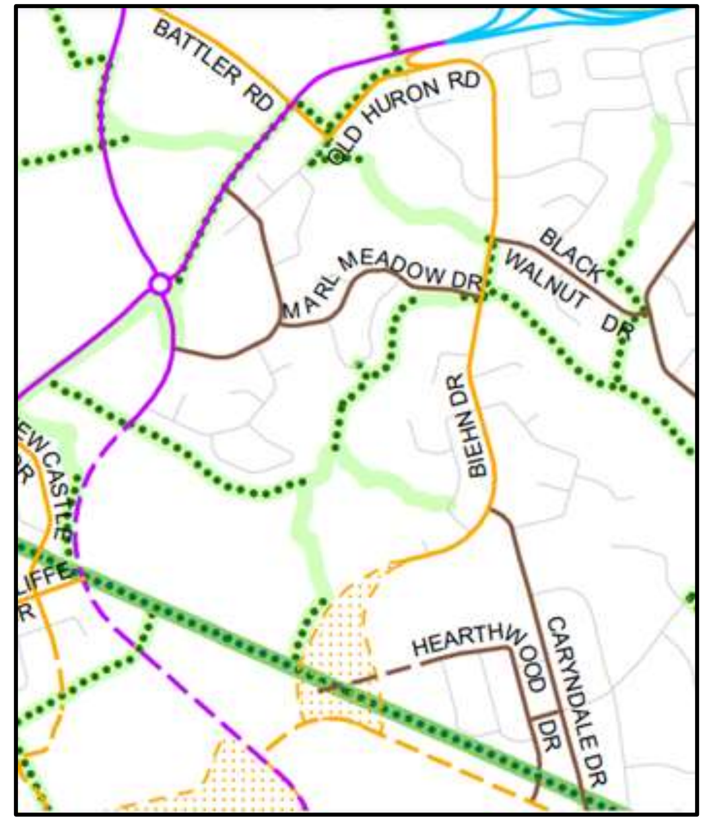


Figure 2: Future Road Network (OP Map 11 - Integrated Transportation System)

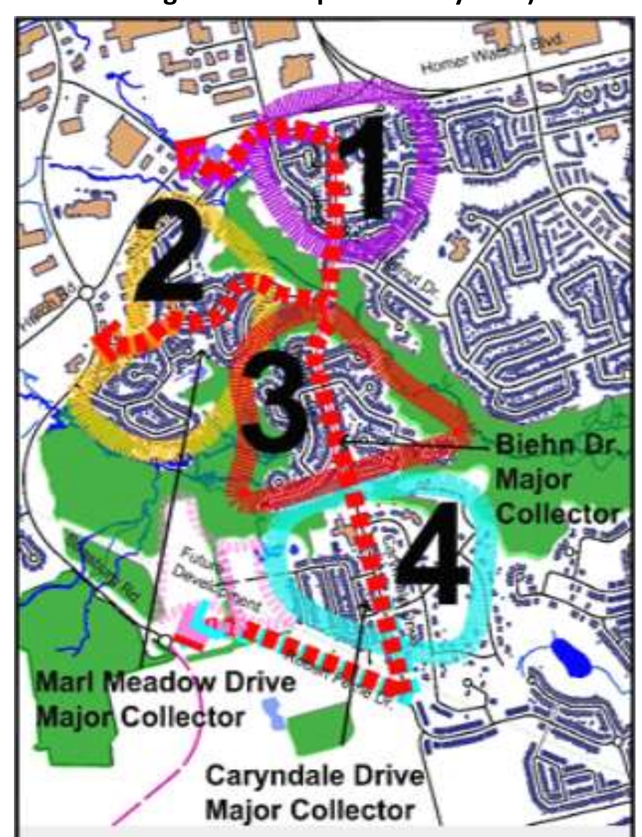


Figure 3: Community Neighbourhoods

3. WHAT IS THE TRAFFIC RATIONALE FOR THE BIEHN DRIVE EXTENSION?

During the recently held Community Café event, residents on Biehn Drive questioned the transportation justification for the street extension. Many previous transportation studies have described the need for an adequate collector road network for access to the community.

The individual neighbourhoods are shown in **Figure 3**. These neighbourhoods are bounded by Strasburg Road and Huron Road, each an arterial road. Close convenient access to the arterial road network will minimize traffic on any one collector road and provide greater safety. To demonstrate the rationale for the current plan (Biehn Drive extension), the four neighbourhoods and the average travel distance of each to the arterial road system are as follows:

Neighbourhood 1 (purple): average distance to Huron Road is approximately 800 metres.

Neighbourhood 2 (yellow): average distance to Strasburg Road is approximately 450 metres.

Neighbourhood 3 (red): average current distance to Strasburg Road is approximately 1200 metres, and 1300 metres to Huron Road.

Neighbourhood 4 (blue): average distance to Strasburg Road is approximately 600 metres.

If the new Biehn Drive link is not constructed, traffic from Neighbourhood 3 will continue to go through an adjacent neighbourhood.

4. PREVIOUS NEED AND JUSTIFICATION REVIEW (2014)

The Biehn Drive Extension Need and Justification Report was completed by Paradigm Transportation Solutions in June 2014. This report identified that eliminating the Biehn Drive extension would result in:

- Inefficiencies in the road network and backtracking/out-of-way travel for residents in the Doon South/Brigadoon communities;
- Insufficient capacity to accommodate the forecast traffic demands at the 2031 planning horizon; and
- Increased traffic on adjacent streets (i.e. Caryndale Drive, Templewood Drive, and Biehn Drive, northeast of the Study Area). These roads would be operating at traffic levels above their road classifications.

The Report concluded that eliminating Biehn Drive would be a fundamental design change to the Doon South/Brigadoon communities and would result in significant impacts to adjacent roads and other neighbourhoods, and that the Biehn Drive extension is therefore required

5. ALTERNATIVES

Three alternatives were presented at Public Information Centre (PIC) No. 1 and to residents at the Community Café event. Based on comments received by attendees at the Community Café, a fourth alternative has been added for the subsequent evaluation. The preliminary transportation alternatives for the study are shown on **Figure 4** below:

New: Alternative 4 will use existing collector roads to move vehicular traffic within the Doon South and Brigadoon communities, as shown in the figure below. With Alternative 4, these collector roads will serve traffic from their local neighbourhoods as well as Neighbourhood 3 (red). The project will include an extension of Biehn Drive for a maintenance road for the new sanitary sewer extension and an active transportation link as per the Official Plan.

Alternative 1 - Carried Forward ✔	Alternative 2 - Carried Forward ✔	Alternative 3 - Not Carried Forward ✘	Alternative 4 - Carried Forward ✔
Extension of Biehn Drive to Strasburg Road east of Hydro One transmission tower	Extension of Biehn Drive to Strasburg Road west of Hydro One transmission tower	Extension of Biehn Drive to Strasburg Road directly westerly to Strasburg Road (**not carried forward** based on higher relative environmental impacts)	Use existing collector roads in adjacent neighbourhoods to access the arterial roads ●●●● Sanitary sewer and active transportation link

Figure 4: Alternatives

6. FREQUENT QUESTIONS AND ANSWERS

Answers to questions we received at the initial community engagement are provided on the City's website at https://www.kitchener.ca/en/development-and-construction/infrastructure-projects.aspx#Frequently-asked-questions

NEXT STEPS

Next steps in the Class Environmental Assessment (EA) process are:

- Carry out environmental inventories and technical investigations;
- Complete the analysis and evaluation of alternatives;
- Hold Public Information Centre No. 2;
- Document the recommendations in the Environmental Study Report; and
- 30-day public review period of the Environmental Study Report.

There is an opportunity for public input at any point during the EA process. Comments and questions can be sent to the City and Consultant representatives below. All information is being collected in accordance with the *Freedom of Information and Privacy Act*.

Steve Taylor, P.Eng.	Eric Riek, C.E.T.
EA Project Manager	City Project Manager
BT Engineering Inc.	City of Kitchener
509 Talbot Street	200 King Street West
London, Ontario N6A 2S5	Kitchener, ON N2G 4G7
Tel: 519-672-2222	Tel: 519-741-2200 ext. 7330
Email: stevenj.taylor@bteng.ca	Email: eric.riek@kitchener.ca

BT ENGINEERING BTE

KITCHENER

Public Information Centre No. 2 Summary Report

Biehn Drive Municipal Class Environmental Assessment

December 2021

Submitted by:
BT Engineering Inc.
509 Talbot Street
London, ON N6A 2S5
519-672-2222

Table of Contents

List of Figures

List of Tables

List of Appendices

1.0 INTRODUCTION

The City of Kitchener (City) has initiated a Class Environmental Assessment (EA) Study to develop a transportation plan for the extension of Biehn Drive westerly to the Robert Ferrie Drive Extension. The Biehn Drive extension will include municipal services including a trunk sanitary sewer, storm sewer/ditches and watermain.

The Class EA Study will complete all required phases of the Municipal Class Environmental Assessment. The study will: establish the need and justification for the improvements; complete environmental inventories; establish a baseline to compare alternatives; consider all reasonable alternatives; and proactively involve the public in defining a recommended plan for improvements.

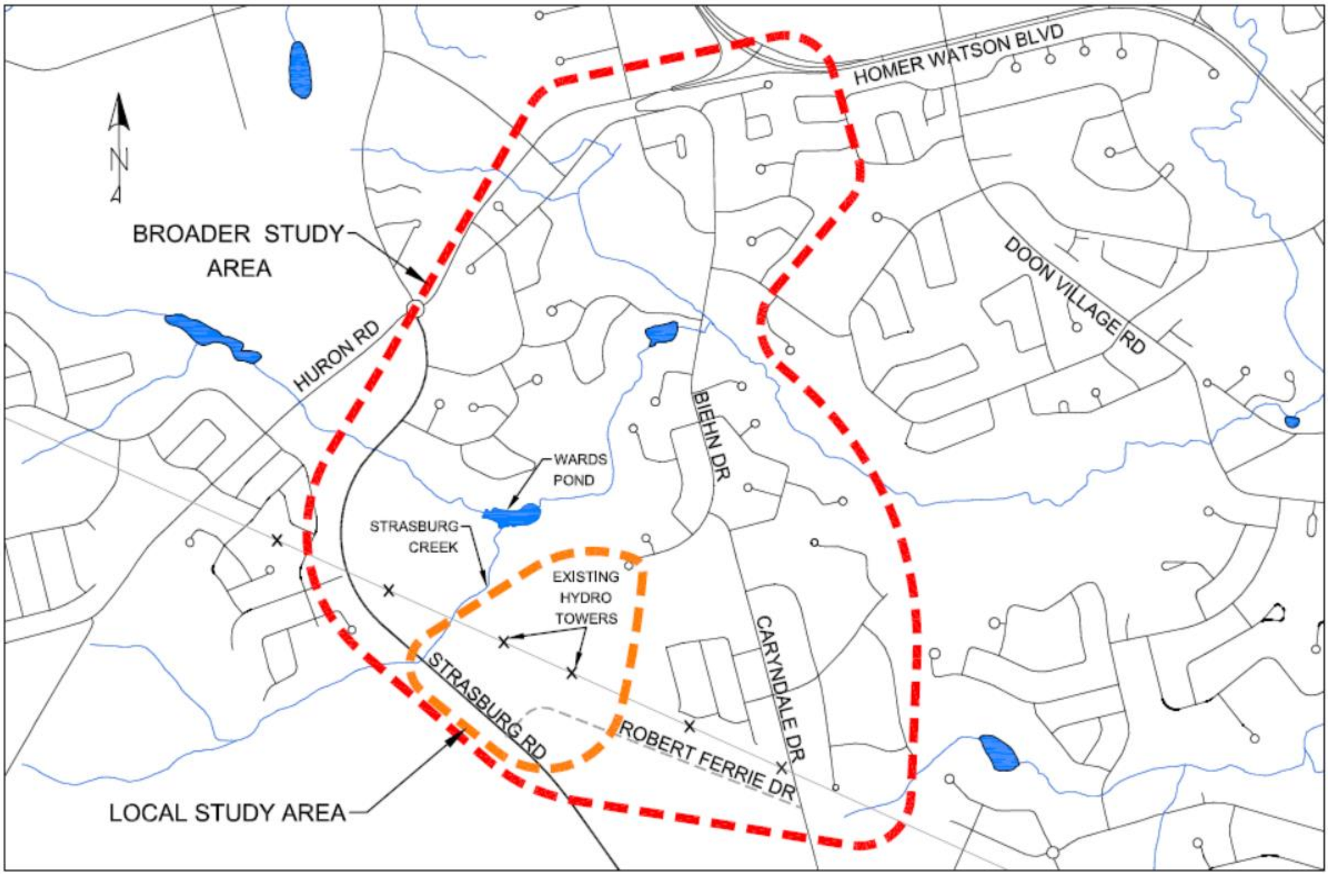
Based on the range of anticipated effects and capital cost of the project, the study is being conducted as a Municipal Schedule C Class EA. At the completion of the project, an Environmental Study Report will be prepared for a 30-day public review period.

Public Information Centre (PIC) No. 2 for this Study was held online from November 15 to November 29, 2021. A “live” virtual meeting was held on November 17, 2021 from 6:30 to 8:00 pm and included a presentation and a question and answers session. The Public Information Centre presented information on background information, the analysis and evaluation of alternatives, and the technically preferred alternative.

All members of the public and interest groups were invited to view the Online Public Information Centre material and were encouraged to provide a written response to any issues or concerns.

1.1 Study Area

The Study Area is located in the City of Kitchener and is illustrated on **Figure 1**.The Local Study Area extends from the current terminus of Biehn Drive, approximately 60 m west of Spencer Court, southerly to the future Robert Ferrie Drive Extension. Based on comments from the public at the Community Café and Public Information Centre No. 1, the Study Area was expanded to a Broader Study Area to consider traffic effects in adjacent neighbourhoods.



Legend	
Local Study Area	
Broader Study Area	
Based on comments from PIC No. 1	

Figure 1: Project Location

2.0 PUBLIC AND AGENCY CONSULTATION

One of the key aspects of the study is to provide the public, interested parties, affected agencies and municipalities with the opportunity for input. In order to ensure this objective is met, a public and agency notification program was undertaken. The program includes a number of communication mechanisms, discussed in the following sections.

2.1 Individual Property Owner Contacts

Notices were mailed to property owners within the study area, inviting them to attend the online Public Information Centre. The notice was also distributed electronically to members of the public/ stakeholders that had identified an interest in the study or requested to be on the mailing list.

2.2 Indigenous Peoples Contacts

Notices were sent to the Indigenous Peoples in the vicinity of the Study Area, inviting them to attend the online PIC. Notices were sent to the following:

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

2.3 Newspaper Notice

Notices of the Public Information Centre were published in The Record on October 29, 2021.

The newspaper notice is in **Appendix A**.

2.4 Agency and Stakeholder Contacts

The following ministries, agencies and stakeholders were invited to attend the online PIC:

- Ministry of the Environment, Conservation and Parks
- Ministry of Natural Resources and Forestry
- Ministry of Heritage, Sport, Tourism and Culture Industries
- Environment Canada, Ontario Region
- Infrastructure Ontario
- Ministry of Agriculture, Food and Rural Affairs
- Ministry of Indigenous Affairs
- Grand River Conservation Authority
- Emergency Services
- Utilities
- Regional Municipality of Waterloo

3.0 PIC COMMENTS

PIC Exhibits were provided online for public/agencies to view at their convenience. A copy of the PIC exhibits is provided in **Appendix B**.

Nine (9) comment sheets and emails were received during and after the comment period. Copies of the comments, excluding personal information, are provided in **Appendix C**.

3.1 Summary of Comments

The comments received and discussions held during the Public Information Centre are summarized below in **Table 1**.

Table 1: Summary of Written Comments

Comment	Number of Respondents	Comment Sheet No.
Support for extension of Biehn Drive to Robert Ferrie Drive.	2	1, 5
Concern for prioritizing road improvements and development over the environment and not preserving green areas.	4	2, 4, 6, 7
Opposition to constructing a parking lane and multi use path on the Biehn Drive extension to minimize disruption to the wetland and preserve the environment.	1	3
Concern for community disruption and increased traffic volumes, and identifying the need for traffic calming measures.	4	4, 6, 7, 9
Concern for sightlines of vehicles entering/exiting driveways along the existing Biehn Drive.	2	7, 8
Concern that the publics' input was not included in the decision making process and selection of the preferred alternative.	3	6, 7, 8
Opposition to the extension of Biehn Drive extension and concern that the roadwork does not align with the City of Kitchener's strategic plan for environmental protection.	1	8
Concern that private properties will flood due to permanent disruptions to the wetland.	2	4, 8
Emergency access/response should rely on response time instead of access.	1	4
People shortcut through Marl Meadow Drive and Templewood Drive to Strasburg Road or Huron Road. This should be taken into consideration in the evaluation for efficiency of travel and community disruption to Biehn Drive north.	1	4
Concern regarding the negative impacts on Strasburg Creek which connects to the wetland.	1	4

Request to redo the evaluation of alternatives after removing traffic from Caryndale South and Doon South since it will be accommodated by the Robert Ferrie Drive extension.	1	4
Concern that Alternative 4 was not fairly evaluated and evaluation criteria were prejudiced against this criterion. Concerns include: • Introducing a second access road to Street A on the north side of the hydro tower for this alternative. • Need to consider proper development of the lands south of the PSW. • Traffic will be support by the extension of Robert Ferrie Drive.	1	4

4.0 CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The main comments or concerns, both verbal (i.e. phone calls, virtual meetings) and written, from the public information centre include:

- Disruption to the environment/wetland and prioritizing transportation needs over the environment
- Support for the project and the need for the Biehn Drive extension
- Negative impacts on Strasburg Creek which connects to the wetland
- Impacts to drainage and groundwater levels due to possible wetland and environment disruption
- Consider greater use of Caryndale Drive to carry additional traffic and have more community traffic reach Strasburg Road using Robert Ferrie Drive as opposed to Biehn Drive

Recommendations for Future Actions

Actions for future review and consideration in the design include:

- Consideration of sightlines of vehicles entering/exiting driveways along the existing Biehn Drive
- Consideration for modifications to the cross section to minimize wetland disruption (i.e. removing the multi-use pathway, narrower boulevards and parking lanes)

Appendix A

Newspaper Notice

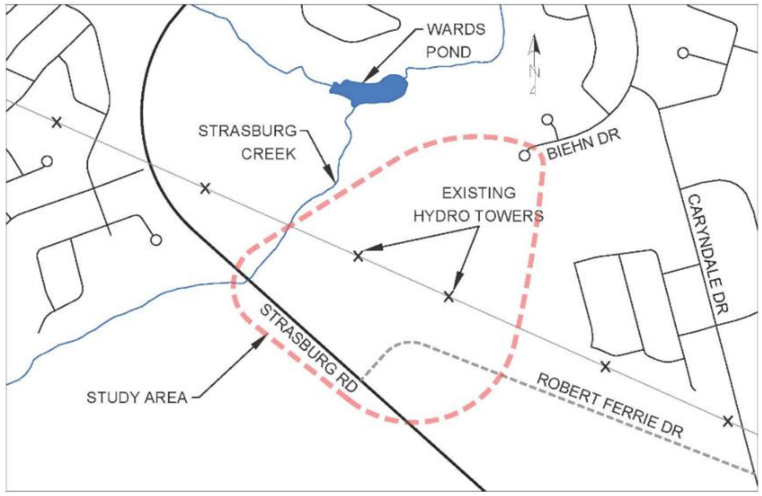
BT ENGINEERING

Notice of Online Public Information Centre (PIC)

City of Kitchener

Biehn Drive Extension Environmental Assessment Study

INTRODUCTION



The City of Kitchener is conducting an Environmental Assessment (EA) Study for the extension of Biehn Drive from the existing terminus 300 m west of Caryndale Drive to the future Robert Ferrie Drive extension. The Study will evaluate alternatives for alignment, cross sections, intersections, and active transportation to develop a preferred plan to address the needs of the Study Area and reflect the recommendations in the City of Kitchener Transportation Master Plan.

STUDY PROCESS

The Biehn Drive Extension EA is being conducted as a Schedule C EA Study under the Municipal Class Environmental Assessment (MCEA) (2015). The Transportation Master Plan (TMP) has previously completed Phases 1 and 2 of the Class EA; this Study will review the previously completed phases and complete Phases 3 and 4. The Study will consider all reasonable alternatives with acceptable effects on the natural, social and cultural environments, and proactively involve the public, stakeholders and Indigenous Peoples.

PUBLIC CONSULTATION

The City wishes to ensure that anyone interested in this study has the opportunity to be involved and provide input. The City has scheduled a second online Public Information Centre (PIC) meeting for this project that will include a series of exhibits that present background information, the evaluation of alternatives and the Technically Preferred Alternative. At the present time, this PIC is relying on web-based communications due to restrictions on public gatherings. Comments on the information presented can be provided by contacting the City or consultant project managers' email addresses listed below.

The PIC will be held for a two-week period, with a "live" virtual Zoom meeting on November 17, 2021. **To register for the Zoom meeting, please contact Steve Taylor or Eric Riek.** The Online Public Information Centre is scheduled for:

PIC Date: November 15 to 29, 2021

Virtual Zoom Meeting Date: November 17, 2021 from 6:30 to 8:00 PM

Website: https://www.kitchener.ca/en/development-and-construction/infrastructure-projects.aspx

There is an opportunity at any time during the Class EA process for interested persons to provide comments. Early identification of individual and group concerns greatly aids in addressing these concerns. All information will be collected in accordance with the *Freedom of Information and Protection of Privacy Act* (2009). With the exception of personal information, all comments will become part of the public record. Persons will be advised of future communication opportunities by newspaper public notice, email notice and posting on the City website.

For more information or if you wish to be placed on the study's email mailing list, contact either:

Steve Taylor, P.Eng.
EA Project Manager
BT Engineering Inc.
509 Talbot Street
London, ON N6A 2S5
Tel: 519-672-2222
Email: stevenj.taylor@bteng.ca

Eric Riek, C.E.T.
City Project Manager
City of Kitchener
200 King Street West
Kitchener, ON N2G 4G7
Tel: 519-741-2200 ext. 7330
Email: eric.riek@kitchener.ca

Appendix B

PIC Exhibits

BT ENGINEERING

Welcome!
City of Kitchener
Biehn Drive Extension
Class Environmental Assessment

Thank you for participating in the Online Public Information Centre (PIC) for the City of Kitchener's Class Environmental Assessment (EA) for the extension of Biehn Drive and the sanitary trunk sewer.

At the present time, the Province of Ontario has implemented restrictions on public gatherings to deal with the COVID-19 pandemic. As a result, this Public Information Centre is relying on web-based communications. Should you have any questions regarding the study, please contact the City or Consultant Project Managers.

There is an opportunity at any time during the Class EA process for interested persons to provide written input. Any comments received will be collected under the *Environmental Assessment Act* and, with the exception of personal information, will become part of the public record.

Comments can be submitted by emailing stevenj.taylor@bteng.ca and/or eric.riek@kitchener.ca by **November 29, 2021**.

KITCHENER

1

Purpose of Public Information Centre

The purpose of this meeting is to:

- Present the evaluation of alternatives.
- Obtain comments on the Technically Preferred Alternative.
- Obtain comments on the proposed mitigation plan.
- Identify any remaining areas of concern.

2

2

Introduction

The City of Kitchener has retained BT Engineering Inc. to undertake an Environmental Assessment (EA) Study for the extension of Biehn Drive from its current terminus to the future Robert Ferrie Drive Extension. The Study includes the extension of the trunk sanitary sewer, watermain and storm sewers to Robert Ferrie Drive, to serve areas to the south.

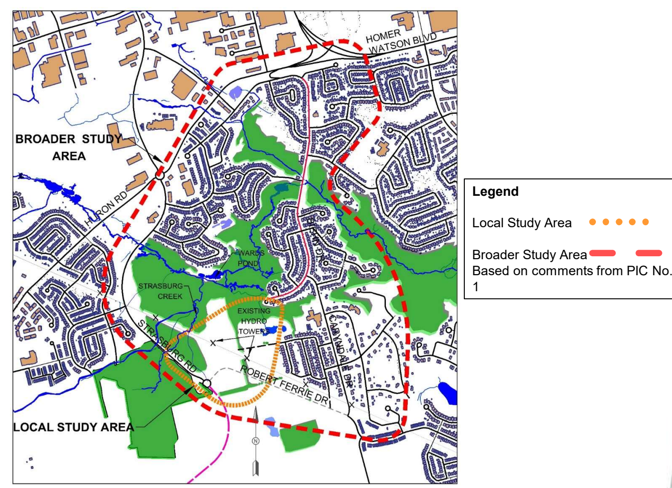
The City has completed Phases 1 and 2 of the Municipal Class EA through the Transportation Master Plan, which has been reviewed and summarized in this study. Phases 3 and 4 of the Municipal Class EA are being completed by developing and evaluating alternative designs and completing the Environmental Study Report, while proactively involving the public and stakeholders in defining a recommended plan for improvements.

This Study is being completed as a Schedule C undertaking, based on the range of anticipated effects, and the proposed infrastructure extension will be completed as a Schedule B. The Study Design Report describing the study process has been made available for agency and public comments and on the website.

3

3

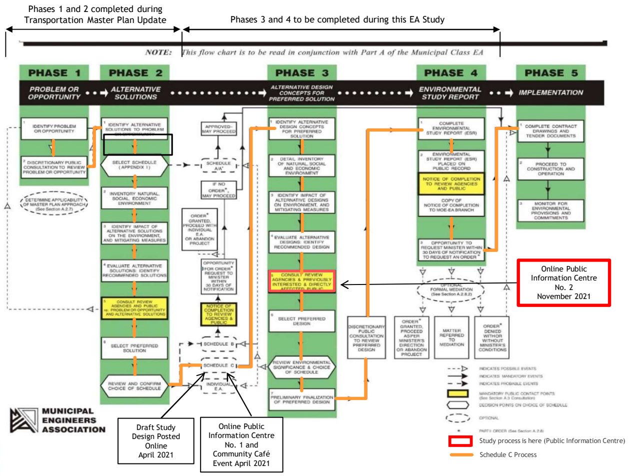
EA Study Area



4

4

Municipal Class Environmental Assessment



5

5

Background Studies

The following studies have been completed that are relevant to this study:

1. Brigadoon Community Plan (1989);
2. Official Plan Amendment No. 98 (1991);
3. Doon South – Brigadoon Transportation Network and Corridor Study (McCormick Rankin, 1994);
4. Kitchener Planning and Development Staff Report PD95/51 (1994);
5. Updated Brigadoon Community Plan (2005);
6. Kitchener Integrated Transportation Master Plan (2013);
7. Robert Ferrie Drive Extension Environmental Assessment (2014); and
8. Official Plan Amendment No. 103 in March 21, 2019.

These reports are available online for review upon request. Please contact the identified Project Managers to arrange for review.

6

6

Background Information

- Community Plans for the Doon South and Brigadoon areas have established the need for the extension of Biehn Drive
- This has been documented in the Official Plan and Transportation Master Plan
- The new road link will accommodate all modes of transportation (vehicles, trucks, pedestrians and cyclists)

Why is the project needed?

- Needed to evenly distribute traffic to the arterial road network.
- Multiple connections to arterial roads reduce the traffic volumes in any one neighbourhood and the travel time, and improve access for emergency services.
- Currently, existing traffic from Biehn Drive must travel through adjacent neighbourhoods.
- To provide a sanitary and water service corridor.

Why is it being implemented now?

- Strasburg Road has been constructed and will provide a western arterial street to service the community.
- With implementation of the proposed Biehn Drive extension, traffic will not have to take a circuitous route through neighbourhoods to reach the arterial road network.
- Required to accommodate future development.

7

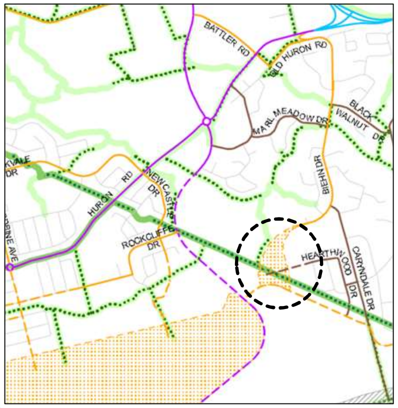
7

Existing Conditions

8

8

Official Plan – Integrated Transportation System



Source: City of Kitchener Official Map 11 Integrated Transportation System, 2014

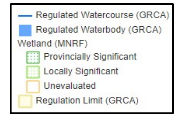
9

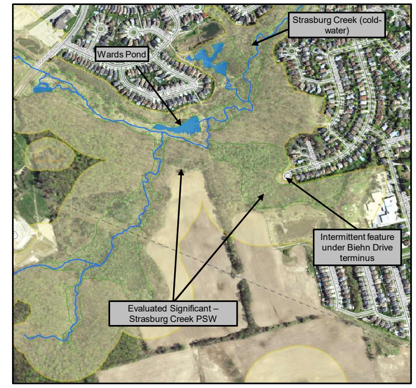
9

Natural Environment

Overview:

- Strasburg Creek Provincially Significant Wetland
- Intermittent overland flow through the wetland
- Strasburg Creek
- Wildlife habitat
- Specimen trees





10

10

Well Head Protection Area

Regulated Watercourse (GRCA)
Municipal Well (GRCA)
WHPA Vulnerability (GRCA)
10
8
6
4
2
Regulated Waterbody (GRCA)

https://maps.grandriver.ca/web-gis/public/?theme=MYP&bbox=542091,4802909,545343,4804695

11

11

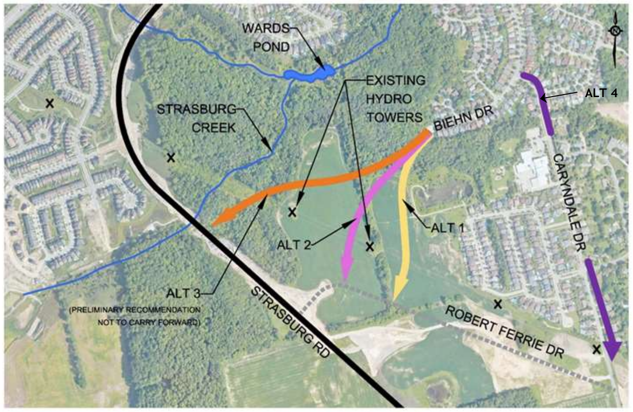
Preliminary Design Alternatives

12

12

Preliminary Alignment Alternatives

Alternative 4 added following PIC No. 1



13

13

Coarse Screening of Alignment Alternatives

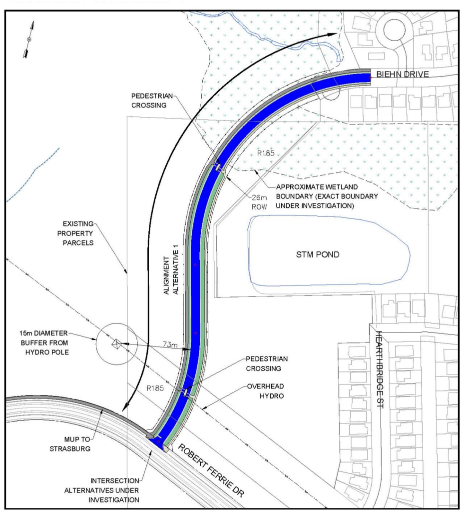
Coarse Screening of Alignment Alternatives				
Screening Criteria	Alternative 1: Connect to Robert Ferrie Drive east of Hydro Tower	Alternative 2: Connect to Robert Ferrie Drive west of Hydro Tower	Alternative 3: Strasburg Road Connection	Alternative 4: Connect Biehn Drive to Robert Ferrie Drive – Via Caryndale Drive
Does this alternative satisfy forecast traffic demand, improve safety, and address all modes of transportation?	Provides a north-south connection to Robert Ferrie Drive. Accommodates all modes. Reduces cut-through traffic on Biehn Drive.	Provides a north-south connection to Robert Ferrie Drive. Accommodates all modes. Reduces cut-through traffic on Biehn Drive.	Provides a north-south connection to Strasburg Road. Accommodates all modes.	Provides a north-south connection to Strasburg Road. Accommodates all modes. However, there are increased levels of traffic on local roads.
Does the approach result in significant impacts to the natural environment?	Minor impacts to the woodlot/PSW (~0.3 ha).	Minor impacts to the woodlot/PSW (~0.3 ha).	Significant impacts to the woodlot/wetland (~1.3 ha).	No impacts.
Is the approach affordable for the City to implement?	No significant difference.	No significant difference.	Higher cost - requires an intersection onto Strasburg Road (arterial).	Affordable alternative.
Does this alternative comply with the recommendations of the City's planning documents (i.e., TMP, OP, KGMP)	This alternative complies with the recommendations of the City's planning documents.	This alternative complies with the recommendations of the City's planning documents.	Does not comply with the recommendations of the Official Plan or Growth Management Plan. Based on the previous design and construction of the Strasburg Road and roundabout within the Study Area, this previous alternative is no longer considered feasible.	This alternative does not comply with the recommendations of the City's planning documents.
Recommendation:	✓ Carry forward for further evaluation	✓ Carry forward for further evaluation	✗ Do not carry forward	✓ Carry forward for further evaluation

14

14

Alignment Alternative 1

Connect Biehn Drive to Robert Ferrie Drive – East Alignment

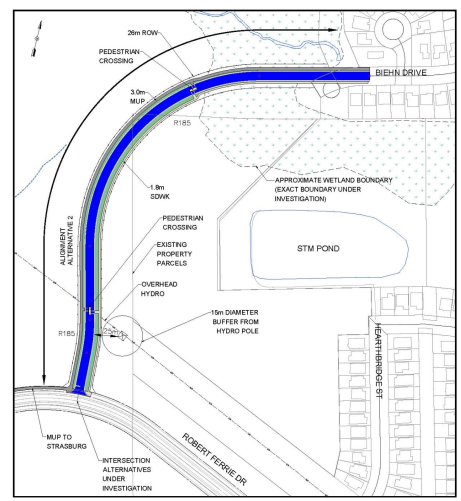


15

15

Alignment Alternative 2

Connect Biehn Drive to Robert Ferrie Drive – Central Alignment

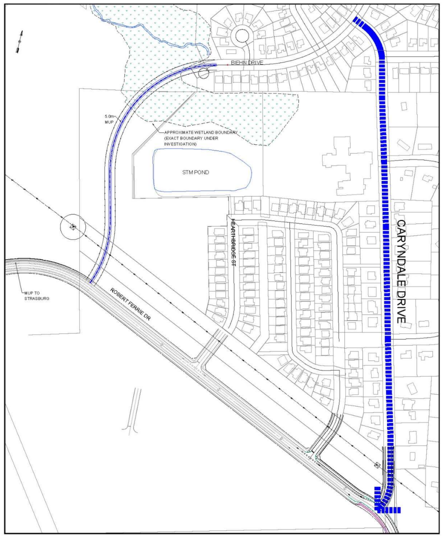


16

16

Alignment Alternative 4

Connect Biehn Drive to Robert Ferrie Drive – Via Caryndale Drive



17

17

Analysis and Evaluation Alignment Alternatives

The analysis and evaluation of the alternatives has been undertaken using a quantitative evaluation methodology. Seven global evaluation factor were considered:

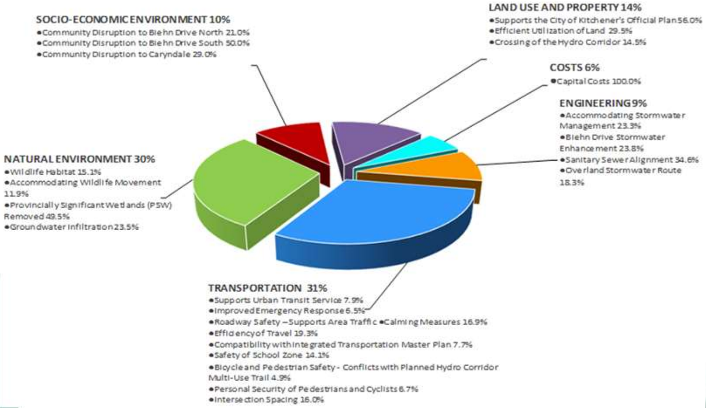
- Transportation
- Natural Environment
- Cultural Environment
- Socio-Economic Environment
- Land Use and Property
- Cost
- Engineering

- The factor groups are made up of measurable criteria (sub-factors) used to identify relevant benefits and impacts.
- They define a unit of measure and the relative differences between alternatives.
- Evaluation data was collected from literature reviews of background documentation and environmental inventories completed for this project.
- The results are presented on the following exhibits and documented in the Analysis and Evaluation Report, available upon request.

18

18

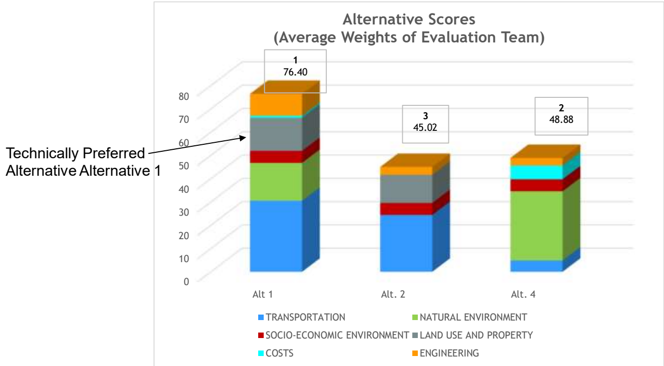
Evaluation - Global Factor Weights and Sub-factor Weights



19

19

Alignment Alternatives - Scores



20

20

Sensitivity Testing

Alternatives			Alt 1	Alt. 2	Alt. 4
FACTORS	WEIGHT	Score:	76.40	45.02	48.88
Ranking			1	3	2
TRANSPORTATION	High	45.00%	1	2	3
	Low	20.00%	1	3	2
NATURAL ENVIRONMENT	High	40.00%	1	3	2
	Low	20.00%	1	2	3
SOCIO-ECONOMIC ENVIRONMENT	High	15.00%	1	3	2
	Low	10.00%	1	3	2
LAND USE AND PROPERTY	High	20.00%	1	2	3
	Low	10.00%	1	3	2
COST	High	10.00%	1	3	2
	Low	2.00%	1	2	3
ENGINEERING	High	15.00%	1	3	2
	Low	5.00%	1	3	2

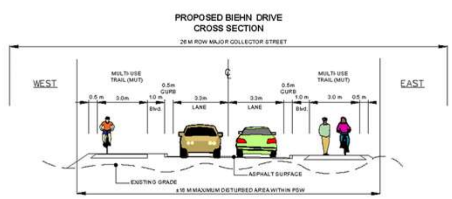
Cross Section Alternative Evaluation

Alternatives were developed to reflect the City of Kitchener's Complete Streets guidelines.

Evaluation Criteria	Alternative 1 – 26 m ROW with Multi-use Trail ✓	Alternative 2 – 26 m ROW with Bike Lanes
Active Transportation	MUTs are preferred by the greatest proportion of cyclists (interested but concerned). Greater network continuity for cyclists with the future MUT along the Hydro corridor and potential to connect to the MUTs along Strasburg Road	Better accommodates pedestrians by separating pedestrians and cyclists. Increased conflict between cyclists and access to/from parked vehicles
Traffic Calming	The reduced pavement width would better promote lower travel speeds	Wider asphalt surface would be less effective in reducing travel speeds
Impacts to Natural Environment / Storm Water Quality	All alternatives considered equal.	All alternatives considered equal.
Impacts to Developable Lands	All alternatives considered equal.	All alternatives considered equal.
Cost	MUTs are more cost effective to construct with reduced pavement thickness and granulars	Wider roadway pavement structure increases construction cost

Preferred Cross Section

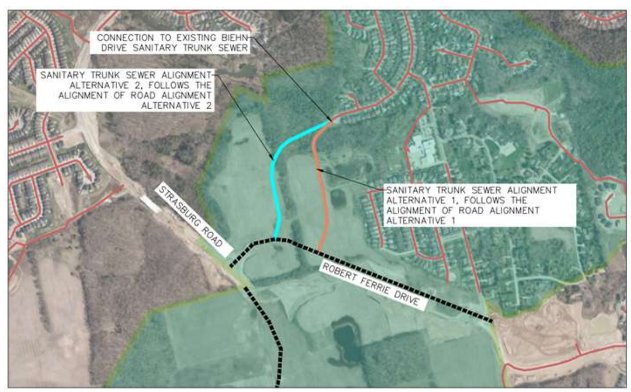
CROSS SECTION ALTERNATIVE 1



TYPICAL PSW SECTION

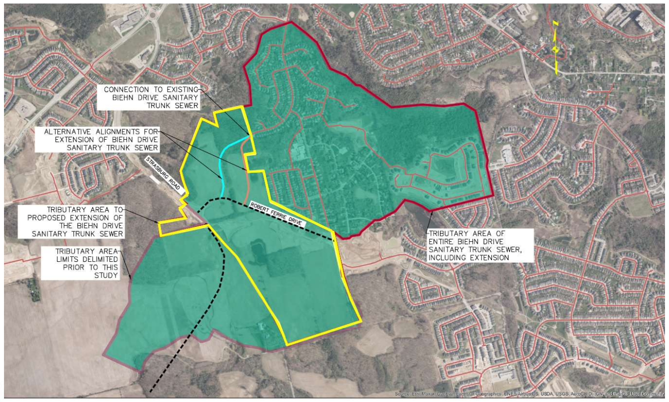
Preliminary Design Alternatives

- Two (2) Sanitary Sewer Alignment Alternatives were considered.
- The Preferred Sanitary Sewer alignment matches the Preferred Road Alignment Alternative 1.



Preliminary Design Alternatives

- Sanitary Sewer service area

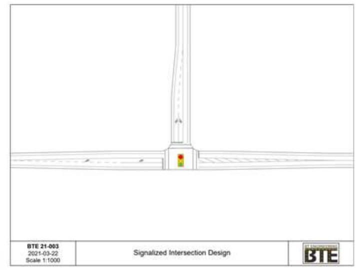


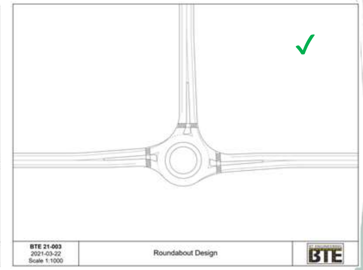
25

25

Preliminary Design Alternatives Intersection Alternatives

Biehn Drive and Robert Ferrie Drive





26

26

Traffic Projections

The proposed extension of Biehn Drive is projected to:

- Carry an average of 2500–3000 vehicles/day, well within its capacity as a major collector road,
- Result in a more balanced redistribution of area traffic volumes, providing relief (reducing the traffic volumes) on other area roads including Caryndale Drive and the north segment of Biehn Drive, which are both currently overutilized.

A roundabout is proposed at the intersection of Biehn Drive and Robert Ferrie Drive:

- Consistent with the approved plan identified in the Robert Ferrie Drive Class Environmental Assessment
- Due to the proximity to Strasburg Road (to limit queuing) and to accommodate pedestrian crossings
- To accommodate access to future development south of Robert Ferrie Drive.

27

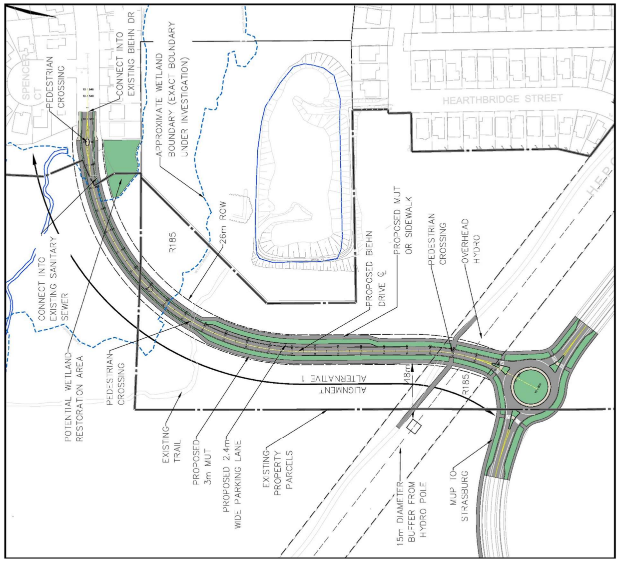
27

Technically Preferred Alternative

28

28

Preferred Alignment Alternative



Mitigation Table

Issue/Concern Potential Effects	Concerned Agency	Proposed Mitigation (prevent, lessen or remedy potential detrimental environmental effects)
Loss of Provincially Significant Wetland (PSW)	GRCA	• Wetland Restoration in vacant lot on Biehn Drive. • Narrowing of roadway through PSW. • Utilize Best Management Practices and limit disturbance to wetlands and vegetation. • Limit vegetation removal, where feasible. • Protect vegetation to remain using tree protection.
Wildlife Crossing	GRCA	Provide equalization culverts and permanent, directional wildlife fencing to permit wildlife passage across roadway.
Groundwater	MECP	Avoid draw-down of water table by ensuring the bottom of granulars are above original ground.
Fish Habitat: downstream impacts to Strasburg Creek cold water fish habitat	GRCA, NDMNRF	• Provide erosion and sediment controls. • Minimize the delivery of sediments and associated pollutants to receiving watercourses. • Minimize the impact of road salt on the local vegetation and receiving watercourses. • Minimize the impact of increased flows on receiving watercourses. • Minimize potential erosion within the drainage system, and within the local receiving watercourses.

Mitigation Table

Issue/Concern Potential Effects	Concerned Agency	Proposed Mitigation (prevent, lessen or remedy potential detrimental environmental effects)
SAR	MECP	• Undertake targeted, specialized SAR surveys during Detail Design as required depending on species conservation status designations as they exist at that time. At this time, no SAR have been identified in the Study Area. • Ensure the design and construction complies with the *Endangered Species Act* (ESA, 2007)
Migratory Birds	NDMNRF	Any clearing and grubbing should be completed outside of the active breeding bird season of April 1 to August 31.
Turtles and Turtle Habitat	NDMNRF	• Install silt fencing before turtle nesting season (May 15 to Sept. 30). • Protect and buffer active nests. • Avoid groundwater alteration in nearby wetlands between October 1 and April 1 during turtle hibernation.
Water Quality and Stormwater	MECP	Provide a Stormwater Management Plan.
Significant Woodlots	NDMNRF	Avoid specimen trees and limit tree clearing.

Mitigation Table

Issue/Concern Potential Effects	Concerned Agency	Proposed Mitigation (prevent, lessen or remedy potential detrimental environmental effects)
Noise	City	Municipal Noise By-laws are to be followed during construction adjacent to residential areas.
Management of Surplus Materials	MECP	OPSS 180 apply MECP "Management of Excess Materials in Road Construction and Maintenance Guidelines". Management and Disposal of Wet Soils.
Traffic calming	City	• Narrowing of cross section • Reduced lane widths • Provision of a roundabout to assist in controlling speeds
Lighting	GRCA	Provide cut-off lighting through PSW.
Utilities		Liaison during detail design.
Changes to Emergency Services		Liaison during detail design.

Next Steps

33

Next Steps

Following this Public Information Centre we will:

- Review all online Public Information Centre comments and prepare a Summary Report
- Develop refinements to the Technically Preferred Alternatives (if required) based on public comments
- Prepare the Environmental Study Report (ESR)
- Initiate 30-day public review period of the ESR

34

Your Involvement

How can you remain involved in the Study?

- Request that your name/e-mail be added to the Study Mailing List
- Provide an online comment
- Contact the Municipality's representative or the consultant at any time. Contact information is available below.

Thank you for your participation in this online Public Information Centre.

Your input into this study is valuable and appreciated.

All information is collected in accordance with the *Freedom of Information and Protection of Privacy Act.*

For More Information Please Contact:

Steve Taylor, P.Eng.
BT Engineering Inc., Project Manager
Email: stevenj.taylor@bteng.ca
Phone: 519-672-2222

Eric Riek, C.E.T.
City of Kitchener, Project Manager
Development Engineering
Email: eric.riek@kitchener.ca
Phone: 591-741-2200 ext. 7330

Please submit any questions or comments to the contacts listed above by **November 29, 2021**.

35

Appendix C

Comment Sheets

BT ENGINEERING

1

[redacted]
Sent: Wednesday, May 19, 2021 5:49 PM
To: Christine Michaud <Christine.Michaud@kitchener.ca>
Cc: Eric Riek <Eric.Riek@kitchener.ca>
Subject: [EXTERNAL] Biehn Road Extension Project

Hi Christine

We received your letter today regarding the proposed Biehn Drive extension project. As you mentioned in your letter, this project has been on the books for a long time. We have lived in the area for 30 years and were made aware of this plan in the early 1990's.

From the tone of your letter it appears that the vocal group of people opposed to this project have caught your attention more so than the group of us who want the extension to go ahead as planned. This is a classic case of "NIMBYism" where the home owners didn't complete their due diligence when they moved into their residences. Looking at the Biehn Drive dead end it is obvious that there was always a plan to continue the road.

The people opposed to these changes [redacted] must realize that their own homes were also once part of the rural area that made way for progress when the Brigadoon area was built. There have been many changes to this part of Kitchener since we have lived here. The fields and forests we used to hike in around here have been developed and new areas have been opened up for people to live in this part of the city. It is unfortunate that people can't see beyond their own yards to understand the city needs to grow and it can't always be in someone else's neighbourhood. As you know most of the undeveloped land left in Kitchener is in the south west and perhaps if people don't want to see development, they should move to more established areas.

We hope you will support the planning department in their efforts to proceed with the plans to finally bring this project to fruition. I know as a local politician it can be difficult to support a well planned project when a very vocal group of potential voters are opposed to it, but giving in to a NIMBY mentality is not the way a city progresses.

Thank you for keeping us in the loop about the status of the Biehn Road extension project.

[redacted]

2

[redacted]
Sent: November 17, 2021 4:18 PM
To: Steve Taylor (London) <stevenj.taylor@bteng.ca>; eric.riek@kitchener.ca <eric.riek@kitchener.ca>
Cc: [redacted]
Subject: Biehn Drive Extension for Discussion Nov 17 2021

Eric,
As per the Freedom of Information Act, provide the GRCA assessments from the past 3 decades. You have completely left them out, and therefore your EA is incomplete. These need to be aligned with the content of the latest options you have provided in the PowerPoint presentation online.

Also, I find this EA a complete failure in light of the COP 26 which was also a failure.

You may consider yourselves part of the problem here where we continue to clear forests which are in short supply on earth now while you line your pockets. Maybe you take clean air for granted these days. Did you know CO2 levels have risen 400% over the past century because of forest removal?

Shame on you for doing this.

Perhaps you should take half an hour and come out to the walking trail in this area around Wards Pond and see the beauty of the area which many families enjoy. Instead of having the vision to promote the Doon area as a green oasis within the City of Kitchener, you only seek to honour promises from Mayor Cardillo signed over to the contractors to over-develop Kitchener as they see fit. But that is ancient history I guess. Again, shame on you. This is a scandal which you are all part of.

It's such a shame.

[redacted]

3

[redacted]
Sent: November 18, 2021 10:06 AM
To: Steve Taylor (London) <stevenj.taylor@bteng.ca>
Cc: Eric Riek <eric.riek@kitchener.ca>
Subject: Biehn Drive extension

[redacted] and am opposed to the extension through this Algonquin like wetland.

Re: proposed Preferred Cross section on page 23 of the plan;

If the plan is to minimize disruption to the wetland, why is a parking lane shown in the schematic as well as multi use paths on either side of the road? Would this not add an increase of traffic and invasion of the wetland?
There are already natural trails through the wetland and wooded areas.
For the preservation of this environment, it needs to be left natural.
IF a road is approved by council, that's all it should be, a ROAD.

Sent from my iPhone

4

[redacted]
Sent: Monday, November 29, 2021 9:07:06 PM
To: Eric Riek <Eric.Riek@kitchener.ca>; Christine Michaud <Christine.Michaud@kitchener.ca>
Subject: [EXTERNAL] Comments, Questions and Concerns about Biehn Drive Extension Environmental Assessment

Good evening Eric and Christine,

Following the Virtual Zoom Meeting on Nov 17th, we were invited to provide feedback and comments. Please find below my comments, questions and concerns about the Biehn Drive Extension Environmental Assessment (EA).

The EA's evaluation weights set the Transportation weight at 31% and the Natural Environment at 30%. On June 24, 2019 the City of Kitchener's city council unanimously voted to declare a climate emergency. Since then, Canada has also made several statements, including at COP26, about reducing our impact on climate which is to be achieved through the preservation of the natural environment. On the transportation side, the City of Kitchener had made no such emergency declaration. As a result, how can a weight for the Natural Environment being less than Transportation make any sense when the emergency declaration and the statements from the Federal Government are taken into consideration? The Natural Environment weight should be much greater than the Transportation weight if we hope to have some kind of decent environment to live in for the decades to come.

The EA mentions the need to distribute the traffic evenly in the arterial road network. Where is the analysis of the current situation? One can observe in the morning the vast majority of the traffic coming down Caryndale towards Biehn Drive and then go north on Biehn. There is some traffic going from Biehn Drive and up Caryndale but did BTE check to make sure they are not simply going to the school? If going to the school, extending Biehn drive will not change this. For the traffic coming down Caryndale and going north on Biehn, it seems to be sourced from the south end of Caryndale and Doon South neighborhoods. Why should the residents of Biehn Drive be forced to have the residents of other neighborhoods go through ours? Is it possible that the traffic other neighborhood (north of Brigadoon) think is coming from Biehn is simply flowing through Biehn and coming from communities south of Biehn? This is where the opening of Robert Ferrie Drive to Strasburg will fix this situation and improve school zone safety on Caryndale. All the extension of Biehn Drive would do with the traffic situation is substantially and permanently damage to Provincial Significant Wetlands (PSW) at the end of Biehn Drive.

The EA project manager (Steven Taylor) mentioned during the Nov 17th meeting an increase of about 2,500 vehicles per day, where did this come from? He also mentioned the north side of Biehn Drive was being overused. The Biehn Drive Extension Need and Justification Review conducted by Paradigm Transportation Solutions (page 4) in 2014 mentions that by 2031, Biehn drive would be handling 8,100 vehicles per day (in excess of capacity as mentioned in that review) which factored in the development of Robert Ferrie Drive. This is a **substantial** increase compared to what BTE is mentioning. Also, at the Biehn Drive traffic calming meeting of Nov 23, Steve Ryder made a comment about the traffic on Biehn Drive being appropriate/acceptable since the road is a collector road. So, which one is it? Is it overused, fine or are the residents of Biehn Drive about to have a massive increase that will destroy the safety of the Biehn south neighborhood and the PSW?!

For alternative 4, why is the south side of the PSW not showing any development? A court could be developed on that side while ensuring the PSW does not have a street going through it to minimize the environmental impact. Proper drainage could be implemented to ensure stormwater is properly directed to the Storm Water Management pond that is currently beside the wet lands. This would help to provide a more fair comparison to alternative 1 and would increase the scoring for both the Land Use and the Engineering global factors.

This section of comments, questions and concerns factors in the Analysis and Evaluation Report for the Biehn Drive Extension EA

For the Improved Emergency Response (pg 70), why is the evaluation done on an access basis when normally response to something is calculated based on time? All emergency services determine their performance on time to the location where the emergency is happening. What is the current response time to the various neighborhoods and what would be the impact of each option?

For the Roadway Safety – Supports Area Traffic Calming Measures (pg 71), has the impact of Robert Ferrie being built been factored in the evaluation? Since the majority of traffic on Biehn is coming from the south end of Caryndale and Doon South, the minute Robert Ferrie would be open, a lot of this traffic flow should go away. Extending Biehn Drive will have a marginal impact (if any) on the traffic from south Caryndale and Doon South (which is a major issue) compared to Robert Ferrie opening.

For the Efficiency of Travel (pg 72), was the shortcut a lot of people take from Biehl Drive through Marl Meadow Drive and Templewood Drive to Strasburg Road or Biehn Drive through Marl Meadow Drive and Templewood Drive to Huron Road taken into account? If not, how would this impact the ratings for the various alternatives?

For the Safety of School Zone (pg 74), was the impact of opening Robert Ferrie drive and the reduction of the traffic coming down from South Caryndale and Doon South been factored in? This has a direct impact on how many vehicles go through the school zone especially in the morning. If factored in, how would it impact the rating of the various alternatives?

For the Bicycle and Pedestrian Safety - Conflicts with Planned Hydro Corridor Multi-Use Trail (pg 75), Caryndale is already crossing the hydro corridor. Alternative 4 is being unfairly impacted by including this already existing crossing. Also, Alternative 4 is further being unfairly designed (bordering on flagrant) for this part of the assessment by introducing a second access road to Street A (pg 77) on the north side of the hydro tower. This second access road from Robert

Ferrie Drive would be about 50 meters from where Biehn Drive (south portion that would not cross PSW) would connect. There is no need for this second access road since it was not included in the other alternatives. As a result, all alternatives are going to introduce the same number of new crossings. What would be the impact to the overall rating of eliminating this item since it is the same for all alternatives?

For the Personal Security of Pedestrians and Cyclists (pg 78), Alternative 4 is not being treated fairly since it does not need Multi-Use Pathway (MUP) connections because there is no continuous road being put through!! It has something even better, a dedicated walkway for pedestrians and cyclists, as shown on page 58, which doubles as access for the utilities!!! As a result, the way this criterion is set up is prejudicial to Alternative 4. Therefore, what would be the impact on the overall rating of eliminating this item?

The ratings for Wildlife Habitat (pg 80), Accommodating Wildlife Movement (pg 82), Provincially Significant Wetlands Removed (pg 85) and Groundwater Infiltration (pg 87) clearly demonstrate that Alternative 1 and 2 would have negative impacts on the environment. How is the over $2 million investment by the City of Kitchener (as mentioned in The Record on April 11, 2020) in Strasburg Creek and saving the brook trout being protected? The PSW at the end of Biehn Drive links right into this creek and having a through road will impact not only the PSW but by extension Strasburg Creek. How many more millions will it be to reverse the negative impacts of this through road?

For the Community Disruption to Biehn Drive North (pg 88), was the fact that a substantial part of the traffic on Biehn Drive North is the result of traffic coming from Caryndale South and Doon South? How would it impact the rating if this traffic was removed from the analysis since it will be handled by Robert Ferrie Drive? Also, are the shortcuts a lot of people take from Biehl Drive through Marl Meadow Drive and Templewood Drive to Strasburg Road or Biehn Drive through Marl Meadow Drive and Templewood Drive to Huron Road taken into account? If not, how would this impact the ratings for the various alternatives?

For the Efficient Utilization of Future Development Land (pg 96), was the proper development of the lands for Alternative 4(removal of the through road going through the PSW from Alternative 1) factored into the rating? If so, please demonstrate. If not, what would be the impact to the rating of Alternative 4?

For the Crossing of the Hydro Corridor (pg 97), Alternative 4 is being unfairly designed (bordering on flagrant) for this part of the assessment. The crescent should give on the portion of Biehn Drive South (between PSW and Rebert Ferrie Drive since it would not go through the PSW) just like for Alternative 1. The only difference between Alternative 1 and Alternative 4 for these evaluation criteria should be the removal of the through road going through the PSW. There is no need for this second access road as demonstrated by its exclusion from the other alternatives. As a result, all alternatives are going to introduce the same number of new crossings. What would be the impact to the overall rating of eliminating this item since it is the same for all alternatives?

For the Accommodating Stormwater Management (pg 99), has the proper development of the lands south of the PSW been factored in for Alternative 4 (removal of the through road going through the PSW from Alternative 1)? What is the impact on the rating of Alternative 4 if this is factored in?

For the Biehn Drive Stormwater Enhancement (pg 100), has the impact of the natural absorption of the stormwater been factored in? That is nature doing what it does well when there is little human interruption. What is the impact on the rating of Alternative 4 if this is factored in?

For the Overland Stormwater Management Route (pg 103), has the proper development of the lands south of the PSW been factored in for Alternative 4 (removal of the through road going through the PSW from Alternative 1)? What is the impact on the rating of Alternative 4 if this is factored in?

Thank you for the opportunity to make comments and ask questions that will become part of the public record on this important issue.

[redacted]

5

[redacted]
Sent: Wednesday, November 17, 2021 8:09:20 PM
To: Eric Riek <Eric.Riek@kitchener.ca>
Subject: Biehn

The EA for Biehn fixes the location of the RF roundabout. That is why the EA for Biehn has to be completed now.

Sent from my iPhone

6

[redacted]

Sent: November 21, 2021 9:37 PM
To: Steve Taylor (London) <stevenj.taylor@bteng.ca>; Eric Riek <eric.riek@kitchener.ca>; Christine Michaud <christine.michaud@kitchener.ca>
Subject: Re: Biehn Dr extension

Christine, Steve, Eric,

Please forward my message on to whoever else you need.

First of all, I'm not used to these kind of processes, but my gut reaction to Wednesday's meeting was I don't see the point of involving the public when you're just talking for the first 45 min about what your choice is and not actually going to change it or reconfigure or do anything about it based on all of our concerns. At that point, it seems like a massive waste of time and money, which as always brings a lot of doubt about our tax dollars being used effectively and to our benefit.

Have you had that many residents reaching out to say that they are excited and hopeful for the Biehn Dr extension? I find it hard to believe that a majority of residents feel that way. Especially when we presented specific concerns and recommendations that were either not answered or not met, how does it not come across that you have a jaded/biased perspective on transportation vs the environment.

So, I'm in the structural eng field, and when someone doesn't trust my design they can ask for my calcs. I'd like to see how your report numbers were assigned, because on the one hand I understand you are saying you are an impartial consulting company hired by the city to do an assessment, but on the other hand, your report and designs determine how the city and council will be swayed. And there is someone human who is assigning factors to things. Saying transportation is rated higher than the environment sounds an awful lot like that person is more focused on moving cars around the region than preserving the little green space we have left. Which is directly contradicting what the region and most reputable scientists would recommend as they declare a state of emergency when it comes to global warming.

It also seems like the focus is making the cars per day numbers etc work out in your theoretical models vs listening to the residents that experience the traffic day to day. The current traffic level on Biehn is tolerable and would be better with speed control. I understand you're using future numbers to run these models, but how will future numbers be larger than what they are now, there's no area to add housing in these neighborhoods. Our decisions affect people in the future, and who in the future is going to be happy about having Biehn not be a cul de sac. People living on Caryndale as well as Biehn know what the existing traffic level is when they buy and speed calming has and will been done to make it better.

Back to the graphs and tables in the presentation, I find it extremely convenient that the alternative 1 got a score of 1 for every item. Even someone making up numbers would vary the scores so it doesn't look suspicious.

Also the housing land use brown factor is 0 for alt 4? You can still make road access from the south from Robert Ferrie. To me assigning an actual realistic value for the land use factor to alternative 4 would bring alternative 1 and 4 closer in score.

End of the day, it's not just the trails that exist in this protected area, it's the way Biehn ends in a woodlot that creates a beautiful bubble at the end for the neighborhood to enjoy. And as many times as you want to say how you're the experts and the numbers check out and this is the best technical recommendation for the project, just means that you're more and more ignoring the effect on the people that actually live in the area and benefit from what you're recommending be destroyed.

7

[redacted]
Sent: Thursday, November 25, 2021 4:23 PM
To: Eric Riek <Eric.Riek@kitchener.ca>
Cc: Christine Michaud <Christine.Michaud@kitchener.ca>
Subject: [EXTERNAL] Biehn Drive Extension Class Environmental Assessment Comments

Good afternoon Eric,

My comments are attached.

[redacted]

ATTACHMENT:

I want to say how disappointed I am in the City of Kitchener. You have shown us you want to choose development over environment. And you have chosen to disrupt a quiet community for a highway going past our homes. And make no mistake, when Biehn is finished, there will be hundreds, if not thousands of commuters coming up from the 401, using Biehn Drive as a shortcut from Strasburg to Homer Watson. You will have a huge problem on your hands, but then, the damage will be done, and there will be no solution. (Or maybe, you just won't care.)

There is another situation that I am upset about. Again, it shows a lack of consideration for the residents of this area. You gave us options for the route of the road, and then chose the one you, or the developer, preferred. Do we not get a say in anything? Why show us the alternatives if you don't give us the opportunity to have at least have a say in the decision- making process?

Everything here seems slanted, dictatorial. When did City of Kitchener become so narrow minded?

[redacted] Our unsettling concern is that either option does not give us a good sightline of the road. Coming out of our driveway will be very hazardous. The bend of the road coming out from the forest seems much too abrupt.

Let's finish Robert Ferrie first and then see if the extension is necessary.

[redacted]

8

[redacted]
Sent: Saturday, November 27, 2021 9:22:16 AM
To: Eric Riek <Eric.Riek@kitchener.ca>
Cc: Christine Michaud <Christine.Michaud@kitchener.ca>
Subject: [EXTERNAL] November 17, 2021 Public Information Centre Comments

Good morning Eric,

My comments are attached.

Have a great weekend.

Regards,

[redacted].

ATTACHMENT:

Biehn Drive Extension
Class Environmental Assessment
November 17, 2021 Public Information (PIC) Centre Comments

The Grand River Conservation Authority (GRCA). has confirmed that the area behind our house and the existing Cull de Sac is part of the Provincially Significant Strasburg Creek Wetland Complex. According to the City of Kitchener (C of K) Notice of Study and Community Café, “The study will consider all reasonable alternatives with acceptable effects on the natural, social and cultural environments”. The C of K Strategic Plan for the Environment states “our strategic plan for the environment shows how we will put the environment first, reduce our carbon emissions and preserve our planet. We work to develop and maintain an ecologically diverse open space network that incorporates typical naturally occurring landscapes, significant natural features and the urban forest, all of which embody our natural heritage. We protect our water supply by working with the Region of Waterloo and the Grand River Conservation Authority to replenish and protect our water and wetlands”. If Biehn Drive is extended the C of K is violating its own Strategic Plan for the Environment. It is time for C of K staff and elected officials to lead, not continue as in the past.

Area residents have lived in a wet area for 30 years How is the C of K going to ensure we do not get more water on our properties and in our basements if the wetlands are tampered with? What is the Contingency Plan if this occurs? Documentation of the contingency plan is only fair to existing residents.

The Environmental Assessment (EA) is inherently flawed towards transportation and **must be redone**. On Page 19 of the EA Evaluation – Global Factor Weights and Sub-factor weights show Transportation 31% and Natural Environment 30%. This is wrong! The Natural Environment must be rated much higher and the scores recalculated. Current examples of what climate change is doing to Canada in British Columbia and Nova Scotia are front page news.

Robert Ferrrie Drive was not even planned when the initial extension of Biehn Drive was approved. Why not wait until Robert Ferrie Drive is extended to Strasburg Road and after a sufficient time period for residents to use this new alternative, then evaluate the need to extend Biehn Drive? As discussed on numerous occasions a road is not required for watermain and sewer installation. This can be done with an easement.

If the extension of Biehn Drive is approved by Council, area residents must have a voice on which alternative is chosen. This is only fair to the existing residents, many of whom are long term residents.

As discussed in Tuesday's (November 23) Traffic Calming Review – Biehn Drive, our section of Biehn was not included in the review and traffic calming measures the same as the rest of Biehn would be done after construction. This is wrong and not fair to the existing residents of our section of Biehn.

[redacted] If Biehn Drive is extended with the preferred alternative (Alternative1) and corresponding sharp curve, will there be appropriate sight lines for us and close neighbours to get out of and into our driveways safely?

9

[redacted]
Sent: November 24, 2021 7:58 PM
To: Eric Riek <Eric.Riek@kitchener.ca>
Cc: Steve Taylor (London) <stevenj.taylor@bteng.ca>; Christine Michaud <Christine.Michaud@kitchener.ca>
Subject: Re: Re: Biehn Dr extension

Eric,

In the biehn Dr traffic calming presentation last night, they mentioned that major collectors in the area are designed for around 5000 to 8000 a day
They also mentioned that Biehn Dr traffic numbers are in line or bit less than the standard major collector numbers.

This seems to conflict with the concept that is one of the main proponents for proposing the biehn Dr extension, as the extension presentation seemed to say Biehn Dr numbers are far above what they should be. And that it will just get worse even when robert ferrie extension is made.

Do you have more exact numbers regarding Biehn Dr traffic and what it should be? I wasn't able to find it in this report you sent

Community Café Summary Report

Biehn Drive Municipal Class Environmental Assessment

May 2021

Submitted by:
BT Engineering Inc.
509 Talbot Street
London, ON N6A 2S5
519-672-2222

Table of Contents

List of Figures

List of Tables

List of Appendices

1.0 INTRODUCTION

This report summarizes the results of the comments received at the online Community Café carried out by BT Engineering Inc. (BTE) in support of the Municipal Class Environmental Assessment (EA) Study for the extension of Biehn Drive in the City of Kitchener.

At the time of the Community Café, the Province of Ontario implemented restrictions on public gatherings to deal with the COVID-19 pandemic, and as such the meeting relied on web-based communications.

The Environmental Assessment (EA) and land use planning for this road link have been ongoing for several decades, and the previous Transportation Master Plan and current Official Plan have identified this project. The TMP completed Phases 1 and 2 of the Municipal Class EA. The current study is completing the subsequent Phases 3 to 5 of the Municipal Class EA and has been initiated by the City of Kitchener to develop a transportation plan for the extension of Biehn Drive westerly to the Robert Ferrie Drive extension. The Biehn Drive extension will include municipal services including a trunk sanitary sewer, storm sewer/ditches and watermain. The Study will evaluate alternatives for the alignment of the Biehn Drive extension, intersection locations and designs, and municipal services while minimizing the environmental, social, and cultural impacts of the project.

The Study Area is located in the City of Kitchener and is illustrated on **Figure 1**.

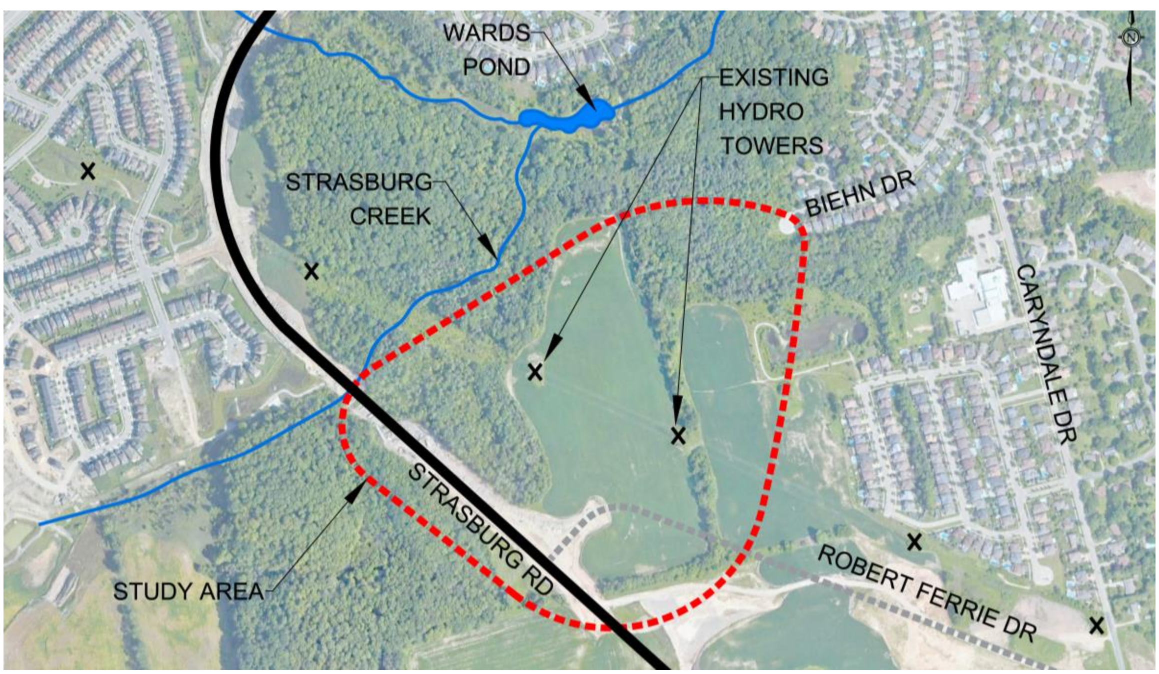


Figure 1: Study Area

The online Community Café event was held on April 20, 2021. Notices and invitations were sent out prior to the event and copies are included in **Appendix A**. The Community Café was conducted with key stakeholders and the public as part of the Environmental Assessment process. Thirty-two (32) people attended the Community Café event.

1.1 History of the Biehn Drive Extension

The Biehn Drive extension has been included in City planning documents since the late 1980's. It first appeared in the Brigadoon Community Plan in 1989 and was identified as a necessary connection between the Brigadoon Community and Strasburg Road.

Following this Community Plan, the road link was adopted into the City's Official Plan as Amendment No. 98 in 1991. The extension has been identified in every subsequent Official Plan, Transportation Master Plan and area planning study including:

- Doon South – Brigadoon Transportation Network and Corridor Study (McCormick Rankin, 1994)
- Kitchener Planning and Development Staff Report PD95/51 (1994)
- Updated Brigadoon Community Plan (2005)
- Kitchener Integrated Transportation Master Plan (2013)

In recent years, the extension of Biehn Drive was reviewed as part of the Robert Ferrie Drive Environmental Assessment (EA). A Need and Justification Review was completed in 2014 as part of this EA and concluded that the extension to Robert Ferrie Drive as well as the extension of Biehn drive were both necessary collector roads to accommodate the transportation needs of the Brigadoon/Doon South communities.

This recommendation was included in the Official Plan Amendment No. 103 in March 21, 2019.

2.0 METHODOLOGY

The Community Café process follows the principles of the "World Café" philosophy; namely, that people want to talk together about issues that matter, and that as we talk together we are able to collectively achieve greater wisdom. People have the capacity to work together and can collectively be creative and insightful when actively engaged in meaningful conversations. The Community Café is a simple yet effective conversational method for fostering dialogue, accessing collective intelligence and creating innovative possibilities for action. The seven Café principles are:

1. Set the context
2. Create hospitable space
3. Explore questions that matter
4. Encourage everyone's contributions
5. Connect diverse perspectives
6. Listen together for insights
7. Share collective discoveries

The Community Café was an informal event that facilitated conversation by providing participants with a comfortable and welcoming environment. Informational exhibits were prepared in advance of the Café and were available on the City's website. Copies of the exhibits are provided in **Appendix B**.

The event was organized to create a dialogue about issues that matter to the stakeholders and community. Each conversation was chosen to consider the most important parameters of the project and the desired goals of the participants. Four discussion topics were provided to reflect the concerns of the community. As participants discussed each topic, key ideas and perspectives were exchanged, providing new insights to the project.

A facilitator encouraged all participants to contribute to the conversation and to remain focused on the topic being discussed.

The four topics chosen to be discussed during the event were:

1. Traffic Operations
2. Pedestrians/Cyclists
3. Intersection Design
4. Neighbourhood Concerns

2.1 Opening Presentation

The Community Café event began with an introductory presentation from Mr. Steve Taylor, Consultant Project Manager, (see the Café Presentation in **Appendix C**). Mr. Taylor introduced the project and provided background information including the project issues, approach and process.

Following the project introduction, Mr. Taylor explained the process and objectives of the Community Café event. The participants were then moved to small breakout rooms to begin discussion on the applicable topics.

3.0 TOPIC DISCUSSIONS

In each breakout room, a topic of conversation was provided for discussion. Each topic had several questions associated with the topic; however, the conversation often diverged from the given questions. This allowed for conversation to flow freely and created an encouraging environment for all participants to contribute ideas and perspectives. It also provided the participants an opportunity to direct the conversation to issues that are relevant to their actual concerns.

The following sections summarize the ideas and comments expressed during the event. The comments are listed based on the discussion topic of the table.

3.1 Topic 1: Traffic Operations

Question 1: What intersection/roadway improvements would you like to see with the extension of Biehn Drive?

- General opposition to the extension of Biehn Drive from residents living on Biehn Drive.
    - The proposed extension of Biehn Drive should not be considered as a "done deal".
    - Extension of Biehn Drive will have massive impacts on residents. This has already happened to Caryndale Drive with the extension of Robert Ferrie Drive.
    - The EA should not be initiated until Robert Ferrie Drive extension is constructed. This would allow the City to collect traffic information instead of relying on projections.
    - Consideration should be given to changes in travel patterns with more workers working from home.
    - Road users are already set in their traffic patterns. The extension is not required. Two collector roads in such close proximity are redundant.
- The extension is not considered to be required because the neighbourhood is already connected to Robert Ferrie Drive at Caryndale Drive.
- Participants noted they were aware of the project and want to ensure that the road extension will protect the natural, social and cultural environments.
    - The project has been documented in various City planning documents for approximately 20 years.
    - The proposed extension of Biehn Drive has always been part of planned area development and the plan was in place when many of the area residents purchased their homes.
    - The understanding is that the Biehn Drive and Robert Ferrie Drive Extensions are interconnected projects that would be delivered together, benefiting area traffic.
- The potential for increased traffic volume on Biehn Drive was also a concern; there were conflicting opinions that the traffic volumes on Biehn Drive would increase while

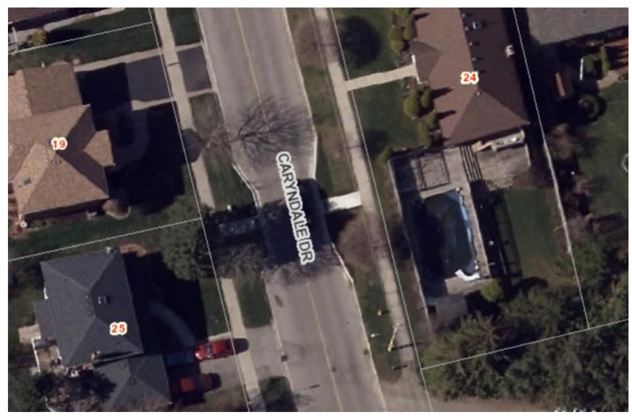
others acknowledged that the traffic volumes on sections of Biehn Drive can be expected to decrease.
  - The planned extensions of Biehn Drive and Robert Ferrie Drive would combine to redirect traffic away from Caryndale Drive and existing Biehn Drive.
- Conflicting opinions were expressed regarding access to the arterial road network:
  - That there is no problem driving north to Huron Road from within the neighbourhood; versus
  - The shorter distance to the Strasburg Road Extension would be a convenient alternative that they would use.
- Preference for Alternative 1; however, participants did not support the road or services extension.
- Consideration should be given to creating a cul-de-sac on the south side of the Provincially Significant Wetland to service the development instead of extending Biehn Drive.
- Consideration should be given to extending Biehn Drive for active transportation uses only. This would limit impacts to the natural environment and improve connectivity of the trail network.
- The opportunity for transit service through the neighbourhood, with the planned extension, would benefit existing area traffic.

Question 2: Do you have any safety concerns related to the future extension of Biehn Drive (i.e. speed, volumes, cut-through traffic)?

- There are existing safety concerns on Caryndale Road and Biehn Drive because of high speeds and traffic volumes.
  - Support for reducing the posted speed on Biehn Drive.
  - Support for making the area a Community Safety Zone or School Safety Zone.
- There are safety concerns at the corner of Biehn Drive and Caryndale Road because approximately 25% of cars at the intersection don’t stop. This a safety issue for the school.
- There is already a high collision rate at Robertson Crescent and Biehn Drive.
- Need to maintain a safe area for vulnerable road users.
  - There are several schools located in close proximity to the Study Area.
  - Neighbourhood children frequently use the current Biehn Drive cul-de-sac for activities. The dead-end creates a safe space for children.
- Concern for increased traffic volumes as a result of the proposed development north of Robert Ferrie Drive on the existing farmland.
  - Would the road alignment alternatives support different development scenarios (i.e. housing, commercial, large apartment buildings, traffic generators)?
- There is a lot of truck traffic on the existing Biehn Drive. Truck traffic should not be allowed on the extension.

Question 3: Should traffic calming features be included (i.e. medians, speed humps)?

- High speeds are an issue on Biehn Drive. Controlling traffic speed on Biehn Drive was noted to be a major concern for many individuals.
- Mitigation with narrowing roads and signs bolted to street create more of a road hazard than slowing people down. More traffic in the neighbourhood increases the chances of an injury/accident. Kids walking to school and people walking in the neighbourhood are at risk already.
- The traffic calming measures constructed on Caryndale Drive are ineffective and create more confusion for drivers (see photos below).
    - Drivers don't know how to navigate the mini roundabout constructed.
    - Drivers don't know if they are required to stop at the crosswalk. Crosswalks should be signed and have flashing lights to alert drivers.



- Centre medians are more cosmetically appealing and reflect the neighbourhood character, additional green space/grassed area.
- Narrowing roads/chicanes/medians are road hazards. Narrowing lanes forces traffic together. Chicanes would be difficult for snow removal and aren't aesthetically appealing.
- Speed humps work to slow down traffic, but drivers weave around them creating a safety concern.
- Any traffic calming measure implemented must ensure it will not impact emergency services operations.
- Support for a curvilinear alignment to slow down drivers.
- Potential to have a 90-degree bend at the existing Biehn Drive cul-de-sac to slow drivers down as they approach the future extension.

3.2 Topic 2: Pedestrians/Cyclists

Question 1: What are the main safety concerns for pedestrians/cyclists along the extension of Biehn Drive?

- Biehn Drive and the future extension are not safe because of traffic volumes and speed.
- Active transportation facilities need to be safe for children and people with disabilities.
    - There are three group homes in this area for people with disabilities.
    - There are multiple schools located in close proximity.
    - There is a day-care close to the Study Area, and they frequently walk to the dead-end.
- Crossings need to be provided to allow kids and vulnerable road users a way to cross the street.
    - Consider installing pedestrian cross-overs.

Question 2: Should active transportation facilities be provided along the Biehn Drive extension, and if so which type (i.e. MUT, sidewalk)?

- A multi-use trail from Robert Ferrie Drive to the existing end of Biehn Drive would be preferred.
    - A MUT provides a safe space for all road users.
    - There are a lot of children with bikes in the area; children's safety is a very important consideration for the project.
- Extending sidewalks along both sides of the proposed extension, as exists along existing Biehn Drive, was also suggested.

Question 3: How should cycling be accommodated in the corridor?

- There are no facilities for cyclists along the existing Biehn Drive.
    - If cycling facilities were built, they wouldn't be continuous.
- A separated cycling lane with dividers looks bad and doesn't create a welcoming environment for all cyclists.
- Pedestrians and cyclists to be separated from vehicular traffic.
- There should be a boulevard/separation between vehicular lanes and active transportation facilities.
- Preference to reduce the width of the boulevard through the wetland to protect the natural environment.

Question 4: How should linkages be made to the existing trail system?

- It was noted that there has already been an increase in the number of pedestrians using area trails.
- It is important to maintain the existing trail system and linkages to parks/schools, natural features etc.
    - Access needs to be maintained between residential areas and public spaces.
- There is an informal trail that exits the Parkwood Estates development. It should be continued. The trail would need to cross Biehn Drive to get to the other side.

3.3 Intersection Design

Question 1: Are there concerns about implementing a roundabout at the new intersection with the future extension of Robert Ferrie Drive?

- Support for a full-size roundabout at the Biehn Drive/Robert Ferrie Drive extension.
  - Allows for continuous traffic flow.
  - A roundabout would reduce traffic speeds.
- Concern for the proximity of the roundabouts on Robert Ferrie Drive at Biehn Drive and Strasburg Road.
- Concern for pedestrian safety at roundabouts

3.4 Neighbourhood Concerns

Question 1: What are the community concerns with respect to the existing neighbourhood (i.e. noise, visual intrusion etc.)?

- Concern for the cost of the project to City taxpayers.
- The majority of impacts will be on residents located west of Caryndale Road. These residents will experience increased traffic volumes, noise and pollution in front of their homes.
- The out-of-way travel to Robert Ferrie Drive is short enough that the extension is not needed.
- Concern for construction traffic in the neighbourhood
- Investigation of the natural environment, cultural heritage significance and archaeological potential of the area is required.
- Parking on the existing Biehn Drive should be maintained.
- Benefits of the proposed extension would include improved Emergency Vehicle Access to the existing neighbourhood.

Question 2: Do you have any environmental concerns for the natural areas being crossed by the project?

- The wetland attracts many visitors. The community doesn’t want to lose this asset.
  - The wetland contributes to the mental and physical health of the residents and should be maintained.
  - People move to the area because of the wetland. It is the most important feature of the community.
  - The park area serves the community and should be protected.
  - The increased number of pedestrians already using area trails is already an impact on the environment.
- Concern for impacts to the natural environment and the PSW.

    - How will a road be maintained through a wetland without being washed out/compromised continuously?
    - There are branches of Strasburg Creek that are located beneath the proposed Biehn Drive extension.
        - Construction of a new road and sanitary sewer will impact the flow of water.
        - The water table is already very high and some residents have sump pumps running year round. The water table has been stable (no huge flood events) but does cutting into the environmental area impact the water table? If the water table rises, flooding basements would be inevitable.
        - Concern for sediment contamination in watercourses during construction.
- Developers have historically not protected the environment. They need to follow regulations and protect the natural habitat during construction.
    - Developers should not be allowed to build houses in the wetland.
    - A buffer should be maintained between the development and the wetland.
- The road will interrupt existing wildlife corridors.
    - Deer, foxes, ducks etc. are frequently seen in the wetland. The past winter was the best winter for deer – they follow behind the existing houses and through the environmental areas towards the Grand River.
    - Species at Risk (SAR) need to be identified and protected.
    - A rare salamander was found in the woodlot.
- There is a need to protect existing trees/vegetation.
    - It is Kitchener's policy to not cut trees and encourage tree growth - how is this road extension lining up with that?
        - It was suggested that the proposed extension violates the City of Kitchener's Strategic Plan for the Environment.
    - Any tree removed for this project should be replaced at two or three times the number.
    - Replacement trees should be native species. Avoid Norway maples.
- Concern for the impact to existing wells.
    - The health of the City's water supply should be considered.
- Concern for the increased impermeable area because of increased asphalt.
    - This will result in more salt entering the wetland.
- Support for a wildlife crossing (tunnel under Biehn Drive).

4.0 COMMENT SHEETS

Six comment sheets were received in advance of the Community Café and during the subsequent two-week comment period. These comments are summarized in **Table 1** and, with the exception of personal information, are provided in **Appendix D**.

Table 1: Summary of Written Comments

Comment	Number of Respondents	Comment Sheet No.
Opposition to the extension of Biehn Drive.	3	1, 2, 3
Current cul-de-sac is a quiet, safe spot without heavy traffic	1	1
The natural environment and trails in the Study Area are important features of the area.	3	1, 3, 4
Concern for the impacts to the natural environment as a result of the extension.	5	1, 2, 3, 4, 5
Concern for impacts to the water table.	3	2, 3, 5
Is there a need for the extension once traffic is diverted to Robert Ferrie Drive and Strasburg Road?	2	1, 2
Consider providing only municipal services (i.e. water, storm and sanitary sewer) through the extension (no road).	2	1, 3
Some residents in the area were not aware that the extension was planned.	1	2
Future consultation with residents should clarify that the extension will be built so there isn't confusion over other alternatives being considered.	1	2
Additional traffic studies should be completed or made available for the Study Area.	1	2
It is discouraging that the City is more focused on serving developers instead or preserving green space/quiet neighbourhoods.	1	2
The City is violating its own strategic plan to protect the natural environment if Biehn Drive is extended.	1	3
More transparency is required regarding the evaluation of alternatives (i.e. environmental impacts). Mitigation measures must also be described in the EA.	1	3
Concern for the cost of the extension.	1	3
Consider providing a road through the development that does not connect to Biehn Drive (cul-de-sac before the wetland).	4	2, 4, 5, 6
Traffic speeds/volumes are already an issue on Biehn Drive. The extension will make this worse.	1	5

5.0 SUMMARY AND NEXT STEPS

The discussion presented in this report represents the opinions and input of the meeting participants. This input reflects perspectives of local residents along Biehn Drive who may not have been unaware or do not support the community planning that was predicated on providing a westerly connection of Biehn Drive to Strasburg Road as part of the transportation and land use plan since the 1980's. The key messages from attendees that were summarized at the end of the meeting include:

- Can earlier decisions be reviewed including not extending Biehn Drive (change the traffic planning to divert this traffic to other communities/streets)?
- Can the link be solely for active transportation?
- Can the need for the street extension be communicated to those living near the extension?
- Create a context sensitive project that recognizes the environmental significance of the Provincially Significant Wetland.
- Traffic calming of any project should achieve a slow and safe road for those living along Biehn Drive.

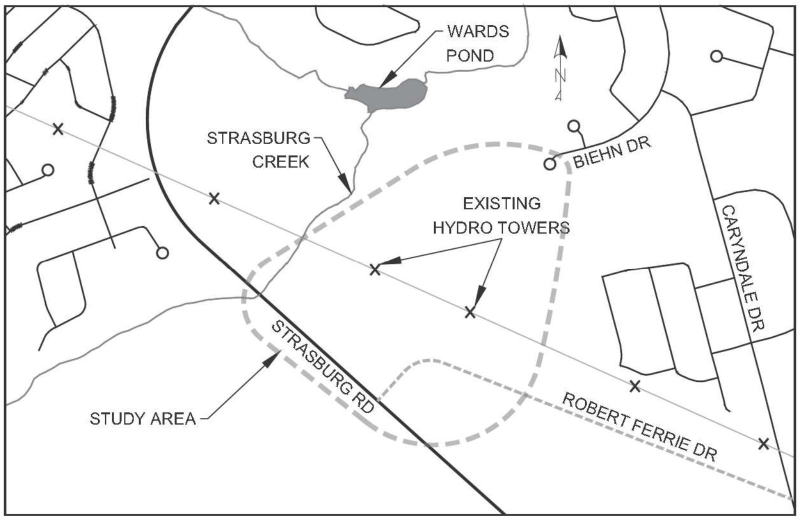
This discussion will be used as input by the Project Team for subsequent steps in the Study. At this stage of the study no decisions have been made.

Readers of the report are cautioned that the recorded ideas and discussions are unsubstantiated, may or may not be feasible, and require development. They do, however, represent an effort for the early identification of the issues and alternatives for the project that are consistent with the values and opinions of the meeting participants.

Appendix A

Notice of Study Commencement and Community Café

Notice of Study Commencement and Community Café
City of Kitchener
Biehn Drive Extension Environmental Assessment



INTRODUCTION

The City of Kitchener has retained BT Engineering Inc. to undertake an Environmental Assessment (EA) Study for the extension of Biehn Drive from the existing terminus 300 m west of Caryndale Drive to the future Robert Ferrie Drive extension. The Study will evaluate alternatives for alignment, cross sections, intersections and active transportation to develop a preferred plan to address the needs of the Study Area and reflect the recommendations in the City of Kitchener Transportation Master Plan.

STUDY PROCESS

The Biehn Drive Extension EA Study is being conducted as a Schedule C EA Study under the Municipal Class Environmental Assessment (MCEA) (2015). The Transportation Master Plan (TMP) has previously completed Phases 1 and 2 of the Class EA; this Study will review the previously completed phases and complete Phases 3 and 4. The Study will consider all reasonable alternatives with acceptable effects on the natural, social and cultural environments, and proactively involve the public, stakeholders and Indigenous Peoples.

PUBLIC CONSULTATION

Study Design Report: A draft Study Design Report has been prepared that describes the study background, approach, process, alternatives and consultation program. The draft Study Design Report is available on the City's website at: https://www.kitchener.ca/en/development-and-construction/infrastructure-projects.aspx

Community Café: An online Community Café event will be held to help define the study scope and issues. The goal of the Community Café event is to engage the public/stakeholders on their perspectives and interests in the Study. **To register for the Community Café, please contact Steve Taylor or Eric Riek.**

The online Community Café will be held as follows:

Date: April 20, 2021
Time: 6:30 to 8:00 pm
Location: Register by email to be sent the Virtual Meeting Room (Zoom) Link

Comments: There is an opportunity at any time during the Class EA process for interested persons to provide comments. Early identification of individual and group concerns greatly aids in addressing these concerns. All information will be collected in accordance with the *Municipal Freedom of Information and Protection of Privacy Act* (2009). With the exception of personal information, all comments will become part of the public record. Persons will be advised of future communication opportunities by electronic notice in addition to newspaper public notices.

For more information, to register for the Community Café, or if you wish to be placed on the study's mailing or emailing list, contact either:

Steve Taylor, P.Eng.
EA Project Manager
BT Engineering Inc.
509 Talbot Street
London, ON N6A 2S5
Tel: 519-672-2222
Email: stevenj.taylor@bteng.ca

Eric Riek, C.E.T.
City Project Manager
City of Kitchener
200 King Street West
Kitchener, ON N2G 4G7
Tel: 519-741-2200 ext. 7330
Email: eric.riek@kitchener.ca

This notice issued on March 26, 2021.

Appendix B

Community Café Exhibits

BT ENGINEERING

Welcome!
City of Kitchener
Biehn Drive Extension
Class Environmental Assessment

Thank you for participating in the Online Public Information Centre (PIC) for the City of Kitchener's Class Environmental Assessment (EA) for the extension of Biehn Drive and the sanitary trunk sewer.

At the present time, the Province of Ontario has implemented restrictions on public gatherings to deal with the COVID-19 pandemic. As a result, this Public Information Centre is relying on web-based communications. Should you have any questions regarding the study, please contact the City or Consultant Project Managers.

There is an opportunity at any time during the Class EA process for interested persons to provide written input. Any comments received will be collected under the *Environmental Assessment Act* and, with the exception of personal information, will become part of the public record.

Comments can be submitted by emailing stevenj.taylor@bteng.ca and/or eric.riek@kitchener.ca by **May 4, 2021**.

KITCHENER

Introduction

The City of Kitchener has initiated a Class Environmental Assessment (EA) Study for the extension of Biehn Drive and the sanitary trunk sewer from the current terminus of Biehn Drive (approximately 60 m west of Spencer Court) southerly to the future Robert Ferrie Drive Extension.

This Study will complete the planning and preliminary design steps of the Municipal Class EA by conducting a transportation needs assessment, generating and evaluating planning alternatives, and proactively involving the public in defining a recommended plan for improvements.

This Study is being completed as a Municipal Schedule C Class EA undertaking based on the range of anticipated effects. A Draft Study Design Report describing the study process has been made available for agency and public comments and is available on the City's website.

Class Environmental Assessment (Class EA) Process

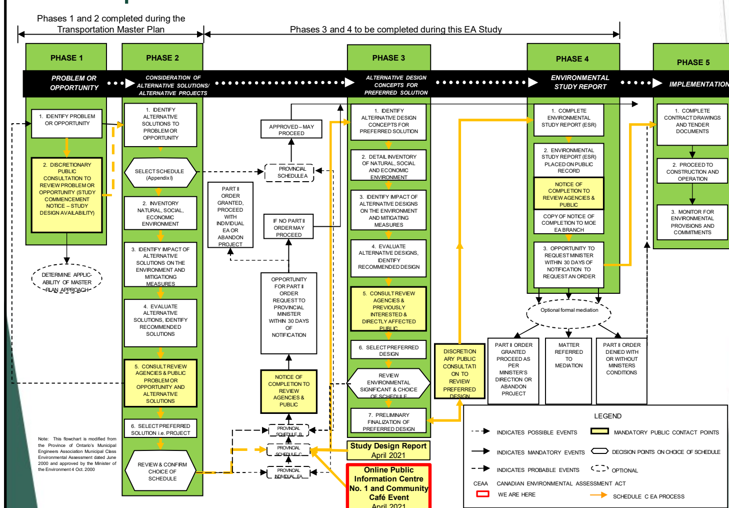
This study is being initiated as a Municipal Schedule C project as defined by the Municipal Class Environmental Assessment (MCEA). Consultation is a key component of the Class EA process. The goal of consultation is to provide stakeholders and affected individuals opportunities to make their interests and concerns known to the project team throughout the EA process. The early identification of issues and concerns allows the project team to investigate with the goal of, if possible, resolving the concern.

At the completion of the EA process, an Environmental Study Report (ESR) will be produced. The Report will document key components of the study: need and justification; the range and types of consultation; natural and socio-economic environmental inventories; evaluation of alternatives; selection of the recommended alternative; and supporting reports produced for the project. Upon the completion of the ESR, the public and interested stakeholders will be made aware of 30-day public review of the Report.

If, after viewing the future ESR and having made your concerns known to the project team, you still have concerns during the 30-day review period, you have rights under the *Environmental Assessment Act.* These rights will be outlined in the public notice advising of the 30-day public review period.

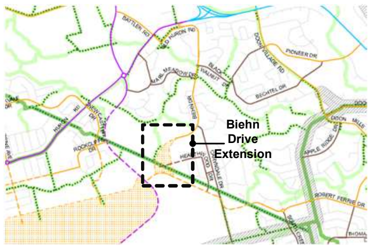
The Municipal Class EA process is illustrated on the following exhibit.

Municipal Class EA Process



Background

Since the mid-2000's, the road network and municipal servicing for the Doon South and Brigadoon areas in the City of Kitchener have been planned to accommodate area development and evolving transportation needs. Several planning documents including the City's Official Plan and Transportation Master Plan (TMP) have identified the need to extend Biehn Drive westerly to the Robert Ferrie Drive extension. The Biehn Drive Extension would be a major collector road, as identified in Schedule B of the City of Kitchener's Official Plan. This link would accommodate vehicles to and from the Brigadoon community, and would help mitigate cut-through traffic on local streets within the community. A collector road collects traffic from local roads within the community and provides connectivity to arterial roads including Strasburg Road.



Biehn Drive Extension as identified in the Official Plan (Integrated Transportation System)

Problem and Opportunity Statement

Future development within the Doon South and Brigadoon communities requires a defined alignment for the extension of Biehn Drive to Robert Ferrie Drive as part of the area road network. In order to determine the road alignment, this Study will consider the natural, social environments and the future land use in the Study Area. The extension of Biehn Drive is required to accommodate municipal servicing, and safely and reliably accommodate all modes of transportation including vehicular, pedestrians, cyclists and trucks. By defining the future road and municipal servicing plans, the subsequent land use plans can be completed by developers.

The Study will provide the opportunity to: improve accessibility to the local community by providing additional network links; define a multi-modal transportation plan to support travel within the local neighbourhoods; and allow development to proceed on lands that currently require the roadway to be defined prior to developing the land use plan.

Study Considerations

- **Existing Community**
  - Changes in sound levels
  - Changes in traffic volumes on Biehn Drive
  - Potential mitigation may include traffic calming measures, pedestrians/cyclist facilities, and mitigation of noise impacts.
- **Natural Environment**
  - Potential for Species at Risk (SAR) in woodlots and the Strasburg Creek Provincially Significant Wetland (PSW)
  - Two cold-water systems: Strasburg Creek (immediately north of the Study Area) and Blair Creek (900 m south of the Study Area).
  - Minimize footprint within, and impacts to, the Strasburg Creek system.
- **Transportation**
  - Improvements are required to address long-term traffic operations.
- **Active Transportation:**
  - Active modes of transportation will require separated facilities to service all ages and abilities as identified in the Cycling and Trails Master Plan.
  - This could include multi-use pathways, sidewalks, buffered bicycle lanes and/or raised cycle tracks.

Assessment of Alternative Planning Solutions

Alternative Planning Solutions (Alternatives to the Undertaking) represent alternative ways or methods of addressing the problem to be solved by the project. In determining the preferred undertaking for the City, the following Planning Solutions were evaluated:

- ✘ Do Nothing: This alternative would maintain the existing road network and would not extend Biehn Drive.
- ✓ Transportation Demand Management (TDM): Reduces vehicular traffic demand (encourages alternative work hours, work at home and active modes of transportation).
- ✘ Greater Use of Local Roads: Encourage the use of local roads to reduce the need to extend Biehn Drive. Local roads are generally not designed or maintained to accommodate high traffic volumes.
- ✘ Limit Land Use Development: Limit any new residential, commercial or industrial development and therefore reduce the generation of new trips.
- ✓ Extend Biehn Drive: Provides a long-term solution for improved traffic capacity, operations and safety.

Based on the preliminary review of Alternative Planning Solutions, "**Transportation Demand Management"** and **"Extend Biehn Drive"** are recommended. This Planning Solution addresses the problem statement by improving transportation service and safety.

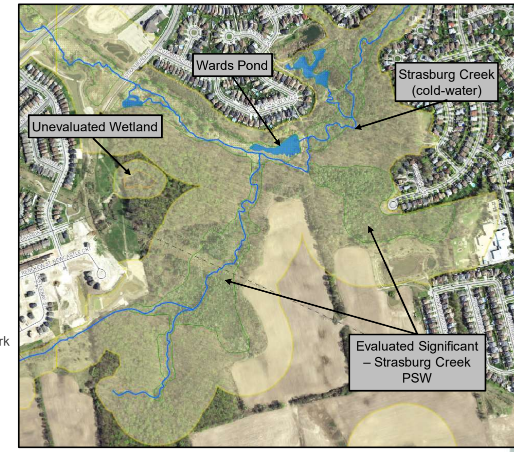
The evaluation is documented on the following exhibit for public review and comment. All comments received will be reviewed and considered before proceeding with the Study and the evaluation of TDM (Active Transportation Improvements) and New Infrastructure alternatives.

Assessment of Alternative Planning Solutions

Screening Criteria	Alternative 1: Do Nothing	Alternative 2: TDM	Alternative 3: Local Roads	Alternative 4: Limit Development	Alternative 5: Extend Biehn Drive
Transportation	Does not address forecast traffic demand. Results in increased volumes on local roads.	May reduce vehicular demand by mode shift or work at home but will not eliminate need for new or improved infrastructure.	Local roads not designed to accommodate increased volumes.	May reduce vehicular demand by reducing the number of trips generated by development but does not address existing demands and/or background growth.	Accommodates all modes of transportation.
Environmental	No impacts.	No or low impacts. Low impacts may be associated with active transportation projects/ improvements (i.e. sidewalks, bike lanes).	Low impacts. Creates disruption to properties on local roads that would experience an increase in traffic.	No impacts.	Low to medium environmental effect possible with new corridor. Magnitude of effects is subject to environmental mitigation.
City Planning Objectives	Does not meet objectives/ recommendations in City Planning documents.	Supports objective to encourage active transportation and alternate modes.	Does not meet objectives/ recommendations in City Planning documents.	Does not meet objectives/ recommendations in City Planning documents.	Supports the recommendations for the extension of Biehn Drive in OP and TMP.
Recommendations	Not recommended. ✘	Recommended as a complementary solution. ✓	Not recommended. ✘	Not recommended. ✘	Recommended to be carried forward. ✓

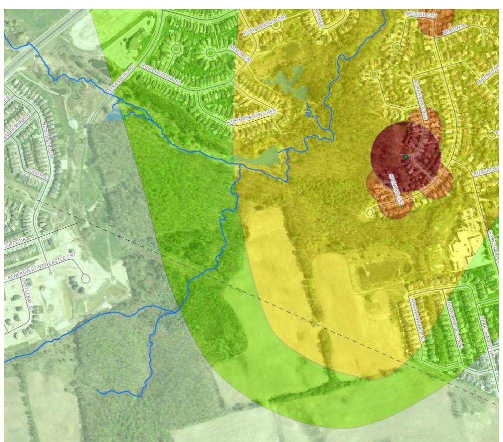
Existing Conditions
Natural Environment

- Regulated Watercourse (GRCA)
- Regulated Waterbody (GRCA)
- Wetland (MNRF)
  - Provincially Significant
  - Locally Significant
  - Unevaluated
- Regulation Limit (GRCA)



- Potential SAR:
  - Butternut (Endangered)
  - Snapping Turtle (Special Concern)
  - Eastern Meadowlark (Threatened)
  - Bobolink (Threatened)

Existing Conditions
Well Head Protection Area



Regulated Watercourse (GRCA)
Municipal Well (GRCA)
WHPA Vulnerability (GRCA)
10
8
6
4
2
Regulated Waterbody (GRCA)

https://maps.grandriver.ca/web-gis/public/?theme=MYP&bbox=542091,4802909,545343,4804695

Preliminary Design Alternatives

Preliminary design alternatives for the extension of Biehn Drive were categorized into 5 groups:

Alignment Alternatives
- Connect to Robert Ferrie Drive east of Hydro Tower
- Connect to Robert Ferrie Drive west of Hydro Tower
- Connect to Strasburg Road

Intersection Alternatives
- Signalized
- Unsignalized
- Roundabout

Sanitary Sewer Alignments
- On Road Alignment
- New Alignment

Cross Section Alternatives
- Urban Cross Section with sidewalk/ Separated Bike Facilities
- Semi-Urban Cross Section with Separated Bike Facilities

Traffic Calming Alternatives
- Chicanes
- Median
- Narrower Driving Lanes
- Median Bulb-Out

These groups of alternatives are presented on the following exhibits.

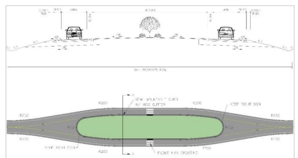
Traffic Calming Alternatives

Traffic calming measures, to control speed and discourage through traffic, will be considered along the extension of Biehn Drive, and will further support future recommendations for the Biehn Drive Traffic Calming Study being completed to the north of the Biehn Drive extension. These may include:

Speed Humps/Cushions or Raised Crosswalks

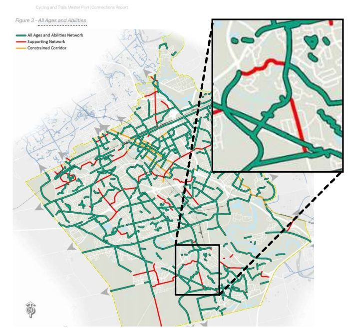
Centre Median

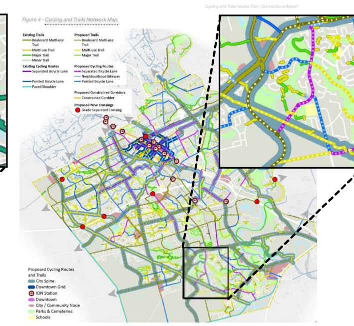
Chicanes



Median Bulb-outs

Cycling and Trails Master Plan





- Identified Cycling Facilities on Biehn Drive to be for all Ages and Abilities.
- Proposed Separated Bicycle Lanes on Biehn Drive with Multi-Use Trails along Strasburg Road and the Hydro Corridor.

Types of Separated Bicycle Facilities

Accommodating all ages and abilities of cyclists along the proposed extension of Biehn Drive could consider a variety of alternatives. These may include:

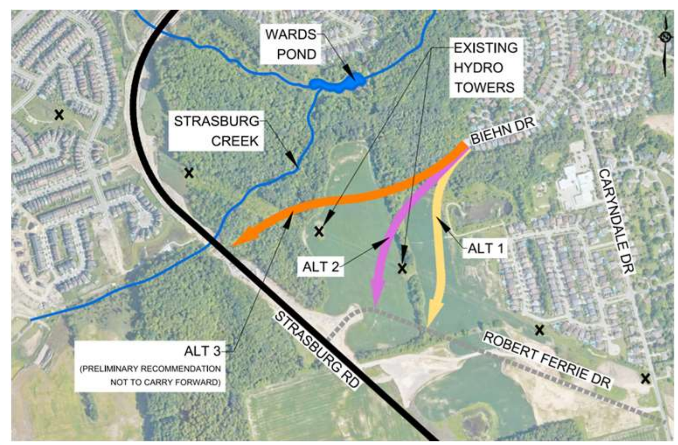
Boulevard Multi-Use Trails

Buffered Bike Lanes

Raised Cycle Tracks

Although Separated Bike lanes/Cycle Tracks were identified in the CTMP, consideration of Boulevard MUTs would be an extension of the facilities on Strasburg Road and along the Hydro Corridor and could transition to another type of future facility along existing Biehn Drive if necessary.

Alignment Alternatives

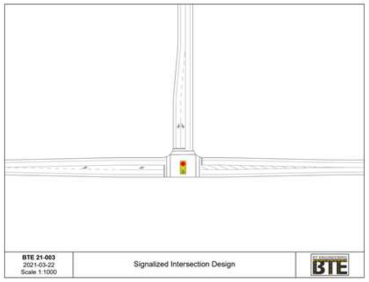


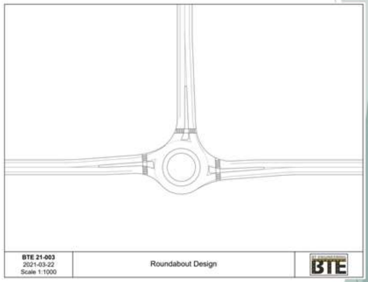
Alignment Alternatives

Coarse Screening

Screening Criteria	Alternative 1: Connect to Robert Ferrie Drive east of Hydro Tower	Alternative 2: Connect to Robert Ferrie Drive west of Hydro Tower	Alternative 3: Strasburg Road Connection
Does this alternative satisfy forecast traffic demand, improve safety, and address all modes of transportation?	Provides a north-south connection to Robert Ferrie Drive. Accommodates all modes. Reduces cut-through traffic on Biehn Drive.	Provides a north-south connection to Robert Ferrie Drive. Accommodates all modes. Reduces cut-through traffic on Biehn Drive.	Provides a north-south connection to Strasburg Road. Accommodates all modes.
Does the approach result in significant impacts to the natural environment?	Minor impacts to the woodlot/PSW (~0.3 ha).	Minor impacts to the woodlot/PSW (~0.3 ha).	Significant impacts to the woodlot/wetland (~1.3 ha).
Is the approach affordable for the City to implement?	No significant difference.	No significant difference.	Higher cost - requires an intersection onto Strasburg Road (arterial).
Does this alternative comply with the recommendations of the City's planning documents (I.e., TMP, OP, KGMP)	This alternative complies with the recommendations of the City's planning documents.	This alternative complies with the recommendations of the City's planning documents.	Does not comply with the recommendations of the Official Plan or Growth Management Plan. Based on the previous design and construction of the Strasburg Road and roundabout within the Study Area, this previous alternative is no longer considered feasible.
Recommendation:	Carry forward for further evaluation ✓	Carry forward for further evaluation ✓	Do not carry forward ✗

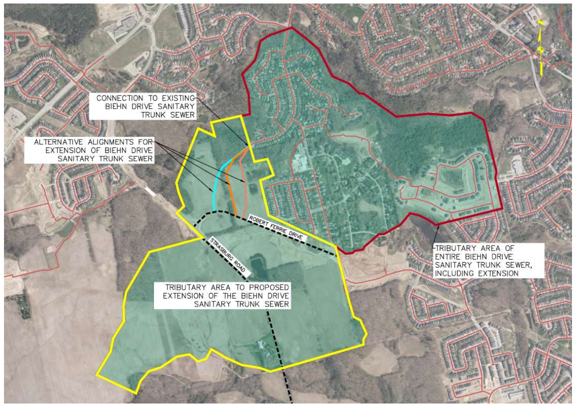
Intersection Alternatives





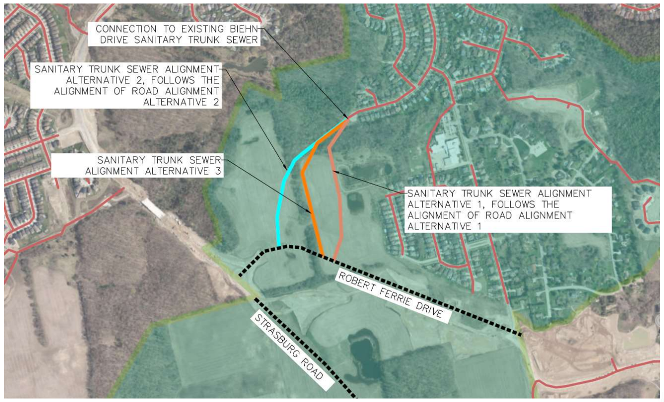
Sanitary Trunk Sewer Extension Alternatives

The trunk sanitary sewer will extend from the existing Biehn Drive cul-de-sac to the future Robert Ferrie Drive Extension. The trunk sewer will serve the area shown.



Sanitary Trunk Sewer Extension Alternatives

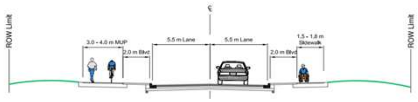
Three alternative alignments will be considered. They are shown schematically in the figure.



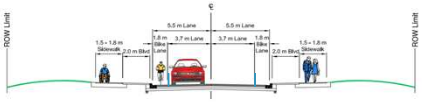
Potential Cross Section Alternatives

Could include but not be limited to:

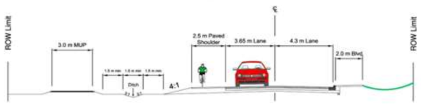
Urban with multi-use path and sidewalk



Urban with sidewalk and buffered bike lanes



Semi-urban with multi-use path and paved shoulder



The planned extension of Biehn Drive is proposed to:

- Not provide direct driveway access. This will improve safety for cyclists and pedestrians,
- Not permit on-street parking.

Access to residential lots and on-street parking would be provided along local roads within the adjacent community.

The preferred cross section will consider LID measures for stormwater management within the ROW.

Analysis and Evaluation

Alternatives will be evaluated following this Public Information Centre. The following long list of evaluation criteria (factor groups and subfactors) is being considered for the assessment of the alternatives:

Natural Environment
Air quality
Species at Risk (SAR)
Cold / cool / and warmwater fish habitat impacted
Water quality – stormwater runoff
Migratory bird nesting impact/loss of existing vegetated areas
Provincially significant natural areas and habitat (i.e. Provincially Significant Wetlands)
Regionally significant natural areas and wildlife habitat (i.e. woodlots, non provincially significant wetlands, fauna and flora)
Natural habitat impacted (e.g. specimen trees removed)
Groundwater
Climate change

Land Use and Property
Property required (Residential)
Property required (Agricultural)
Property required (Commercial)

Cost
Capital cost
Future life cycle cost
Utility relocation

Social and Cultural Environment
Historic archaeological potential
Prehistoric archaeological potential areas impacted
Built heritage sites impacts
Cultural landscape features
Noise impacts
Vibration impacts
Excess materials management
Water wells impacted
Lighting and visual impacts
Economic environment

Transportation
Traffic operations - delays
Safety - collision potential
Safety – design consistency
Movement of goods
Pedestrian access
Ability to accommodate cyclists
Emergency vehicle access

Next Steps

Following this meeting we will:

- Review all comments
- Carry out environmental inventories and technical investigations
- Complete the analysis and evaluation of alternatives
- Hold Public Information Centre No. 2

We want to hear from you!

- Please provide comments by filling out the comment form or by contacting the City's representative or the consultant below:

Steve Taylor, P.Eng. EA Project Manager BT Engineering Inc. 509 Talbot Street London, Ontario N6A 2S5 Tel: 519-672-2222 Email: stevenj.taylor@bteng.ca	**Eric Riek, C.E.T.** City Project Manager City of Kitchener 200 King Street West Kitchener, ON N2G 4G7 Tel: 519-741-2200 ext. 7330 Email: eric.riek@kitchener.ca

Please provide your comments on or before **May 4, 2021.**

Thank you for your participation in the study.

- To receive updates on the project, request that your name/e-mail be added to the mailing list.
- Your input into this study is valuable and appreciated.

All information is collected in accordance with the *Freedom of Information and Privacy Act*.

Appendix C

Community Café Presentation

Biehn Drive Extension and Sanitary Trunk Sewer Extension

ONLINE COMMUNITY CAFÉ

APRIL 2021

1

Meeting Overview

- Project Introduction
- Community Café Overview
- Café Roundtable Discussions
- Final Wrap-up

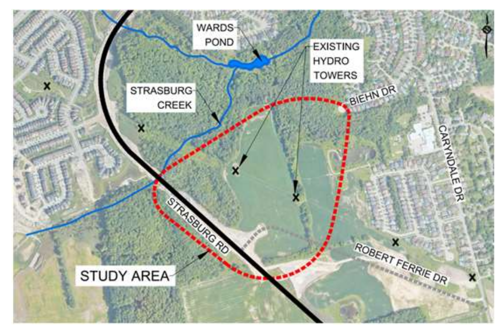
2

Project Introduction

3

Project Introduction

- This Study will be undertaken as a Schedule C Municipal Class Environmental Assessment for the extension of Biehn Drive from its current terminus to the future Robert Ferrie Drive Extension
- The Study will also include the extension of the trunk sanitary sewer, watermain and storm sewers (Schedule B)



4

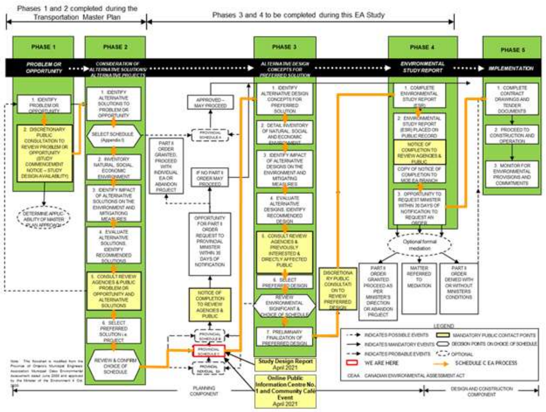
Class EA Process

Biehn Drive Extension

"Construction of new roads or other linear paved facilities (e.g. HOV lanes)" > 2.4 m – Schedule C

Sanitary Sewer Extension:

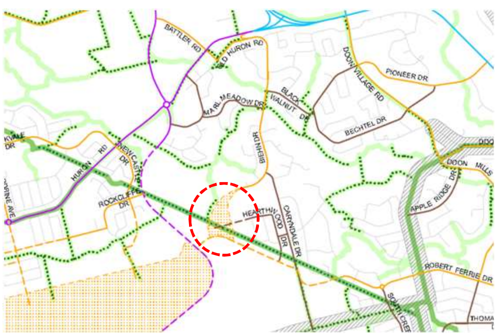
"Establish, extend or enlarge a sewage collection system and all works necessary to connect the system to an existing sewage outlet where such facilities are not in an existing road allowance or an existing utility corridor." – Schedule B



Background Information

- Community Plans for the Doon South and Brigadoon areas have established the need for the extension of Biehn Drive
- This has been documented in the Official Plan and Transportation Master Plan
- The new road link will accommodate all modes of transportation (vehicles, trucks, pedestrians and cyclists)

Official Plan – Integrated Transportation System



Key Issues

- **Impacts on the Existing Community**: The existing Brigadoon community is an established residential area with low ambient sound levels and low traffic volumes on Biehn Drive
  - Walking, cycling and parking are prevalent along Biehn Drive

Key Issues

- **Natural Environment** : The EA will investigate the protection of surrounding terrestrial habitat and will establish mitigation for any potential impacts to the natural environment
  - There is potential for SAR in the woodlots

9

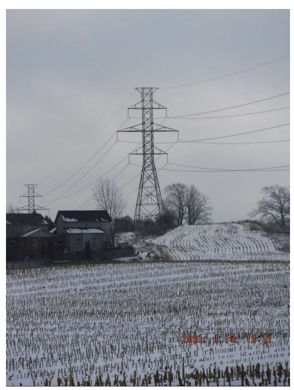
Key Issues

- **Social and Cultural Environment:**
  - Maintain access to adjacent properties
  - Mitigate impacts to property owners and road users during and post construction (i.e. noise, air quality, safety)
  - Consideration of vulnerable road users (i.e. pedestrians, cyclists and transit)
  - Potential property impacts to residential and agricultural lands
  - Archaeological and cultural heritage resources (the Study Area is located within the Haldimand Tract)

10

Key Issues

- Other issues include:
  - Proximity to adjacent intersections on Robert Ferrie Drive and the need to accommodate trucks through the roundabout
  - Consideration of any proposed plans of subdivision/utilization of development land and the potential network of future local streets
  - Potential utility conflicts including the east-west hydro corridor and the vertical clearance to existing aerial lines
  - Consideration and assessment of potential traffic calming measures to assist in controlling traffic speeds



11

Preliminary Design Alternatives

- Several groups of preliminary design alternatives will be developed and evaluated:

Alignment Alternatives	Intersection Alternatives	Sanitary Sewer Alignments	Cross Section Alternatives	Traffic Calming Alternatives
Connect to Robert Ferrie Drive east of Hydro Tower	Signalized	On Road Alignment	Urban Cross Section with sidewalk/ Separated Bike Facilities	Chicanes
Connect to Robert Ferrie Drive west of Hydro Tower	Unsignalized	New Alignment	Semi-Urban Cross Section with Separated Bike Facilities	Median
Connect to Strasburg Road	Roundabout			Narrower Driving Lanes
				Median Bulb-Out

12

Preliminary Design Alternatives

Alignment Alternatives

13

Preliminary Design Alternatives

Separated Bicycle Facility Alternatives

Boulevard Multi-Use Trails

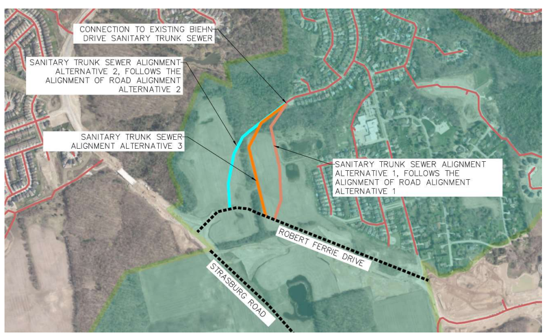
Buffered Bike Lanes

Raised Cycle Tracks

14

Preliminary Design Alternatives

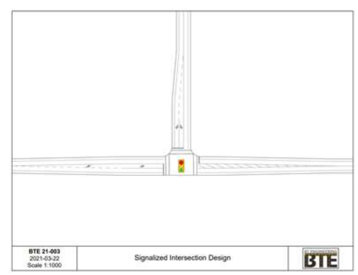
Sanitary Sewer Alignment Alternatives

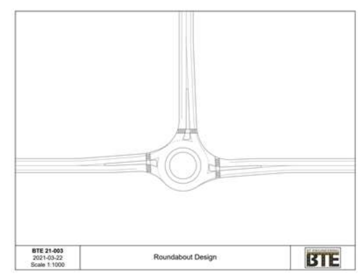


15

Preliminary Design Alternatives

Intersection Alternatives





16

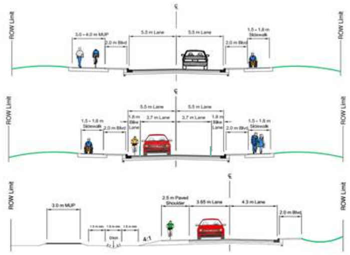
Preliminary Design Alternatives

Cross Section Alternatives

Urban with multi-use path and sidewalk

Urban with sidewalk and buffered bike lanes

Semi-urban with multi-use path and paved shoulder



17

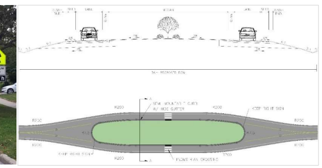
Preliminary Design Alternatives

Traffic Calming Alternatives

Speed Humps/Cushions or Raised Crosswalks

Centre Median

Chicanes



Median Bulb-outs

18

Community Café

19

Community Café Process

- Participants will be divided into small groups to allow conversations and dialogue
- At the conclusion of a discussion period, participants will be asked to change tables and mix between topics
- Participants are free to sit out a session
- A recorder person will make notes of the discussion of problems and potential solutions, and pose questions to generate discussion

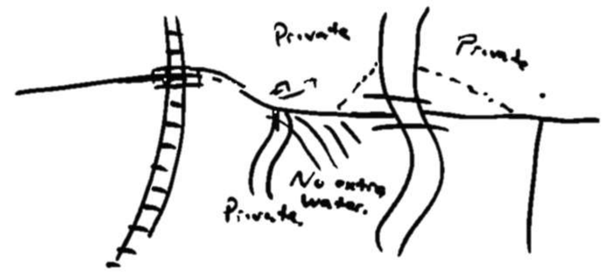
20

Café Approach

- Focus on dialogue between neighbours
- We are here to listen to your values and priorities
- Informal discussion of topics
- Encouraged to doodle sketches
- Build consensus of perspectives
- Records will be kept of discussions

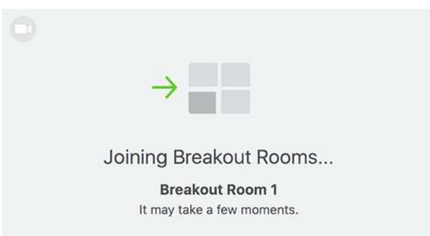
21

Sample Doodle



22

Small Group Discussions



23

Tonight's Café Discussion Topics

- Traffic Operations
- Pedestrians/Cyclists
- Intersection Design
- Impacts to Neighbourhood

24

Schedule and Next Steps

25

Next Steps

1. Needs analysis and presentation of Draft Study Design Report (SDR)
2. Environmental inventories and technical investigations to be used as input for the evaluation
3. Analysis and evaluation of alternatives
4. Selection of Recommended Plan – preferred alignment and consideration of refinements and mitigation for the Recommended Plan
5. Present Preliminary Design of Recommended Plan at PIC No. 2

26

Study Schedule

Task	Date
Project Start-Up Meeting	January 2021
Study Commencement Notice	Winter 2021
Information Gathering	Winter 2021
Environmental Review	Winter/Spring 2021
Study Design	February 2021
Public Information Centre No. 1/ Community Café	Spring 2021
Analysis and Evaluation of Alternatives	May/June 2021
Preparation of ESR	Summer/Fall 2021
Public Information Centre No. 2	Summer/Fall 2021
City Review of ESR	September/November 2021
30-day Public Review Period	October/November 2021

27

Community Café Wrap-up

- Additional information can be found at:

https://www.kitchener.ca/en/development-and-construction/infrastructure-projects.aspx

28

Appendix D

Community Café Comment Sheets

From: [redacted]
Sent: Wednesday, March 31, 2021 7:40 PM
To: Eric Riek <Eric.Riek@kitchener.ca>; stevenj.taylor@bteng.ca
Subject: [EXTERNAL] Biehn Dr extension

Hi Eric and Steve,

Can I please get the link for the virtual discussion regarding this extension?

I know there'll probably be the chance to share opinions but the current cul de sac is a wonderful quiet spot to take kids for a walk and let them run around without the heavy traffic that is near our place on Biehn. Not to mention there is a scattering of great trails through that area that allows us to enjoy the woods.

As is, it will already be a big change when subdivisions inevitably get built in the farm fields to the south west of the end of Biehn, but it would be wonderful if there wasn't also a road directing traffic through this area too.

I'd be interested to first see the numbers on how much traffic will get diverted to the Robert ferrie extension when it meets up with the Strasburg extension, as my gut would be that it would help take some of the traffic away from the north end of biehn. I can't see the cars from the area south of caryndale on Biehn adding that much to the traffic on Biehn, I would assume the majority is the other more dense subdivisions to the north of caryndale and would only get added to with the new houses on Robert ferrie.

So to me the Robert ferrie to Strasburg extension makes sense as it will disturb no more forest than it already has (the section that Strasburg has cut through with the bridge). But I don't see the benefit of extending Biehn Drive as well.

If there is the need to divert or run water and or sewer lines from the end of Biehn to connect to Robert ferrie, perhaps there is a option of just running the lines through without the additional cut needed for a full road plus sidewalks.

[redacted]

Re: Biehn Dr extension

[redacted]
Wed 4/21/2021 11:46 AM

To: Steve Taylor (London) <stevenj.taylor@bteng.ca>
Cc: eric.riek@kitchener.ca <eric.riek@kitchener.ca>; Katherine Scott <katherine.scott@bteng.ca>

Hi all,

Not sure how these community cafes typically go, and how they compare in the Zoom format vs in person, but I think the main takeaway for me was how much of the study group was opposed to the Biehn road extension. I think it's a hard stance to take that the extension will benefit more residents than those that it will hinder/negatively impact.

The concern about affecting the water table is a valid one especially for those that back onto that wetland, and I think the biggest issue for me is how small an area of farmland would actually be accessed by this extension. I don't see the benefit of the access off of Biehn vs directing it all towards Robert Ferrie and Strasburg.

That being said, it sounds like decisions have already been made in the past, though it's definitely interesting to hear how many people on the cafe said they've lived 20+ years in the area and how many were surprised that the extension had already been approved.

I think the descriptions of the paper pamphlet as well as the language used last night by the moderators gave the impression that there was still room for input regarding whether the extension would happen or not. Might have been a bit smoother to say right off the bat, the extension has been approved and is going ahead. This discussion is to get feedback on what that extension would look like.

However, I know from my end being a relatively new resident (5+ years), it is frustrating not having any say in whether the extension happens or not since this discussion has been in the works for so long. And for a project that's been so long in the works, I'm surprised there isn't more data on the existing traffic volumes and the expected volumes when new housing is built and if the extension is built to show what is being used to determine that the extension will in fact cause less traffic on Biehn instead of more.

I find communities like this one where a residential area is almost circled by green space are few and far between and it's pretty discouraging that the city/planners seem more focused on serving new developments vs preserving green space and quiet neighborhoods. I don't think anyone can argue that even the best designed subdivision these days provides a nicer atmosphere than the section of neighborhood at the end of Biehn Dr.

Like I said in the breakout group, I'm not opposed to the development of the farmload beyond the wetland, that is something that we all assume will happen at some point. But there was already a swath of green space that was cut through for the Strasburg extension, and all the new development will already crowd around the greenspace that is left. So I find it hard to justify the Biehn extension for the amount of farmland available for development to the south of the current end of Biehn.

[redacted]

Biehn Drive Extension Class Environmental Assessment and April 20, 2021 Community Café Comments

Land use planning matters.

The Grand River Conservation Authority (GRCA). has confirmed that the area behind our house and the existing Cull de Sac is part of the Provincially Significant Strasburg Creek Wetland Complex. According to the City of Kitchener (C of K) Notice of Study and Community Café, “The study will consider all reasonable alternatives with acceptable effects on the natural, social and cultural environments”. The C of K Strategic Plan for the Environment states “our strategic plan for the environment shows how we will put the environment first, reduce our carbon emissions and preserve our planet. We work to develop and maintain an ecologically diverse open space network that incorporates typical naturally occurring landscapes, significant natural features and the urban forest, all of which embody our natural heritage. We protect our water supply by working with the Region of Waterloo and the Grand River Conservation Authority to replenish and protect our water and wetlands”. If Biehn Drive is extended the C of K is violating its own Strategic Plan for the Environment. It is time for C of K staff and elected officials to lead, not continue as in the past.

Area residents have lived in a wet area for 30 years How is the C of K going to ensure we do not get more water on our properties and in our basements if the wetlands are tampered with? What is the Contingency Plan if this occurs? Documentation of the contingency plan is only fair to existing residents.

Page 9 of the Environmental Assessment (EA)

Alternative 5: Extend Biehn Drive Environmental “Low to medium environmental effect possible with new corridor. Management of effects is subject to environmental mitigation”.

Background data and methodology on how this rating was achieved must be included as part of the EA. As it reads now, the rating is only an opinion of the author(s).

“Magnitude of effects is subject to environmental mitigation.” What does this mean? Environmental mitigation steps must also be documented in the EA.

Page 13 of the EA: Biehn Drive Traffic Calming Study

Please provide the modelling data and any other information for this study as it becomes available.

During the Community Café it was pointed out many times that the proposed extension of Biehn Drive does nothing for the existing residents. We do not want the road extended. Extending Biehn Drive is an unnecessary expense.

It was also pointed out on numerous occasions in the Café that if water and sewer connections are required to the existing infrastructure on Biehn Drive a road is not required to do this. The connections could be done with an easement.

In conclusion the entire EA and Community Café is slanted towards the extension of Biehn Drive. The environment and wishes of existing area residents must be considered. Does the C of K lead and follow its Strategic Plan for the Environment or do mistakes from the past continue?

[redacted]

Biehn Drive City Café and Environmental Assessment Comments

The City of Kitchener invited interested residents to a Community Café Zoom meeting April 20 to discuss the extension of Biehn Drive. Many people talked at the meeting. We ask that you come to a decision with an open mind. Please take into account the comments the people have made.

Kitchener has a decision to make. On one hand the extension of Biehn, which involves plowing through the Provincially Significant Strasburg Creek Wetland Complex. On the other hand, planning a new route through the new subdivision, leaving the wetland alone.

The wetland at the end of Biehn Drive is loved by our family. It is part of our neighbourhood. We have lived here for 31 years and have seen the trees from all our windows. We have seen the forest change through the seasons, seen the mature trees moving in the wind, seen the sunset through their branches. The land behind our house and around the circle is extremely wet. It is a true wetland with its unique and complex biodiversity.

Kitchener can be archaic or Kitchener can be progressive. Archaic-disregard nature. Stick to a plan that was devised 30 years ago. Progressive- see the value of this wetland and change with the times.

Unfortunately, the forest that joins our wetland has already been altered by the removal of trees and the paving of Strasburg Road right through it. The forest was sliced in half.

How many wetlands in the City of Kitchener and Waterloo Region have been lost during all these years of development?

We hope you will save this one. Please do so before it is too late, and all that is left are regrets.

Sincerely,

[redacted]

From: [redacted]
Sent: April 23, 2021 4:28 PM
To: Steve Taylor (London) <stevenj.taylor@bteng.ca>
Cc: eric.riek@kitchener.ca <eric.riek@kitchener.ca>
Subject: Re: Biehn drive extension assessment zoom meeting

Hi Steve
I did not receive a Zoom link for the Community Cafe on April 20.
Even though I was not able to take part in the discussions I am still interested in the plans for the Biehn Extension.
I wonder how much influence local residents actually will have on developing a design.

I have read the draft report on the website and have some thoughts.
-It refers to Biehn as becoming a major collector road - It already is. The speed of the traffic on Biehn has already become dangerous. If the extension is built the problem will increase. It will create the need for added "calming" devices installed to slow drivers down. At the moment cars have to stop to turn onto Caryndale. That slows the raceway down a bit.
- Mention is made of "cut through" traffic. What streets are those? Biehn is the main road through.
- what is going to happen to the wildlife corridor behind Biehn? If it gets disturbed for a road, the wildlife will be cut off from their pond access and roaming areas. Their habitat has already been disturbed by the Strasburg Extension construction.
- How will the swamp recharge area be handled? This is a sensitive area.
- Could the developers not access servicing off Hearthwood or Robert Ferrie?

Please add me to the study's mailing list.
[redacted]

Katherine Scott

From: [redacted]
Sent: April 22, 2021 1:04 PM
To: Katherine Scott
Subject: RE: Biehn Drive | Online Community Cafe (April 20, 2021)

I have one add on suggestion please

Would it be possible to build the road towards Biehn dr. and just stopping short of wetlands? You could build a cul de sac? This would allow development for most of area

Thanks

[redacted]

Sent from Mail for Windows 10

From: Katherine Scott
Sent: April 12, 2021 11:24 AM
Cc: Steve Taylor (London); Eric Riek
Subject: Biehn Drive | Online Community Cafe (April 20, 2021)

Good morning,

Thank you for registering for the Biehn Drive Extension Class Environmental Assessment (EA) Community Cafe Event. The online Community Cafe is scheduled for April 20, 2021 from 6:30 to 8:00 pm. The meeting will be held on Zoom and can be accessed via the following link: https://us02web.zoom.us/j/88151905825

I will also forward a meeting invite to update your calendar.

Please let me know if you have any comments or concerns in advance of the call.

Thanks,

Katherine Scott

BT ENGINEER

509 Talbot Street

London, Ontario N6A 2S5

katherine.scott@bteng.ca

(519) 672-2222

Newsletter

Biehn Drive Extension

1. BIEHN DRIVE EXTENSION CLASS ENVIRONMENTAL ASSESSMENT

The City of Kitchener (City) is conducting a Class Environmental Assessment (EA) Study for the extension of Biehn Drive southerly to the Robert Ferrie Drive. The Biehn Drive extension will include a trunk sanitary sewer, storm sewer/ditches and watermain. The Study is evaluating alternatives for the alignment of the Biehn Drive extension, intersection locations and designs, and municipal services, while minimizing natural, social, cultural and land use impacts. The Study Area is illustrated on the **Figure 1, Study Area**.

Figure 1: Study Area

2. NEED AND JUSTIFICATION

The extension of Biehn Drive has been part of the integrated land use and transportation plan for the larger community. The City of Kitchener Official Plan (November 2014) identifies Biehn Drive as a Major Community Collector Street, shown in yellow. Refer to **Figure 2, Future Road Network**. Collector streets function to collect traffic from several local streets and provide access to arterial streets, shown in purple.

The previous studies that have led to this plan have included:

1) Brigadoon Community Plan (1989);
2) Official Plan Amendment No. 98 (1991);
3) Doon South – Brigadoon Transportation Network and Corridor Study (McCormick Rankin, 1994);
4) Kitchener Planning and Development Staff Report PD95/51 (1994);
5) Updated Brigadoon Community Plan (2005);
6) Kitchener Integrated Transportation Master Plan (2013);
7) Robert Ferrie Drive Extension Environmental Assessment (2014); and
8) Official Plan Amendment No. 103 in March 21, 2019.

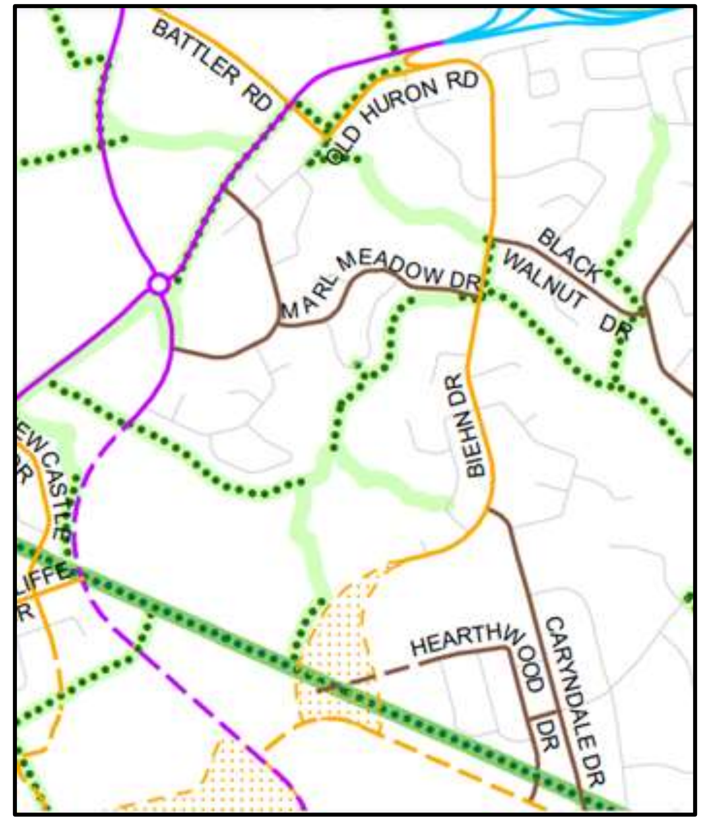


Figure 2: Future Road Network (OP Map 11 - Integrated Transportation System)

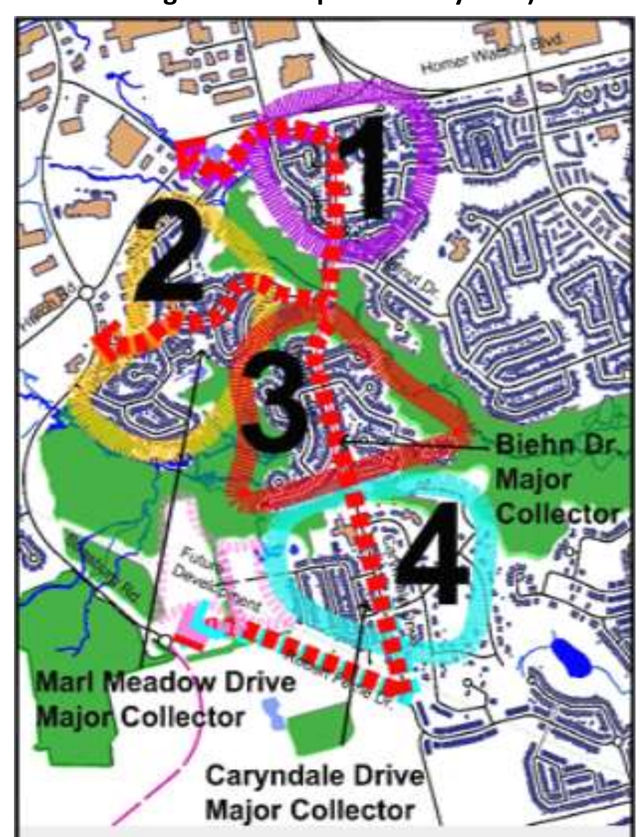


Figure 3: Community Neighbourhoods

3. WHAT IS THE TRAFFIC RATIONALE FOR THE BIEHN DRIVE EXTENSION?

During the recently held Community Café event, residents on Biehn Drive questioned the transportation justification for the street extension. Many previous transportation studies have described the need for an adequate collector road network for access to the community.

The individual neighbourhoods are shown in **Figure 3**. These neighbourhoods are bounded by Strasburg Road and Huron Road, each an arterial road. Close convenient access to the arterial road network will minimize traffic on any one collector road and provide greater safety. To demonstrate the rationale for the current plan (Biehn Drive extension), the four neighbourhoods and the average travel distance of each to the arterial road system are as follows:

Neighbourhood 1 (purple): average distance to Huron Road is approximately 800 metres.

Neighbourhood 2 (yellow): average distance to Strasburg Road is approximately 450 metres.

Neighbourhood 3 (red): average current distance to Strasburg Road is approximately 1200 metres, and 1300 metres to Huron Road.

Neighbourhood 4 (blue): average distance to Strasburg Road is approximately 600 metres.

If the new Biehn Drive link is not constructed, traffic from Neighbourhood 3 will continue to go through an adjacent neighbourhood.

4. PREVIOUS NEED AND JUSTIFICATION REVIEW (2014)

The Biehn Drive Extension Need and Justification Report was completed by Paradigm Transportation Solutions in June 2014. This report identified that eliminating the Biehn Drive extension would result in:

- Inefficiencies in the road network and backtracking/out-of-way travel for residents in the Doon South/Brigadoon communities;
- Insufficient capacity to accommodate the forecast traffic demands at the 2031 planning horizon; and
- Increased traffic on adjacent streets (i.e. Caryndale Drive, Templewood Drive, and Biehn Drive, northeast of the Study Area). These roads would be operating at traffic levels above their road classifications.

The Report concluded that eliminating Biehn Drive would be a fundamental design change to the Doon South/Brigadoon communities and would result in significant impacts to adjacent roads and other neighbourhoods, and that the Biehn Drive extension is therefore required

5. ALTERNATIVES

Three alternatives were presented at Public Information Centre (PIC) No. 1 and to residents at the Community Café event. Based on comments received by attendees at the Community Café, a fourth alternative has been added for the subsequent evaluation. The preliminary transportation alternatives for the study are shown on **Figure 4** below:

New: Alternative 4 will use existing collector roads to move vehicular traffic within the Doon South and Brigadoon communities, as shown in the figure below. With Alternative 4, these collector roads will serve traffic from their local neighbourhoods as well as Neighbourhood 3 (red). The project will include an extension of Biehn Drive for a maintenance road for the new sanitary sewer extension and an active transportation link as per the Official Plan.

Alternative 1 - Carried Forward	Alternative 2 - Carried Forward	Alternative 3 - Not Carried Forward ✗	Alternative 4 - Carried Forward
Extension of Biehn Drive to Strasburg Road east of Hydro One transmission tower	Extension of Biehn Drive to Strasburg Road west of Hydro One transmission tower	Extension of Biehn Drive to Strasburg Road directly westerly to Strasburg Road (**not carried forward** based on higher relative environmental impacts)	Use existing collector roads in adjacent neighbourhoods to access the arterial roads ●●●● Sanitary sewer and active transportation link

Figure 4: Alternatives

6. FREQUENT QUESTIONS AND ANSWERS

Answers to questions we received at the initial community engagement are provided on the City's website at https://www.kitchener.ca/en/development-and-construction/infrastructure-projects.aspx#Frequently-asked-questions

NEXT STEPS

Next steps in the Class Environmental Assessment (EA) process are:

- Carry out environmental inventories and technical investigations;
- Complete the analysis and evaluation of alternatives;
- Hold Public Information Centre No. 2;
- Document the recommendations in the Environmental Study Report; and
- 30-day public review period of the Environmental Study Report.

There is an opportunity for public input at any point during the EA process. Comments and questions can be sent to the City and Consultant representatives below. All information is being collected in accordance with the *Freedom of Information and Privacy Act*.

Steve Taylor, P.Eng.	Eric Riek, C.E.T.
EA Project Manager	City Project Manager
BT Engineering Inc.	City of Kitchener
509 Talbot Street	200 King Street West
London, Ontario N6A 2S5	Kitchener, ON N2G 4G7
Tel: 519-672-2222	Tel: 519-741-2200 ext. 7330
Email: stevenj.taylor@bteng.ca	Email: eric.riek@kitchener.ca

BT ENGINEERING BTE

KITCHENER

Public Information Centre No. 2 Summary Report

Biehn Drive Municipal Class Environmental Assessment

December 2021

Submitted by:
BT Engineering Inc.
509 Talbot Street
London, ON N6A 2S5
519-672-2222

Table of Contents

List of Figures

List of Tables

List of Appendices

1.0 INTRODUCTION

The City of Kitchener (City) has initiated a Class Environmental Assessment (EA) Study to develop a transportation plan for the extension of Biehn Drive westerly to the Robert Ferrie Drive Extension. The Biehn Drive extension will include municipal services including a trunk sanitary sewer, storm sewer/ditches and watermain.

The Class EA Study will complete all required phases of the Municipal Class Environmental Assessment. The study will: establish the need and justification for the improvements; complete environmental inventories; establish a baseline to compare alternatives; consider all reasonable alternatives; and proactively involve the public in defining a recommended plan for improvements.

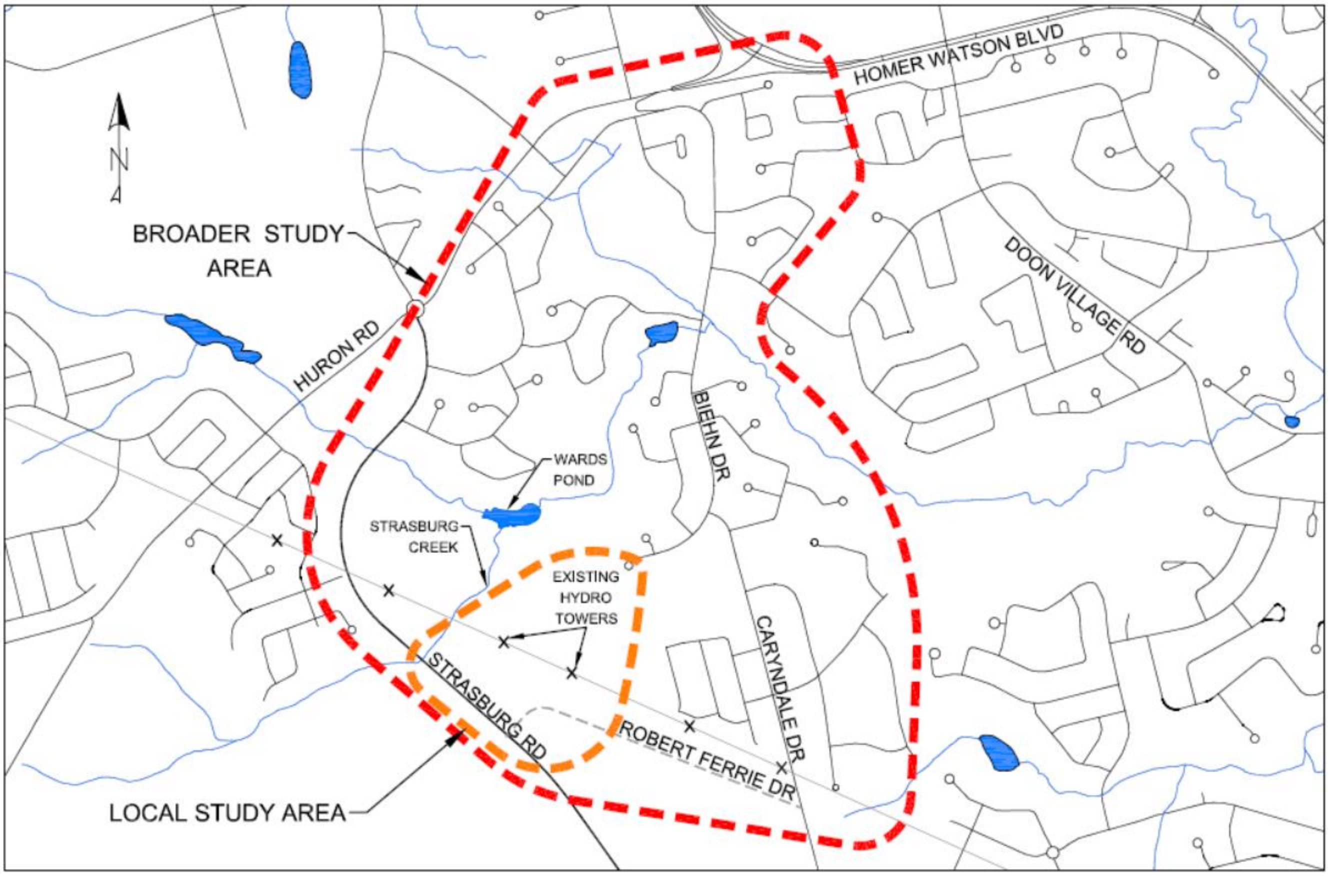
Based on the range of anticipated effects and capital cost of the project, the study is being conducted as a Municipal Schedule C Class EA. At the completion of the project, an Environmental Study Report will be prepared for a 30-day public review period.

Public Information Centre (PIC) No. 2 for this Study was held online from November 15 to November 29, 2021. A “live” virtual meeting was held on November 17, 2021 from 6:30 to 8:00 pm and included a presentation and a question and answers session. The Public Information Centre presented information on background information, the analysis and evaluation of alternatives, and the technically preferred alternative.

All members of the public and interest groups were invited to view the Online Public Information Centre material and were encouraged to provide a written response to any issues or concerns.

1.1 Study Area

The Study Area is located in the City of Kitchener and is illustrated on **Figure 1**.The Local Study Area extends from the current terminus of Biehn Drive, approximately 60 m west of Spencer Court, southerly to the future Robert Ferrie Drive Extension. Based on comments from the public at the Community Café and Public Information Centre No. 1, the Study Area was expanded to a Broader Study Area to consider traffic effects in adjacent neighbourhoods.



Legend

Local Study Area

Broader Study Area

Based on comments from PIC No. 1

Figure 1: Project Location

2.0 PUBLIC AND AGENCY CONSULTATION

One of the key aspects of the study is to provide the public, interested parties, affected agencies and municipalities with the opportunity for input. In order to ensure this objective is met, a public and agency notification program was undertaken. The program includes a number of communication mechanisms, discussed in the following sections.

2.1 Individual Property Owner Contacts

Notices were mailed to property owners within the study area, inviting them to attend the online Public Information Centre. The notice was also distributed electronically to members of the public/ stakeholders that had identified an interest in the study or requested to be on the mailing list.

2.2 Indigenous Peoples Contacts

Notices were sent to the Indigenous Peoples in the vicinity of the Study Area, inviting them to attend the online PIC. Notices were sent to the following:

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

2.3 Newspaper Notice

Notices of the Public Information Centre were published in The Record on October 29, 2021.

The newspaper notice is in **Appendix A**.

2.4 Agency and Stakeholder Contacts

The following ministries, agencies and stakeholders were invited to attend the online PIC:

- Ministry of the Environment, Conservation and Parks
- Ministry of Natural Resources and Forestry
- Ministry of Heritage, Sport, Tourism and Culture Industries
- Environment Canada, Ontario Region
- Infrastructure Ontario
- Ministry of Agriculture, Food and Rural Affairs
- Ministry of Indigenous Affairs
- Grand River Conservation Authority
- Emergency Services
- Utilities
- Regional Municipality of Waterloo

3.0 PIC COMMENTS

PIC Exhibits were provided online for public/agencies to view at their convenience. A copy of the PIC exhibits is provided in **Appendix B**.

Nine (9) comment sheets and emails were received during and after the comment period. Copies of the comments, excluding personal information, are provided in **Appendix C**.

3.1 Summary of Comments

The comments received and discussions held during the Public Information Centre are summarized below in **Table 1**.

Table 1: Summary of Written Comments

Comment	Number of Respondents	Comment Sheet No.
Support for extension of Biehn Drive to Robert Ferrie Drive.	2	1, 5
Concern for prioritizing road improvements and development over the environment and not preserving green areas.	4	2, 4, 6, 7
Opposition to constructing a parking lane and multi use path on the Biehn Drive extension to minimize disruption to the wetland and preserve the environment.	1	3
Concern for community disruption and increased traffic volumes, and identifying the need for traffic calming measures.	4	4, 6, 7, 9
Concern for sightlines of vehicles entering/exiting driveways along the existing Biehn Drive.	2	7, 8
Concern that the publics' input was not included in the decision making process and selection of the preferred alternative.	3	6, 7, 8
Opposition to the extension of Biehn Drive extension and concern that the roadwork does not align with the City of Kitchener's strategic plan for environmental protection.	1	8
Concern that private properties will flood due to permanent disruptions to the wetland.	2	4, 8
Emergency access/response should rely on response time instead of access.	1	4
People shortcut through Marl Meadow Drive and Templewood Drive to Strasburg Road or Huron Road. This should be taken into consideration in the evaluation for efficiency of travel and community disruption to Biehn Drive north.	1	4
Concern regarding the negative impacts on Strasburg Creek which connects to the wetland.	1	4

Request to redo the evaluation of alternatives after removing traffic from Caryndale South and Doon South since it will be accommodated by the Robert Ferrie Drive extension.	1	4
Concern that Alternative 4 was not fairly evaluated and evaluation criteria were prejudiced against this criterion. Concerns include: • Introducing a second access road to Street A on the north side of the hydro tower for this alternative. • Need to consider proper development of the lands south of the PSW. • Traffic will be support by the extension of Robert Ferrie Drive.	1	4

4.0 CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The main comments or concerns, both verbal (i.e. phone calls, virtual meetings) and written, from the public information centre include:

- Disruption to the environment/wetland and prioritizing transportation needs over the environment
- Support for the project and the need for the Biehn Drive extension
- Negative impacts on Strasburg Creek which connects to the wetland
- Impacts to drainage and groundwater levels due to possible wetland and environment disruption
- Consider greater use of Caryndale Drive to carry additional traffic and have more community traffic reach Strasburg Road using Robert Ferrie Drive as opposed to Biehn Drive

Recommendations for Future Actions

Actions for future review and consideration in the design include:

- Consideration of sightlines of vehicles entering/exiting driveways along the existing Biehn Drive
- Consideration for modifications to the cross section to minimize wetland disruption (i.e. removing the multi-use pathway, narrower boulevards and parking lanes)

Appendix A

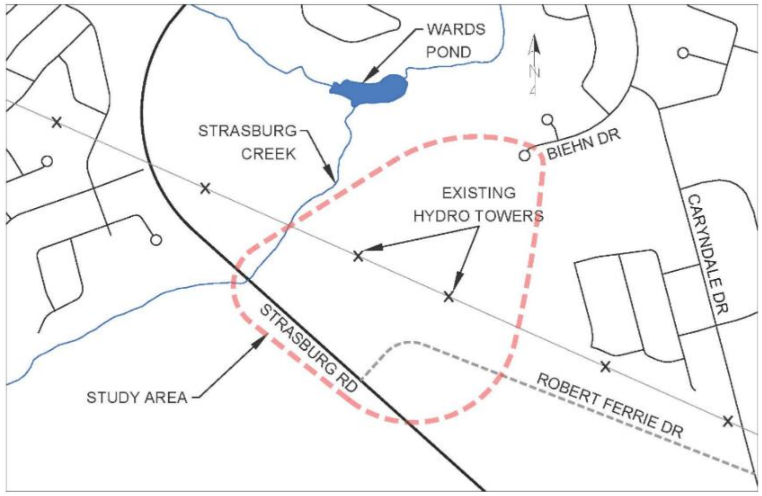
Newspaper Notice

BT ENGINEERING

Notice of Online Public Information Centre (PIC)
City of Kitchener
Biehn Drive Extension Environmental Assessment Study

INTRODUCTION

The City of Kitchener is conducting an Environmental Assessment (EA) Study for the extension of Biehn Drive from the existing terminus 300 m west of Caryndale Drive to the future Robert Ferrie Drive extension. The Study will evaluate alternatives for alignment, cross sections, intersections, and active transportation to develop a preferred plan to address the needs of the Study Area and reflect the recommendations in the City of Kitchener Transportation Master Plan.



STUDY PROCESS

The Biehn Drive Extension EA is being conducted as a Schedule C EA Study under the Municipal Class Environmental Assessment (MCEA) (2015). The Transportation Master Plan (TMP) has previously completed Phases 1 and 2 of the Class EA; this Study will review the previously completed phases and complete Phases 3 and 4. The Study will consider all reasonable alternatives with acceptable effects on the natural, social and cultural environments, and proactively involve the public, stakeholders and Indigenous Peoples.

PUBLIC CONSULTATION

The City wishes to ensure that anyone interested in this study has the opportunity to be involved and provide input. The City has scheduled a second online Public Information Centre (PIC) meeting for this project that will include a series of exhibits that present background information, the evaluation of alternatives and the Technically Preferred Alternative. At the present time, this PIC is relying on web-based communications due to restrictions on public gatherings. Comments on the information presented can be provided by contacting the City or consultant project managers' email addresses listed below.

The PIC will be held for a two-week period, with a "live" virtual Zoom meeting on November 17, 2021. **To register for the Zoom meeting, please contact Steve Taylor or Eric Riek.** The Online Public Information Centre is scheduled for:

> **PIC Date:** November 15 to 29, 2021
>
> **Virtual Zoom Meeting Date:** November 17, 2021 from 6:30 to 8:00 PM
>
> **Website:** https://www.kitchener.ca/en/development-and-construction/infrastructure-projects.aspx

There is an opportunity at any time during the Class EA process for interested persons to provide comments. Early identification of individual and group concerns greatly aids in addressing these concerns. All information will be collected in accordance with the *Freedom of Information and Protection of Privacy Act* (2009). With the exception of personal information, all comments will become part of the public record. Persons will be advised of future communication opportunities by newspaper public notice, email notice and posting on the City website.

For more information or if you wish to be placed on the study's email mailing list, contact either:

Steve Taylor, P.Eng.
EA Project Manager
BT Engineering Inc.
509 Talbot Street
London, ON N6A 2S5
Tel: 519-672-2222
Email: stevenj.taylor@bteng.ca

Eric Riek, C.E.T.
City Project Manager
City of Kitchener
200 King Street West
Kitchener, ON N2G 4G7
Tel: 519-741-2200 ext. 7330
Email: eric.riek@kitchener.ca

Appendix B

PIC Exhibits

Welcome!
City of Kitchener
Biehn Drive Extension
Class Environmental Assessment

Thank you for participating in the Online Public Information Centre (PIC) for the City of Kitchener's Class Environmental Assessment (EA) for the extension of Biehn Drive and the sanitary trunk sewer.

At the present time, the Province of Ontario has implemented restrictions on public gatherings to deal with the COVID-19 pandemic. As a result, this Public Information Centre is relying on web-based communications. Should you have any questions regarding the study, please contact the City or Consultant Project Managers.

There is an opportunity at any time during the Class EA process for interested persons to provide written input. Any comments received will be collected under the *Environmental Assessment Act* and, with the exception of personal information, will become part of the public record.

Comments can be submitted by emailing stevenj.taylor@bteng.ca and/or eric.riek@kitchener.ca by **November 29, 2021**.

KITCHENER

1

Purpose of Public Information Centre

The purpose of this meeting is to:

- Present the evaluation of alternatives.
- Obtain comments on the Technically Preferred Alternative.
- Obtain comments on the proposed mitigation plan.
- Identify any remaining areas of concern.

2

Introduction

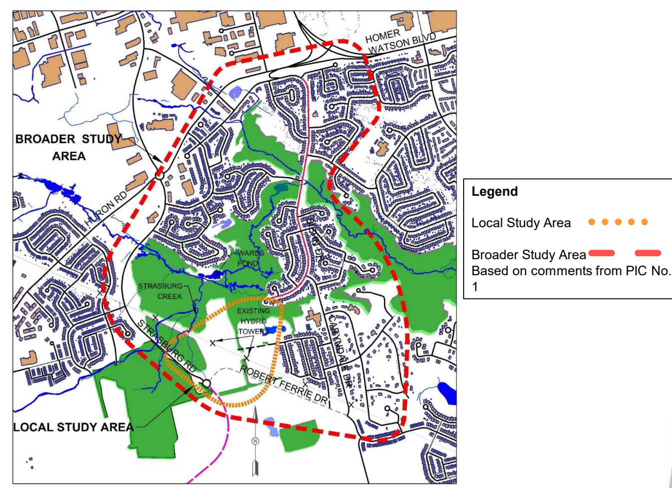
The City of Kitchener has retained BT Engineering Inc. to undertake an Environmental Assessment (EA) Study for the extension of Biehn Drive from its current terminus to the future Robert Ferrie Drive Extension. The Study includes the extension of the trunk sanitary sewer, watermain and storm sewers to Robert Ferrie Drive, to serve areas to the south.

The City has completed Phases 1 and 2 of the Municipal Class EA through the Transportation Master Plan, which has been reviewed and summarized in this study. Phases 3 and 4 of the Municipal Class EA are being completed by developing and evaluating alternative designs and completing the Environmental Study Report, while proactively involving the public and stakeholders in defining a recommended plan for improvements.

This Study is being completed as a Schedule C undertaking, based on the range of anticipated effects, and the proposed infrastructure extension will be completed as a Schedule B. The Study Design Report describing the study process has been made available for agency and public comments and on the website.

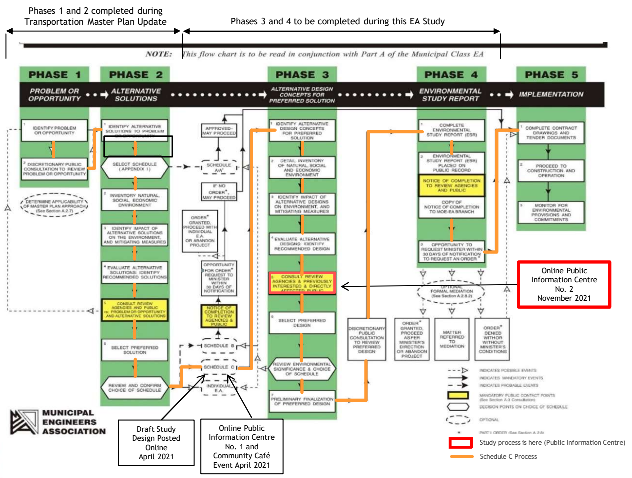
3

EA Study Area



4

Municipal Class Environmental Assessment



5

6

Background Studies

The following studies have been completed that are relevant to this study:

1. Brigadoon Community Plan (1989);
2. Official Plan Amendment No. 98 (1991);
3. Doon South – Brigadoon Transportation Network and Corridor Study (McCormick Rankin, 1994);
4. Kitchener Planning and Development Staff Report PD95/51 (1994);
5. Updated Brigadoon Community Plan (2005);
6. Kitchener Integrated Transportation Master Plan (2013);
7. Robert Ferrie Drive Extension Environmental Assessment (2014); and
8. Official Plan Amendment No. 103 in March 21, 2019.

These reports are available online for review upon request. Please contact the identified Project Managers to arrange for review.

6

Background Information

- Community Plans for the Doon South and Brigadoon areas have established the need for the extension of Biehn Drive
- This has been documented in the Official Plan and Transportation Master Plan
- The new road link will accommodate all modes of transportation (vehicles, trucks, pedestrians and cyclists)

Why is the project needed?

- Needed to evenly distribute traffic to the arterial road network.
- Multiple connections to arterial roads reduce the traffic volumes in any one neighbourhood and the travel time, and improve access for emergency services.
- Currently, existing traffic from Biehn Drive must travel through adjacent neighbourhoods.
- To provide a sanitary and water service corridor.

Why is it being implemented now?

- Strasburg Road has been constructed and will provide a western arterial street to service the community.
- With implementation of the proposed Biehn Drive extension, traffic will not have to take a circuitous route through neighbourhoods to reach the arterial road network.
- Required to accommodate future development.

7

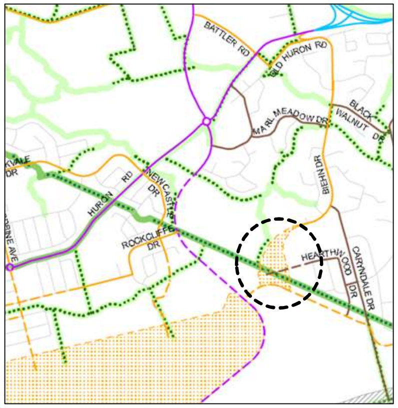
7

Existing Conditions

8

8

Official Plan – Integrated Transportation System



Source: City of Kitchener Official Map 11
Integrated Transportation System, 2014

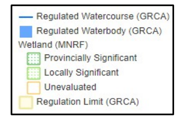
9

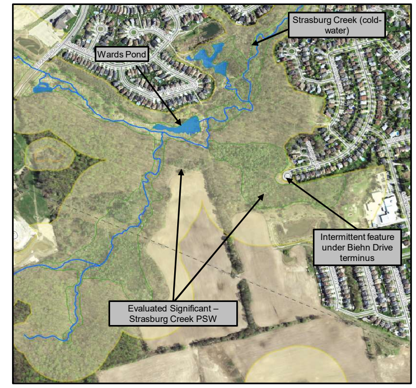
9

Natural Environment

Overview:

- Strasburg Creek Provincially Significant Wetland
- Intermittent overland flow through the wetland
- Strasburg Creek
- Wildlife habitat
- Specimen trees

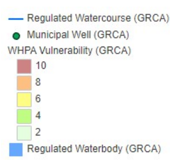




10

10

Well Head Protection Area



https://maps.grandriver.ca/web-gis/public/?theme=MYP&bbox=542091,4802909,545343,4804695

11

11

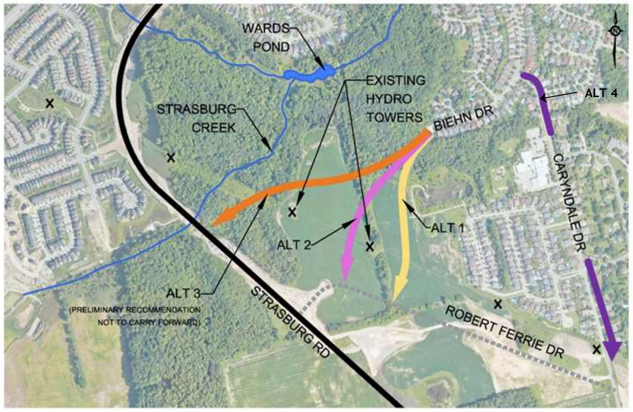
Preliminary Design Alternatives

12

12

Preliminary Alignment Alternatives

Alternative 4 added following PIC No. 1



13

13

Coarse Screening of Alignment Alternatives

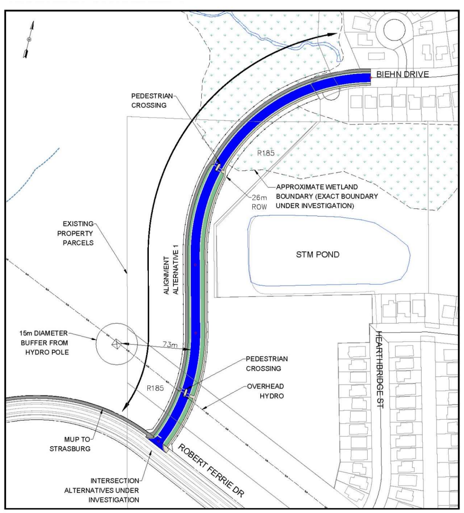
Coarse Screening of Alignment Alternatives				
Screening Criteria	Alternative 1: Connect to Robert Ferrie Drive east of Hydro Tower	Alternative 2: Connect to Robert Ferrie Drive west of Hydro Tower	Alternative 3: Strasburg Road Connection	Alternative 4: Connect Biehn Drive to Robert Ferrie Drive – Via Caryndale Drive
Does this alternative satisfy forecast traffic demand, improve safety, and address all modes of transportation?	Provides a north-south connection to Robert Ferrie Drive. Accommodates all modes. Reduces cut-through traffic on Biehn Drive.	Provides a north-south connection to Robert Ferrie Drive. Accommodates all modes. Reduces cut-through traffic on Biehn Drive.	Provides a north-south connection to Strasburg Road. Accommodates all modes.	Provides a north-south connection to Strasburg Road. Accommodates all modes. However, there are increased levels of traffic on local roads.
Does the approach result in significant impacts to the natural environment?	Minor impacts to the woodlot/PSW (~0.3 ha).	Minor impacts to the woodlot/PSW (~0.3 ha).	Significant impacts to the woodlot/wetland (~1.3 ha).	No impacts.
Is the approach affordable for the City to implement?	No significant difference.	No significant difference.	Higher cost - requires an intersection onto Strasburg Road (arterial).	Affordable alternative.
Does this alternative comply with the recommendations of the City's planning documents (i.e., TMP, OP, KGMP)	This alternative complies with the recommendations of the City's planning documents.	This alternative complies with the recommendations of the City's planning documents.	Does not comply with the recommendations of the Official Plan or Growth Management Plan. Based on the previous design and construction of the Strasburg Road and roundabout within the Study Area, this previous alternative is no longer considered feasible.	This alternative does not comply with the recommendations of the City's planning documents.
Recommendation:	✓ Carry forward for further evaluation	✓ Carry forward for further evaluation	✗ Do not carry forward	✓ Carry forward for further evaluation

14

14

Alignment Alternative 1

Connect Biehn Drive to Robert Ferrie Drive – East Alignment

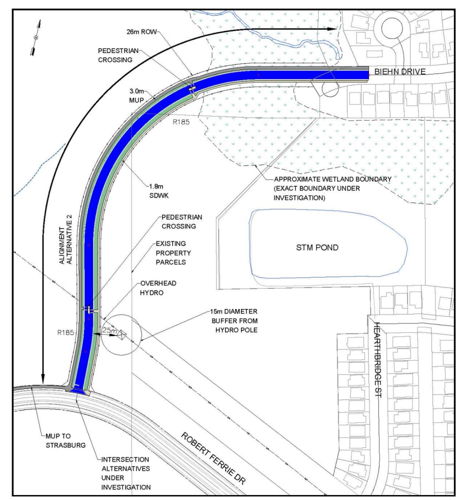


15

15

Alignment Alternative 2

Connect Biehn Drive to Robert Ferrie Drive – Central Alignment

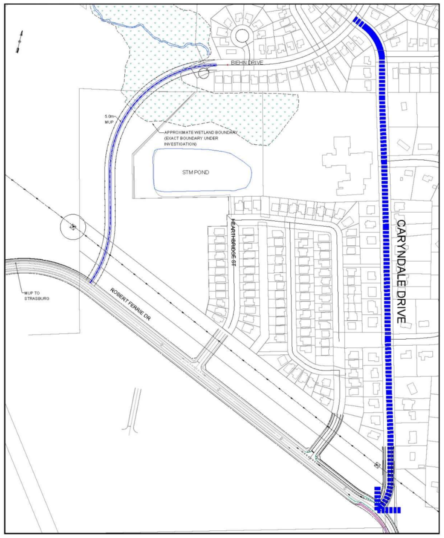


16

16

Alignment Alternative 4

Connect Biehn Drive to Robert Ferrie Drive – Via Caryndale Drive



17

17

Analysis and Evaluation Alignment Alternatives

The analysis and evaluation of the alternatives has been undertaken using a quantitative evaluation methodology. Seven global evaluation factor were considered:

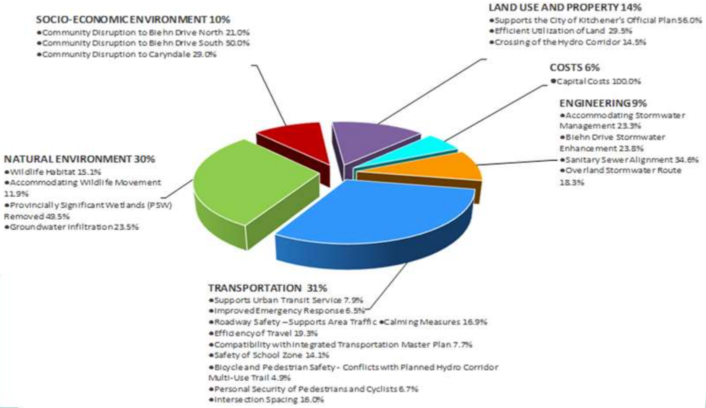
- Transportation
- Natural Environment
- Cultural Environment
- Socio-Economic Environment
- Land Use and Property
- Cost
- Engineering

- The factor groups are made up of measurable criteria (sub-factors) used to identify relevant benefits and impacts.
- They define a unit of measure and the relative differences between alternatives.
- Evaluation data was collected from literature reviews of background documentation and environmental inventories completed for this project.
- The results are presented on the following exhibits and documented in the Analysis and Evaluation Report, available upon request.

18

18

Evaluation - Global Factor Weights and Sub-factor Weights

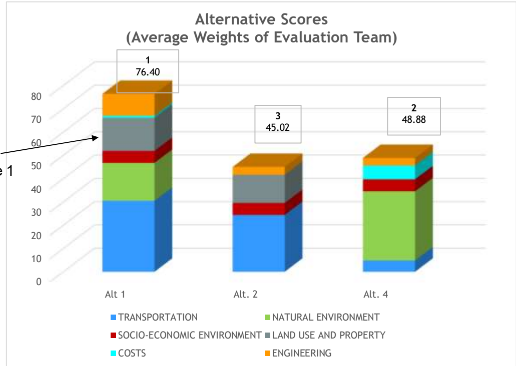


19

19

Alignment Alternatives - Scores

Technically Preferred Alternative Alternative 1



20

20

Sensitivity Testing

Alternatives			Alt 1	Alt. 2	Alt. 4
FACTORS	WEIGHT	Score:	76.40	45.02	48.88
Ranking			1	3	2
TRANSPORTATION	High	45.00%	1	2	3
	Low	20.00%	1	3	2
NATURAL ENVIRONMENT	High	40.00%	1	3	2
	Low	20.00%	1	2	3
SOCIO-ECONOMIC ENVIRONMENT	High	15.00%	1	3	2
	Low	10.00%	1	3	2
LAND USE AND PROPERTY	High	20.00%	1	2	3
	Low	10.00%	1	3	2
COST	High	10.00%	1	3	2
	Low	2.00%	1	2	3
ENGINEERING	High	15.00%	1	3	2
	Low	5.00%	1	3	2

21

21

Cross Section Alternative Evaluation

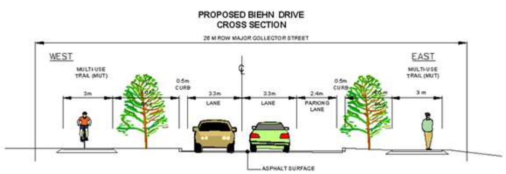
Alternatives were developed to reflect the City of Kitchener's Complete Streets guidelines.

Evaluation Criteria	Alternative 1 – 26 m ROW with Multi-use Trail ✓	Alternative 2 – 26 m ROW with Bike Lanes
Active Transportation	MUTs are preferred by the greatest proportion of cyclists (interested but concerned). Greater network continuity for cyclists with the future MUT along the Hydro corridor and potential to connect to the MUTs along Strasburg Road	Better accommodates pedestrians by separating pedestrians and cyclists. Increased conflict between cyclists and access to/from parked vehicles
Traffic Calming	The reduced pavement width would better promote lower travel speeds	Wider asphalt surface would be less effective in reducing travel speeds
Impacts to Natural Environment / Storm Water Quality	All alternatives considered equal.	All alternatives considered equal.
Impacts to Developable Lands	All alternatives considered equal.	All alternatives considered equal.
Cost	MUTs are more cost effective to construct with reduced pavement thickness and granulars	Wider roadway pavement structure increases construction cost

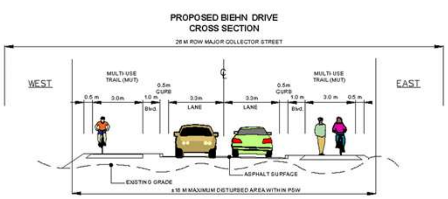
22

22

Preferred Cross Section



CROSS SECTION
ALTERNATIVE 1



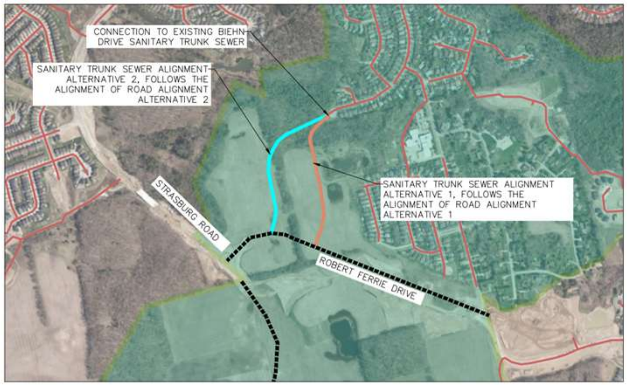
TYPICAL PSW SECTION

23

23

Preliminary Design Alternatives

- Two (2) Sanitary Sewer Alignment Alternatives were considered.
- The Preferred Sanitary Sewer alignment matches the Preferred Road Alignment Alternative 1.

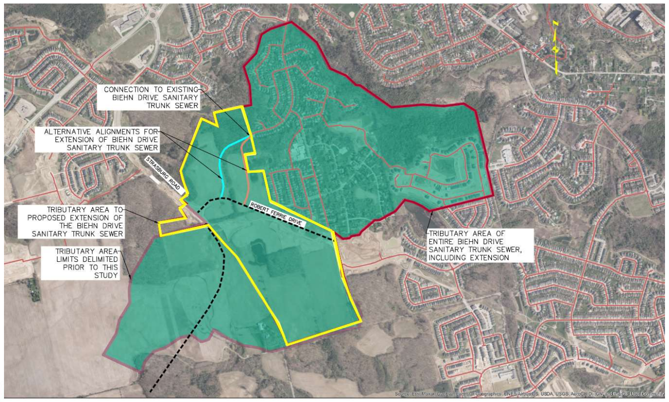


24

24

Preliminary Design Alternatives

- Sanitary Sewer service area



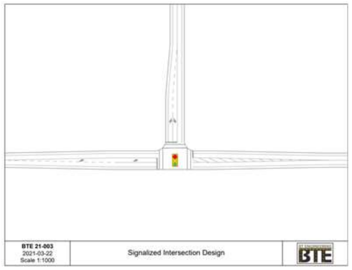
0 0.275 0.55 1.1 Kilometers 1:10,000

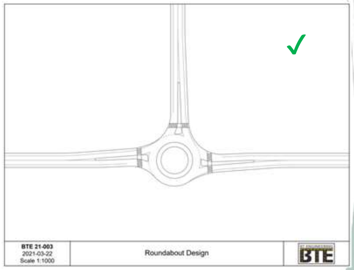
25

25

Preliminary Design Alternatives Intersection Alternatives

Biehn Drive and Robert Ferrie Drive





26

26

Traffic Projections

The proposed extension of Biehn Drive is projected to:

- Carry an average of 2500–3000 vehicles/day, well within its capacity as a major collector road,
- Result in a more balanced redistribution of area traffic volumes, providing relief (reducing the traffic volumes) on other area roads including Caryndale Drive and the north segment of Biehn Drive, which are both currently overutilized.

A roundabout is proposed at the intersection of Biehn Drive and Robert Ferrie Drive:

- Consistent with the approved plan identified in the Robert Ferrie Drive Class Environmental Assessment
- Due to the proximity to Strasburg Road (to limit queuing) and to accommodate pedestrian crossings
- To accommodate access to future development south of Robert Ferrie Drive.

27

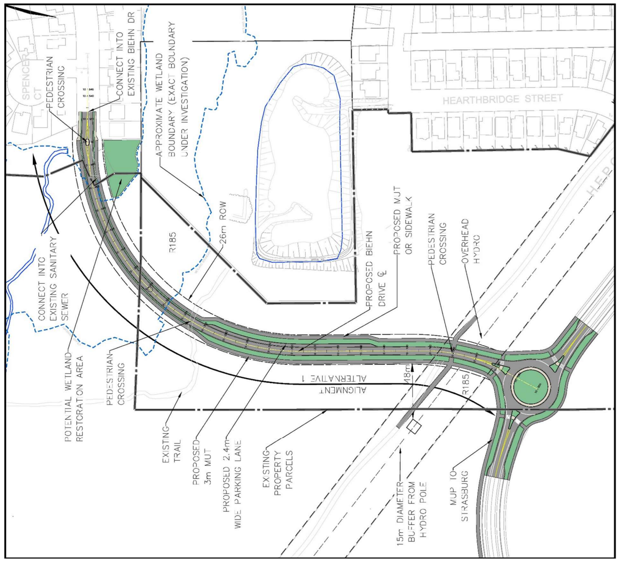
27

Technically Preferred Alternative

28

28

Preferred Alignment Alternative



29

29

Mitigation Table

Issue/Concern Potential Effects	Concerned Agency	Proposed Mitigation (prevent, lessen or remedy potential detrimental environmental effects)
Loss of Provincially Significant Wetland (PSW)	GRCA	• Wetland Restoration in vacant lot on Biehn Drive. • Narrowing of roadway through PSW. • Utilize Best Management Practices and limit disturbance to wetlands and vegetation. • Limit vegetation removal, where feasible. • Protect vegetation to remain using tree protection.
Wildlife Crossing	GRCA	Provide equalization culverts and permanent, directional wildlife fencing to permit wildlife passage across roadway.
Groundwater	MECP	Avoid draw-down of water table by ensuring the bottom of granulars are above original ground.
Fish Habitat: downstream impacts to Strasburg Creek cold water fish habitat	GRCA, NDMNRF	• Provide erosion and sediment controls. • Minimize the delivery of sediments and associated pollutants to receiving watercourses. • Minimize the impact of road salt on the local vegetation and receiving watercourses. • Minimize the impact of increased flows on receiving watercourses. • Minimize potential erosion within the drainage system, and within the local receiving watercourses.

30

30

Mitigation Table

Issue/Concern Potential Effects	Concerned Agency	Proposed Mitigation (prevent, lessen or remedy potential detrimental environmental effects)
SAR	MECP	• Undertake targeted, specialized SAR surveys during Detail Design as required depending on species conservation status designations as they exist at that time. At this time, no SAR have been identified in the Study Area. • Ensure the design and construction complies with the *Endangered Species Act* (ESA, 2007)
Migratory Birds	NDMNRF	Any clearing and grubbing should be completed outside of the active breeding bird season of April 1 to August 31.
Turtles and Turtle Habitat	NDMNRF	• Install silt fencing before turtle nesting season (May 15 to Sept. 30). • Protect and buffer active nests. • Avoid groundwater alteration in nearby wetlands between October 1 and April 1 during turtle hibernation.
Water Quality and Stormwater	MECP	Provide a Stormwater Management Plan.
Significant Woodlots	NDMNRF	Avoid specimen trees and limit tree clearing.

31

31

Mitigation Table

Issue/Concern Potential Effects	Concerned Agency	Proposed Mitigation (prevent, lessen or remedy potential detrimental environmental effects)
Noise	City	Municipal Noise By-laws are to be followed during construction adjacent to residential areas.
Management of Surplus Materials	MECP	OPSS 180 apply MECP "Management of Excess Materials in Road Construction and Maintenance Guidelines". Management and Disposal of Wet Soils.
Traffic calming	City	• Narrowing of cross section • Reduced lane widths • Provision of a roundabout to assist in controlling speeds
Lighting	GRCA	Provide cut-off lighting through PSW.
Utilities		Liaison during detail design.
Changes to Emergency Services		Liaison during detail design.

32

32

Next Steps

33

33

Next Steps

Following this Public Information Centre we will:

- Review all online Public Information Centre comments and prepare a Summary Report
- Develop refinements to the Technically Preferred Alternatives (if required) based on public comments
- Prepare the Environmental Study Report (ESR)
- Initiate 30-day public review period of the ESR

34

34

Your Involvement

How can you remain involved in the Study?

- Request that your name/e-mail be added to the Study Mailing List
- Provide an online comment
- Contact the Municipality's representative or the consultant at any time. Contact information is available below.

Thank you for your participation in this online Public Information Centre.

Your input into this study is valuable and appreciated.

All information is collected in accordance with the *Freedom of Information and Protection of Privacy Act.*

For More Information Please Contact:

Steve Taylor, P.Eng.
BT Engineering Inc., Project Manager
Email: stevenj.taylor@bteng.ca
Phone: 519-672-2222

Eric Riek, C.E.T.
City of Kitchener, Project Manager
Development Engineering
Email: eric.riek@kitchener.ca
Phone: 591-741-2200 ext. 7330

Please submit any questions or comments to the contacts listed above by **November 29, 2021**.

35

35

Appendix C

Comment Sheets

1

[redacted]
Sent: Wednesday, May 19, 2021 5:49 PM
To: Christine Michaud <Christine.Michaud@kitchener.ca>
Cc: Eric Riek <Eric.Riek@kitchener.ca>
Subject: [EXTERNAL] Biehn Road Extension Project

Hi Christine

We received your letter today regarding the proposed Biehn Drive extension project. As you mentioned in your letter, this project has been on the books for a long time. We have lived in the area for 30 years and were made aware of this plan in the early 1990's.

From the tone of your letter it appears that the vocal group of people opposed to this project have caught your attention more so than the group of us who want the extension to go ahead as planned. This is a classic case of "NIMBYism" where the home owners didn't complete their due diligence when they moved into their residences. Looking at the Biehn Drive dead end it is obvious that there was always a plan to continue the road.

The people opposed to these changes [redacted] must realize that their own homes were also once part of the rural area that made way for progress when the Brigadoon area was built. There have been many changes to this part of Kitchener since we have lived here. The fields and forests we used to hike in around here have been developed and new areas have been opened up for people to live in this part of the city. It is unfortunate that people can't see beyond their own yards to understand the city needs to grow and it can't always be in someone else's neighbourhood. As you know most of the undeveloped land left in Kitchener is in the south west and perhaps if people don't want to see development, they should move to more established areas.

We hope you will support the planning department in their efforts to proceed with the plans to finally bring this project to fruition. I know as a local politician it can be difficult to support a well planned project when a very vocal group of potential voters are opposed to it, but giving in to a NIMBY mentality is not the way a city progresses.

Thank you for keeping us in the loop about the status of the Biehn Road extension project.

[redacted]

2

[redacted]
Sent: November 17, 2021 4:18 PM
To: Steve Taylor (London) <stevenj.taylor@bteng.ca>; eric.riek@kitchener.ca <eric.riek@kitchener.ca>
Cc: [redacted]
Subject: Biehn Drive Extension for Discussion Nov 17 2021

Eric,
As per the Freedom of Information Act, provide the GRCA assessments from the past 3 decades. You have completely left them out, and therefore your EA is incomplete. These need to be aligned with the content of the latest options you have provided in the PowerPoint presentation online.

Also, I find this EA a complete failure in light of the COP 26 which was also a failure.

You may consider yourselves part of the problem here where we continue to clear forests which are in short supply on earth now while you line your pockets. Maybe you take clean air for granted these days. Did you know CO2 levels have risen 400% over the past century because of forest removal?

Shame on you for doing this.

Perhaps you should take half an hour and come out to the walking trail in this area around Wards Pond and see the beauty of the area which many families enjoy. Instead of having the vision to promote the Doon area as a green oasis within the City of Kitchener, you only seek to honour promises from Mayor Cardillo signed over to the contractors to over-develop Kitchener as they see fit. But that is ancient history I guess. Again, shame on you. This is a scandal which you are all part of.

It's such a shame.

[redacted]

3

[redacted]
Sent: November 18, 2021 10:06 AM
To: Steve Taylor (London) <stevenj.taylor@bteng.ca>
Cc: Eric Riek <eric.riek@kitchener.ca>
Subject: Biehn Drive extension

[redacted] and am opposed to the extension through this Algonquin like wetland.

Re: proposed Preferred Cross section on page 23 of the plan;

If the plan is to minimize disruption to the wetland, why is a parking lane shown in the schematic as well as multi use paths on either side of the road? Would this not add an increase of traffic and invasion of the wetland?
There are already natural trails through the wetland and wooded areas.
For the preservation of this environment, it needs to be left natural.
IF a road is approved by council, that's all it should be, a ROAD.

Sent from my iPhone

4

[redacted]
Sent: Monday, November 29, 2021 9:07:06 PM
To: Eric Riek <Eric.Riek@kitchener.ca>; Christine Michaud <Christine.Michaud@kitchener.ca>
Subject: [EXTERNAL] Comments, Questions and Concerns about Biehn Drive Extension Environmental Assessment

Good evening Eric and Christine,

Following the Virtual Zoom Meeting on Nov 17th, we were invited to provide feedback and comments. Please find below my comments, questions and concerns about the Biehn Drive Extension Environmental Assessment (EA).

The EA's evaluation weights set the Transportation weight at 31% and the Natural Environment at 30%. On June 24, 2019 the City of Kitchener's city council unanimously voted to declare a climate emergency. Since then, Canada has also made several statements, including at COP26, about reducing our impact on climate which is to be achieved through the preservation of the natural environment. On the transportation side, the City of Kitchener had made no such emergency declaration. As a result, how can a weight for the Natural Environment being less than Transportation make any sense when the emergency declaration and the statements from the Federal Government are taken into consideration? The Natural Environment weight should be much greater than the Transportation weight if we hope to have some kind of decent environment to live in for the decades to come.

The EA mentions the need to distribute the traffic evenly in the arterial road network. Where is the analysis of the current situation? One can observe in the morning the vast majority of the traffic coming down Caryndale towards Biehn Drive and then go north on Biehn. There is some traffic going from Biehn Drive and up Caryndale but did BTE check to make sure they are not simply going to the school? If going to the school, extending Biehn drive will not change this. For the traffic coming down Caryndale and going north on Biehn, it seems to be sourced from the south end of Caryndale and Doon South neighborhoods. Why should the residents of Biehn Drive be forced to have the residents of other neighborhoods go through ours? Is it possible that the traffic other neighborhood (north of Brigadoon) think is coming from Biehn is simply flowing through Biehn and coming from communities south of Biehn? This is where the opening of Robert Ferrie Drive to Strasburg will fix this situation and improve school zone safety on Caryndale. All the extension of Biehn Drive would do with the traffic situation is substantially and permanently damage to Provincial Significant Wetlands (PSW) at the end of Biehn Drive.

The EA project manager (Steven Taylor) mentioned during the Nov 17th meeting an increase of about 2,500 vehicles per day, where did this come from? He also mentioned the north side of Biehn Drive was being overused. The Biehn Drive Extension Need and Justification Review conducted by Paradigm Transportation Solutions (page 4) in 2014 mentions that by 2031, Biehn drive would be handling 8,100 vehicles per day (in excess of capacity as mentioned in that review) which factored in the development of Robert Ferrie Drive. This is a **substantial** increase compared to what BTE is mentioning. Also, at the Biehn Drive traffic calming meeting of Nov 23, Steve Ryder made a comment about the traffic on Biehn Drive being appropriate/acceptable since the road is a collector road. So, which one is it? Is it overused, fine or are the residents of Biehn Drive about to have a massive increase that will destroy the safety of the Biehn south neighborhood and the PSW?!

For alternative 4, why is the south side of the PSW not showing any development? A court could be developed on that side while ensuring the PSW does not have a street going through it to minimize the environmental impact. Proper drainage could be implemented to ensure stormwater is properly directed to the Storm Water Management pond that is currently beside the wet lands. This would help to provide a more fair comparison to alternative 1 and would increase the scoring for both the Land Use and the Engineering global factors.

This section of comments, questions and concerns factors in the Analysis and Evaluation Report for the Biehn Drive Extension EA

For the Improved Emergency Response (pg 70), why is the evaluation done on an access basis when normally response to something is calculated based on time? All emergency services determine their performance on time to the location where the emergency is happening. What is the current response time to the various neighborhoods and what would be the impact of each option?

For the Roadway Safety – Supports Area Traffic Calming Measures (pg 71), has the impact of Robert Ferrie being built been factored in the evaluation? Since the majority of traffic on Biehn is coming from the south end of Caryndale and Doon South, the minute Robert Ferrie would be open, a lot of this traffic flow should go away. Extending Biehn Drive will have a marginal impact (if any) on the traffic from south Caryndale and Doon South (which is a major issue) compared to Robert Ferrie opening.

For the Efficiency of Travel (pg 72), was the shortcut a lot of people take from Biehl Drive through Marl Meadow Drive and Templewood Drive to Strasburg Road or Biehn Drive through Marl Meadow Drive and Templewood Drive to Huron Road taken into account? If not, how would this impact the ratings for the various alternatives?

For the Safety of School Zone (pg 74), was the impact of opening Robert Ferrie drive and the reduction of the traffic coming down from South Caryndale and Doon South been factored in? This has a direct impact on how many vehicles go through the school zone especially in the morning. If factored in, how would it impact the rating of the various alternatives?

For the Bicycle and Pedestrian Safety - Conflicts with Planned Hydro Corridor Multi-Use Trail (pg 75), Caryndale is already crossing the hydro corridor. Alternative 4 is being unfairly impacted by including this already existing crossing. Also, Alternative 4 is further being unfairly designed (bordering on flagrant) for this part of the assessment by introducing a second access road to Street A (pg 77) on the north side of the hydro tower. This second access road from Robert

Ferrie Drive would be about 50 meters from where Biehn Drive (south portion that would not cross PSW) would connect. There is no need for this second access road since it was not included in the other alternatives. As a result, all alternatives are going to introduce the same number of new crossings. What would be the impact to the overall rating of eliminating this item since it is the same for all alternatives?

For the Personal Security of Pedestrians and Cyclists (pg 78), Alternative 4 is not being treated fairly since it does not need Multi-Use Pathway (MUP) connections because there is no continuous road being put through!! It has something even better, a dedicated walkway for pedestrians and cyclists, as shown on page 58, which doubles as access for the utilities!!! As a result, the way this criterion is set up is prejudicial to Alternative 4. Therefore, what would be the impact on the overall rating of eliminating this item?

The ratings for Wildlife Habitat (pg 80), Accommodating Wildlife Movement (pg 82), Provincially Significant Wetlands Removed (pg 85) and Groundwater Infiltration (pg 87) clearly demonstrate that Alternative 1 and 2 would have negative impacts on the environment. How is the over $2 million investment by the City of Kitchener (as mentioned in The Record on April 11, 2020) in Strasburg Creek and saving the brook trout being protected? The PSW at the end of Biehn Drive links right into this creek and having a through road will impact not only the PSW but by extension Strasburg Creek. How many more millions will it be to reverse the negative impacts of this through road?

For the Community Disruption to Biehn Drive North (pg 88), was the fact that a substantial part of the traffic on Biehn Drive North is the result of traffic coming from Caryndale South and Doon South? How would it impact the rating if this traffic was removed from the analysis since it will be handled by Robert Ferrie Drive? Also, are the shortcuts a lot of people take from Biehl Drive through Marl Meadow Drive and Templewood Drive to Strasburg Road or Biehn Drive through Marl Meadow Drive and Templewood Drive to Huron Road taken into account? If not, how would this impact the ratings for the various alternatives?

For the Efficient Utilization of Future Development Land (pg 96), was the proper development of the lands for Alternative 4(removal of the through road going through the PSW from Alternative 1) factored into the rating? If so, please demonstrate. If not, what would be the impact to the rating of Alternative 4?

For the Crossing of the Hydro Corridor (pg 97), Alternative 4 is being unfairly designed (bordering on flagrant) for this part of the assessment. The crescent should give on the portion of Biehn Drive South (between PSW and Rebert Ferrie Drive since it would not go through the PSW) just like for Alternative 1. The only difference between Alternative 1 and Alternative 4 for these evaluation criteria should be the removal of the through road going through the PSW. There is no need for this second access road as demonstrated by its exclusion from the other alternatives. As a result, all alternatives are going to introduce the same number of new crossings. What would be the impact to the overall rating of eliminating this item since it is the same for all alternatives?

For the Accommodating Stormwater Management (pg 99), has the proper development of the lands south of the PSW been factored in for Alternative 4 (removal of the through road going through the PSW from Alternative 1)? What is the impact on the rating of Alternative 4 if this is factored in?

For the Biehn Drive Stormwater Enhancement (pg 100), has the impact of the natural absorption of the stormwater been factored in? That is nature doing what it does well when there is little human interruption. What is the impact on the rating of Alternative 4 if this is factored in?

For the Overland Stormwater Management Route (pg 103), has the proper development of the lands south of the PSW been factored in for Alternative 4 (removal of the through road going through the PSW from Alternative 1)? What is the impact on the rating of Alternative 4 if this is factored in?

Thank you for the opportunity to make comments and ask questions that will become part of the public record on this important issue.

[redacted]

5

[redacted]
Sent: Wednesday, November 17, 2021 8:09:20 PM
To: Eric Riek <Eric.Riek@kitchener.ca>
Subject: Biehn

The EA for Biehn fixes the location of the RF roundabout. That is why the EA for Biehn has to be completed now.

Sent from my iPhone

6

[redacted]

Sent: November 21, 2021 9:37 PM
To: Steve Taylor (London) <stevenj.taylor@bteng.ca>; Eric Riek <eric.riek@kitchener.ca>; Christine Michaud <christine.michaud@kitchener.ca>
Subject: Re: Biehn Dr extension

Christine, Steve, Eric,

Please forward my message on to whoever else you need.

First of all, I'm not used to these kind of processes, but my gut reaction to Wednesday's meeting was I don't see the point of involving the public when you're just talking for the first 45 min about what your choice is and not actually going to change it or reconfigure or do anything about it based on all of our concerns. At that point, it seems like a massive waste of time and money, which as always brings a lot of doubt about our tax dollars being used effectively and to our benefit.

Have you had that many residents reaching out to say that they are excited and hopeful for the Biehn Dr extension? I find it hard to believe that a majority of residents feel that way. Especially when we presented specific concerns and recommendations that were either not answered or not met, how does it not come across that you have a jaded/biased perspective on transportation vs the environment.

So, I'm in the structural eng field, and when someone doesn't trust my design they can ask for my calcs. I'd like to see how your report numbers were assigned, because on the one hand I understand you are saying you are an impartial consulting company hired by the city to do an assessment, but on the other hand, your report and designs determine how the city and council will be swayed. And there is someone human who is assigning factors to things. Saying transportation is rated higher than the environment sounds an awful lot like that person is more focused on moving cars around the region than preserving the little green space we have left. Which is directly contradicting what the region and most reputable scientists would recommend as they declare a state of emergency when it comes to global warming.

It also seems like the focus is making the cars per day numbers etc work out in your theoretical models vs listening to the residents that experience the traffic day to day. The current traffic level on Biehn is tolerable and would be better with speed control. I understand you're using future numbers to run these models, but how will future numbers be larger than what they are now, there's no area to add housing in these neighborhoods. Our decisions affect people in the future, and who in the future is going to be happy about having Biehn not be a cul de sac. People living on Caryndale as well as Biehn know what the existing traffic level is when they buy and speed calming has and will been done to make it better.

Back to the graphs and tables in the presentation, I find it extremely convenient that the alternative 1 got a score of 1 for every item. Even someone making up numbers would vary the scores so it doesn't look suspicious.

Also the housing land use brown factor is 0 for alt 4? You can still make road access from the south from Robert Ferrie. To me assigning an actual realistic value for the land use factor to alternative 4 would bring alternative 1 and 4 closer in score.

End of the day, it's not just the trails that exist in this protected area, it's the way Biehn ends in a woodlot that creates a beautiful bubble at the end for the neighborhood to enjoy. And as many times as you want to say how you're the experts and the numbers check out and this is the best technical recommendation for the project, just means that you're more and more ignoring the effect on the people that actually live in the area and benefit from what you're recommending be destroyed.

7

[redacted]
Sent: Thursday, November 25, 2021 4:23 PM
To: Eric Riek <Eric.Riek@kitchener.ca>
Cc: Christine Michaud <Christine.Michaud@kitchener.ca>
Subject: [EXTERNAL] Biehn Drive Extension Class Environmental Assessment Comments

Good afternoon Eric,

My comments are attached.

[redacted]

ATTACHMENT:

I want to say how disappointed I am in the City of Kitchener. You have shown us you want to choose development over environment. And you have chosen to disrupt a quiet community for a highway going past our homes. And make no mistake, when Biehn is finished, there will be hundreds, if not thousands of commuters coming up from the 401, using Biehn Drive as a shortcut from Strasburg to Homer Watson. You will have a huge problem on your hands, but then, the damage will be done, and there will be no solution. (Or maybe, you just won't care.)

There is another situation that I am upset about. Again, it shows a lack of consideration for the residents of this area. You gave us options for the route of the road, and then chose the one you, or the developer, preferred. Do we not get a say in anything? Why show us the alternatives if you don't give us the opportunity to have at least have a say in the decision- making process?

Everything here seems slanted, dictatorial. When did City of Kitchener become so narrow minded?

[redacted] Our unsettling concern is that either option does not give us a good sightline of the road. Coming out of our driveway will be very hazardous. The bend of the road coming out from the forest seems much too abrupt.

Let's finish Robert Ferrie first and then see if the extension is necessary.

[redacted]

8

[redacted]
Sent: Saturday, November 27, 2021 9:22:16 AM
To: Eric Riek <Eric.Riek@kitchener.ca>
Cc: Christine Michaud <Christine.Michaud@kitchener.ca>
Subject: [EXTERNAL] November 17, 2021 Public Information Centre Comments

Good morning Eric,

My comments are attached.

Have a great weekend.

Regards,

[redacted].

ATTACHMENT:

Biehn Drive Extension
Class Environmental Assessment
November 17, 2021 Public Information (PIC) Centre Comments

The Grand River Conservation Authority (GRCA). has confirmed that the area behind our house and the existing Cull de Sac is part of the Provincially Significant Strasburg Creek Wetland Complex. According to the City of Kitchener (C of K) Notice of Study and Community Café, “The study will consider all reasonable alternatives with acceptable effects on the natural, social and cultural environments”. The C of K Strategic Plan for the Environment states “our strategic plan for the environment shows how we will put the environment first, reduce our carbon emissions and preserve our planet. We work to develop and maintain an ecologically diverse open space network that incorporates typical naturally occurring landscapes, significant natural features and the urban forest, all of which embody our natural heritage. We protect our water supply by working with the Region of Waterloo and the Grand River Conservation Authority to replenish and protect our water and wetlands”. If Biehn Drive is extended the C of K is violating its own Strategic Plan for the Environment. It is time for C of K staff and elected officials to lead, not continue as in the past.

Area residents have lived in a wet area for 30 years How is the C of K going to ensure we do not get more water on our properties and in our basements if the wetlands are tampered with? What is the Contingency Plan if this occurs? Documentation of the contingency plan is only fair to existing residents.

The Environmental Assessment (EA) is inherently flawed towards transportation and **must be redone**. On Page 19 of the EA Evaluation – Global Factor Weights and Sub-factor weights show Transportation 31% and Natural Environment 30%. This is wrong! The Natural Environment must be rated much higher and the scores recalculated. Current examples of what climate change is doing to Canada in British Columbia and Nova Scotia are front page news.

Robert Ferrrie Drive was not even planned when the initial extension of Biehn Drive was approved. Why not wait until Robert Ferrie Drive is extended to Strasburg Road and after a sufficient time period for residents to use this new alternative, then evaluate the need to extend Biehn Drive? As discussed on numerous occasions a road is not required for watermain and sewer installation. This can be done with an easement.

If the extension of Biehn Drive is approved by Council, area residents must have a voice on which alternative is chosen. This is only fair to the existing residents, many of whom are long term residents.

As discussed in Tuesday's (November 23) Traffic Calming Review – Biehn Drive, our section of Biehn was not included in the review and traffic calming measures the same as the rest of Biehn would be done after construction. This is wrong and not fair to the existing residents of our section of Biehn.

[redacted] If Biehn Drive is extended with the preferred alternative (Alternative1) and corresponding sharp curve, will there be appropriate sight lines for us and close neighbours to get out of and into our driveways safely?

9

[redacted]
Sent: November 24, 2021 7:58 PM
To: Eric Riek <Eric.Riek@kitchener.ca>
Cc: Steve Taylor (London) <stevenj.taylor@bteng.ca>; Christine Michaud <Christine.Michaud@kitchener.ca>
Subject: Re: Re: Biehn Dr extension

Eric,

In the biehn Dr traffic calming presentation last night, they mentioned that major collectors in the area are designed for around 5000 to 8000 a day
They also mentioned that Biehn Dr traffic numbers are in line or bit less than the standard major collector numbers.

This seems to conflict with the concept that is one of the main proponents for proposing the biehn Dr extension, as the extension presentation seemed to say Biehn Dr numbers are far above what they should be. And that it will just get worse even when robert ferrie extension is made.

Do you have more exact numbers regarding Biehn Dr traffic and what it should be? I wasn't able to find it in this report you sent

Appendix C

Select Correspondence

BT ENGINEERING

Ministry of Heritage, Sport, Tourism and Culture Industries

Programs and Services Branch
401 Bay Street, Suite 1700
Toronto, ON M7A 0A7
Tel: 437.239.3404

Ministère des Industries du Patrimoine, du Sport, du Tourisme et de la Culture

Direction des programmes et des services
401, rue Bay, Bureau 1700
Toronto, ON M7A 0A7
Tél: 437.239.3404

April 28, 2021 EMAIL ONLY

Steve Taylor, P.Eng.
EA Project Manager
BT Engineering Inc. 509 Talbot Street
London, ON N6A 2S5
stevenj.taylor@bteng.ca

MHSTCI File	**:**	**0013923**
Proponent	**:**	**City of Kitchener**
Subject	**:**	**Notice of Commencement – MCEA Schedule C**
Project	**:**	**Biehn Drive Extension**
Location	**:**	**City of Kitchener**

Dear Steve Taylor:

Thank you for providing the Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI) with the Notice of Study Commencement and the Draft Study Design Report completed by BTE Engineering Inc. (dated March 2021) for the above-referenced project. MHSTCI's interest in this Environmental Assessment (EA) project relates to its mandate of conserving Ontario's cultural heritage.

Under the EA process, the proponent is required to determine a project's potential impact on cultural heritage resources.

Project Summary

The Biehn Drive Extension EA Study is being conducted as a Schedule C EA Study under the Municipal Class Environmental Assessment (MCEA) (2015). The Transportation Master Plan (TMP) has previously completed Phases 1 and 2 of the Class EA; this Study will review the previously completed phases and complete Phases 3 and 4.

Identifying Cultural Heritage Resources

While some cultural heritage resources may have already been formally identified, others may be identified through screening and evaluation. Indigenous communities may have knowledge that can contribute to the identification of cultural heritage resources, and we suggest that any engagement with Indigenous communities includes a discussion about known or potential cultural heritage resources that are of value to these communities. Municipal Heritage Committees, historical societies and other local heritage organizations may also have knowledge that contributes to the identification of cultural heritage resources.

Cultural heritage resources are often of critical importance to Indigenous communities. Indigenous communities may have knowledge that can contribute to the identification of cultural heritage resources, and we suggest that any engagement with Indigenous communities includes a discussion about known or potential cultural heritage resources that are of value to them.

Project Comments
MHSTCI has reviewed the above referenced notice and draft Study Design Report and has the following comments:

Archaeological Resources
Section 4.2.3.1.7 of the draft Study Design Report (2nd paragraph) indicates that a Stage 1 archaeological assessment (AA) will be completed as part of this undertaking.

A Stage 1 AA shall be completed prior to any ground disturbing activities and prior to the issuance of the notice of completion. MHSTCI recommends that any additional assessments be completed as early as possible during detailed design phase.

Approval authorities (such as a municipality or MECP) typically wait to receive the ministry's review letter for an archaeological assessment report before issuing a decision on the application as it can be used, for example, to document that due diligence has been undertaken.

Archaeological assessment reports may identify site locations which are considered sensitive and not to be made public. To this end, the licensed archaeologist is required to record sensitive data, such as site location, in a separate Supplementary Documentation Report. MHSTCI understands that the proponents like to share information as part of the environmental assessment process for accountability and transparency purposes. Therefore, MHSTCI recommends that the final report be posted on the website without the Supplementary Documentation and with MHSTCI's letter indicating that the report has been entered into the Ontario Public Register of Archaeological Report.

The results of the AA will be summarized in the ESR, i.e. the Executive Summary of each AA report provides a brief summary of the work completed and the recommendations for next steps, whether for further archaeological assessment, in which case the report will include a map that identifies those areas, or for no further assessment. The ESR must also include clear commitments to undertake any further AA stages recommended, and a timeline for their completion.

We recommend revising the 2nd paragraph as follows:

- Archaeological assessment(s) (AA) will be undertaken by an archaeologist licenced under the *Ontario Heritage Act*, who is responsible for submitting the report directly to MHSTCI for review.
- Stage 1 AA consists of a review of geographic, land use and historical information for the property and the relevant surrounding area, a property visit to inspect its current condition and contacting MHSTCI to find out whether, or not, there are any known archaeological sites on or near the property. Its purpose is to identify areas of archaeological potential and determine whether additional archaeological assessment is necessary (e.g. Stage 2,3,4).

Built Heritage Resources and Cultural Heritage Landscapes

Section 4.2.3.1.7 (1st paragraph) indicates that a technical memorandum on cultural heritage resources will be completed as part of this undertaking.

MHSTCI recommends that all known or potential built heritage resources and cultural heritage landscapes be identified prior to the selection of preferred alternatives.

A Cultural Heritage Report: Existing Conditions and Preliminary Impact Assessment shall be undertaken for the entire study area (not a technical memo) prior to the selection of preferred alternatives and summarized in the Environmental Study Report. This study will:

1. Describe the existing baseline cultural heritage conditions within the study area by identifying all known or potential built heritage resources and cultural heritage landscapes, including a historical summary of the study area. MHSTCI has developed screening criteria that may assist with this exercise: *Criteria for Evaluating for Potential Built Heritage Resources and Cultural Heritage Landscapes*.

2. Identify preliminary potential project-specific impacts on the known and potential built heritage resources and cultural heritage landscapes that have been identified. The report should include a description of the anticipated impact to each known or potential built heritage resource or cultural heritage landscape that has been identified.

3. Recommend measures to avoid or mitigate potential negative impacts to known or potential built heritage resources and cultural heritage landscapes. The proposed mitigation measures are to inform the next steps of project planning and design.

MHSTCI recommends revising the 1st paragraph as follows:

- A Cultural Heritage Report: Existing Conditions and Preliminary Impact Assessment will be undertaken for the entire study area prior to the selection of preferred alternatives and summarized in the ESR. This study will identify all known or potential built heritage resources and cultural heritage landscapes (BHR/CHLs); and include a historical summary of the study area. Potential project impacts to BHR/CHLs will be identified and strategies will be provided to mitigate identified impacts. These mitigation measures will inform project planning and design.

Environmental Assessment Reporting
All technical cultural heritage studies and their recommendations are to be addressed and incorporated into EA projects.

Thank you for consulting MHSTCI on this project and please continue to do so throughout the EA process. If you have any questions or require clarification, do not hesitate to contact me.

Sincerely,

Joseph Harvey
Heritage Planner
joseph.harvey@Ontario.ca

Copied to: Eric Riek, City Project Manager, City of Kitchener
Katherine Scott, BT Engineering Inc

It is the sole responsibility of proponents to ensure that any information and documentation submitted as part of their EA report or file is accurate. MHSTCI makes no representation or warranty as to the completeness, accuracy or quality of the any checklists, reports or supporting documentation submitted as part of the EA process, and in no way shall MHSTCI be liable for any harm, damages, costs, expenses, losses, claims or actions that may result if any checklists, reports or supporting documents are discovered to be inaccurate, incomplete, misleading or fraudulent.

Please notify MHSTCI if archaeological resources are impacted by EA project work. All activities impacting archaeological resources must cease immediately, and a licensed archaeologist is required to carry out an archaeological assessment in accordance with the *Ontario Heritage Act* and the *Standards and Guidelines for Consultant Archaeologists*.

If human remains are encountered, all activities must cease immediately and the local police as well as the Registrar, Burials of the Ministry of Government and Consumer Services (416-326-8800) must be contacted. In situations where human remains are associated with archaeological resources, MHSTCI should also be notified to ensure that the site is not subject to unlicensed alterations which would be a contravention of the *Ontario Heritage Act*.

Hydro One Networks Inc
483 Bay St
Toronto, ON

May 21, 2021

Re: Biehn Drive Extension Class Environmental Assessment Study

Attention:
Steve Taylor, P.Eng. EA
Project Manager
BT Engineering Inc.

Thank you for sending us notification regarding (Biehn Drive Extension Class Environmental Assessment Study). The Secondary Land Use group is aware of this project. Please continue construction conversations with Lana Kegel, Hydro One Senior Real Estate Coordinator. Please inform us when you have more detailed drawings. Note that this response does not constitute approval for your plans and is being sent to you as a courtesy to inform you that we must continue to be consulted on your project.

In addition to the existing infrastructure mentioned above, the applicable transmission corridor may have provisions for future lines or already contain secondary land uses (e.g., pipelines, watermains, parking). Please take this into consideration in your planning.

Also, we would like to bring to your attention that should (Biehn Drive Extension Class Environmental Assessment Study) result in a Hydro One station expansion or transmission line replacement and/or relocation, an Environmental Assessment (EA) will be required as described under the Class Environmental Assessment for Minor Transmission Facilities (Hydro One, 2016). This EA process would require a minimum of 6 months for a Class EA Screening Process (or up to 18 months if a Full Class EA were to be required) to be completed. Associated costs will be allocated and recovered from proponents in accordance with the Transmission System Code. If triggered, Hydro One will rely on studies completed as part of the EA you are current undertaking.

Consulting with Hydro One on such matters during your project's EA process is critical to avoiding conflicts where possible or, where not possible, to streamlining processes (e.g., ensuring study coverage of expansion/relocation areas within the current EA). Once in receipt of more specific project information regarding the potential for conflicts (e.g., siting, routing), Hydro One will be in a better position to communicate objections or not objections to alternatives proposed.

If possible at this stage, please formally confirm that Hydro One infrastructure and associated rights-of-way will be completely avoided, or if not possible, allocate appropriate lead-time in your project schedule to collaboratively work through potential conflicts with Hydro One, which ultimately could result in timelines identified above.

In planning, note that developments should not reduce line clearances or limit access to our infrastructure at any time. Any construction activities must maintain the electrical clearance from the transmission line conductors as specified in the Ontario Health and Safety Act for the respective line voltage.

Be advised that any changes to lot grading or drainage within, or in proximity to Hydro One transmission corridor lands must be controlled and directed away from the transmission corridor.

Please note that the proponent will be held responsible for all costs associated with modifications or relocations of Hydro One infrastructure that result from your project, as well as any added costs that may be incurred due to increased efforts to maintain said infrastructure.

We reiterate that this message does not constitute any form of approval for your project. Hydro One must be consulted during all stages of your project. Please ensure that all future communications about this and future project(s) are sent to us electronically to secondarylanduse@hydroone.com

Sent on behalf of,

Secondary Land Use
Asset Optimization
Strategy & Integrated Planning
Hydro One Networks Inc.

Ministry of the Environment, Conservation and Parks

Environmental Assessment Branch

1st Floor
135 St. Clair Avenue W
Toronto ON M4V 1P5
Tel.: 416 314-8001
Fax.: 416 314-8452

Ministère de l'Environnement, de la Protection de la nature et des Parcs

Direction des évaluations environnementales

Rez-de-chaussée
135, avenue St. Clair Ouest
Toronto ON M4V 1P5
Tél. : 416 314-8001
Téléc. : 416 314-8452

Ontario

May 20, 2021

Eric Riek
Project Manager
City of Kitchener

Re: **Biehn Drive Extension EA**
City of Kitchener
Municipal Class EA
Response to Notice of Commencement

Dear Eric Riek,

This letter is in response to the Notice of Commencement for the above noted project. The Ministry of the Environment, Conservation and Parks (MECP) acknowledges that the City of Kitchener has indicated that the study is following the approved environmental planning process for a Schedule C project under the Municipal Class Environmental Assessment (Class EA).

The **updated (February 2021)** attached "Areas of Interest" document provides guidance regarding the ministry's interests with respect to the Class EA process. Please address all areas of interest in the EA documentation at an appropriate level for the EA study. Proponents who address all the applicable areas of interest can minimize potential delays to the project schedule. **Further information is provided at the end of the Areas of Interest document relating to recent changes to the Environmental Assessment Act through Bill 197, Covid-19 Economic Recovery Act 2020.**

The Crown has a legal duty to consult Aboriginal communities when it has knowledge, real or constructive, of the existence or potential existence of an Aboriginal or treaty right and contemplates conduct that may adversely impact that right. Before authorizing this project, the Crown must ensure that its duty to consult has been fulfilled, where such a duty is triggered. Although the duty to consult with Aboriginal peoples is a duty of the Crown, the Crown may delegate procedural aspects of this duty to project proponents while retaining oversight of the consultation process.

The proposed project may have the potential to affect Aboriginal or treaty rights protected under Section 35 of Canada's *Constitution Act* 1982. Where the Crown's duty to consult is triggered in relation to the proposed project**, the MECP is delegating the procedural aspects of rights-based consultation to the proponent through this letter.** The Crown intends to rely on the delegated consultation process in discharging its duty to consult and maintains the right to participate in the consultation process as it sees fit.

Based on information provided to date and the Crown`s preliminary assessment the proponent is required to consult with the following communities who have been identified as potentially affected by the proposed project:

- Mississaugas of the Credit First Nation
- Six Nations of the Grand River (both Elected Council and Haudenosaunee Confederacy Chiefs Council)

Steps that the proponent may need to take in relation to Aboriginal consultation for the proposed project are outlined in the "Code of Practice for Consultation in Ontario's Environmental Assessment Process". Additional information related to Ontario's Environmental Assessment Act is available online at: www.ontario.ca/environmentalassessments.

Please also refer to the attached document "A Proponent's Introduction to the Delegation of Procedural Aspects of consultation with Aboriginal Communities" for further information, including the MECP's expectations for EA report documentation related to consultation with communities.

The proponent must contact the Director of Environmental Assessment Branch (EABDirector@ontario.ca) under the following circumstances subsequent to initial discussions with the communities identified by MECP:

- Aboriginal or treaty rights impacts are identified to you by the communities
- You have reason to believe that your proposed project may adversely affect an Aboriginal or treaty right
- Consultation with Indigenous communities or other stakeholders has reached an impasse
- A Part II Order request is expected on the basis of impacts to Aboriginal or treaty rights

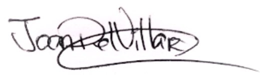
The MECP will then assess the extent of any Crown duty to consult for the circumstances and will consider whether additional steps should be taken, including what role you will be asked to play should additional steps and activities be required.

A draft copy of the report should be sent directly to me prior to the filing of the final report, allowing a minimum of 30 days for the ministry's technical reviewers to provide comments.

Please also ensure a copy of the final notice is sent to the ministry's West Central Region EA notification email account (eanotification.swregion@ontario.ca) after the draft report is reviewed and finalized.

Should you or any members of your project team have any questions regarding the material above, please contact me at joan.delvillarcuicas@ontario.ca or 365-889-1180.

Yours truly,



Joan Del Villar C
Regional Environmental Assessment Coordinator – West Central Region

cc Katy Potter, Supervisor, Environmental Assessment Services, MECP
Steve Taylor, P. Eng. EA Project Manager, BT Engineering Inc

Attach: Areas of Interest
A Proponent's Introduction to the Delegation of Procedural Aspects of Consultation with Aboriginal Communities

AREAS OF INTEREST (v. February 2021)

It is suggested that you check off each section after you have considered / addressed it.

- ☐ **Planning and Policy**

- Projects located in MECP Central Region are subject to **A Place to Grow: Growth Plan for the Greater Golden Horseshoe (2020).** Parts of the study area may also be subject to the Oak Ridges Moraine Conservation Plan (2017), Niagara Escarpment Plan (2017), Greenbelt Plan (2017) or Lake Simcoe Protection Plan (2014). Applicable plans and the applicable policies should be identified in the report, and the proponent should describe how the proposed project adheres to the relevant policies in these plans.

- The **Provincial Policy Statement (2020)** contains policies that protect Ontario's natural heritage and water resources. Applicable policies should be referenced in the report, and the proponent should describe how the proposed project is consistent with these policies.

- In addition to the provincial planning and policy level, the report should also discuss the planning context at the municipal and federal levels, as appropriate.

- ☐ **Source Water Protection**

The *Clean Water Act*, 2006 (CWA) aims to protect existing and future sources of drinking water. To achieve this, several types of vulnerable areas have been delineated around surface water intakes and wellheads for every municipal residential drinking water system that is located in a source protection area. These vulnerable areas are known as a Wellhead Protection Areas (WHPAs) and surface water Intake Protection Zones (IPZs). Other vulnerable areas that have been delineated under the CWA include Highly Vulnerable Aquifers (HVAs), Significant Groundwater Recharge Areas (SGRAs), Event-based modelling areas (EBAs), and Issues Contributing Areas (ICAs). Source protection plans have been developed that include policies to address existing and future risks to sources of municipal drinking water within these vulnerable areas.

Projects that are subject to the Environmental Assessment Act that fall under a Class EA, or one of the Regulations, have the potential to impact sources of drinking water if they occur in designated vulnerable areas or in the vicinity of other at-risk drinking water systems (i.e. systems that are not municipal residential systems). MEA Class EA projects may include activities that, if located in a vulnerable area, could be a threat to sources of drinking water (i.e. have the potential to adversely affect the quality or quantity of drinking water sources) and the activity could therefore be subject to policies in a source protection plan. Where an activity poses a risk to drinking water, policies in the local source protection plan may impact how or where that activity is undertaken. Policies may prohibit certain activities, or they may require risk management measures for these activities. Municipal Official Plans, planning decisions, Class EA projects (where the project includes an activity that is a threat to drinking water) and prescribed instruments must conform with policies that address significant risks to drinking water and must have regard for policies that address moderate or low risks.

- In October 2015, the MEA Parent Class EA document was amended to include reference to the Clean Water Act (Section A.2.10.6) and indicates that proponents undertaking a Municipal Class EA project must identify early in their process whether a project is or could potentially be occurring with a vulnerable area. **Given this requirement, please include a section in the report on source water protection.**
    - The proponent should identify the source protection area and should clearly document how the proximity of the project to sources of drinking water (municipal or other) and any delineated vulnerable areas was considered and assessed. Specifically, the report should discuss whether or not the project is located in a vulnerable area and provide applicable details about the area.

- If located in a vulnerable area, proponents should document whether any project activities are prescribed drinking water threats and thus pose a risk to drinking water (this should be consulted on with the appropriate Source Protection Authority). Where an activity poses a risk to drinking water, the proponent must document and discuss in the report how the project adheres to or has regard to applicable policies in the local source protection plan. This section should then be used to inform and be reflected in other sections of the report, such as the identification of net positive/negative effects of alternatives, mitigation measures, evaluation of alternatives etc.

- While most source protection plans focused on including policies for significant drinking water threats in the WHPAs and IPZs it should be noted that even though source protection plan policies may not apply in HVAs, these are areas where aquifers are sensitive and at risk to impacts and within these areas, activities may impact the quality of sources of drinking water for systems other than municipal residential systems.

- In order to determine if this project is occurring within a vulnerable area, proponents can use this mapping tool: http://www.applications.ene.gov.on.ca/swp/en/index.php. Note that various layers (including WHPAs, WHPA-Q1 and WHPA-Q2, IPZs, HVAs, SGRAs, EBAs, ICAs) can be turned on through the “Map Legend” bar on the left. The mapping tool will also provide a link to the appropriate source protection plan in order to identify what policies may be applicable in the vulnerable area.

- For further information on the maps or source protection plan policies which may relate to their project, proponents must contact the appropriate source protection authority. **Please consult with the local source protection authority to discuss potential impacts on drinking water. Please document the results of that consultation within the report and include all communication documents/correspondence.**

More Information

For more information on the *Clean Water Act*, source protection areas and plans, including specific information on the vulnerable areas and drinking water threats, please refer to Conservation Ontario’s website where you will also find links to the local source protection plan/assessment report.

A list of the prescribed drinking water threats can be found in section 1.1 of Ontario Regulation 287/07 made under the *Clean Water Act*. In addition to prescribed drinking water threats, some source protection plans may include policies to address additional “local” threat activities, as approved by the MECP.

Climate Change

The document "Considering Climate Change in the Environmental Assessment Process" (Guide) is now a part of the Environmental Assessment program's Guides and Codes of Practice. The Guide sets out the MECP's expectation for considering climate change in the preparation, execution and documentation of environmental assessment studies and processes. The guide provides examples, approaches, resources, and references to assist proponents with consideration of climate change in EA. Proponents should review this Guide in detail.

- **The MECP expects proponents of Class EA projects to:**

  1. Consider during the assessment of alternative solutions and alternative designs, the following:
     a. the project's expected production of greenhouse gas emissions and impacts on carbon sinks (climate change mitigation); and
     b. resilience or vulnerability of the undertaking to changing climatic conditions (climate change adaptation).
  2. Include a discrete section in the report detailing how climate change was considered in the EA.

How climate change is considered can be qualitative or quantitative in nature and should be scaled to the project’s level of environmental effect. In all instances, both a project's impacts on climate change (mitigation) and impacts of climate change on a project (adaptation) should be considered.

- The MECP has also prepared another guide to support provincial land use planning direction related to the completion of energy and emission plans. The "Community Emissions Reduction Planning: A Guide for Municipalities" document is designed to educate stakeholders on the municipal opportunities to reduce energy and greenhouse gas emissions, and to provide guidance on methods and techniques to incorporate consideration of energy and greenhouse gas emissions into municipal activities of all types. We encourage you to review the Guide for information.

Air Quality, Dust and Noise

- If there are sensitive receptors in the surrounding area of this project, a quantitative air quality/odour impact assessment will be useful to evaluate alternatives, determine impacts and identify appropriate mitigation measures. The scope of the assessment can be determined based on the potential effects of the proposed alternatives, and typically includes source and receptor characterization and a quantification of local air quality impacts on the sensitive receptors and the environment in the study area. The assessment will compare to all applicable standards or guidelines for all contaminants of concern. **Please contact this office for further consultation on the level of Air Quality Impact Assessment required for this project if not already advised.**

- If a quantitative Air Quality Impact Assessment is not required for the project, the MECP expects that the report contain a qualitative assessment which includes:

    - A discussion of local air quality including existing activities/sources that significantly impact local air quality and how the project may impact existing conditions;
    - A discussion of the nearby sensitive receptors and the project's potential air quality impacts on present and future sensitive receptors;
    - A discussion of local air quality impacts that could arise from this project during both construction and operation; and
    - A discussion of potential mitigation measures.

- As a common practice, "air quality" should be used an evaluation criterion for all road projects.

- Dust and noise control measures should be addressed and included in the construction plans to ensure that nearby residential and other sensitive land uses within the study area are not adversely affected during construction activities.

- The MECP recommends that non-chloride dust-suppressants be applied. For a comprehensive list of fugitive dust prevention and control measures that could be applied, refer to *Cheminfo Services Inc. Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities* report prepared for Environment Canada. March 2005.

- The report should consider the potential impacts of increased noise levels during the operation of the completed project. The proponent should explore all potential measures to mitigate significant noise impacts during the assessment of alternatives.

Ecosystem Protection and Restoration

- Any impacts to ecosystem form and function must be avoided where possible. The report should describe any proposed mitigation measures and how project planning will protect and enhance the local ecosystem.

- Natural heritage and hydrologic features should be identified and described in detail to assess potential impacts and to develop appropriate mitigation measures. The following sensitive environmental features may be located within or adjacent to the study area:
    - Key Natural Heritage Features: Habitat of endangered species and threatened species, fish habitat, wetlands, areas of natural and scientific interest (ANSIs), significant valleylands,

significant woodlands; significant wildlife habitat (including habitat of special concern species); sand barrens, savannahs, and tallgrass prairies; and alvars.
  - Key Hydrologic Features: Permanent streams, intermittent streams, inland lakes and their littoral zones, seepage areas and springs, and wetlands.
  - Other natural heritage features and areas such as: vegetation communities, rare species of flora or fauna, Environmentally Sensitive Areas, Environmentally Sensitive Policy Areas, federal and provincial parks and conservation reserves, Greenland systems etc.

We recommend consulting with the Ministry of Natural Resources and Forestry (MNRF), Fisheries and Oceans Canada (DFO) and your local conservation authority to determine if special measures or additional studies will be necessary to preserve and protect these sensitive features. In addition, you may consider the provisions of the Rouge Park Management Plan if applicable.

- [ ] **Species at Risk**

- The Ministry of the Environment, Conservation and Parks has now assumed responsibility of Ontario's Species at Risk program. Information, standards, guidelines, reference materials and technical resources to assist you are found at https://www.ontario.ca/page/species-risk.

- The Client's Guide to Preliminary Screening for Species at Risk (Draft May 2019) has been attached to the covering email for your reference and use. Please review this document for next steps.

- For any questions related to subsequent permit requirements, please contact SAROntario@ontario.ca.

- [ ] **Surface Water**

- The report must include enough information to demonstrate that there will be no negative impacts on the natural features or ecological functions of any watercourses within the study area. Measures should be included in the planning and design process to ensure that any impacts to watercourses from construction or operational activities (e.g. spills, erosion, pollution) are mitigated as part of the proposed undertaking.

- Additional stormwater runoff from new pavement can impact receiving watercourses and flood conditions. Quality and quantity control measures to treat stormwater runoff should be considered for all new impervious areas and, where possible, existing surfaces. The ministry's Stormwater Management Planning and Design Manual (2003) should be referenced in the report and utilized when designing stormwater control methods. **A Stormwater Management Plan should be prepared as part of the Class EA process** that includes:

  - Strategies to address potential water quantity and erosion impacts related to stormwater draining into streams or other sensitive environmental features, and to ensure that adequate (enhanced) water quality is maintained
  - Watershed information, drainage conditions, and other relevant background information
  - Future drainage conditions, stormwater management options, information on erosion and sediment control during construction, and other details of the proposed works
  - Information on maintenance and monitoring commitments.

- Ontario Regulation 60/08 under the *Ontario Water Resources Act* (OWRA) applies to the Lake Simcoe Basin, which encompasses Lake Simcoe and the lands from which surface water drains into Lake Simcoe. If the proposed sewage treatment plant is listed in Table 1 of the regulation, the report should describe how the proposed project and its mitigation measures are consistent with the requirements of this regulation and the OWRA.

- Any potential approval requirements for surface water taking or discharge should be identified in the report. A Permit to Take Water (PTTW) under the OWRA will be required for any water takings that exceed 50,000 L/day, except for certain water taking activities that have been prescribed by the Water Taking EASR Regulation – *O. Reg. 63/16*. These prescribed water-taking activities require registration in the EASR instead of a PTTW. Please review the Water Taking User Guide for EASR for more information. Additionally, an Environmental Compliance Approval under the OWRA is required for municipal stormwater management works.

Groundwater

- The status of, and potential impacts to any well water supplies should be addressed. If the project involves groundwater takings or changes to drainage patterns, the quantity and quality of groundwater may be affected due to drawdown effects or the redirection of existing contamination flows. In addition, project activities may infringe on existing wells such that they must be reconstructed or sealed and abandoned. Appropriate information to define existing groundwater conditions should be included in the report.

- If the potential construction or decommissioning of water wells is identified as an issue, the report should refer to Ontario Regulation 903, Wells, under the OWRA.

- Potential impacts to groundwater-dependent natural features should be addressed. Any changes to groundwater flow or quality from groundwater taking may interfere with the ecological processes of streams, wetlands or other surficial features. In addition, discharging contaminated or high volumes of groundwater to these features may have direct impacts on their function. Any potential effects should be identified, and appropriate mitigation measures should be recommended. The level of detail required will be dependent on the significance of the potential impacts.

- Any potential approval requirements for groundwater taking or discharge should be identified in the report. A Permit to Take Water (PTTW) under the OWRA will be required for any water takings that exceed 50,000 L/day, with the exception of certain water taking activities that have been prescribed by the Water Taking EASR Regulation – *O. Reg. 63/16*. These prescribed water-taking activities require registration in the EASR instead of a PTTW. Please review the Water Taking User Guide for EASR for more information.

- Consultation with the railroad authorities is necessary wherever there is a plan to use construction dewatering in the vicinity of railroad lines or where the zone of influence of the construction dewatering potentially intercepts railroad lines.

Excess Materials Management

- In December 2019, MECP released a new regulation under the Environmental Protection Act, titled "On-Site and Excess Soil Management" (O. Reg. 406/19) to support improved management of excess construction soil. This regulation is a key step to support proper management of excess soils, ensuring valuable resources don't go to waste and to provide clear rules on managing and reusing excess soil. New risk-based standards referenced by this regulation help to facilitate local beneficial reuse which in turn will reduce greenhouse gas emissions from soil transportation, while ensuring strong protection of human health and the environment. The new regulation is being phased in over time, with the first phase in effect on January 1, 2021. For more information, please visit https://www.ontario.ca/page/handling-excess-soil.

- The report should reference that activities involving the management of excess soil should be completed in accordance with O. Reg. 406/19 and the MECP's current guidance document titled "Management of Excess Soil – A Guide for Best Management Practices" (2014).

- All waste generated during construction must be disposed of in accordance with ministry requirements

- **Contaminated Sites**

- Any current or historical waste disposal sites should be identified in the report. The status of these sites should be determined to confirm whether approval pursuant to Section 46 of the EPA may be required for land uses on former disposal sites. We recommend referring to the MECP's D-4 guideline for land use considerations near landfills and dumps.
  - Resources available may include regional/local municipal official plans and data; provincial data on large landfill sites and small landfill sites; Environmental Compliance Approval information for waste disposal sites on Access Environment.

- Other known contaminated sites (local, provincial, federal) in the study area should also be identified in the report (Note – information on federal contaminated sites is found on the Government of Canada's website).

- The location of any underground storage tanks should be investigated in the report. Measures should be identified to ensure the integrity of these tanks and to ensure an appropriate response in the event of a spill. The ministry's Spills Action Centre must be contacted in such an event.

- Since the removal or movement of soils may be required, appropriate tests to determine contaminant levels from previous land uses or dumping should be undertaken. If the soils are contaminated, you must determine how and where they are to be disposed of, consistent with *Part XV.1 of the Environmental Protection Act* (EPA) and Ontario Regulation 153/04, Records of Site Condition, which details the new requirements related to site assessment and clean up. Please contact the appropriate MECP District Office for further consultation if contaminated sites are present.

- **Servicing, Utilities and Facilities**

- The report should identify any above or underground utilities in the study area such as transmission lines, telephone/internet, oil/gas etc. The owners should be consulted to discuss impacts to this infrastructure, including potential spills.

- The report should identify any servicing infrastructure in the study area such as wastewater, water, stormwater that may potentially be impacted by the project.

- Any facility that releases emissions to the atmosphere, discharges contaminants to ground or surface water, provides potable water supplies, or stores, transports or disposes of waste must have an Environmental Compliance Approval (ECA) before it can operate lawfully. Please consult with MECP's Environmental Permissions Branch to determine whether a new or amended ECA will be required for any proposed infrastructure.

- We recommend referring to the ministry's environmental land use planning guides to ensure that any potential land use conflicts are considered when planning for any infrastructure or facilities related to wastewater, pipelines, landfills or industrial uses.

- **Mitigation and Monitoring**

- Contractors must be made aware of all environmental considerations so that all environmental standards and commitments for both construction and operation are met. Mitigation measures should be clearly referenced in the report and regularly monitored during the construction stage of the project. In addition, we encourage proponents to conduct post-construction monitoring to ensure all mitigation measures have been effective and are functioning properly.

- Design and construction reports and plans should be based on a best management approach that centres on the prevention of impacts, protection of the existing environment, and opportunities for rehabilitation and enhancement of any impacted areas.

- The proponent's construction and post-construction monitoring plans must be documented in the report, as outlined in Section A.2.5 and A.4.1 of the MEA Class EA parent document.

Consultation

- The report must demonstrate how the consultation provisions of the Class EA have been fulfilled, including documentation of all stakeholder consultation efforts undertaken during the planning process. This includes a discussion in the report that identifies concerns that were raised and **describes how they have been addressed by the proponent** throughout the planning process. The report should also include copies of comments submitted on the project by interested stakeholders, and the proponent's responses to these comments (as directed by the Class EA to include full documentation).

- Please include the full stakeholder distribution/consultation list in the documentation.

Class EA Process

- If this project is a Master Plan: there are several different approaches that can be used to conduct a Master Plan, examples of which are outlined in Appendix 4 of the Class EA. **The Master Plan should clearly indicate the selected approach for conducting the plan**, by identifying whether the levels of assessment, consultation and documentation are sufficient to fulfill the requirements for Schedule B or C projects. Please note that any Schedule B or C projects identified in the plan would be subject to Part II Order Requests under the Environmental Assessment Act, although the plan itself would not be. **Please include a description of the approach being undertaken (use Appendix 4 as a reference).**

- If this project is a Master Plan: Any identified projects should also include information on the MCEA schedule associated with the project.

- The report should provide clear and complete documentation of the planning process in order to allow for transparency in decision-making.

- The Class EA requires the consideration of the effects of each alternative on all aspects of the environment (including planning, natural, social, cultural, economic, technical). The report should include a level of detail (e.g. hydrogeological investigations, terrestrial and aquatic assessments, cultural heritage assessments) such that all potential impacts can be identified, and appropriate mitigation measures can be developed. Any supporting studies conducted during the Class EA process should be referenced and included as part of the report.

- Please include in the report a list of all subsequent permits or approvals that may be required for the implementation of the preferred alternative, including but not limited to, MECP's PTTW, EASR Registrations and ECAs, conservation authority permits, species at risk permits, MTO permits and approvals under the *Impact Assessment Act*, 2019.

- Ministry guidelines and other information related to the issues above are available at http://www.ontario.ca/environment-and-energy/environment-and-energy. We encourage you to review all the available guides and to reference any relevant information in the report.

Amendments to the EAA through the Covid-19 Economic Recovery Act, 2020

Once the EA Report is finalized, the proponent must issue a Notice of Completion providing a minimum 30-day period during which documentation may be reviewed and comment and input can be submitted to the proponent. The Notice of Completion must be sent to the appropriate MECP Regional Office email address (for projects in MECP Southwest Region, the email is eanotification.swregion@ontario.ca).

The public has the ability to request a higher level of assessment on a project if they are concerned about potential adverse impacts to constitutionally protected Aboriginal and treaty rights. In addition, the Minister may issue an order on his or her own initiative within a specified time period. The Director (of the Environmental Assessment Branch) will issue a Notice of Proposed Order to the proponent if the Minister is considering an order for the project within 30 days after the conclusion of the comment period on the Notice of Completion. At this time, the Director may request additional information from the proponent. Once the requested information has been received, the Minister will have 30 days within which to make a decision or impose conditions on your project.

Therefore, the proponent cannot proceed with the project until at least 30 days after the end of the comment period provided for in the Notice of Completion. Further, the proponent may not proceed after this time if:

- a Part II Order request has been submitted to the ministry regarding potential adverse impacts to constitutionally protected Aboriginal and treaty rights, or
- the Director has issued a Notice of Proposed order regarding the project.

Please ensure that the Notice of Completion advises that outstanding concerns are to be directed to the proponent for a response, and that in the event there are outstanding concerns regarding potential adverse impacts to constitutionally protected Aboriginal and treaty rights, Part II Order requests on those matters should be addressed in writing to:

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

and

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

A PROPONENT'S INTRODUCTION TO THE DELEGATION OF PROCEDURAL ASPECTS OF CONSULTATION WITH ABORIGINAL COMMUNITIES

DEFINITIONS

The following definitions are specific to this document and may not apply in other contexts:

Aboriginal communities – the First Nation or Métis communities identified by the Crown for the purpose of consultation.

Consultation – the Crown's legal obligation to consult when the Crown has knowledge of an established or asserted Aboriginal or treaty right and contemplates conduct that might adversely impact that right. This is the type of consultation required pursuant to s. 35 of the *Constitution Act, 1982*. Note that this definition does not include consultation with Aboriginal communities for other reasons, such as regulatory requirements.

Crown – the Ontario Crown, acting through a particular ministry or ministries.

Procedural aspects of consultation – those portions of consultation related to the process of consultation, such as notifying an Aboriginal community about a project, providing information about the potential impacts of a project, responding to concerns raised by an Aboriginal community and proposing changes to the project to avoid negative impacts.

Proponent – the person or entity that wants to undertake a project and requires an Ontario Crown decision or approval for the project.

I. PURPOSE

The Crown has a legal duty to consult Aboriginal communities when it has knowledge of an existing or asserted Aboriginal or treaty right and contemplates conduct that may adversely impact that right. In outlining a framework for the duty to consult, the Supreme Court of Canada has stated that the Crown may delegate procedural aspects of consultation to third parties. This document provides general information about the Ontario Crown's approach to delegation of the procedural aspects of consultation to proponents.

This document is not intended to instruct a proponent about an individual project, and it does not constitute legal advice.

II. WHY IS IT NECESSARY TO CONSULT WITH ABORIGINAL COMMUNITIES?

The objective of the modern law of Aboriginal and treaty rights is the *reconciliation* of Aboriginal peoples and non-Aboriginal peoples and their respective rights, claims and interests. Consultation is an important component of the reconciliation process.

The Crown has a legal duty to consult Aboriginal communities when it has knowledge of an existing or asserted Aboriginal or treaty right and contemplates conduct that might adversely impact that right. For example, the Crown's duty to consult is triggered when it considers issuing a permit, authorization or approval for a project which has the potential to adversely impact an Aboriginal right, such as the right to hunt, fish, or trap in a particular area.

The scope of consultation required in particular circumstances ranges across a spectrum depending on both the nature of the asserted or established right and the seriousness of the potential adverse impacts on that right.

Depending on the particular circumstances, the Crown may also need to take steps to accommodate the potentially impacted Aboriginal or treaty right. For example, the Crown may be required to avoid or minimize the potential adverse impacts of the project.

III. THE CROWN'S ROLE AND RESPONSIBILITIES IN THE DELEGATED CONSULTATION PROCESS

The Crown has the responsibility for ensuring that the duty to consult, and accommodate where appropriate, is met. However, the Crown may delegate the procedural aspects of consultation to a proponent.

There are different ways in which the Crown may delegate the procedural aspects of consultation to a proponent, including through a letter, a memorandum of understanding, legislation, regulation, policy and codes of practice.

If the Crown decides to delegate procedural aspects of consultation, the Crown will generally:

- Ensure that the delegation of procedural aspects of consultation and the responsibilities of the proponent are clearly communicated to the proponent;
- Identify which Aboriginal communities must be consulted;
- Provide contact information for the Aboriginal communities;
- Revise, as necessary, the list of Aboriginal communities to be consulted as new information becomes available and is assessed by the Crown;
- Assess the scope of consultation owed to the Aboriginal communities;
- Maintain appropriate oversight of the actions taken by the proponent in fulfilling the procedural aspects of consultation;
- Assess the adequacy of consultation that is undertaken and any accommodation that may be required;
- Provide a contact within any responsible ministry in case issues arise that require direction from the Crown; and
- Participate in the consultation process as necessary and as determined by the Crown.

IV. THE PROPONENT'S ROLE AND RESPONSIBILITIES IN THE DELEGATED CONSULTATION PROCESS

Where aspects of the consultation process have been delegated to a proponent, the Crown, in meeting its duty to consult, will rely on the proponent's consultation activities and documentation of those activities. The consultation process informs the Crown's decision of whether or not to approve a proposed project or activity.

A proponent's role and responsibilities will vary depending on a variety of factors including the extent of consultation required in the circumstance and the procedural aspects of consultation the Crown has delegated to it. Proponents are often in a better position than the Crown to discuss a project and its potential impacts with Aboriginal communities and to determine ways to avoid or minimize the adverse impacts of a project.

A proponent can raise issues or questions with the Crown at any time during the consultation process. If issues or concerns arise during the consultation that cannot be addressed by the proponent, the proponent should contact the Crown.

a) What might a proponent be required to do in carrying out the procedural aspects of consultation?

Where the Crown delegates procedural aspects of consultation, it is often the proponent's responsibility to provide notice of the proposed project to the identified Aboriginal communities. The notice should indicate that the Crown has delegated the procedural aspects of consultation to the proponent and should include the following information:

- a description of the proposed project or activity;
- mapping;
- proposed timelines;
- details regarding anticipated environmental and other impacts;
- details regarding opportunities to comment; and
- any changes to the proposed project that have been made for seasonal conditions or other factors, where relevant.

Proponents should provide enough information and time to allow Aboriginal communities to provide meaningful feedback regarding the potential impacts of the project. Depending on the nature of consultation required for a project, a proponent also may be required to:

- provide the Crown with copies of any consultation plans prepared and an opportunity to review and comment;
- ensure that any necessary follow-up discussions with Aboriginal communities take place in a timely manner, including to confirm receipt of information, share and update information and to address questions or concerns that may arise;
- as appropriate, discuss with Aboriginal communities potential mitigation measures and/or changes to the project in response to concerns raised by Aboriginal communities;
- use language that is accessible and not overly technical, and translate material into Aboriginal languages where requested or appropriate;
- bear the reasonable costs associated with the consultation process such as, but not limited to, meeting hall rental, meal costs, document translation(s), or to address technical & capacity issues;
- provide the Crown with all the details about potential impacts on established or asserted Aboriginal or treaty rights, how these concerns have been considered and addressed by the proponent and the Aboriginal communities and any steps taken to mitigate the potential impacts;
- provide the Crown with complete and accurate documentation from these meetings and communications; and
- notify the Crown immediately if an Aboriginal community not identified by the Crown approaches the proponent seeking consultation opportunities.

b) What documentation and reporting does the Crown need from the proponent?

Proponents should keep records of all communications with the Aboriginal communities involved in the consultation process and any information provided to these Aboriginal communities.

As the Crown is required to assess the adequacy of consultation, it needs documentation to satisfy itself that the proponent has fulfilled the procedural aspects of consultation delegated to it. The documentation required would typically include:

- the date of meetings, the agendas, any materials distributed, those in attendance and copies of any minutes prepared;
- the description of the proposed project that was shared at the meeting;
- any and all concerns or other feedback provided by the communities;
- any information that was shared by a community in relation to its asserted or established Aboriginal or treaty rights and any potential adverse impacts of the proposed activity, approval or disposition on such rights;
- any proposed project changes or mitigation measures that were discussed, and feedback from Aboriginal communities about the proposed changes and measures;
- any commitments made by the proponent in response to any concerns raised, and feedback from Aboriginal communities on those commitments;
- copies of correspondence to or from Aboriginal communities, and any materials distributed electronically or by mail;
- information regarding any financial assistance provided by the proponent to enable participation by Aboriginal communities in the consultation;
- periodic consultation progress reports or copies of meeting notes if requested by the Crown;
- a summary of how the delegated aspects of consultation were carried out and the results; and
- a summary of issues raised by the Aboriginal communities, how the issues were addressed and any outstanding issues.

In certain circumstances, the Crown may share and discuss the proponent's consultation record with an Aboriginal community to ensure that it is an accurate reflection of the consultation process.

c) Will the Crown require a proponent to provide information about its commercial arrangements with Aboriginal communities?

The Crown may require a proponent to share information about aspects of commercial arrangements between the proponent and Aboriginal communities where the arrangements:

- include elements that are directed at mitigating or otherwise addressing impacts of the project;
- include securing an Aboriginal community's support for the project; or
- may potentially affect the obligations of the Crown to the Aboriginal communities.

The proponent should make every reasonable effort to exempt the Crown from confidentiality provisions in commercial arrangements with Aboriginal communities to the extent necessary to allow this information to be shared with the Crown.

The Crown cannot guarantee that information shared with the Crown will remain confidential. Confidential commercial information should not be provided to the Crown as part of the consultation record if it is not relevant to the duty to consult or otherwise required to be submitted to the Crown as part of the regulatory process.

V. WHAT ARE THE ROLES AND RESPONSIBILITIES OF ABORIGINAL COMMUNITIES' IN THE CONSULTATION PROCESS?

Like the Crown, Aboriginal communities are expected to engage in consultation in good faith. This includes:

- responding to the consultation notice;
- engaging in the proposed consultation process;
- providing relevant documentation;
- clearly articulating the potential impacts of the proposed project on Aboriginal or treaty rights; and
- discussing ways to mitigates any adverse impacts.

Some Aboriginal communities have developed tools, such as consultation protocols, policies or processes that provide guidance on how they would prefer to be consulted. Although not legally binding, proponents are encouraged to respect these community processes where it is reasonable to do so. Please note that there is no obligation for a proponent to pay a fee to an Aboriginal community in order to enter into a consultation process.

To ensure that the Crown is aware of existing community consultation protocols, proponents should contact the relevant Crown ministry when presented with a consultation protocol by an Aboriginal community or anyone purporting to be a representative of an Aboriginal community.

VI. WHAT IF MORE THAN ONE PROVINCIAL CROWN MINISTRY IS INVOLVED IN APPROVING A PROPONENT'S PROJECT?

Depending on the project and the required permits or approvals, one or more ministries may delegate procedural aspects of the Crown's duty to consult to the proponent. The proponent may contact individual ministries for guidance related to the delegation of procedural aspects of consultation for ministry-specific permits/approvals required for the project in question. Proponents are encouraged to seek input from all involved Crown ministries sooner rather than later.

Administration Centre: 400 Clyde Road, P.O. Box 729 Cambridge, ON N1R 5W6

Phone: 519-621-2761 Toll free: 1-866-900-4722 Fax: 519-621-4844 www.grandriver.ca

April 14, 2021

Eric Riek, C.E.T., Project Manager
City of Kitchener
Via email: eric.riek@kitchener.ca

Re: Biehn Drive Extension Municipal Class Environmental Assessment Schedule C
Biehn Drive to future Robert Ferrie Drive, City of Kitchener

Dear Mr. Riek,

Grand River Conservation Authority (GRCA) staff have received a Notice of Study Commencement in regards to the above-noted Municipal Class Environmental Assessment (Class EA). The study area contains features of interest to the GRCA, including the Provincially Significant Strasburg Creek Wetland Complex, tributaries of the Grand River, floodplain, slope erosion hazard, and the associated allowances to these features. Please allow this correspondence to act as notice that we have an interest in the Class EA and wish to participate in the study review.

Please be further advised that a GRCA permit pursuant to Ontario Regulation 150/06 will be required for any of the proposed works that fall within the GRCA regulated areas. We recommend that you contact our office early in the study process to discuss permitting requirements.

If you have any questions or concerns, please do not hesitate to contact **Jenn Simons, Intermediate Planner, at 519-621-2763 ext. 2230** or jsimons@grandriver.ca.

Sincerely,

Melissa Larion, MCIP, RPP
Supervisor of Resource Planning
Grand River Conservation Authority

JS/ml

c.c. Steve Taylor, BT Engineering Inc.(via email)

Fw: Biehn Drive Extension Class Environmental Assessment Study | Notice

Steve Taylor (London) <stevenj.taylor@bteng.ca>

Mon 2021-04-12 8:28 AM

To: Julia Hoglund <julia.hoglund@bteng.ca>
Cc: Katherine Scott <katherine.scott@bteng.ca>

Save this in the select correspondence appendix.
Steve

Steve Taylor P.Eng., M.Eng., CVS-LIFE, P.E.
President
509 Talbot Street
London, Ontario
N6A 2S5
E-Mail: stevenj.taylor@bteng.ca
Phone: 519-672-2222
FAX: 1-613-280-1305
Toll Free: 1-855-228-4813
[www.bteng.ca]www.bteng.ca

From: Kevin Schimus <Kevin.Schimus@enbridge.com>
Sent: April 12, 2021 7:36 AM
To: Katherine Scott <katherine.scott@bteng.ca>
Cc: Steve Taylor (London) <stevenj.taylor@bteng.ca>; Eric Riek <Eric.Riek@kitchener.ca>; Gord Bell <gord.bell@bteng.ca>
Subject: RE: Biehn Drive Extension Class Environmental Assessment Study | Notice

Good morning Katherine,

Enbridge Gas Inc. does not have any existing or proposed infrastructure in this area. Please contact Kitchener Utilities Gas for gas information in this area. I can be removed from distribution list and future communications re: this project. Thanks.

Regards,

Kevin Schimus
Sr. Advisor, Construction and Project Management
Southeast Region Construction and Growth

Enbridge Gas Inc
Cell: 519-635-9488 | Kevin.Schimus@enbridge.com
603 Kumpf Drive, Waterloo, Ontario, N2V 1K3

enbridgegas.com
Safety. Integrity. Respect. Inclusion.

From: Katherine Scott <katherine.scott@bteng.ca>
Sent: Wednesday, March 31, 2021 8:55 AM
Cc: Steve Taylor (London) <stevenj.taylor@bteng.ca>; Eric Riek <Eric.Riek@kitchener.ca>; Gord Bell <gord.bell@bteng.ca>
Subject: [External] Biehn Drive Extension Class Environmental Assessment Study | Notice

EXTERNAL: PLEASE PROCEED WITH CAUTION.
This e-mail has originated from outside of the organization. Do not respond, click on links or open attachments unless you recognize the sender or know the content is safe.

Good morning,

The City of Kitchener has initiated a Class Environmental Assessment for the Biehn Drive Extension and Sanitary Trunk Sewer Extension. The attached Notice provides additional information on the Study and the availability of background materials.

Please let me know if you have any additional questions or concerns.

Thanks,

Katherine Scott

BT ENGINEERING

509 Talbot Street
London, Ontario N6A 2S5
katherine.scott@bteng.ca
(519) 672-2222

Katherine Scott

From:	MNRF Ayl Planners (MNRF) <MNRF.Ayl.Planners@ontario.ca>
Sent:	April 15, 2021 1:56 PM
To:	Steve Taylor (London); Eric Riek
Cc:	Gord Bell; Katherine Scott
Subject:	RE: Biehn Drive Extension Class Environmental Assessment Study | Notice
Attachments:	21-003 Kitchener Biehn Dr Commencement-Café Letters Laura W, MNRF QC.pdf; NHGuide_MNRF_2019-04-01.pdf

Ministry of Natural Resources and Forestry **Ministère des Richesses naturelles et des Forêts**

Ontario

April 15, 2021

Steve Taylor, P.Eng.
EA Project Manager
BT Engineering Inc.
509 Talbot Street
London, ON N6A 2S5
Tel: 519-672-2222
Email: stevenj.taylor@bteng.ca

Eric Riek, C.E.T.
City Project Manager
City of Kitchener
200 King Street West
Kitchener, ON N2G 4G7
Tel: 519-741-2200 ext. 7330
Email: eric.riek@kitchener.ca

Subject: Biehn Drive Extension Class Environmental Assessment Study | Notice

The Ministry of Natural Resources and Forestry (MNRF) received the attached notice for the proposed Biehn Drive Extension project. Thank you for circulating this information to our office, however, please note that we have not completed a screening of natural heritage or other resource values for the project at this time. Please also note that it is your responsibility to be aware of and comply with all relevant federal or provincial legislation, municipal by-laws or other agency approvals.

This response provides information to guide you in identifying and assessing natural features and resources as required by applicable policies and legislation, and engaging with the MNRF for advice as needed.

Natural Heritage & Endangered Species Act

In order to provide the most efficient service possible, the attached Natural Heritage Information Request Guide has been developed to assist you with accessing natural heritage data and values from convenient online sources.

It remains the proponent's responsibility to complete a preliminary screening for each project, to obtain available information from multiple sources, to conduct any necessary field studies, and to consider any potential environmental impacts that may result from an activity. We wish to emphasize the need for the proponents of development activities to complete screenings prior to contacting the Ministry or other agencies for more detailed technical information and advice.

The Ministry continues to work on updating data housed by Land Information Ontario and the Natural Heritage Information Centre, and ensuring this information is accessible through online resources. Species at risk data is regularly being updated. To ensure access to reliable and up to date information, please contact the Ministry of the Environment, Conservation and Parks at SAROntario@ontario.ca.

Petroleum Wells & Oil, Gas and Salt Resource Act

There may be petroleum wells within the proposed project area. Please consult the Ontario Oil, Gas and Salt Resources Library website (www.ogsrlibrary.com) for the best known data on any wells recorded by MNRF. Please reference the 'Definitions and Terminology Guide' listed in the publications on the Library website in order to better understand the well information available. Any oil and gas wells in your project area are regulated by the *Oil, Gas and Salt Resource Act*, and the supporting regulations and operating standards. If any unanticipated wells are encountered during development of the project, or if the proponent has questions regarding petroleum operations, the proponent should contact the Petroleum Operations Section at POSRecords@ontario.ca or 519-873-4634.

Public Lands Act & Lakes and Rivers Improvement Act

Some projects may be subject to the provisions of the *Public Lands Act* or the *Lakes and Rivers Improvement Act*. Please review the information on MNRF's web pages provided below regarding when an approval is required or not. Please note that many of the authorizations issued under the *Lakes and Rivers Improvement Act* are administered by the local Conservation Authority.

- For more information about the *Public Lands Act*: https://www.ontario.ca/page/crown-land-work-permits
- For more information about the *Lakes and Rivers Improvement Act*: https://www.ontario.ca/document/lakes-and-rivers-improvement-act-administrative-guide

The MNRF would appreciate the opportunity to review any draft reporting completed in support of this project when it becomes available.

If you have any questions or concerns, please feel free to contact me.

Sincerely,
Karina

Karina Černiavskaja, District Planner
Ministry of Natural Resources and Forestry
Email: MNRF.Ayl.Planners@ontario.ca

As part of providing accessible customer service, please let me know if you have any accommodation needs or require communication supports or alternate formats.

From: Katherine Scott <katherine.scott@bteng.ca>
Sent: March-31-21 8:48 AM
To: MNRF Ayl Planners (MNRF) <MNRF.Ayl.Planners@ontario.ca>
Cc: Steve Taylor (London) <stevenj.taylor@bteng.ca>; Gord Bell <gord.bell@bteng.ca>; Eric Riek <Eric.Riek@kitchener.ca>
Subject: Biehn Drive Extension Class Environmental Assessment Study | Notice

CAUTION -- EXTERNAL E-MAIL - Do not click links or open attachments unless you recognize the sender.

Good morning,

The City of Kitchener has initiated a Class Environmental Assessment for the Biehn Drive Extension and Sanitary Trunk Sewer Extension. The attached Notice provides additional information on the Study and the availability of background materials.

Please let me know if you have any additional questions or concerns.

Thanks,

Katherine Scott

BT ENGINEER

509 Talbot Street

London, Ontario N6A 2S5

katherine.scott@bteng.ca

(519) 672-2222

From: Ron <ronmckelvie85@gmail.com>
Sent: January 3, 2022 2:45 PM
To: Steve Taylor (London) <stevenj.taylor@bteng.ca>
Cc: eric.riek@kitchener.ca <eric.riek@kitchener.ca>
Subject: Biehn Drive Extension

Hello Steven and Eric,

We do not believe that the Biehn Extension is needed at this time. A more sensible approach is to allow the connection of Robert Ferrie Dr to Strasburg Rd. Once that has been done, then another study can be completed if necessary.

We need to protect wet lands and environmental protected areas as the city is expecting taxpayers to do. We are referring to the new "Natural Heritage Conservation" zoning that effects private property of landowners. We, as well as our neighbours, have been good stewards of our properties yet have seen the city approve development that has destroyed many acres of natural area.

We remember the sales pitch regarding LRT. This was to curb urban sprawl and development and here we are finding more ways to build more and more roads to accommodate vehicular traffic using polluting fossil fuels!

Gentleman, it's time to do the right thing for us and future generations.

Thankyou for your time.

Ron&Diane Mckelvie

Hydro One Networks Inc.
Facilities & Real Estate Services
P.O. Box 4300
Markham, ON L3R 5Z5
www.HydroOne.com

Courier:
185 Clegg Road
Markham, ON L6G 1B7

Technical Considerations for Hydro One Electrical Transmission Corridors

Your project may involve proposed works on Hydro One electrical transmission corridors or rights-of-way (ROW). Hydro One strives to work with proponents to review secondary land use proposals on the ROWs so that they are compatible with the safety and maintenance requirements of its high-voltage equipment. The Hydro One transmission network can consist of steel lattice towers, monopoles, twin wood poles, overhead conductors.

When preparing a proposal, there are a number of technical considerations that should be kept in mind. A number of these are outlined below. Please note that this is not intended to be a comprehensive list of requirements, but aims to serves as a guideline to prepare a proposal. Reviews for each proposal are conducted individually by Hydro One and may require several weeks or months to complete depending on the complexity of the proposal.

Technical Considerations:

Grading, Drainage and Stormwater Management

- Grading changes must not result in standing water anywhere along the corridor, and especially not within 15m radial zone of transmission structures.
- No fill material may be placed on the ROW without written approval from Hydro One.
- Catch basins that are not positioned within a paved roadway are not permitted.
- Stormwater management (SWM) ponds placed under 115 and 230 kV transmission lines cannot exceed two-thirds of the corridor width.
- SWM ponds under 500 kV transmission lines cannot exceed one-third of the corridor width.
- SWM ponds must be designed to withstand the effects of 100-year storm conditions.

Roads and Parking

- Roads crossing the ROW should be perpendicular to the hydro corridor.
- Roads off ROW should stay 15m clear of transmission structures.
- Curb cuts or access gates should be provided for Hydro One maintenance vehicles.
- Parking facilities on 115 kV and 230 kV ROWs should be restricted to passenger vehicles only. Large truck and trailer parking is generally not permitted.
- Parking facilities are generally not permitted under 500 kV ROWs.
- Transmission towers near roads and parking areas must be protected by standard highway barriers.

Vertical Clearances

- Transmission conductors (wires) are dynamic in nature. They can sag lower to the ground depending on parameters such as ambient temperature and operating conditions.
- Minimum vertical clearances must be maintained from the maximum design sag levels of the conductors (worst-case scenario). Hydro One will review these clearances as they are case-specific and not immediately apparent by observation alone.

Access to Structures

- An unhindered, minimum 6-metre wide access path to facilities on the corridor must be provided for maintenance vehicles.
- A 15-metre clear working radius around transmission structures is required in order to maintain access for vehicles carrying out routine maintenance.
- A 3-metre radius around each tower footing must be left unpaved for access to the footing.

Pipelines & Underground Facilities

- All underground facilities must be designed to withstand the loading conditions created by heavy maintenance vehicles that may be used by Hydro One.
- The ROW must be restored to pre-construction condition once the project is completed.
- Excavation using heavy machinery is prohibited within 10 metres of tower footings to protect foundations. Within 10 metres, excavation must be carried out by hand or by use of a VAC system.
- Pipelines on ROWs must adhere to the provisions of CSA Standard C22.3 No. 6.

Landscape Plantings

- Plantings which grow to a maturity height over 4 metres are not permitted on the ROW. Hydro One has a 'Compatible Species List' which can be provided. It must be noted that plantings should not be planted in such a way as to impede access to the transmission towers. An area of 15 metres around transmission towers should be kept clear of shrubs to permit Hydro One access to towers.

Other Requirements

- Buildings and permanent structures are not permitted on corridor lands.
- Flammable or hazardous materials may not be stored on ROWs.
- Consideration should be given to minimizing the use of conductive (metallic) material where alternatives exist (e.g. fences).
- The proponent is responsible for all costs of modifying, relocating, or monitoring Hydro One assets as a result of the proposal.
- Grounding studies, induction studies, spark discharge and / or step touch potential studies may be required to confirm that the proposal will not conflict with the Hydro One electrical infrastructure. The cost of these studies, our review of the completed studies, and any mitigation measures required as a result of these studies, will be will be borne by the Proponent.

Property Rights: Who is the landowner?

- Transmission corridor lands can be owned by private landowners, Municipalities, Province of Ontario (Infrastructure Ontario), railway companies, and First Nations and Métis communities.
- Hydro One Networks Inc. owns the transmission components/network.
- Hydro One Networks Inc. has rights either registered on land title or by legislation to operate the transmission network.

Property Rights: What Agreements do you require?

Contact Hydro One Real Estate Services at 1.888.231.6657 for the Real Estate Coordinator for your municipality. The Real Estate Coordinator arranges for Hydro One review of your proposal, advises of documentation and provides the Agreements.

Appendix D

Environmental Investigations

509 Talbot Street
London, ON N6A 2S5
519-672-2222

MEMORANDUM

TO:	File	DATE:	April 8, 2022
FROM:	Rudi Warmé, P.Eng., BTE	PROJECT #:	21-003
CC:	Steve Taylor, Stephen Brook, BTE		
PROJECT:	City of Kitchener Biehn Drive Extension Municipal Class Environmental Assessment		
SUBJECT:	Natural Environment Overview and Assessment		

1.0 BACKGROUND

Biehn Drive is a local road at present in a residential area of the City of Kitchener with its southern terminus currently located on the edge of a unit of the Strasburg Creek Provincially Significant Wetland (PSW) Complex. The Study Area is illustrated in **Figure 1**. The City proposes to extend Biehn Drive west and south through a portion of the PSW to connect with a pre-defined alignment of Robert Ferrie Drive. A Municipal Class Environmental Assessment (MCEA) has recently been completed for the project, which confirmed the need for the undertaking, identified alternative solutions, and selected a technically preferred alternative (TPA) for the corridor alignment.

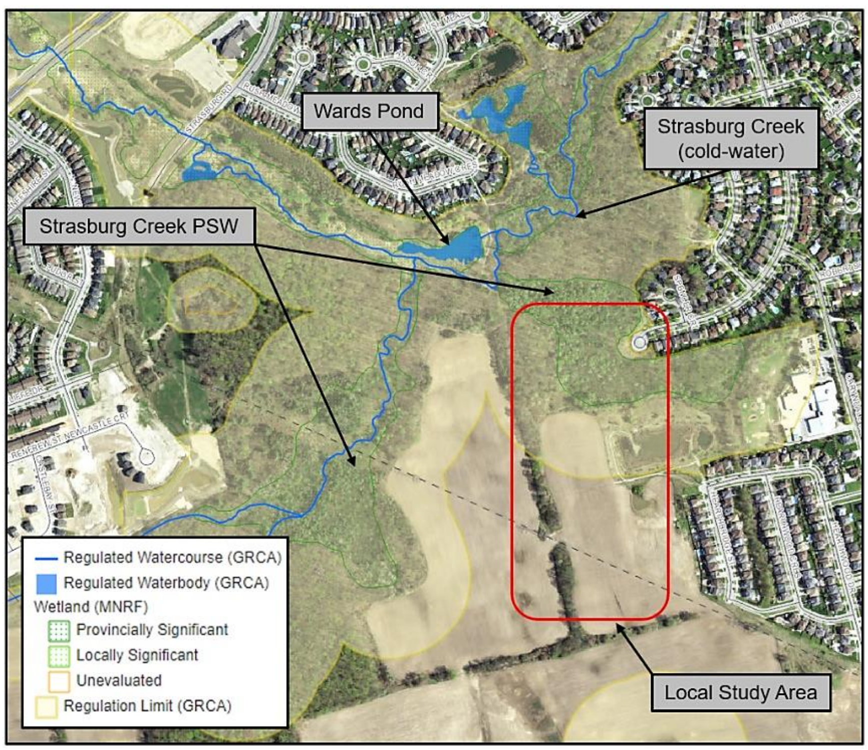


Figure 1: Study Area

A March 25, 2021, site visit was undertaken by BT Engineering Inc. (BTE) biologists to identify aquatic and terrestrial features of the natural environment within and adjacent to the roadway extension corridor to Robert Ferrie Drive. The site was inspected once more on August 26, 2021 with City of Kitchener, Grand River Conservation Authority (GRCA) and the landowners' representatives, including biologists from WSP Canada Group. The PSW boundaries were delineated and staked in the vicinity of the proposed road extension to accurately define the drip lines of the adjacent woodlot edges.

An additional visit was completed on February 18, 2022, with Six Nations of the Grand River (SNGR) representatives to walk the staked centreline alignment of the road corridor and discuss potential wetland offsetting suggestions. The alignment of a proposed multi use trail (MUT) through the PSW within the west right-of-way was also discussed.

2.0 DISCUSSION

The Strasburg Creek PSW unit at Biehn Drive appears as a wooded swamp, with mature hardwoods dominant. The PSW, surrounding woodlands and farmlands are privately owned and slated for residential development in the future. Black Ash (*Fraxinus nigra*), Barn Swallow (*Hirunda rustica*) and Eastern Wood Pewee (*Satophaga ruticilla*) were identified in recent biological surveys of surrounding areas by the landowners' representatives. A BTE desktop background information review did not identify the presence of any other terrestrial or aquatic species at risk (SAR); however, the site reviews did identify suitable habitat conditions for bats within the swamp (roosting trees throughout) and for a variety of SAR listed songbirds including Eastern Meadowlark (*Sturnella magna*) and Bobolink (*Dolichonyx oryzivorus*) on the lands currently under cultivation to the south.

A concrete headwall with twin 1.2 m culvert inlets in the wetland boundary at the south end of the roadway directs wetland drainage and local storm sewer flows from Biehn Drive to an outlet pipe 25 m north of the road, where it becomes a permanently flowing tributary connecting with Strasburg Creek. The floor of the wetland in the immediate vicinity of the culvert entrance was wet with scattered ephemeral pools extending south. Several seasonal channels could be made out within the wetland approaching the culverts from the southwest and southeast. It appears unlikely that fish habitat extends into the PSW, although the culvert approaches were lined with small diameter river stone following the culvert installation.

No permanent open bodies of water are in the vicinity that would indicate possible year round turtle presence in the area. Their occurrence in this PSW unit would probably be only transitory due to the closed canopy and lack of basking areas. Other reptiles and amphibians (frogs, salamanders, snakes, etc.) would, however, be expected to be common. Yellow Birch (*Betula alleghaniensis*), now an uncommon tree species in many parts of southern Ontario, is well represented in the wetland and surrounding woodlands, as are Eastern Hemlock (*Tsuga canadensis*), Black Ash (Threatened) and White Pine (*Pinus strobus*), all of which include large specimens. A grouping of mature Aspen Poplars (*Populus spp*) occurs at the south boundary of the woodlot where the roadway extension will exit the PSW.

The land elevation rises immediately south of the wetland boundary where it abuts to the east the Hearthwood Park stormwater pond and a well-used multi use trail. Informal, connecting pathways presently wind through the wetland and adjacent wooded areas linking neighborhoods.

The TPA centreline and ROW limits have now been staked through the PSW and continue southwest over the gently rolling terrain of cultivated fields and across the hydro corridor before connecting to the future Robert Ferrie Drive.

3.0 IMPACTS, MITIGATION AND WETLAND OFFSETTING OPPORTUNITIES

The cleared ROW width of the Biehn Drive extension will be limited to approximately 10 m through the PSW section to minimize tree removal and wetland impacts beyond the roadway. A semi urban roadway (mountable curbs/gutters, no storm sewer) is recommended for the approximate 160 m length through the PSW to maintain the natural setting (see **Figure 2**). Sidewalks will not extend through the PSW section. Rather, a proposed multi use trail will meander through the PSW avoiding specimen trees and connect at each end with paved pathway/sidewalk. The roadway surface will be slightly elevated above the surrounding wetland to permit placement of cross culverts to minimize surface drainage interference. Use of porous pavement through the PSW should be further explored. A suitably designed wildlife passage beneath the roadway will also be accommodated.

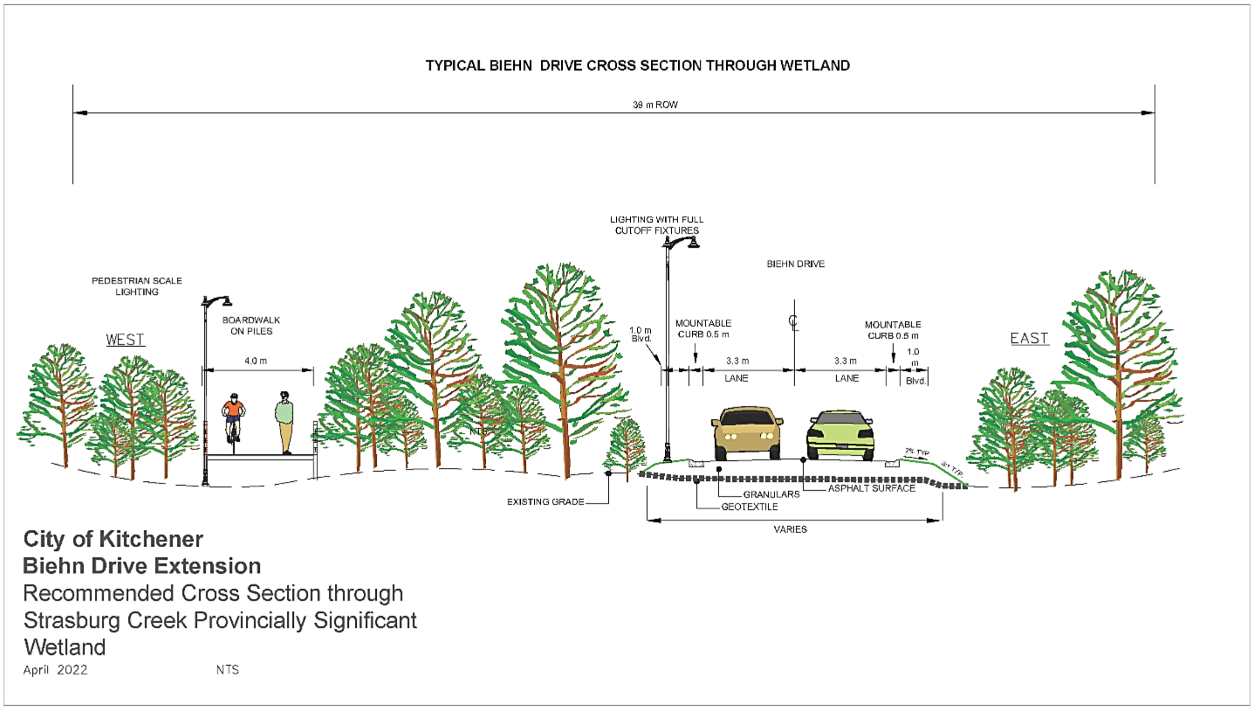


Figure 2: Typical Recommended Roadway Section

The road extension will be constructed to “float” on a geomembrane system placed over the wetland surface. The actual road alignment may be adjusted closer to the east ROW to maximize undisturbed woodlot width to the west and accommodate the MUT. The recommended, municipally owned ROW width will be 39 m through the PSW and beyond to Robert Ferrie Drive.

Although it appears the selected roadway extension alignment will miss much of the significant vegetation within the PSW, there will inevitably some removal of mature trees, disturbances to surface drainage, and loss of habitat features for resident fauna within the identified corridor. In addition to the new Biehn Drive extension, the work will also include installation of a sanitary sewer. Care will be required during its installation to avoid contamination impacts and impacts to the identified regional aquifer. A trenchless installation methodology is recommended.

SNGR suggestions from their site walk include investigations into alternatives to the use of asphalt or stone dust for construction of the MUT (an elevated boardwalk has been illustrated), considerations that the proposed wildlife crossing be sized to accommodate up to medium sized mammals, a preferred 10:1 tree replacement, and 1:1 wetland replacement on-site or 2:1 wetland replacement off-site.

There may be some opportunity to provide offsetting for wetland area and tree losses by re-using salvaged wetland soils/vegetation for re-naturalization in areas adjacent to the extension that will become undevelopable as a result of the works. Three potential locations have been initially identified:

the remnant Biehn Drive cul-de-sac; the isolated lands between PSW and Hearthwood stormwater pond and the current PSW boundary; and, tree plantings in suitable wetland setback buffer areas between the new housing and the PSW.

4.0 CONCLUSIONS

The Biehn Drive roadway extension will result in limited impacts to the PSW following the application of the recommended mitigation and offsetting measures, which will be further developed during detail design stage.

Attachments: A – Site Photographs

Attachment A - Site Photographs

Twin 1.2 m culverts (above) with a river stone entrance apron at the headwall (below) cross under the Biehn Drive cul-de-sac and connect to a permanent Strasburg Creek tributary to the north

A concrete headwall and twin culverts at the PSW drainage outlet can just be seen in the shade in the centre background (above). The Strasburg Creek tributary channel extends north and west (below) meandering through the woodland to eventually connect with the main creek

The floor of the wetland in the immediate vicinity of the culvert entrance was wet, with scattered ephemeral pools in the surrounding area

Several channels could be made out within the wetland approaching the culverts from the southwest (above) and southeast (below)

Bat roosting trees were noted throughout the PSW (above). Yellow Birch, an uncommon species, is well represented (below)

Eastern Hemlock (above, with young tree below) and White Pine are also represented in the PSW, including several large specimens

The land elevation quickly rises (below) as one moves south across the wetland boundary. The Hearthwood Park stormwater pond (below) and well used public trail are immediately south of the PSW

Pedestrian trails (above) and informal connecting pathways through the wetland and woodlot areas (below) link neighborhoods

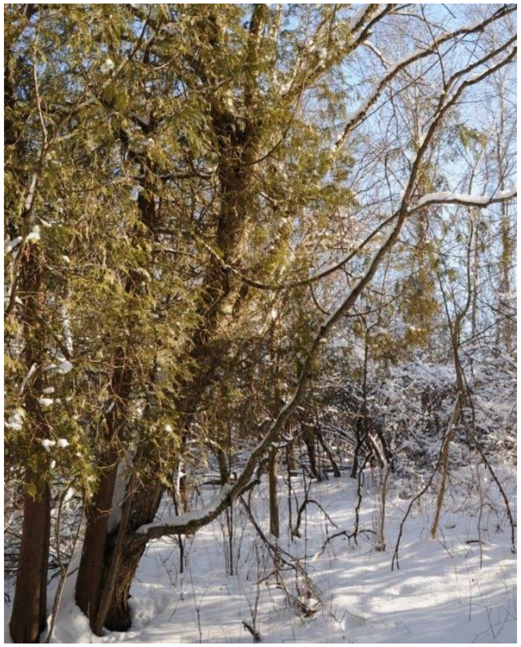
Numerous mature trees are scattered through the PSW (above), including a grouping of large aspens beginning to leaf out at the approximate location where the road extension will exit the wetland. Note the trail along the edge of the woods (below)

View southwest across the corn fields towards the Robert Ferrie Drive roundabout location beyond along the proposed extension alignment

View north along the newly constructed, closed section of Strasburg Road (above). View northeast along the Robert Ferrie Drive alignment towards the Biehn Drive extension connection (below)

Stakes identify the roadway ROW limits (red, above) and centreline alignment (yellow, below) through the PSW at the Biehn Drive cul-de-sac

Staked alignment in the central portion of the PSW. A large Yellow Birch appears to be one of the few mature trees which will be lost (below)



Roadway extension alignment as it exits the PSW south boundary (above). Alignment stakes and borehole/monitoring well locations extend south across the fields towards the Robert Ferrie Drive alignment (below)

Appendix E

Cultural Heritage

Ontario

Ministry of Tourism, Culture and Sport

Programs & Services Branch
401 Bay Street, Suite 1700
Toronto ON M7A 0A7

Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes

A Checklist for the Non-Specialist

The **purpose of the checklist** is to determine:

- if a property(ies) or project area:
    - is a recognized heritage property
    - may be of cultural heritage value
- it includes all areas that may be impacted by project activities, including – but not limited to:
    - the main project area
    - temporary storage
    - staging and working areas
    - temporary roads and detours

Processes covered under this checklist, such as:

- *Planning Act*
- *Environmental Assessment Act*
- *Aggregates Resources Act*
- *Ontario Heritage Act* – Standards and Guidelines for Conservation of Provincial Heritage Properties

Cultural Heritage Evaluation Report (CHER)

If you are not sure how to answer one or more of the questions on the checklist, you may want to hire a qualified person(s) (see page 5 for definitions) to undertake a cultural heritage evaluation report (CHER).

The CHER will help you:

- identify, evaluate and protect cultural heritage resources on your property or project area
- reduce potential delays and risks to a project

Other checklists

Please use a separate checklist for your project, if:

- you are seeking a Renewable Energy Approval under Ontario Regulation 359/09 – separate checklist
- your Parent Class EA document has an approved screening criteria (as referenced in Question 1)

Please refer to the Instructions pages for more detailed information and when completing this form.

Project or Property Name
Biehn Drive Extension and Sanitary Trunk Inc.

Project or Property Location (upper and lower or single tier municipality)
City of Kitchener, Regional Municipality of Waterloo

Proponent Name
BT Engineering

Proponent Contact Information
Katherine Scott, katherine.scott@bteng.ca

Screening Questions

	Yes	No
1. Is there a pre-approved screening checklist, methodology or process in place?	☐	☑

If Yes, please follow the pre-approved screening checklist, methodology or process.

If No, continue to Question 2.

Part A: Screening for known (or recognized) Cultural Heritage Value

	Yes	No
2. Has the property (or project area) been evaluated before and found **not** to be of cultural heritage value?	☐	☑

If Yes, do **not** complete the rest of the checklist.

The proponent, property owner and/or approval authority will:

- summarize the previous evaluation and
- add this checklist to the project file, with the appropriate documents that demonstrate a cultural heritage evaluation was undertaken

The summary and appropriate documentation may be:

- submitted as part of a report requirement
- maintained by the property owner, proponent or approval authority

If No, continue to Question 3.

	Yes	No
3. Is the property (or project area):		
a. identified, designated or otherwise protected under the *Ontario Heritage Act* as being of cultural heritage value?	☐	☑
b. a National Historic Site (or part of)?	☐	☑
c. designated under the *Heritage Railway Stations Protection Act*?	☐	☑
d. designated under the *Heritage Lighthouse Protection Act*?	☐	☑
e. identified as a Federal Heritage Building by the Federal Heritage Buildings Review Office (FHBRO)?	☐	☑
f. located within a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site?	☐	☑

If Yes to any of the above questions, you need to hire a qualified person(s) to undertake:

- a Cultural Heritage Evaluation Report, if a Statement of Cultural Heritage Value has not previously been prepared or the statement needs to be updated

If a Statement of Cultural Heritage Value has been prepared previously and if alterations or development are proposed, you need to hire a qualified person(s) to undertake:

- a Heritage Impact Assessment (HIA) – the report will assess and avoid, eliminate or mitigate impacts

If No, continue to Question 4.

Part B: Screening for Potential Cultural Heritage Value

		Yes	No
4. Does the property (or project area) contain a parcel of land that:			
a.	is the subject of a municipal, provincial or federal commemorative or interpretive plaque?	☐	☑
b.	has or is adjacent to a known burial site and/or cemetery?	☐	☑
c.	is in a Canadian Heritage River watershed?	☐	☑
d.	contains buildings or structures that are 40 or more years old?	☐	☑

Part C: Other Considerations

		Yes	No
5. Is there local or Aboriginal knowledge or accessible documentation suggesting that the property (or project area):			
a.	is considered a landmark in the local community or contains any structures or sites that are important in defining the character of the area?	☐	☑
b.	has a special association with a community, person or historical event?	☐	☑
c.	contains or is part of a cultural heritage landscape?	☐	☑

If Yes to one or more of the above questions (Part B and C), there is potential for cultural heritage resources on the property or within the project area.

You need to hire a qualified person(s) to undertake:

- a Cultural Heritage Evaluation Report (CHER)

If the property is determined to be of cultural heritage value and alterations or development is proposed, you need to hire a qualified person(s) to undertake:

- a Heritage Impact Assessment (HIA) – the report will assess and avoid, eliminate or mitigate impacts

If No to all of the above questions, there is low potential for built heritage or cultural heritage landscape on the property.

The proponent, property owner and/or approval authority will:

- summarize the conclusion
- add this checklist with the appropriate documentation to the project file

The summary and appropriate documentation may be:

- submitted as part of a report requirement e.g. under the *Environmental Assessment Act, Planning Act* processes
- maintained by the property owner, proponent or approval authority

Instructions

Please have the following available, when requesting information related to the screening questions below:

- a clear map showing the location and boundary of the property or project area
  - large scale and small scale showing nearby township names for context purposes
- the municipal addresses of all properties within the project area
- the lot(s), concession(s), and parcel number(s) of all properties within a project area

For more information, see the Ministry of Tourism, Culture and Sport's Ontario Heritage Toolkit or Standards and Guidelines for Conservation of Provincial Heritage Properties.

In this context, the following definitions apply:

- **qualified person(s)** means individuals – professional engineers, architects, archaeologists, etc. – having relevant, recent experience in the conservation of cultural heritage resources.
- **proponent** means a person, agency, group or organization that carries out or proposes to carry out an undertaking or is the owner or person having charge, management or control of an undertaking.

1. Is there a pre-approved screening checklist, methodology or process in place?

An existing checklist, methodology or process may already be in place for identifying potential cultural heritage resources, including:

- one endorsed by a municipality
- an environmental assessment process e.g. screening checklist for municipal bridges
- one that is approved by the Ministry of Tourism, Culture and Sport (MTCS) under the Ontario government's Standards & Guidelines for Conservation of Provincial Heritage Properties [s.B.2.]

Part A: Screening for known (or recognized) Cultural Heritage Value

2. Has the property (or project area) been evaluated before and found not to be of cultural heritage value?

Respond 'yes' to this question, if all of the following are true:

A property can be considered not to be of cultural heritage value if:

- a Cultural Heritage Evaluation Report (CHER) - or equivalent - has been prepared for the property with the advice of a qualified person and it has been determined not to be of cultural heritage value and/or
- the municipal heritage committee has evaluated the property for its cultural heritage value or interest and determined that the property is not of cultural heritage value or interest

A property may need to be re-evaluated, if:

- there is evidence that its heritage attributes may have changed
- new information is available
- the existing Statement of Cultural Heritage Value does not provide the information necessary to manage the property
- the evaluation took place after 2005 and did not use the criteria in Regulations 9/06 and 10/06

Note: Ontario government ministries and public bodies [prescribed under Regulation 157/10] may continue to use their existing evaluation processes, until the evaluation process required under section B.2 of the Standards & Guidelines for Conservation of Provincial Heritage Properties has been developed and approved by MTCS.

To determine if your property or project area has been evaluated, contact:

- the approval authority
- the proponent
- the Ministry of Tourism, Culture and Sport

3a. Is the property (or project area) identified, designated or otherwise protected under the *Ontario Heritage Act* as being of cultural heritage value e.g.:

i. designated under the *Ontario Heritage Act*

- individual designation (Part IV)
- part of a heritage conservation district (Part V)

Individual Designation – Part IV

A property that is designated:

- by a municipal by-law as being of cultural heritage value or interest [s.29 of the *Ontario Heritage Act*]
- by order of the Minister of Tourism, Culture and Sport as being of cultural heritage value or interest of provincial significance [s.34.5]. **Note**: To date, no properties have been designated by the Minister.

Heritage Conservation District – Part V

A property or project area that is located within an area designated by a municipal by-law as a heritage conservation district [s. 41 of the *Ontario Heritage Act*].

For more information on Parts IV and V, contact:

- municipal clerk
- Ontario Heritage Trust
- local land registry office (for a title search)

---

ii. subject of an agreement, covenant or easement entered into under Parts II or IV of the *Ontario Heritage Act*

An agreement, covenant or easement is usually between the owner of a property and a conservation body or level of government. It is usually registered on title.

The primary purpose of the agreement is to:

- preserve, conserve, and maintain a cultural heritage resource
- prevent its destruction, demolition or loss

For more information, contact:

- Ontario Heritage Trust - for an agreement, covenant or easement [clause 10 (1) (c) of the *Ontario Heritage Act*]
- municipal clerk – for a property that is the subject of an easement or a covenant [s.37 of the *Ontario Heritage Act*]
- local land registry office (for a title search)

---

iii. listed on a register of heritage properties maintained by the municipality

Municipal registers are the official lists - or record - of cultural heritage properties identified as being important to the community.

Registers include:

- all properties that are designated under the *Ontario Heritage Act* (Part IV or V)
- properties that have not been formally designated, but have been identified as having cultural heritage value or interest to the community

For more information, contact:

- municipal clerk
- municipal heritage planning staff
- municipal heritage committee

---

iv. subject to a notice of:

- intention to designate (under Part IV of the *Ontario Heritage Act*)
- a Heritage Conservation District study area bylaw (under Part V of the *Ontario Heritage Act*)

A property that is subject to a **notice of intention to designate** as a property of cultural heritage value or interest and the notice is in accordance with:

- section 29 of the *Ontario Heritage Act*
- section 34.6 of the *Ontario Heritage Act.* **Note**: To date, the only applicable property is Meldrum Bay Inn, Manitoulin Island. [s.34.6]

An area designated by a municipal by-law made under section 40.1 of the *Ontario Heritage Act* as a **heritage conservation district study area**.

For more information, contact:

- municipal clerk – for a property that is the subject of notice of intention [s. 29 and s. 40.1]
- Ontario Heritage Trust

---

v. included in the Ministry of Tourism, Culture and Sport's list of provincial heritage properties

Provincial heritage properties are properties the Government of Ontario owns or controls that have cultural heritage value or interest.

The Ministry of Tourism, Culture and Sport (MTCS) maintains a list of all provincial heritage properties based on information provided by ministries and prescribed public bodies. As they are identified, MTCS adds properties to the list of provincial heritage properties.

For more information, contact the MTCS Registrar at registrar@ontario.ca.

3b. Is the property (or project area) a National Historic Site (or part of)?

National Historic Sites are properties or districts of national historic significance that are designated by the Federal Minister of the Environment, under the *Canada National Parks Act*, based on the advice of the Historic Sites and Monuments Board of Canada.

For more information, see the National Historic Sites website.

3c. Is the property (or project area) designated under the *Heritage Railway Stations Protection Act*?

The *Heritage Railway Stations Protection Act* protects heritage railway stations that are owned by a railway company under federal jurisdiction. Designated railway stations that pass from federal ownership may continue to have cultural heritage value.

For more information, see the Directory of Designated Heritage Railway Stations.

3d. Is the property (or project area) designated under the *Heritage Lighthouse Protection Act*?

The *Heritage Lighthouse Protection Act* helps preserve historically significant Canadian lighthouses. The Act sets up a public nomination process and includes heritage building conservation standards for lighthouses which are officially designated.

For more information, see the Heritage Lighthouses of Canada website.

3e. Is the property (or project area) identified as a Federal Heritage Building by the Federal Heritage Buildings Review Office?

The role of the Federal Heritage Buildings Review Office (FHBRO) is to help the federal government protect the heritage buildings it owns. The policy applies to all federal government departments that administer real property, but not to federal Crown Corporations.

For more information, contact the Federal Heritage Buildings Review Office.

See a directory of all federal heritage designations.

3f. Is the property (or project area) located within a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site?

A UNESCO World Heritage Site is a place listed by UNESCO as having outstanding universal value to humanity under the Convention Concerning the Protection of the World Cultural and Natural Heritage. In order to retain the status of a World Heritage Site, each site must maintain its character defining features.

Currently, the Rideau Canal is the only World Heritage Site in Ontario.

For more information, see Parks Canada – World Heritage Site website.

Part B: Screening for potential Cultural Heritage Value

4a. Does the property (or project area) contain a parcel of land that has a municipal, provincial or federal commemorative or interpretive plaque?

Heritage resources are often recognized with formal plaques or markers.

Plaques are prepared by:

- municipalities
- provincial ministries or agencies
- federal ministries or agencies
- local non-government or non-profit organizations

For more information, contact:

- municipal heritage committees or local heritage organizations – for information on the location of plaques in their community
- Ontario Historical Society's Heritage directory – for a list of historical societies and heritage organizations
- Ontario Heritage Trust – for a list of plaques commemorating Ontario's history
- Historic Sites and Monuments Board of Canada – for a list of plaques commemorating Canada's history

4b. Does the property (or project area) contain a parcel of land that has or is adjacent to a known burial site and/or cemetery?

For more information on known cemeteries and/or burial sites, see:

- Cemeteries Regulations, Ontario Ministry of Consumer Services – for a database of registered cemeteries
- Ontario Genealogical Society (OGS) – to locate records of Ontario cemeteries, both currently and no longer in existence; cairns, family plots and burial registers
- Canadian County Atlas Digital Project – to locate early cemeteries

In this context, adjacent means contiguous or as otherwise defined in a municipal official plan.

4c. Does the property (or project area) contain a parcel of land that is in a Canadian Heritage River watershed?

The Canadian Heritage River System is a national river conservation program that promotes, protects and enhances the best examples of Canada's river heritage.

Canadian Heritage Rivers must have, and maintain, outstanding natural, cultural and/or recreational values, and a high level of public support.

For more information, contact the Canadian Heritage River System.

If you have questions regarding the boundaries of a watershed, please contact:

- your conservation authority
- municipal staff

4d. Does the property (or project area) contain a parcel of land that contains buildings or structures that are 40 or more years old?

A 40 year 'rule of thumb' is typically used to indicate the potential of a site to be of cultural heritage value. The approximate age of buildings and/or structures may be estimated based on:

- history of the development of the area
- fire insurance maps
- architectural style
- building methods

Property owners may have information on the age of any buildings or structures on their property. The municipality, local land registry office or library may also have background information on the property.

Note: 40+ year old buildings or structure do not necessarily hold cultural heritage value or interest; their age simply indicates a higher potential.

A building or structure can include:

- residential structure
- farm building or outbuilding
- industrial, commercial, or institutional building
- remnant or ruin
- engineering work such as a bridge, canal, dams, etc.

For more information on researching the age of buildings or properties, see the Ontario Heritage Tool Kit Guide Heritage Property Evaluation.

Part C: Other Considerations

5a. Is there local or Aboriginal knowledge or accessible documentation suggesting that the property (or project area) is considered a landmark in the local community or contains any structures or sites that are important to defining the character of the area?

Local or Aboriginal knowledge may reveal that the project location is situated on a parcel of land that has potential landmarks or defining structures and sites, for instance:

- buildings or landscape features accessible to the public or readily noticeable and widely known
- complexes of buildings
- monuments
- ruins

5b. Is there local or Aboriginal knowledge or accessible documentation suggesting that the property (or project area) has a special association with a community, person or historical event?

Local or Aboriginal knowledge may reveal that the project location is situated on a parcel of land that has a special association with a community, person or event of historic interest, for instance:

- Aboriginal sacred site
- traditional-use area
- battlefield
- birthplace of an individual of importance to the community

5c. Is there local or Aboriginal knowledge or accessible documentation suggesting that the property (or project area) contains or is part of a cultural heritage landscape?

Landscapes (which may include a combination of archaeological resources, built heritage resources and landscape elements) may be of cultural heritage value or interest to a community.

For example, an Aboriginal trail, historic road or rail corridor may have been established as a key transportation or trade route and may have been important to the early settlement of an area. Parks, designed gardens or unique landforms such as waterfalls, rock faces, caverns, or mounds are areas that may have connections to a particular event, group or belief.

For more information on Questions 5.a., 5.b. and 5.c., contact:

- Elders in Aboriginal Communities or community researchers who may have information on potential cultural heritage resources. Please note that Aboriginal traditional knowledge may be considered sensitive.
- municipal heritage committees or local heritage organizations
- Ontario Historical Society's "Heritage Directory" - for a list of historical societies and heritage organizations in the province

An internet search may find helpful resources, including:

- historical maps
- historical walking tours
- municipal heritage management plans
- cultural heritage landscape studies
- municipal cultural plans

Information specific to trails may be obtained through Ontario Trails.

1.0 SCREENING FOR KNOWN CULTURAL HERITAGE VALUE

Has the property (or project area) been evaluated before and found not to be of cultural heritage value?

No; the Subject Property has never been previously evaluated and found not to be of cultural heritage value.

Is the property (or project area):

a. identified, designated or otherwise protected under the *Ontario Heritage Act* as being of cultural heritage value?

No; the Subject Property has not been designated under the *Ontario Heritage Act* (OHA). There are no Ontario Heritage Trust conservation easements on or adjacent to the Subject Property.[1] The Subject Property is not included on the City of Kitchener Heritage Inventory.[2] It is not subject to a notice of intention to designate under Part IV of the OHA, or notice of a Heritage Conservation District study area bylaw under Part V of the OHA. There are no provincial heritage properties located on the Subject Property.

b. a National Historic Site (or part of)?

No; the Subject Property has not been identified as a National Historic Site. There are three National Historic Sites in Kitchener; they are not located on the Subject Property.[3]

c. designated under the Heritage Railway Stations Protection Act?

No; the Subject Property has not designated under the Heritage Railway Stations Protection Act. There is one Historic Railway Station in Kitchener (126 Weber Street); it is not located on the Subject Property.[4]

d. designated under the Heritage Lighthouse Protection Act?

No; the Subject Property has not been designated under the Heritage Lighthouse Protection Act. There are no Heritage Lighthouses located in Kitchener.[5]

---

[1] OHT n.d.: Ontario Heritage Act Register
[2] City of Kitchener n.d.
[3] Parks Canada n.d.
[4] Parks Canada n.d.
[5] Parks Canada n.d.

e. identified as a Federal Heritage Building by the Federal Heritage Buildings Review Office (FHBRO)?

No; the Subject Property has not been identified as a Federal Heritage Building. There are four Federal Heritage Buildings in Kitchener (15 Duke Street, 528 Wellington Street North, 437 Tower Road, and 166 Frederick Street); it is not located on the Subject Property.[6]

f. located within a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site?

No; the Subject Property is not located within a UNESCO World Heritage site. There are no UNESCO World Heritage sites located in Kitchener.[7]

---

[6] Parks Canada n.d.
[7] UNESCO n.d.

2.0 SCREENING FOR POTENTIAL CULTURAL HERITAGE VALUE

Does the property (or project area) contain a parcel of land that:

a. is the subject of a municipal, provincial or federal commemorative or interpretive plaque?

No; the Subject Property is not the subject of a municipal, provincial, or federal commemorative or interpretive plaque. Of the 8 federal plaques in Kitchener, none is located on the subject property.[8] Of the provincial plaques in Kitchener, none is located on the subject property.[9] There are currently no municipal plaques located on the subject property.

b. has or is adjacent to a known burial site and/or cemetery?

No; the Subject Property does not contain, nor is it adjacent to, a known burial site and/or cemetery.[10]

c. is in a Canadian Heritage River watershed?

No; The Subject Property contains a portion of Strasburg Creek, until its confluence with a downstream with Schneider Creek. Schneider Creek, in turn, is a tributary of the Grand River, which was designated as a Canadian Heritage River in 1994.[11] The designation refers to "the 290 km-long Grand River and its major tributaries, the Nith, Conestogo, Speed and Eramosa." As Strasburg Creek is tributary of Schneider Creek which is not included in the designation as a major tributary, the Subject Property does not meet this criterion.

d. contains buildings or structures that are 40 or more years old?

No; there are no buildings or structures located on the Subject Property. Structures were present until the 1950s associated with the road allowance that transects the study area from north to south. These structures are no longer present.

---

[8] Parks Canada n.d.
[9] OHT n.d.: Plaque Database
[10] BAO n.d.; CanadaGenWeb n.d.
[11] Canadian Heritage Rivers System 2017; Grand River Conservation Authority n.d.

3.0 OTHER CONSIDERATIONS

Is there local or Aboriginal knowledge or accessible documentation suggesting that the property (or project area):

a. is considered a landmark in the local community or contains any structures or sites that are important in defining the character of the area?

No; the Subject Property is not considered a landmark.

b. has a special association with a community, person or historical event?

No; it is not known or suggested that the Subject Property meets this criterion.

c. contains or is part of a cultural heritage landscape?

No; the Subject Property does not contain, nor is it part of, a cultural heritage landscape as identified by the City of Kitchener.[12]

[12] City of Kitchener 2014

4.0 RECOMMENDATION

Based on the assessment of the Subject Property against the MTCS Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes, the Subject Property was not found to meet the screening criteria for either known or potential heritage value. No further heritage studies are recommended.

5.0 BIBLIOGRAPHY

Bereavement Authority of Ontario (BAO)

n.d. Public Register. Available online: https://licensees.bereavementauthorityontario.ca/public-register. Accessed April 28, 2021.

CanadaGenWeb

n.d. Cemetery Map Project. Available online: http://cemetery.canadagenweb.org/map/. Accessed April 28, 2021.

Canadian Heritage Rivers System

2017 Grand River: Designation. Available online: http://chrs.ca/the-rivers/grand/designation/. Accessed April 28, 2021.

City of Kitchener

n.d. Municipal Heritage Register. Available online: https://www.kitchener.ca/en/development-and-construction/heritage-properties-and-districts.aspx. Accessed April 28, 2021.

2014 Cultural Heritage Landscapes. Available online: https://www.kitchener.ca/en/resourcesGeneral/Documents/DSD_PLAN_CHL_Study_Report.pdf. Accessed April 28, 2021.

Grand River Conservation Authority

n.d. Heritage River Designation. https://www.grandriver.ca/en/our-watershed/ Heritage-River-Designation.aspx

Ontario Heritage Trust (OHT)

n.d. Ontario Heritage Act Register: Advanced Search. Available online: https://www.heritagetrust.on.ca/en/oha/advanced-search. Accessed April 28, 2021.

Ontario Heritage Trust (OHT)

n.d. Plaque Database. https://www.heritagetrust.on.ca/en/index.php/online-plaque-guide

Parks Canada

n.d. Directory of Federal Heritage Designations. Available online: https://www.pc.gc.ca/apps/dfhd/search-recherche_eng.aspx. Accessed April 28, 2021.

UNESCO

n.d. Canada: Properties Inscribed on the World Heritage List. Available online: https://whc.unesco.org/ en/statesparties/ca. Accessed April 28, 2021.

Appendix F

Noise Report

KITCHENER

Noise Assessment Report
Biehn Drive Municipal Class Environmental Assessment

March 2022

Submitted by:
BT Engineering Inc.
509 Talbot Street
London, ON N6A 2S5

BT ENGINEERING
BTE

TABLE OF CONTENTS

List of Figures

List of Tables

List of Appendices

1.0 INTRODUCTION

The City of Kitchener (City) is conducting a Class Environmental Assessment (EA) Study to develop a transportation plan for the extension of Biehn Drive westerly to the Robert Ferrie Drive extension. The purpose of this report is to review the noise impacts from vehicular sources on existing noise sensitive land uses for the proposed Biehn Drive Extension. The Study Area is shown on **Figure 1**.

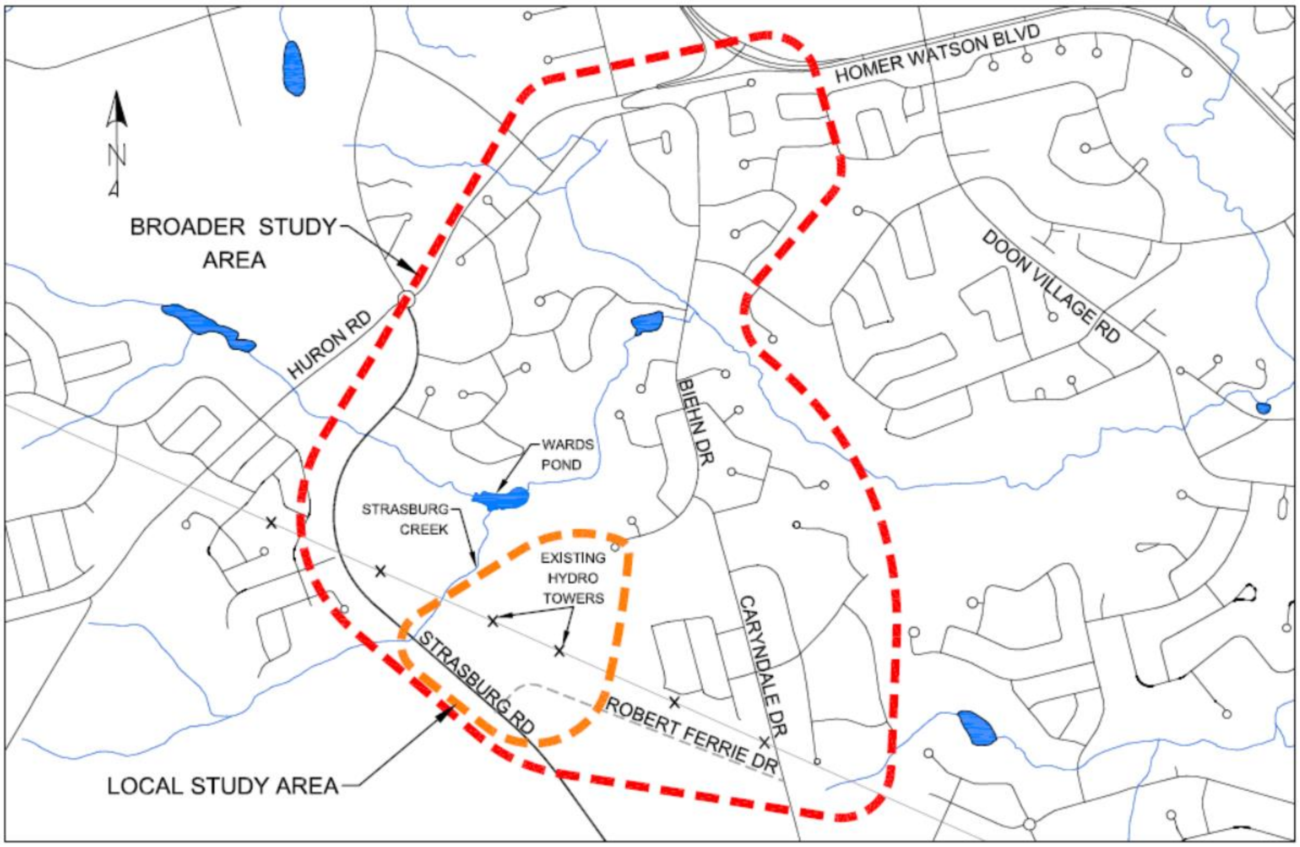


Figure 1: Site Location

Since the mid-2000's, the road network and municipal servicing for the Doon South and Brigadoon areas in the City of Kitchener have planned for area development and evolving transportation needs. Several planning documents including the Official Plan and Transportation Master Plan (TMP) have identified the need to extend Biehn Drive westerly to the Robert Ferrie Drive extension and ultimately to Strasburg Road. The Biehn Drive Extension would be a major collector road, as identified in Schedule B of the City of Kitchener's Official Plan Amendment. This link would accommodate vehicles to and from the Brigadoon community and would help mitigate cut-through traffic on local streets within the community. It would function as a collector street, which collects traffic from local streets within the community and provides connectivity to high tier arterial streets including Strasburg Road.

2.0 METHODOLOGY

This evaluation was conducted within the Study Area to determine the impact to adjacent residential dwelling units as well as what (if any) mitigation measures should be incorporated in the final design, as a component of the EA process.

The noise assessment utilized the STAMSON 5.04 noise software program to determine 16-hour daytime and 8-hour nighttime equivalent sound levels (Leq) for the roadway traffic. The assessment was performed in accordance with the Ministry of the Environment, Conservation and Park's (MECP's) Noise Assessment Criteria (NPC-300) and MTO's Environmental Guide for Noise. The noise assessment was completed using three representative receiver sites, as shown in **Figure 2**. The receiver sites were located in an Outdoor Living Area (OLA) in the backyard during the day and the plane of the window of a bedroom for nighttime assessments.

Figure 2: Representative Receiver Sites

A mitigation assessment is carried out for any receiver sites where the proposed roadworks will result in a noise level increase of greater than 5 dBA 10 years after construction (2040), or above 65 dBA. This assesses mitigation (noise control) measures within the right-of-way for noise sensitive receivers.

3.0 TRAFFIC INPUT DATA

Traffic volumes were provided by the City of Kitchener, see **Appendix A**. The traffic counts were completed in 2018/2019. Biehn Drive and Caryndale are collector roads and are not truck routes, therefore only local deliveries will travel on the roads. Heavy truck volumes are assumed to be 0% and medium truck volumes are assumed to be 3%. An 80/20 daytime/nighttime split for traffic volumes was used for the acoustical assessment.

The construction of the Biehn Drive Extension is expected to change vehicular traffic patterns in the neighbourhood. It is likely that the extension will result in a more balanced redistribution of area traffic volumes, providing relief (reducing the traffic volumes) on other area roads including Caryndale Drive and the north segment of Biehn Drive. **Table 1** summarizes the AADT volumes at the three representative receiver sites within the study area.

Table 1: AADT Volumes at Representative Receiver Sites

Receiver Site	Future AADT (Without Extension)	Future AADT (With Extension)
371 Biehn Drive	960	3000
260 Biehn Drive	5900	2950
453 Caryndale Drive	3000	1500

Additional input to the STAMSON model included:

- The intermediate ground surface (hard surface reflects sound, soft surface absorbs sound);
- Distance, in metres, from the source to the receiver, using the centreline of the road as the source;
- The angle at which the receiver (apartment) intercepts the source (roadway and/or railway), measured relative to the perpendicular line between the source and the receiver;
- Receiver height (standard is 1.5 m above ground level during the daytime and 4.5 m above ground or storey level bedroom during the nighttime);
- Existing buildings which provide effective shielding of roadway or railway noise;
- Posted speed limit – the speed limit for Biehn Drive and Caryndale Drive is 50 km/h within the study limits;

- Depth of woods (0-30 m, 30-60 m, 60 m or more);
- Roadway grade (slope);
- Topography (hills, flatlands); and
- Existing attenuation due to shielding from barriers (natural or man-made).

Biehn Drive is a 2-lane collector roadway extending from Old Heron Road and terminating within the Study Area west of Caryndale Drive. Caryndale Drive is a 2-lane collector roadway extending from Biehn Drive to Stauffer Drive. The speed limit of both roadways is 50 km/h.

4.0 ANALYSIS OF EXISTING AND FUTURE SOUND LEVELS

A future year was selected with and without the Biehn Drive extension. The 16-hour equivalent daytime sound levels and 8-hour nighttime sound levels were forecast for three receiver sites with and without the project, calculated using the STAMSON noise software program. These are shown in **Table 2.**

Table 2: Existing and Future Sound Levels

Receiver Site	Existing Daytime Without Extension (16 h) Sound Level, Leq (dBA)	Existing Nighttime Without Extension (8 h) Sound Level, Leq (dBA)	Future Daytime With Extension (16 h) Sound Level, Leq (dBA)	Future Nighttime With Extension (8 h) Sound Level, Leq (dBA)
371 Biehn Drive	45*	45	50	48
260 Biehn Drive	51	49	48	46
453 Caryndale Drive	48	46	45*	43

* Sound levels are estimated to be 45 dBA and reflect south level measurements obtained on site by BTE. 45 dBA is the minimum urban daytime sound level standard accepted by MECP.

The forecast ambient sound levels at the proposed site have been reviewed comparing equivalent sound level criterion from MECP's Noise Assessment Criteria (NPC-300) for noise sensitive areas. The MECP criteria are summarized below in **Table 3**. The STAMSON outputs are included in **Appendix B**.

Table 3: MECP's Noise Assessment Criteria (NPC-300)

Criteria 1:	Outdoor Sound Level Criteria: The significance of a noise impact for day-time noise levels is assessed by using the objective of 55 dBA (7 a.m. to 11 p.m.) for both road and rail sources combined. These levels are established as acceptable noise levels for outdoor recreation areas of developments adjacent to transportation noise (roads, transit, light rail, and rail).
Criteria 2:	Plane of Window (Sleeping Quarters): Outdoor nighttime (8 h) roadway and rail noise levels at the plane of a bedroom (3rd storey) window must not exceed 60 dBA, otherwise air conditioning is required. If the nighttime rail noise exceeds 55 dBA or the roadway rail noise exceeds 60 dBA, acoustical materials are required in the design and construction of the building.

5.0 MITIGATION REQUIREMENTS

The criterion for mitigation has utilized the MECP Provincial guideline for sound levels in a residential area. Based on all daytime and nighttime sound levels being below 55 dBA, no mitigation is required.

6.0 CONCLUSIONS

The forecast sound levels for daytime and nighttime are below 55 dBA and no mitigation is required.

Report prepared by:

Darcie Dillon, P.Eng.

Reviewed and approved by:

Steven Taylor, P.Eng.

Appendix A

Traffic Counts

BT ENGINEERING

City of Kitchener – Transportation Services
200 King Street Kitchener, ON N2G 4G7
Tel: 519 741 2200

Traffic Summary

Station # - ##Demo?##, Biehn Drive btwn Kilkerran & Caryndale Rd (##)<50>
Date - 0:00 Thursday, August 29, 2019 to 0:00 Wednesday, September 4, 2019 (6 days of data)

Volume

	Total	Weekday	Weekend	ADT	AWDT	AWET
Combined	##Demo?##	11468	3520	2498	2867	##Demo?##
East	7125	5460	1665	##Demo?##	1365	833
West	7863	##Demo?##	1855	1311	1502	928
Days	##Demo?##	4	2	6	4	##Demo?##

Speed

	All Days	Weekdays	Weekend	
Mean speed	47.8	47.9	47.6	km/h
Median speed	##Demo?##	48.4	48.1	km/h
85% speed	54.8	##Demo?##	55.0	km/h

PSL = 60 km/h

Class

Class (*##Demo?##*)	All Days	%	Weekdays	Weekend
1 - CYCLE	585	3.903%	496	##Demo?##
2 - PC	7547	50.35%	5637	##Demo?##
3 - 2A-4T	976	6.512%	791	##Demo?##
4 - BUS	41	0.274%	38	##Demo?##
5 - 2A-6T	138	0.921%	122	##Demo?##
6 - 3A-SU	509	3.396%	352	##Demo?##
7 - 4A-SU	5132	34.24%	3977	##Demo?##
8 - <5A DBL	3	0.020%	3	##Demo?##
9 - 5A DBL	6	0.040%	6	##Demo?##
10 - >6A DBL	3	0.020%	3	##Demo?##
11 - <6A MULTI	0	0.000%	0	##Demo?##
12 - 6A MULTI	0	0.000%	0	##Demo?##
13 - >6A MULTI	48	0.320%	43	##Demo?##

Average Daily Volume

	Mon	Tue	Wed	Thu	##Demo?##	Sat	Sun
East	804	##Demo?##	0	1601	1311	871	##Demo?##
West	805	1929	0	##Demo?##	1543	1031	824
Combined	1609	##Demo?##	0	3332	2854	1902	##Demo?##
AM Pk East	54	154	-	##Demo?##	68	64	48
PM Pk East	##Demo?##	195	-	228	138	##Demo?##	71
AM Pk West	60	245	##Demo?##	187	145	96	85
PM Pk ##Demo?##	77	209	-	155	##Demo?##	80	75
Days	1	1	##Demo?##	1	1	1	1

City of Kitchener – Transportation Services
200 King Street Kitchener, ON N2G 4G7
Tel: 519 741 2200

Traffic Summary

Station # - Biehn Dr, Biehn Dr btwn Marl Meadow & Mcleod Crt <50 kmh>(13)
Date - 0:00 Thursday, August 29, 2019 to 0:00 Wednesday, September 4, 2019 (6 days of data)

Volume

	Total	Weekday	Weekend	ADT	AWDT	AWET
Combined	28021	21223	6798	4670	5306	3399
East	16862	12767	4095	2810	3192	2048
West	11159	8456	2703	1860	2114	1352
Days	6	4	2	6	4	2

Speed

	All Days	Weekdays	Weekend	
Mean speed	52.6	52.7	52.3	km/h
Median speed	52.6	52.6	52.2	km/h
85% speed	58.6	58.6	58.5	km/h

PSL = 60 km/h

Class

Class (*Scheme F3*)	All Days	%	Weekdays	Weekend
1 - CYCLE	213	0.760%	171	42
2 - PC	24192	86.34%	18251	5941
3 - 2A-4T	1745	6.227%	1369	376
4 - BUS	57	0.203%	52	5
5 - 2A-6T	281	1.003%	238	43
6 - 3A-SU	94	0.335%	72	22
7 - 4A-SU	1397	4.986%	1029	368
8 - <5A DBL	1	0.004%	1	0
9 - 5A DBL	12	0.043%	12	0
10 - >6A DBL	3	0.011%	3	0
11 - <6A MULTI	0	0.000%	0	0
12 - 6A MULTI	0	0.000%	0	0
13 - >6A MULTI	26	0.093%	25	1

Average Daily Volume

	Mon	Tue	Wed	Thu	Fri	Sat	Sun
East	1795	3798	0	3921	3253	2145	1950
West	1210	2542	0	2520	2184	1457	1246
Combined	3005	6340	0	6441	5437	3602	3196
AM Pk East	135	326	-	294	195	164	137
PM Pk East	180	409	-	468	301	165	177
AM Pk West	98	277	-	226	186	128	117
PM Pk West	120	266	-	233	182	117	105
Days	1	1	-	1	1	1	1

Report created 10:52 Monday, September 9, 2019 using MTE version 5.0.2.0 - Template not certified by MetroCount

City of Kitchener – Transportation Services
200 King Street Kitchener, ON N2G 4G7
Tel: 519 741 2200

Traffic Summary

Station # - Caryndale Drive, Caryndale Drive btwn Chapel Hill Drive @ Hearthway Street (17) <50km.h>
Date - 0:00 Thursday, June 08, 2017 to 0:00 Wednesday, June 14, 2017 (6 days of data)

Volume						
	Total	**Weekday**	**Weekend**	**ADT**	**AWDT**	**AWET**
Combined	12962	9656	3306	2160	2414	1653
East	5796	4261	1535	966	1065	768
West	7166	5395	1771	1194	1349	886
Days	6	4	2	6	4	2

Speed				
	All Days	**Weekdays**	**Weekend**	
Mean speed	47.9	47.8	48.1	km/h
Median speed	50.0	50.0	50.8	km/h
85% speed	60.8	60.5	61.2	km/h

PSL = 60 km/h

Class				
Class (*Scheme F3*)	**All Days**	**%**	**Weekdays**	**Weekend**
1 - CYCLE	264	2.0%	174	90
2 - PC	9250	71.4%	6710	2540
3 - 2A-4T	1932	14.9%	1480	452
4 - BUS	83	0.6%	79	4
5 - 2A-6T	239	1.8%	194	45
6 - 3A-SU	147	1.1%	115	32
7 - 4A-SU	1040	8.0%	899	141
8 - <5A DBL	0	0.0%	0	0
9 - 5A DBL	1	0.0%	0	1
10 - >6A DBL	0	0.0%	0	0
11 - <6A MULTI	0	0.0%	0	0
12 - 6A MULTI	0	0.0%	0	0
13 - >6A MULTI	6	0.0%	5	1

Average Daily Volume							
	Mon	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**
East	1111	1017	0	1114	1019	854	681
West	1315	1241	0	1444	1395	995	776
Combined	2426	2258	0	2558	2414	1849	1457
AM Pk East	87	81	-	75	73	51	42
PM Pk East	119	122	-	123	92	75	57
AM Pk West	152	147	-	143	134	74	72
PM Pk West	141	124	-	152	139	81	60
Days	1	1	-	1	1	1	1

Report created 10:24 Friday, June 23, 2017 using MTE version 4.0.6.0

City of Kitchener – Transportation Services
200 King Street Kitchener, ON N2G 4G7
Tel: 519 741 2200

Traffic Summary

Station # - Caryndale Drive, Caryndale Drive btwn Robertson Crescent @ Chapel Hill Drive (19) <40km.h>
Date - 0:00 Thursday, June 08, 2017 to 0:00 Wednesday, June 14, 2017 (6 days of data)

Volume						
	Total	**Weekday**	**Weekend**	**ADT**	**AWDT**	**AWET**
Combined	16449	12546	3903	2742	3137	1952
East	7980	6070	1910	1330	1518	955
West	8469	6476	1993	1412	1619	997
Days	6	4	2	6	4	2

Speed				
	All Days	**Weekdays**	**Weekend**	
Mean speed	45.3	44.2	49.0	km/h
Median speed	46.8	45.7	49.3	km/h
85% speed	54.4	53.6	55.8	km/h

PSL = 60 km/h

Class				
Class (*Scheme F3*)	**All Days**	**%**	**Weekdays**	**Weekend**
1 - CYCLE	247	1.5%	167	80
2 - PC	13812	84.0%	10430	3382
3 - 2A-4T	2013	12.2%	1619	394
4 - BUS	139	0.8%	133	6
5 - 2A-6T	201	1.2%	167	34
6 - 3A-SU	22	0.1%	22	0
7 - 4A-SU	12	0.1%	7	5
8 - <5A DBL	0	0.0%	0	0
9 - 5A DBL	2	0.0%	0	2
10 - >6A DBL	0	0.0%	0	0
11 - <6A MULTI	0	0.0%	0	0
12 - 6A MULTI	0	0.0%	0	0
13 - >6A MULTI	1	0.0%	1	0

Average Daily Volume							
	Mon	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**
East	1493	1556	0	1538	1483	1077	833
West	1536	1661	0	1642	1637	1107	886
Combined	3029	3217	0	3180	3120	2184	1719
AM Pk East	134	128	-	130	125	68	55
PM Pk East	142	153	-	162	141	98	74
AM Pk West	176	171	-	159	160	88	77
PM Pk West	181	179	-	178	164	83	68
Days	1	1	-	1	1	1	1

Report created 10:24 Friday, June 23, 2017 using MTE version 4.0.6.0

City of Kitchener – Transportation Services
200 King Street Kitchener, ON N2G 4G7
Tel: 519 741 2200

Traffic Summary

Station # - ##Demo?##, Biehn Drive btwn Kilkerran & Caryndale Rd (##)<50>
Date - 0:00 Thursday, August 29, 2019 to 0:00 Wednesday, September 4, 2019 (6 days of data)

Volume						
	Total	**Weekday**	**Weekend**	**ADT**	**AWDT**	**AWET**
Combined	##Demo?##	11468	3520	2498	2867	##Demo?##
East	7125	5460	1665	##Demo?##	1365	833
West	7863	##Demo?##	1855	1311	1502	928
Days	##Demo?##	4	2	6	4	##Demo?##

Speed				
	All Days	**Weekdays**	**Weekend**	
Mean speed	47.8	47.9	47.6	km/h
Median speed	##Demo?##	48.4	48.1	km/h
85% speed	54.8	##Demo?##	55.0	km/h

PSL = 60 km/h

Class				
Class (*##Demo?##*)	**All Days**	**%**	**Weekdays**	**Weekend**
1 - CYCLE	585	3.903%	496	##Demo?##
2 - PC	7547	50.35%	5637	##Demo?##
3 - 2A-4T	976	6.512%	791	##Demo?##
4 - BUS	41	0.274%	38	##Demo?##
5 - 2A-6T	138	0.921%	122	##Demo?##
6 - 3A-SU	509	3.396%	352	##Demo?##
7 - 4A-SU	5132	34.24%	3977	##Demo?##
8 - <5A DBL	3	0.020%	3	##Demo?##
9 - 5A DBL	6	0.040%	6	##Demo?##
10 - >6A DBL	3	0.020%	3	##Demo?##
11 - <6A MULTI	0	0.000%	0	##Demo?##
12 - 6A MULTI	0	0.000%	0	##Demo?##
13 - >6A MULTI	48	0.320%	43	##Demo?##

Average Daily Volume							
	Mon	**Tue**	**Wed**	**Thu**	**##Demo?##**	**Sat**	**Sun**
East	804	##Demo?##	0	1601	1311	871	##Demo?##
West	805	1929	0	##Demo?##	1543	1031	824
Combined	1609	##Demo?##	0	3332	2854	1902	##Demo?##
AM Pk East	54	154	-	##Demo?##	68	64	48
PM Pk East	##Demo?##	195	-	228	138	##Demo?##	71
AM Pk West	60	245	##Demo?##	187	145	96	85
PM Pk ##Demo?##	77	209	-	155	##Demo?##	80	75
Days	1	1	##Demo?##	1	1	1	1

City of Kitchener – Transportation Services
200 King Street Kitchener, ON N2G 4G7
Tel: 519 741 2200

Traffic Summary

Station # - Biehn Dr, Biehn Dr btwn Marl Meadow & Mcleod Crt <50 kmh>(13)
Date - 0:00 Thursday, August 29, 2019 to 0:00 Wednesday, September 4, 2019 (6 days of data)

Volume

	Total	Weekday	Weekend	ADT	AWDT	AWET
Combined	28021	21223	6798	4670	5306	3399
East	16862	12767	4095	2810	3192	2048
West	11159	8456	2703	1860	2114	1352
Days	6	4	2	6	4	2

Speed

	All Days	Weekdays	Weekend	
Mean speed	52.6	52.7	52.3	km/h
Median speed	52.6	52.6	52.2	km/h
85% speed	58.6	58.6	58.5	km/h

PSL = 60 km/h

Class

Class (*Scheme F3*)	All Days	%	Weekdays	Weekend
1 - CYCLE	213	0.760%	171	42
2 - PC	24192	86.34%	18251	5941
3 - 2A-4T	1745	6.227%	1369	376
4 - BUS	57	0.203%	52	5
5 - 2A-6T	281	1.003%	238	43
6 - 3A-SU	94	0.335%	72	22
7 - 4A-SU	1397	4.986%	1029	368
8 - <5A DBL	1	0.004%	1	0
9 - 5A DBL	12	0.043%	12	0
10 - >6A DBL	3	0.011%	3	0
11 - <6A MULTI	0	0.000%	0	0
12 - 6A MULTI	0	0.000%	0	0
13 - >6A MULTI	26	0.093%	25	1

Average Daily Volume

	Mon	Tue	Wed	Thu	Fri	Sat	Sun
East	1795	3798	0	3921	3253	2145	1950
West	1210	2542	0	2520	2184	1457	1246
Combined	3005	6340	0	6441	5437	3602	3196
AM Pk East	135	326	-	294	195	164	137
PM Pk East	180	409	-	468	301	165	177
AM Pk West	98	277	-	226	186	128	117
PM Pk West	120	266	-	233	182	117	105
Days	1	1	-	1	1	1	1

City of Kitchener – Transportation Services
200 King Street Kitchener, ON N2G 4G7
Tel: 519 741 2200

Traffic Summary

Station # - Caryndale Drive, Caryndale Drive btwn Chapel Hill Drive @ Hearthway Street (17) <50km.h>
Date - 0:00 Thursday, June 08, 2017 to 0:00 Wednesday, June 14, 2017 (6 days of data)

Volume

	Total	Weekday	Weekend	ADT	AWDT	AWET
Combined	12962	9656	3306	2160	2414	1653
East	5796	4261	1535	966	1065	768
West	7166	5395	1771	1194	1349	886
Days	6	4	2	6	4	2

Speed

	All Days	Weekdays	Weekend	
Mean speed	47.9	47.8	48.1	km/h
Median speed	50.0	50.0	50.8	km/h
85% speed	60.8	60.5	61.2	km/h

PSL = 60 km/h

Class

Class (*Scheme F3*)	All Days	%	Weekdays	Weekend
1 - CYCLE	264	2.0%	174	90
2 - PC	9250	71.4%	6710	2540
3 - 2A-4T	1932	14.9%	1480	452
4 - BUS	83	0.6%	79	4
5 - 2A-6T	239	1.8%	194	45
6 - 3A-SU	147	1.1%	115	32
7 - 4A-SU	1040	8.0%	899	141
8 - <5A DBL	0	0.0%	0	0
9 - 5A DBL	1	0.0%	0	1
10 - >6A DBL	0	0.0%	0	0
11 - <6A MULTI	0	0.0%	0	0
12 - 6A MULTI	0	0.0%	0	0
13 - >6A MULTI	6	0.0%	5	1

Average Daily Volume

	Mon	Tue	Wed	Thu	Fri	Sat	Sun
East	1111	1017	0	1114	1019	854	681
West	1315	1241	0	1444	1395	995	776
Combined	2426	2258	0	2558	2414	1849	1457
AM Pk East	87	81	-	75	73	51	42
PM Pk East	119	122	-	123	92	75	57
AM Pk West	152	147	-	143	134	74	72
PM Pk West	141	124	-	152	139	81	60
Days	1	1	-	1	1	1	1

Report created 10:24 Friday, June 23, 2017 using MTE version 4.0.6.0

City of Kitchener – Transportation Services
200 King Street Kitchener, ON N2G 4G7
Tel: 519 741 2200

Traffic Summary

Station # - Caryndale Drive, Caryndale Drive btwn Robertson Crescent @ Chapel Hill Drive (19) <40km.h>
Date - 0:00 Thursday, June 08, 2017 to 0:00 Wednesday, June 14, 2017 (6 days of data)

Volume						
	Total	**Weekday**	**Weekend**	**ADT**	**AWDT**	**AWET**
Combined	16449	12546	3903	2742	3137	1952
East	7980	6070	1910	1330	1518	955
West	8469	6476	1993	1412	1619	997
Days	6	4	2	6	4	2

Speed				
	All Days	**Weekdays**	**Weekend**	
Mean speed	45.3	44.2	49.0	km/h
Median speed	46.8	45.7	49.3	km/h
85% speed	54.4	53.6	55.8	km/h

PSL = 60 km/h

Class				
Class (*Scheme F3*)	**All Days**	**%**	**Weekdays**	**Weekend**
1 - CYCLE	247	1.5%	167	80
2 - PC	13812	84.0%	10430	3382
3 - 2A-4T	2013	12.2%	1619	394
4 - BUS	139	0.8%	133	6
5 - 2A-6T	201	1.2%	167	34
6 - 3A-SU	22	0.1%	22	0
7 - 4A-SU	12	0.1%	7	5
8 - <5A DBL	0	0.0%	0	0
9 - 5A DBL	2	0.0%	0	2
10 - >6A DBL	0	0.0%	0	0
11 - <6A MULTI	0	0.0%	0	0
12 - 6A MULTI	0	0.0%	0	0
13 - >6A MULTI	1	0.0%	1	0

Average Daily Volume							
	Mon	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**
East	1493	1556	0	1538	1483	1077	833
West	1536	1661	0	1642	1637	1107	886
Combined	3029	3217	0	3180	3120	2184	1719
AM Pk East	134	128	-	130	125	68	55
PM Pk East	142	153	-	162	141	98	74
AM Pk West	176	171	-	159	160	88	77
PM Pk West	181	179	-	178	164	83	68
Days	1	1	-	1	1	1	1

Report created 10:24 Friday, June 23, 2017 using MTE version 4.0.6.0

Appendix B

STAMSON Outputs

```
STAMSON 5.0        COMPREHENSIVE REPORT        Date: 08-02-2022 09:08:45
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 260DNO                     Time Period: 16 hours
Description: 260 Biehn Drive Daytime No Extension



Road data, segment # 1: Biehn Drive
-----------------------------------
Car traffic volume  :  4578 veh/TimePeriod
Medium truck volume :   142 veh/TimePeriod
Heavy truck volume  :     0 veh/TimePeriod
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: Biehn Drive
---------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  35.00 m
Receiver height           :   1.50 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

↑
Segment # 1: Biehn Drive
------------------------

Source height = 0.50 m

ROAD (0.00 + 50.73 + 0.00) = 50.73 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.66  58.30   0.00  -6.11  -1.46   0.00   0.00   0.00  50.73
----------------------------------------------------------------------------

Segment Leq : 50.73 dBA

Total Leq All Segments: 50.73 dBA

↑



TOTAL Leq FROM ALL SOURCES:       50.73
↑
```

```
STAMSON 5.0        COMPREHENSIVE REPORT        Date: 08-02-2022 09:51:12
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 260DYES                     Time Period: 16 hours
Description: 260 Biehn Drive Daytime with Extension



Road data, segment # 1: Biehn Drive
-----------------------------------
Car traffic volume  :  2289 veh/TimePeriod
Medium truck volume :    71 veh/TimePeriod
Heavy truck volume  :     0 veh/TimePeriod
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: Biehn Drive
---------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  35.00 m
Receiver height           :   1.50 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Segment # 1: Biehn Drive
------------------------

Source height = 0.50 m

ROAD (0.00 + 47.72 + 0.00) = 47.72 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.66  55.29   0.00  -6.11  -1.46   0.00   0.00   0.00  47.72
----------------------------------------------------------------------------

Segment Leq : 47.72 dBA

Total Leq All Segments: 47.72 dBA




TOTAL Leq FROM ALL SOURCES:       47.72
```

```
STAMSON 5.0        COMPREHENSIVE REPORT        Date: 08-02-2022 09:17:01
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 260NNO                     Time Period: 8 hours
Description: 260 Biehn Drive Nighttime No Extension



Road data, segment # 1: Biehn Drive
-----------------------------------
Car traffic volume  :  1145 veh/TimePeriod
Medium truck volume :    35 veh/TimePeriod
Heavy truck volume  :     0 veh/TimePeriod
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: Biehn Drive
---------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  32.00 m
Receiver height           :   4.50 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

↑
Segment # 1: Biehn Drive
------------------------

Source height = 0.50 m

ROAD (0.00 + 48.65 + 0.00) = 48.65 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.60  55.27   0.00  -5.26  -1.35   0.00   0.00   0.00  48.65
-----------------------------------------------------------------------------

Segment Leq : 48.65 dBA

Total Leq All Segments: 48.65 dBA

↑



TOTAL Leq FROM ALL SOURCES:       48.65
↑
```

```
STAMSON 5.0        COMPREHENSIVE REPORT        Date: 08-02-2022 09:52:24
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 260NYES                     Time Period: 8 hours
Description: 260 Biehn Drive Nighttime with Extension



Road data, segment # 1: Biehn Drive
-----------------------------------
Car traffic volume  :   572 veh/TimePeriod
Medium truck volume :    18 veh/TimePeriod
Heavy truck volume  :     0 veh/TimePeriod
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: Biehn Drive
---------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  32.00 m
Receiver height           :   4.50 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Segment # 1: Biehn Drive
------------------------

Source height = 0.50 m

ROAD (0.00 + 45.67 + 0.00) = 45.67 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.60  52.29   0.00  -5.26  -1.35   0.00   0.00   0.00  45.67
----------------------------------------------------------------------------

Segment Leq : 45.67 dBA

Total Leq All Segments: 45.67 dBA




TOTAL Leq FROM ALL SOURCES:       45.67
```

```
STAMSON 5.0        NORMAL REPORT        Date: 08-02-2022 09:07:45
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 371DNO                     Time Period: 16 hours
Description: 371 Biehn Drive Daytime No Extension



Road data, segment # 1: Biehn Drive
-----------------------------------
Car traffic volume  :   621 veh/TimePeriod
Medium truck volume :    19 veh/TimePeriod
Heavy truck volume  :     0 veh/TimePeriod
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: Biehn Drive
---------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  24.00 m
Receiver height           :   1.50 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

↑
Results segment # 1: Biehn Drive
--------------------------------

Source height = 0.50 m

ROAD (0.00 + 44.76 + 0.00) = 44.76 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.66  49.60   0.00  -3.39  -1.46   0.00   0.00   0.00  44.76
----------------------------------------------------------------------------

Segment Leq : 44.76 dBA

Total Leq All Segments: 44.76 dBA

↑



TOTAL Leq FROM ALL SOURCES:       44.76
↑
```

```
STAMSON 5.0        COMPREHENSIVE REPORT        Date: 08-02-2022 09:50:23
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 371DYES                     Time Period: 16 hours
Description: 371 Biehn Drive Daytime with Extension



Road data, segment # 1: Biehn Drive
-----------------------------------
Car traffic volume  :  2328 veh/TimePeriod
Medium truck volume :    72 veh/TimePeriod
Heavy truck volume  :     0 veh/TimePeriod
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: Biehn Drive
---------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  24.00 m
Receiver height           :   1.50 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Segment # 1: Biehn Drive
------------------------

Source height = 0.50 m

ROAD (0.00 + 50.51 + 0.00) = 50.51 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.66  55.36   0.00  -3.39  -1.46   0.00   0.00   0.00  50.51
----------------------------------------------------------------------------

Segment Leq : 50.51 dBA

Total Leq All Segments: 50.51 dBA




TOTAL Leq FROM ALL SOURCES:       50.51
```

```
STAMSON 5.0        COMPREHENSIVE REPORT        Date: 08-02-2022 09:17:35
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 371NNO                     Time Period: 8 hours
Description: 371 Biehn Drive Nighttime No Extension



Road data, segment # 1: Biehn Drive
-----------------------------------
Car traffic volume  :   310 veh/TimePeriod
Medium truck volume :    10 veh/TimePeriod
Heavy truck volume  :     0 veh/TimePeriod
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: Biehn Drive
---------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  24.00 m
Receiver height           :   4.50 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

↑
Segment # 1: Biehn Drive
------------------------

Source height = 0.50 m

ROAD (0.00 + 45.05 + 0.00) = 45.05 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.60  49.67   0.00  -3.27  -1.35   0.00   0.00   0.00  45.05
----------------------------------------------------------------------------

Segment Leq : 45.05 dBA

Total Leq All Segments: 45.05 dBA

↑



TOTAL Leq FROM ALL SOURCES:       45.05
↑
```

```
STAMSON 5.0        COMPREHENSIVE REPORT        Date: 08-02-2022 09:51:56
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 371NYES                     Time Period: 8 hours
Description: 371 Biehn Drive Nighttime with Extension



Road data, segment # 1: Biehn Drive
-----------------------------------
Car traffic volume  :   582 veh/TimePeriod
Medium truck volume :    18 veh/TimePeriod
Heavy truck volume  :     0 veh/TimePeriod
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: Biehn Drive
---------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  24.00 m
Receiver height           :   4.50 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Segment # 1: Biehn Drive
------------------------

Source height = 0.50 m

ROAD (0.00 + 47.72 + 0.00) = 47.72 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.60  52.35   0.00  -3.27  -1.35   0.00   0.00   0.00  47.72
----------------------------------------------------------------------------

Segment Leq : 47.72 dBA

Total Leq All Segments: 47.72 dBA



TOTAL Leq FROM ALL SOURCES:       47.72
```

```
STAMSON 5.0        COMPREHENSIVE REPORT        Date: 08-02-2022 09:09:38
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 453DNO                     Time Period: 16 hours
Description: 453 Caryndale Daytime No Extension



Road data, segment # 1: Caryndale Dr
------------------------------------
Car traffic volume  :  2328 veh/TimePeriod
Medium truck volume :    72 veh/TimePeriod
Heavy truck volume  :     0 veh/TimePeriod
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: Caryndale Dr
----------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  35.00 m
Receiver height           :   1.50 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

↑
Segment # 1: Caryndale Dr
-------------------------

Source height = 0.50 m

ROAD (0.00 + 47.79 + 0.00) = 47.79 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.66  55.36   0.00  -6.11  -1.46   0.00   0.00   0.00  47.79
----------------------------------------------------------------------------

Segment Leq : 47.79 dBA

Total Leq All Segments: 47.79 dBA

↑



TOTAL Leq FROM ALL SOURCES:       47.79
↑
```

```
STAMSON 5.0        COMPREHENSIVE REPORT        Date: 08-02-2022 09:53:06
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 453DYES                     Time Period: 16 hours
Description: 453 Caryndale Daytime with Extension



Road data, segment # 1: Caryndale Dr
------------------------------------
Car traffic volume  :  1164 veh/TimePeriod
Medium truck volume :    36 veh/TimePeriod
Heavy truck volume  :     0 veh/TimePeriod
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: Caryndale Dr
----------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  35.00 m
Receiver height           :   1.50 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

↑
Segment # 1: Caryndale Dr
-------------------------

Source height = 0.50 m

ROAD (0.00 + 44.78 + 0.00) = 44.78 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.66  52.35   0.00  -6.11  -1.46   0.00   0.00   0.00  44.78
----------------------------------------------------------------------------

Segment Leq : 44.78 dBA

Total Leq All Segments: 44.78 dBA

↑



TOTAL Leq FROM ALL SOURCES:       44.78
↑
```

```
STAMSON 5.0        COMPREHENSIVE REPORT        Date: 08-02-2022 09:13:33
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: 453NNO                     Time Period: 8 hours
Description: 453 Caryndale Nighttime No Extension



Road data, segment # 1: Caryndale Dr
------------------------------------
Car traffic volume  :   582 veh/TimePeriod
Medium truck volume :    18 veh/TimePeriod
Heavy truck volume  :     0 veh/TimePeriod
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: Caryndale Dr
----------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  32.00 m
Receiver height           :   4.50 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

↑
Segment # 1: Caryndale Dr
-------------------------

Source height = 0.50 m

ROAD (0.00 + 45.73 + 0.00) = 45.73 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.60  52.35   0.00  -5.26  -1.35   0.00   0.00   0.00  45.73
----------------------------------------------------------------------------

Segment Leq : 45.73 dBA

Total Leq All Segments: 45.73 dBA

↑



TOTAL Leq FROM ALL SOURCES:       45.73
↑
```

```
STAMSON 5.0        COMPREHENSIVE REPORT        Date: 08-02-2022 09:54:10
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename:                       Time Period: 8 hours
Description:


Road data, segment # 1: Caryndale Dr
------------------------------------
Car traffic volume  :   310 veh/TimePeriod
Medium truck volume :    10 veh/TimePeriod
Heavy truck volume  :     0 veh/TimePeriod
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: Caryndale Dr
----------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  32.00 m
Receiver height           :   4.50 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

↑
Segment # 1: Caryndale Dr
-------------------------

Source height = 0.50 m

ROAD (0.00 + 43.05 + 0.00) = 43.05 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.60  49.67   0.00  -5.26  -1.35   0.00   0.00   0.00  43.05
----------------------------------------------------------------------------

Segment Leq : 43.05 dBA

Total Leq All Segments: 43.05 dBA

↑



TOTAL Leq FROM ALL SOURCES:       43.05
↑
↑
```

Appendix G

Biehn Drive Trunk Sanitary Sewer Extension
Technical Memorandum

TECHNICAL MEMORANDUM

TO:	Steve Taylor, P.Eng.	**OUR REF.:**	SN0447
FROM:	Leonardo Sanchez, P.Eng.	**DATE:**	March 31, 2022
COPY:	Katherine Scott, P.Eng.		

RE: **City of Kitchener**
Biehn Drive Trunk Sanitary Sewer Extension

The purpose of this Technical Memorandum is to present the initial design of the proposed trunk sanitary sewer extension of the existing sanitary trunk sewer on Biehn Drive.

Existing Sanitary Sewer

The original drainage area for the entire system was defined in the City's GIS system and is shown on Figure 1. The Strasburg-Biehn drainage area is part of the Schneider sanitary system and includes 209.1 ha. The undeveloped portion of the drainage area that is denoted as tributary to the existing sanitary trunk sewer at the proposed extension covers 128.9 ha.

The existing Biehn Drive trunk sanitary sewer is a 525 mm diameter pipe at the current end of the system. The existing pipe has capacity for 186 litres per second (l/s) flowing half-full, which corresponds to the peak flow that would be produced by the undeveloped tributary area if it was developed as low density residential.

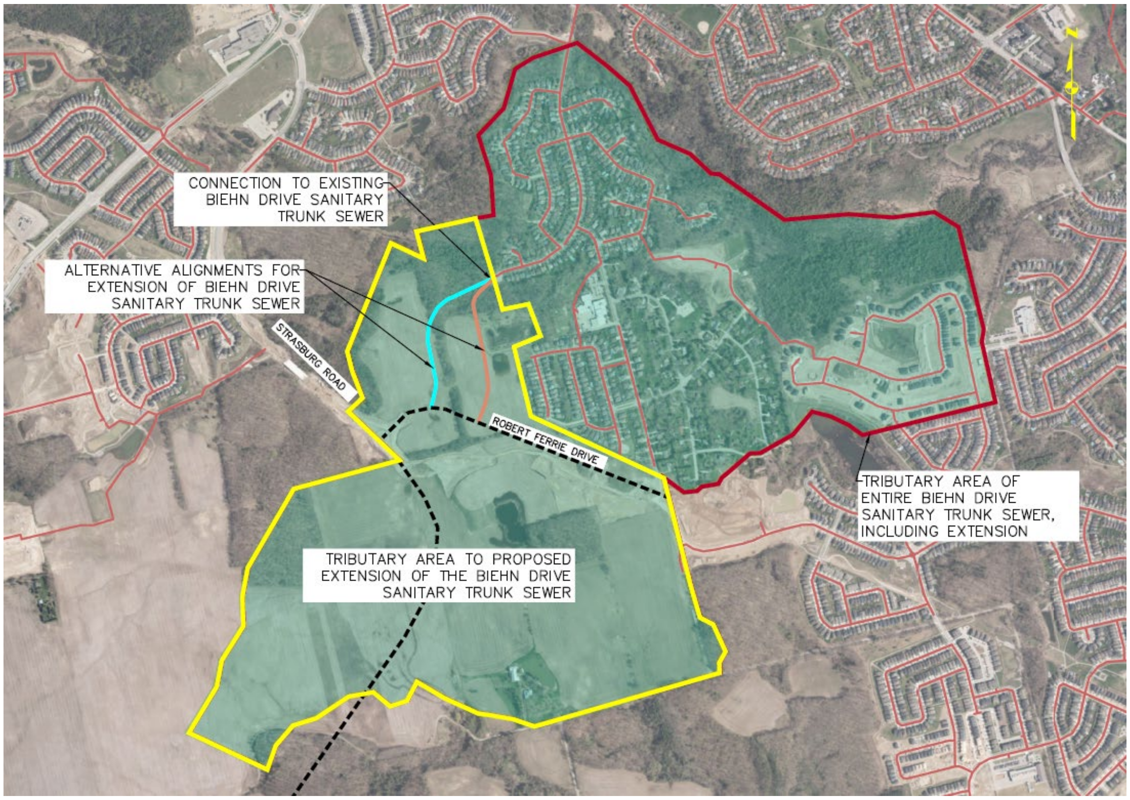


Figure 1 - Original Sanitary Sewer Tributary Area

The City's Official Plan designates the lands within the original drainage area as shown on Figure 2. The lands designated as Rural and Agricultural drain naturally to the adjacent watershed and will not be connected to the sanitary trunk sewer. Therefore, these lands can be considered to be non-tributary.

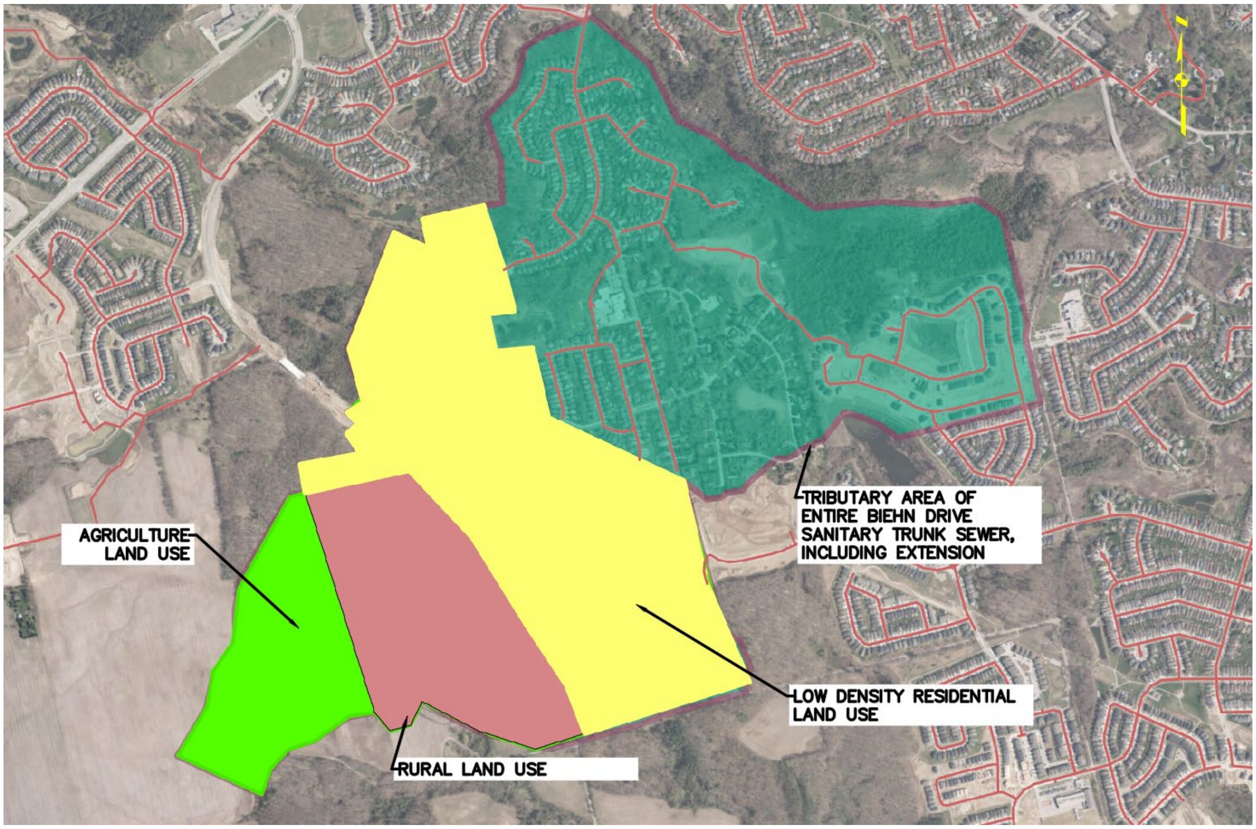


Figure 2 - Land Uses per Official Plan

Therefore, the revised sanitary drainage area was modified to include only the lands that are designated for urban development. The revised sanitary trunk sewer drainage area, shown on Figure 3, includes 72.0 ha.

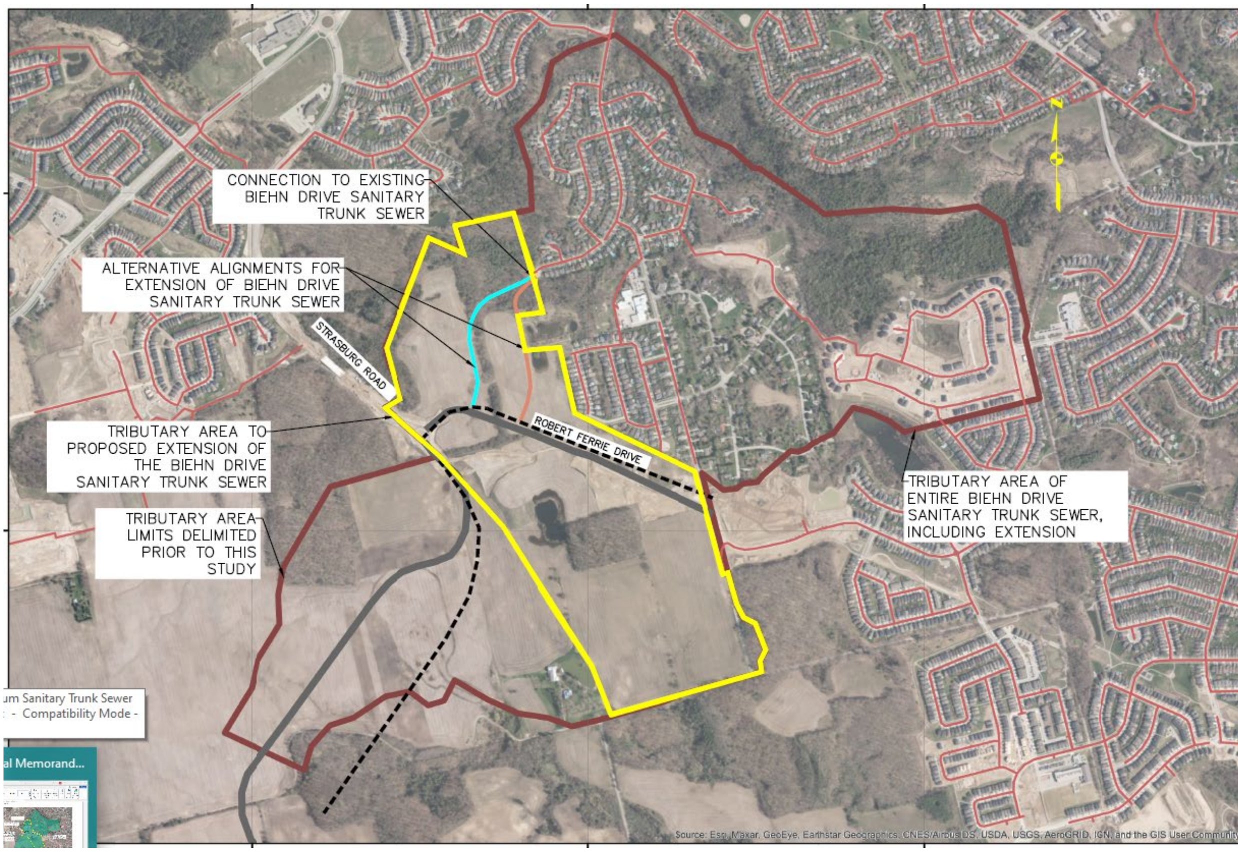


Figure 3 - Revised Sanitary Trunk Sewer Drainage Area

Population Estimate

The Official Plan designates the urban areas within the sanitary trunk sewer drainage area as Low Density Residential, which allows for a maximum of 30 dwellings per hectare. Based on the drainage area of 72.0 ha, the total number of dwellings is 1920. This is a conservative estimate, given that it does not subtract the area required for roadways, parks, and schools. However, given that the proposed development is not fully defined, it represents a reasonable estimate.

Statistics Canada 2016 Census data show that the average number of persons per dwelling in the Region is 2.6 persons. On this basis, the population of the revised drainage area is 5016 persons.

Estimated Sanitary Sewage Flow

The 2021 Development Manual of the City of Kitchener provides the design criteria for sanitary servicing. Based on the Kitchener Development Manual, the average flow per capita for new sanitary sewers is 305 litres per day (305 l/cap/day). The peak flow in the sanitary sewer must be calculated using a Peaking Factor Formula (the Harmon Formula) related to the serviced population.

In addition to the average sewage flow, the sanitary sewer must have hydraulic capacity to accommodate a minimum flow resulting from inflow and infiltration (I/I flow). The required I/I flow is 0.15 l/s/ha.

On this basis, the peak flowrate at the junction of the trunk sewer extension and the existing sewer is 67 l/s.

It should be noted that the existing sanitary trunk sewer has a hydraulic capacity of 168 l/s, which is appropriate for the larger drainage area of 127.3 ha.

Alternative Sanitary Trunk Sewer Alignments

Two Sanitary Sewer Alignment Alternatives were considered, as shown on Figure 4.

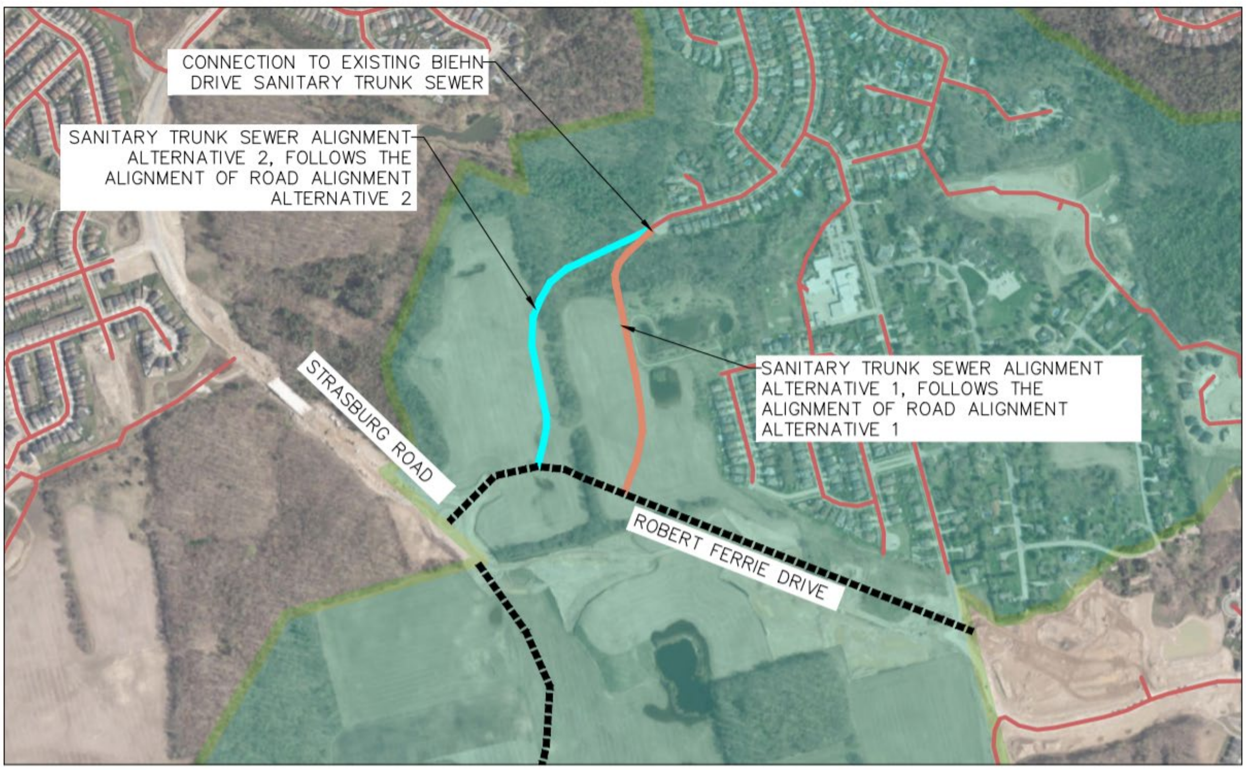


Figure 4 - Sanitary Sewer Alignment Alternatives

The two alternative alignments were evaluated in conjunction with the analysis and evaluation of the road alignment alternatives, as discussed in the Environmental Study Report. Based on the evaluation of alternatives, the Technically Preferred Sanitary Sewer Alignment Alternative is Sanitary Sewer Alignment 1.

New Sanitary Trunk Sewer

The new trunk sanitary sewer will follow the alignment of the Biehn Drive extension to Robert

Ferrie Drive. Based on the sanitary drainage area, the new trunk sewer will be designed for a peak flow of 67 l/s, and will be installed at a grade of 0.50% to allow connection of the areas of the sewershed located south of Robert Ferrie Drive. The required trunk sanitary sewer pipe will be a 500 mm diameter HDPE pipe or a 525 mm diameter pipe. The type of pipe will be confirmed in the preliminary design.

Figure 5 shows an approximate alignment of a future sanitary sewer that would serve the southern portion of the sewershed. Figure 6 shows the ground and sewer profiles along the same alignment. The maximum depths could be up to 21 m.

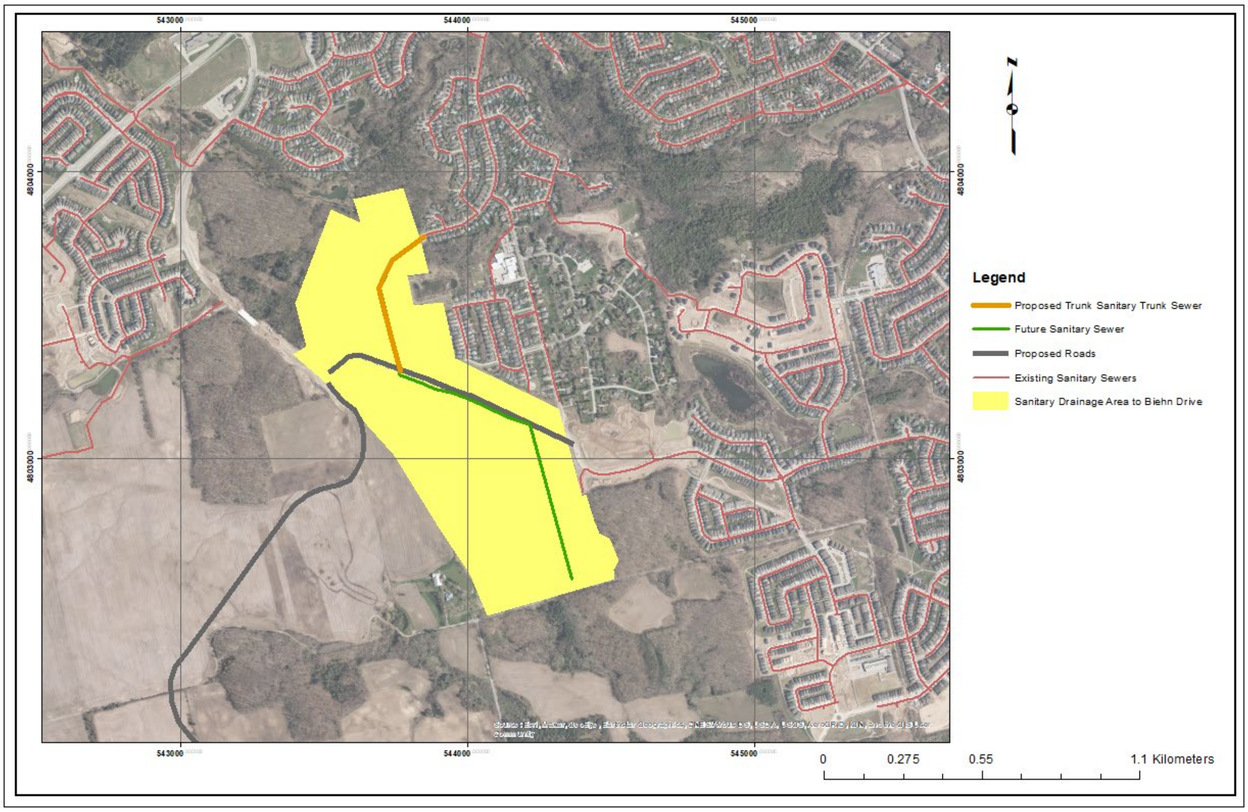


Figure 5 - Future Sanitary Sewer

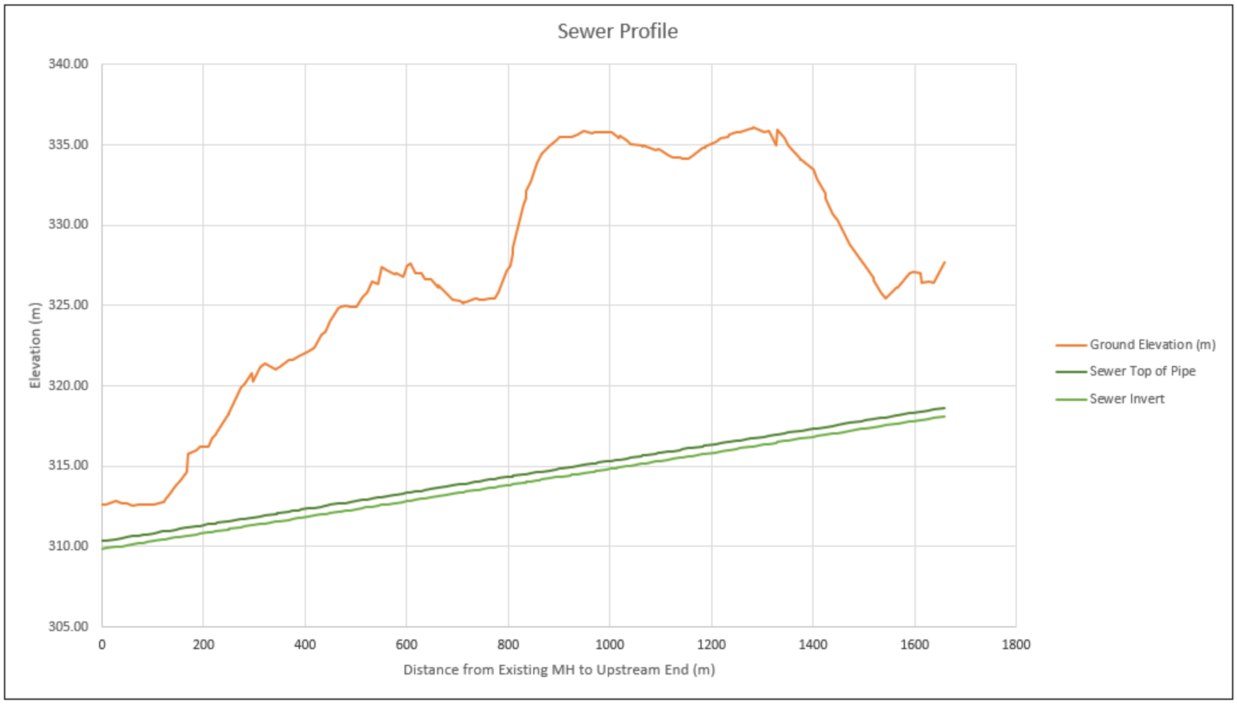


Figure 6 - Future Sewer Profile

Although it is possible to install the pipe at the depth shown, other options may be more appropriate to serve this area in the future. For example, the southern half of the tributary area may require a pumping station and forcemain. Alternatively, the City may wish to consider draining the southern portion to the adjacent New Dundee sewershed, if the hydraulic capacity of that system permits. However, to provide for the possibility that the entire system connects to the proposed Biehn Drive trunk sanitary sewer extension, the sewer needs to set at the lowest feasible grade.

Additional details will be provided in the preliminary design.

Prepared by,

Leonardo Sanchez, P.Eng.

Appendix H

Analysis and Evaluation Report

BT ENGINEERING

Analysis and Evaluation Report

City of Kitchener
Biehn Drive Extension Environmental Assessment Study
Municipal Class Environmental Assessment

October 2021
REV. 1 October 18, 2021
REV. 2 November 9, 2021

Submitted by:
BT Engineering Inc.
509 Talbot Street
London, ON N6A 2S5
519-672-2222

Table of Contents

List of Figures

List of Tables

List of Appendices

1.0 INTRODUCTION

The City of Kitchener (City) is conducting a Class Environmental Assessment (EA) Study for the extension of Biehn Drive southerly to the Robert Ferrie Drive Extension. The Biehn Drive extension will include a trunk sanitary sewer, storm sewer/ditches and watermain. The Study is evaluating alternatives for the alignment of the Biehn Drive extension, intersection locations and designs, and municipal services, while attempting to minimize natural, social, cultural and land use impacts. This report describes the evaluation of the Preliminary Alignment Alternatives carried forward following PIC No. 1.

1.1 Problem and Opportunity Statement

Future development within the Doon South and Brigadoon communities requires a defined alignment for the extension of Biehn Drive to Robert Ferrie Drive as part of the area road network. In order to determine the road alignment, this Study will consider the natural, social environments and the future land use in the Study Area. The extension of Biehn Drive and the associated municipal servicing has been a longstanding part of the integrated plan for the Brigadoon neighbourhood. The planned extension will improve local access to Strasburg Road to accommodate all modes of transportation including vehicular safely and reliably, pedestrians, and cyclists, and provide access to potential future transit. By defining the future road and municipal servicing plans, the subsequent land use plans can be completed by developers.

The Study will provide the opportunity to: improve accessibility to the local community by providing additional network links; define a multi-modal transportation plan to support travel within the local neighbourhoods and; allow development to proceed on lands that currently require the roadway plan to be defined prior to developing the land use plan.

1.2 Study Area

The Local Study Area extends from the current terminus of Biehn Drive, approximately 60 m west of Spencer Court, southerly to the future Robert Ferrie Drive Extension.

Comments received from the public at the combined Community Café and Public Information Centre No. 1, indicated that the Study Area should be expanded to include a Broader Study Area and consider traffic effects in adjacent neighbourhoods. The Study Area is illustrated in **Figure 1.**

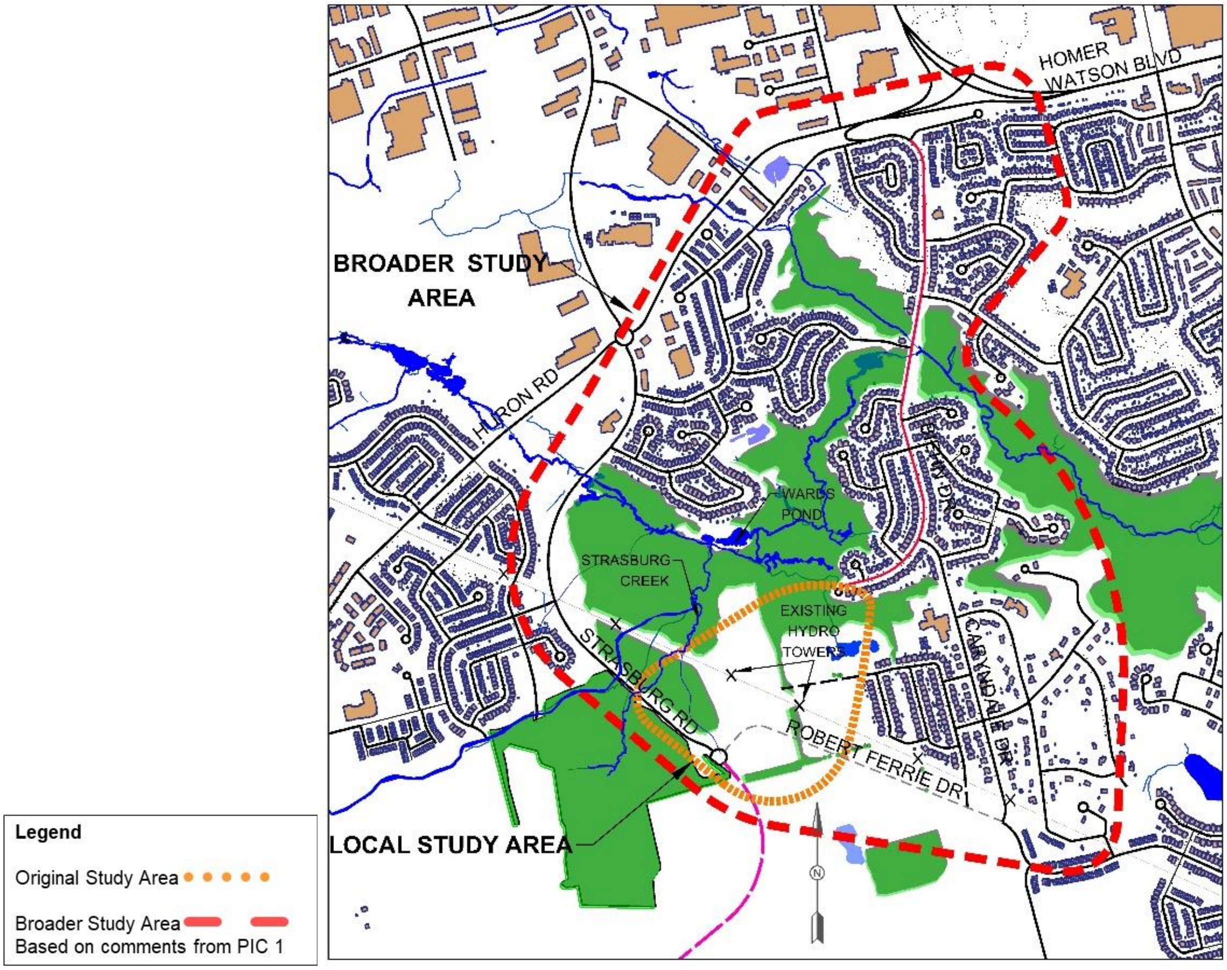


Figure 1: Study Area

1.3 Study Introduction

This study was initiated as a Municipal Schedule C project as defined by the Municipal Class Environmental Assessment (MCEA). The Study is evaluating alternative alignments for Biehn Drive to serve the Brigadoon Community located in the southwest portion of the City of Kitchener. The extension of Biehn Drive has long been a part of the integrated land use and transportation plan for the larger community. The City of Kitchener Official Plan (November 2014) identifies Biehn Drive as a Major Community Collector Street, shown in yellow, refer to **Figure 2**. Collector streets function to collect traffic from several local streets and provide access to arterial streets, shown in purple.

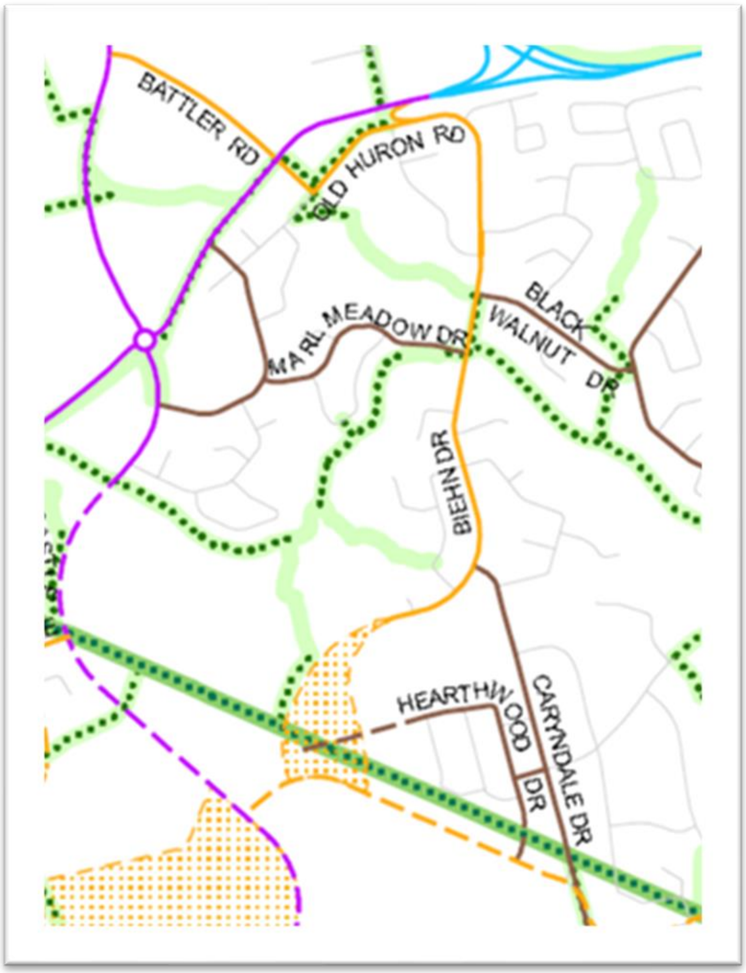


Figure 2: Future Road Network (City of Kitchener Official Plan: A Complete & Healthy Kitchener November 19, 2014 OP Map 11 - Integrated Transportation System)

1.4 Background

Since the mid-2000's, the road network and municipal servicing for the Doon South and Brigadoon areas in the City of Kitchener have planned for area development and evolving transportation needs. Several planning documents including the Official Plan and Transportation Master Plan (TMP) have identified the need to extend Biehn Drive westerly to the Robert Ferrie Drive extension and ultimately to Strasburg Road. The Biehn Drive Extension would be a major collector road, as identified in Schedule B of the City of Kitchener's Official Plan Amendment. This link would accommodate vehicles to and from the Brigadoon community and would help mitigate cut-through traffic on local streets within the community. A collector road would collect traffic from local roads within the community and provide connectivity to high tier arterial roads including Strasburg Road.

2.0 ALTERNATIVES TO THE UNDERTAKING – PLANNING ALTERNATIVES

2.1 Description of Planning Alternatives

Alternatives to the Undertaking (described and evaluated as Planning Alternatives within the Study Design Report) represent alternative ways or methods of addressing the Problem and Opportunity Statement specific to this study. These reflect different strategies and include the "Do Nothing" approach (maintaining the status quo, i.e. not addressing the Problem and Opportunity Statement).

The consideration of all reasonable alternatives is a guiding principle for EA studies. The Biehn Drive extension alignment, sanitary sewer alignment, cross section, and intersection alternatives have been generated through discussions with the City, agencies and the general public. Refer to **Appendix A** for a Glossary of Terms.

The analysis and evaluation process involves a 2-step decision-making process. Initially the study documents the evaluation of Alternatives to the Undertaking (alternative project types or alternative strategies to address the problem) followed by the subsequent evaluation of preliminary design alternatives.

The City of Kitchener TMP previously identified the extension of Biehn Drive as a City Street Capacity Improvement. This TMP completed Phase 1 and 2 of the Class EA process, including the evaluation of Alternative Planning Solutions. The TMP recommended this project as the "implementation of new streets in southwest Kitchener Urban Areas Study Community Master Plan, including extension of Biehn Drive between Biehn Drive and Robert Ferrie Drive".

In determining the preferred undertaking for the City, the following Planning Solutions were evaluated:

Do Nothing: This alternative would maintain the existing road network and would not extend Biehn Drive.

Transportation Demand Management (TDM): Reduces vehicular traffic demand (encourages alternative work hours, work at home and active modes of transportation).

Local Roads: Encourage the use of local roads to reduce the need to extend Biehn Drive. Local roads are generally not designed or maintained to accommodate high traffic volumes.

Limit Land Use Development: Limit any new residential, commercial or industrial development and therefore reduce the generation of new trips.

Extend Biehn Drive: Provides a long-term solution for improved traffic capacity, operations and safety.

Based on the preliminary review of Alternative Planning Solutions, "**Transportation Demand Management", "Local Roads"**, (including the proposed trunk sanitary sewer, maintenance roadway/multi-use path and watermain from Biehn Drive to Robert Ferrie Drive) and **"Extend Biehn Drive"** are recommended.

The evaluation of the Alternatives to the Undertaking (Planning Alternatives) for this Study is shown in **Table 1**.

Table 1: Planning Alternatives

Screening Criteria	Alternative 1: Do Nothing	Alternative 2: TDM	Alternative 3: Local Roads	Alternative 4: Limit Development	Alternative 5: Extend Biehn Drive
Transportation	Does not address forecast traffic demand. Results in increased volumes on local roads.	May reduce vehicular demand by mode shift or work at home but will not eliminate need for new or improved infrastructure.	Local roads not designed to accommodate increased volumes.	May reduce vehicular demand by reducing the number of trips generated by development but does not address existing demands and/or background growth.	Accommodates all modes of transportation.
Environmental	No impacts.	No or low impacts. Low impacts may be associated with active transportation projects/ improvements (i.e. sidewalks, bike lanes).	Low impacts. Creates disruption to properties on local roads that would experience an increase in traffic.	No impacts.	Low to medium environmental effect possible with new corridor. Magnitude of effects is subject to environmental mitigation.
City Planning Objectives	Does not meet objectives/ recommendations in City Planning documents.	Supports objective to encourage active transportation and alternate modes.	Does not meet objectives/ recommendations in City Planning documents.	Does not meet objectives/ recommendations in City Planning documents.	Supports the recommendations for the extension of Biehn Drive in OP and TMP.
Recommendations	Not recommended to be carried forward.	Recommended as a complementary solution.	Following PIC 1 there was public support to carry forward this alternative.	Not recommended.	Recommended to be carried forward.
	✘	✓	✓	✘	✓

✓ **Recommended Planning Solutions for further evaluation**

The long list of alternatives and the coarse screening evaluation of alternatives was presented to the public at Public Information Centre (PIC) No. 1 in early 2021. Following PIC No. 1 and the public's opportunity to comment, the Preliminary Alignment Alternatives were coarse screened, and the recommended alternatives were carried forward for this detailed evaluation exercise. The coarse screening of the long list of alternatives and a description of the evaluation results will be documented in the final Environmental Study Report (ESR).

The Preliminary Alignment Alternatives (Alternative Methods of implementing the Preferred Planning Alternative) that are proposed to be considered for the recommended Planning Solution are: TDM; Use Existing Roads; and Extend Biehn Drive (see above). Following the selection of the preferred solution, the preliminary design will be developed for the alignment, intersections and cross section(s) for the preferred solution.

3.0 EVALUATION METHODOLOGY

3.1 Alignment Alternatives Evaluation Methodology

For the evaluation of the alignment alternatives, the study utilized a formal quantitative evaluation methodology described as the Multi Attribute Trade-off System (MATS). The use of this multi-criteria decision analysis involves establishing utility scores for each alternative on each criterion. The utility scores allow a translation of units of measure to a non-dimensional number that allows scores to be added between factor groups/sub-factors. The scores are then totalled using a system of weights to determine an overall ranking for each alternative.

A detailed description of the evaluation methodology used in this study for selecting the Technically Preferred Alignment is provided in **Appendix A**.

The quantitative approach for the evaluation of Alignment Alternatives is consistent with the Ministry of Environment, Conservation and Parks (MECP) practices for the evaluation of numerous and complex alternatives. This approach uses an analytical approach that measures scores based on a mathematical relationship, i.e., the degree of subjectivity by the evaluation team is minimized. This traceable process allows the evaluation team and the opportunity to assess trade-offs involved in the evaluation and use this information to support the decision-making process. The evaluation criteria include:

- Factor Groups: Traffic and Transportation; Natural Environment; Cultural Environment; Social Environment; Economic Environment; Land Use and Property; and Cost.
- Sub-factor Criteria (under each Factor Group) may include temporary or permanent property impacts; loss of fish habitat; noise; built heritage resource impacts; emergency response; and capital cost.

4.0 EVALUATION OF ALTERNATIVES

4.1 Coarse Screening Alignment Evaluation

4.1.1 Preliminary Alignment Alternatives

The Preliminary Alignment Alternatives presented to the public at PIC No. 1 are shown in **Figure 3**. One additional Alignment Alternative 4 using existing roadways was added following input from PIC No. 1. All the alternatives carried forward to the detailed evaluation were considered by the Study Team to be reasonable alternatives to the Planning Solution and are listed in **Table 2**.

Table 2: Preliminary Alignment Alternatives

Alternative	Description
Alternative 1	Connect Biehn Drive to Robert Ferrie Drive – East Alignment
Alternative 2	Connect Biehn Drive to Robert Ferrie Drive – Central Alignment
Alternative 3	Connect Biehn Drive to Strasburg Road – West Alignment
Alternative 4	Connect Biehn Drive to Robert Ferrie Drive – Via Caryndale Drive

The coarse screening of Alignment Alternatives is shown in **Table 3.**

The preliminary alignment alternatives will include a trunk sanitary sewer in conjunction with the alternative road extension alternatives. It is noted that some of the alternative alignments for the trunk sewer may diverge from the road alignment alternatives. The Class EA process for extension of the sanitary sewer is a Schedule B process. However, the EA for the road and sanitary sewer will be combined into a single document and will be documented in an ESR. This EA is being undertaken concurrently with the Sanitary Sewer Master Plan.

Figure 3: Preliminary Alignment Alternatives

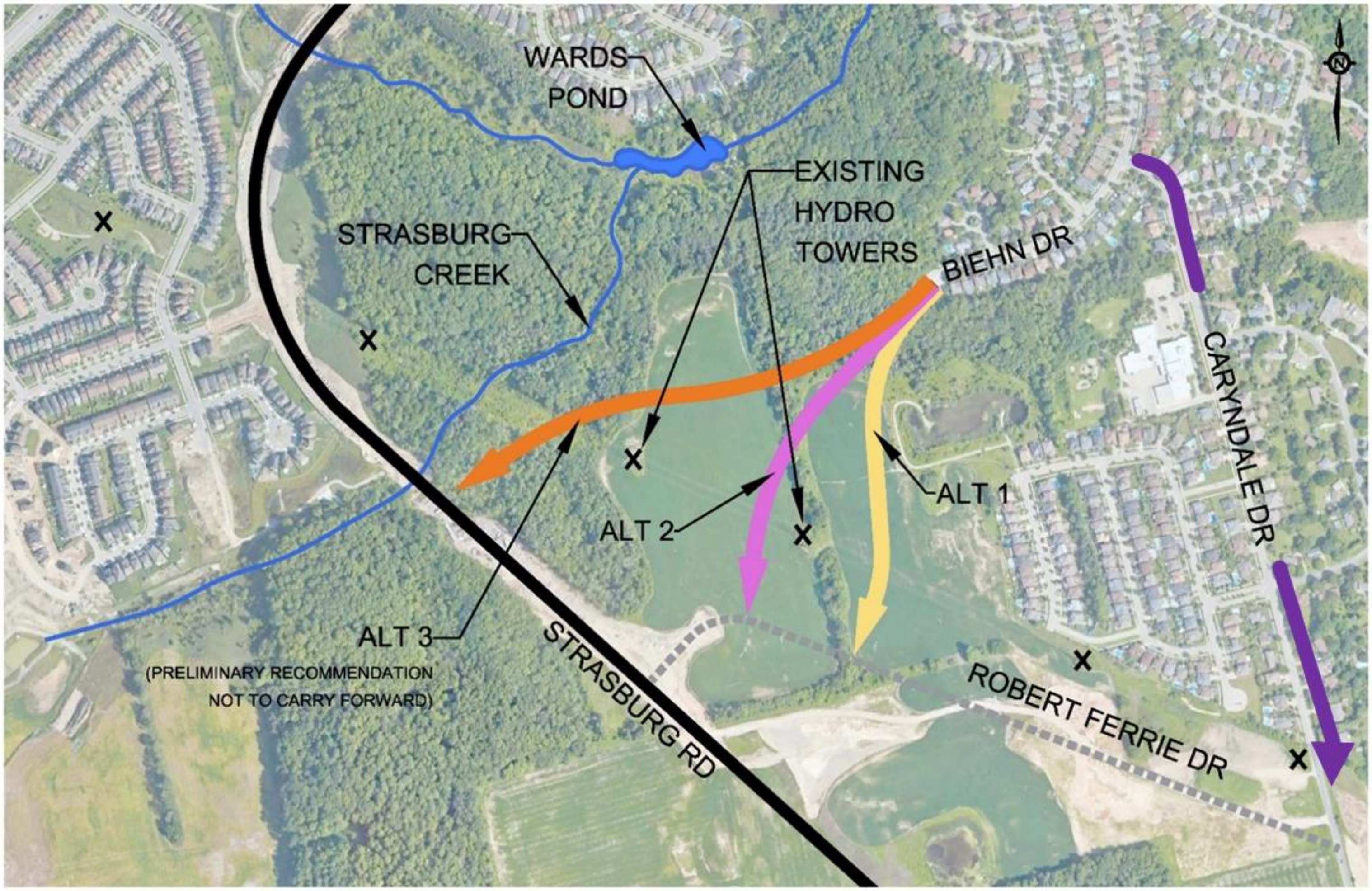


Table 3: Coarse Screening of Alignment Alternatives

Screening Criteria	Alternative 1: Connect to Robert Ferrie Drive east of Hydro Tower	Alternative 2: Connect to Rob ert Ferrie Drive west of Hydro Tower	Alternative 3: Strasburg Road Connection	Alternative 4: Connect Biehn Drive to Robert Ferrie Drive Via Caryndale Drive
Does this alternative sat isfy forecast traffic de mand, improve safety, and address all modes of trans-portation?	Provides a north-south connec-tion to Robert Ferrie Drive. Ac-commodates all modes. Reduces cut-through traffic on Biehn Drive.	Provides a north-south connection to Robert Ferrie Drive. Accommo-dates all modes. Reduces cut-through traffic on Biehn Drive.	Provides a north-south connec-tion to Strasburg Road. Accom-modates all modes.	Provides a north-south connec-tion to Strasburg Road. Accom-modates all modes. However, there are increased levels of traf-fic on local roads.
Does the approach result in significant impacts to the natural environment?	Minor impacts to the wood-lot/PSW (~0.3 ha).	Minor impacts to the wood-lot/PSW (~0.3 ha).	Significant impacts to the wood-lot/wetland (~1.3 ha).	No impacts.
Is the approach affordable for the City to implement?	No significant difference.	No significant difference.	Higher cost - requires an inter-section onto Strasburg Road (ar-terial).	Affordable alternative.
Does this alternative com ply with the recommenda-tions of the City's planning documents (I.e., TMP, OP, KGMP)	This alternative complies with the recommendations of the City's planning documents.	This alternative complies with the recommendations of the City's planning documents.	Does not comply with the recom-mendations of the Official Plan or Growth Management Plan. Based on the previous design and con-struction of the Strasburg Road and roundabout within the Study Area, this previous alternative is no longer considered feasible.	This alternative does not comply with the recommendations of the City's planning documents.
Recommendation:	Carry forward for further evalua-tion	Carry forward for further evalua-tion	Do not carry forward	Carry forward for further evalua-tion
	✓	✓	✗	✓

4.1.2 Short Listed Alignment Alternatives Evaluation

Figure 4 illustrates the three (3) alignment alternatives that were carried forward following the coarse screening. The short listed Alignment Alternatives are shown in **Appendix B** and the preliminary Cross Section Alternatives are shown in **Appendix C**. Alternative 4 was added following public comments received at PIC No.1.

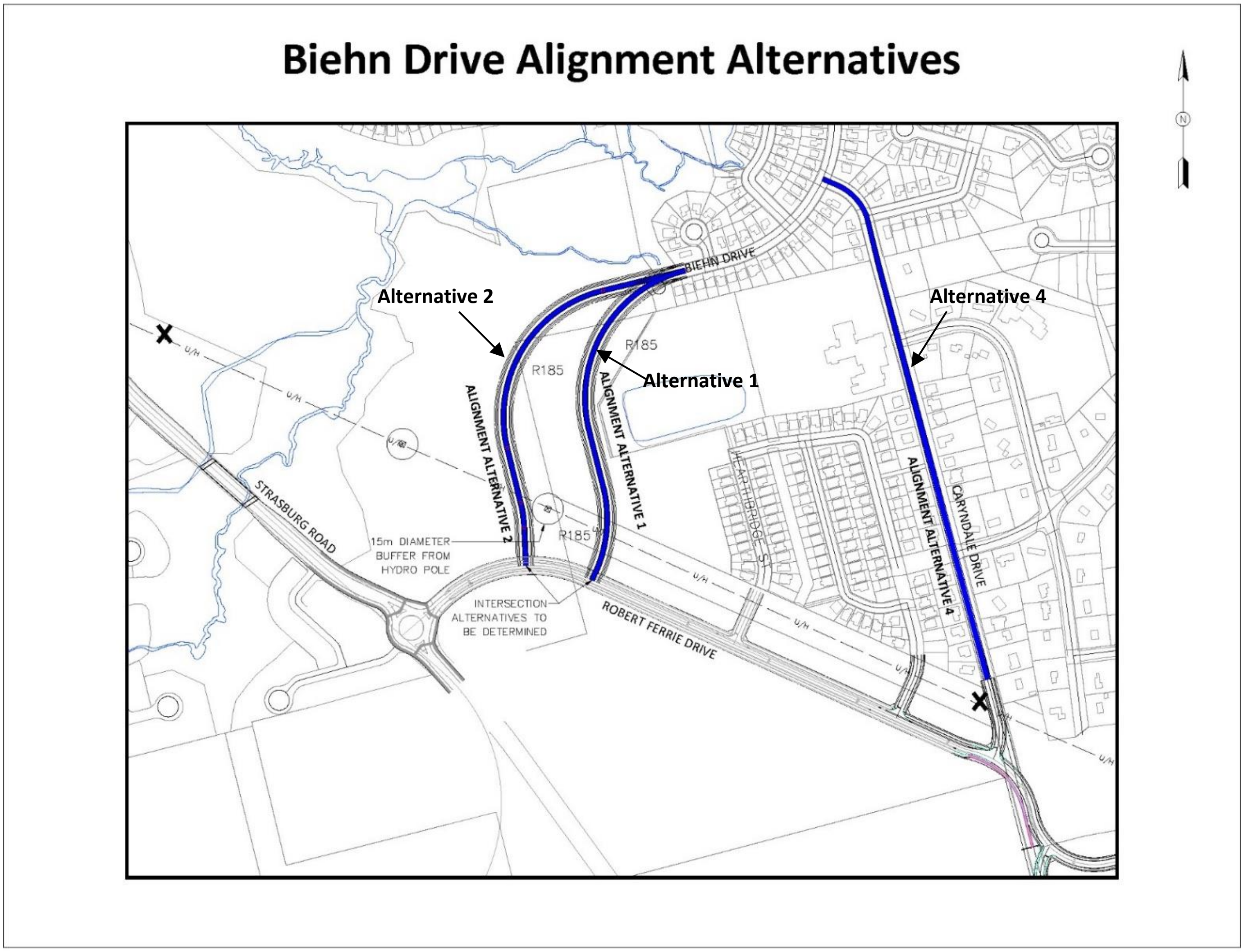


Figure 4: Short Listed Alignment Alternatives

4.1.3 Long List of Criteria - Alignment

The comprehensive long list of sub-factors was established for each of the main factor categories to allow for the identification of all potential benefits and impacts. The relative measured effect of each criterion is also defined to ensure that the significance of each criterion (factor group or sub-factor) is recognized in the evaluation process.

Sub-factors are measurable criteria under a factor group. For example, under the category/factor group "Transportation", sub-factors relate to measurable transportation differences among alternatives. Using the Transportation factor group as an example, sub-factors may relate to safety or traffic operations measures for the identification of benefits and impacts.

Seven categories or factors were selected which were used for each evaluation. Within each of these factor groups are sub-criteria, described as sub-factors, which define the measure and the relative differences of magnitude of impact or benefit. The factor groups include:

- Transportation
- Natural Environment
- Cultural Environment
- Socio-Economic Environment
- Land Use and Property
- Cost
- Engineering

Within each of these categories (factor groups) are sub-factors which define the measure and the relative differences of magnitude of impact. The sub-factors were developed from a long list created by the Study Team (Consultants and City Staff). Where there were no measurable or meaningful differences between alternatives, and it is agreed that the alternatives are generally equal with respect to this criterion, then the sub-factor is not carried forward. When the Evaluation Team (Consultants and City Staff) considered the impacts were double counted among one or more criteria, then only one criterion was selected to be carried forward.

The sub-factors that will not be carried forward are listed in **Appendix D**. For a sub-factor to be carried forward, the sub-factor must:

- Be a measure of a meaningful difference among alternatives;
- Capture a measurable difference among alternatives;
- Not "double count" the effect that was measured under another sub-factor; and
- Describe a difference in performance or an effect on the natural or social environment that the Technical Advisory Committee (Consultants and City Staff) considered necessary to be included in the decision-making process.

The selection of the sub-factors to address the goal of the study, are comprehensive enough to describe all aspects of the effects of the project, and do not double-count sub-factors.

4.1.4 Short Listed Criteria

Sub-factors selected to evaluate the alternatives including their definitions, measurements and utility scores are described in **Appendix E**.

4.1.5 Preferred Corridor Alternative

The Evaluation Team members were responsible for completing separate weighting exercises which provided independent perspectives of the relative importance of factor groups and sub-factors for each specific evaluation. The results of the weighting exercise are illustrated in **Figure 5** and **Figure 6.**

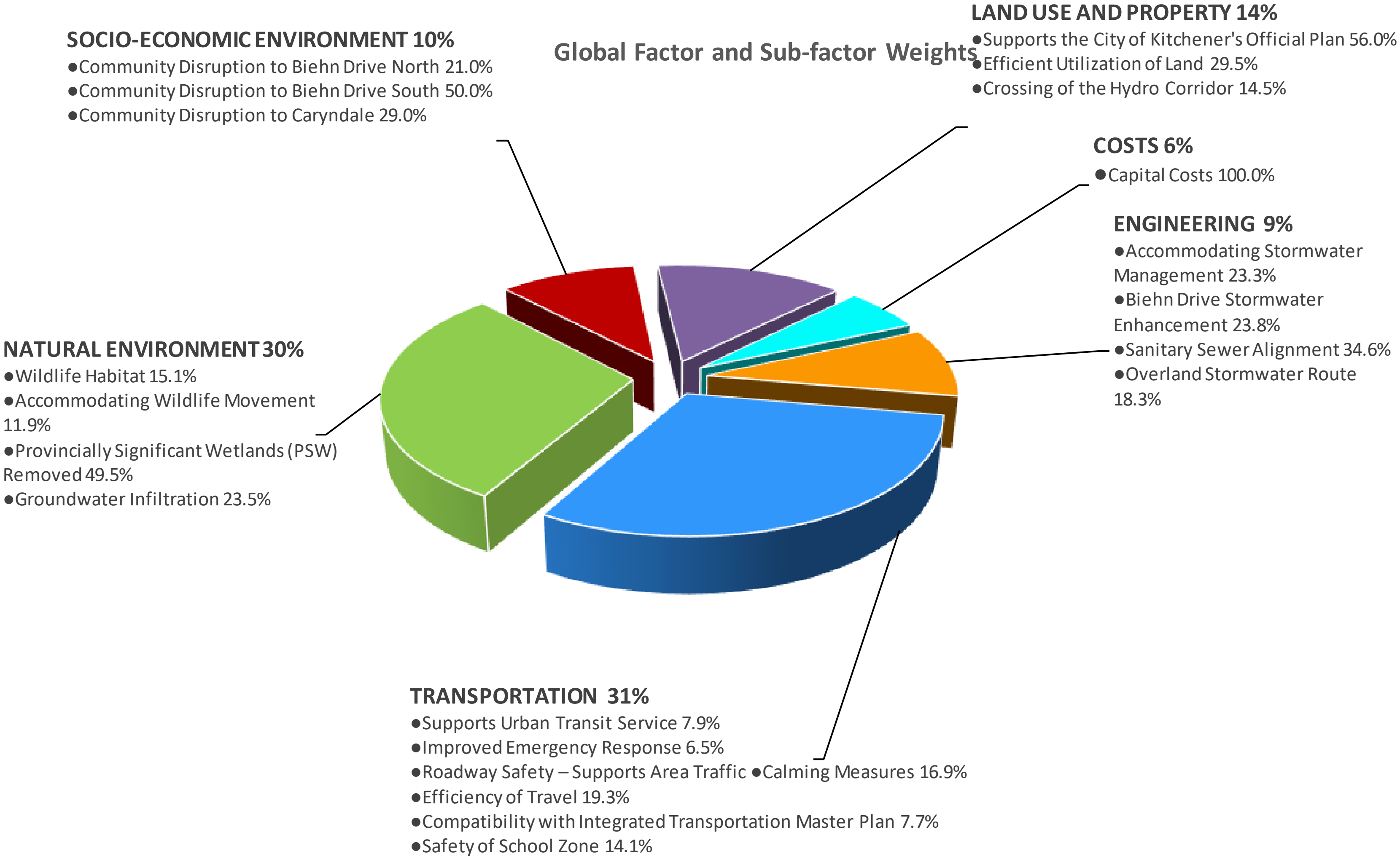


Figure 5: Global Factor and Sub-factor Averaged Weights

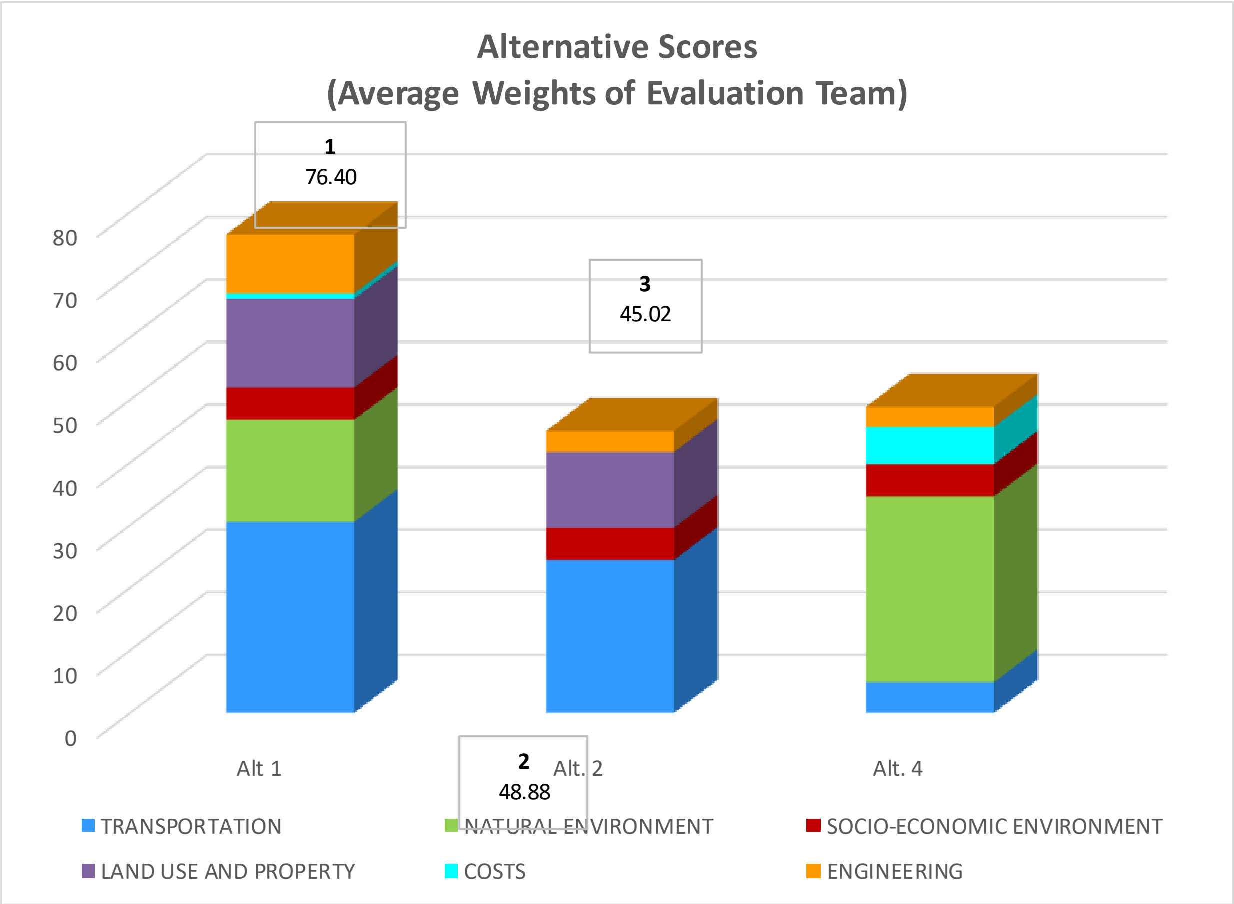


Figure 6: Alternative Scores

4.1.6 Corridor Sensitivity Testing

To validate the weighting exercise, a sensitivity testing program was undertaken to determine whether the Technically Preferred Alternative (TPA) would have changed if a particular factor group was assigned a higher or lower importance than the group average. This ensures greater confidence in the selection process. The results of the sensitivity testing are shown in **Table 4**.

Table 4: Summary of Sensitivity Tests

Alternatives			**Alt 1**	**Alt. 2**	**Alt. 4**
FACTORS	WEIGHT	Score:	76.40	45.02	48.88
Ranking			**1**	**3**	**2**
TRANSPORTATION	High	45.00%	1	2	3
	Low	20.00%	1	3	2
NATURAL ENVIRONMENT	High	40.00%	1	3	2
	Low	20.00%	1	2	3
SOCIO-ECONOMIC ENVIRONMENT	High	15.00%	1	3	2
	Low	10.00%	1	3	2
LAND USE AND PROPERTY	High	20.00%	1	2	3
	Low	10.00%	1	3	2
COST	High	10.00%	1	3	2
	Low	2.00%	1	2	3
ENGINEERING	High	15.00%	1	3	2
	Low	5.00%	1	3	2

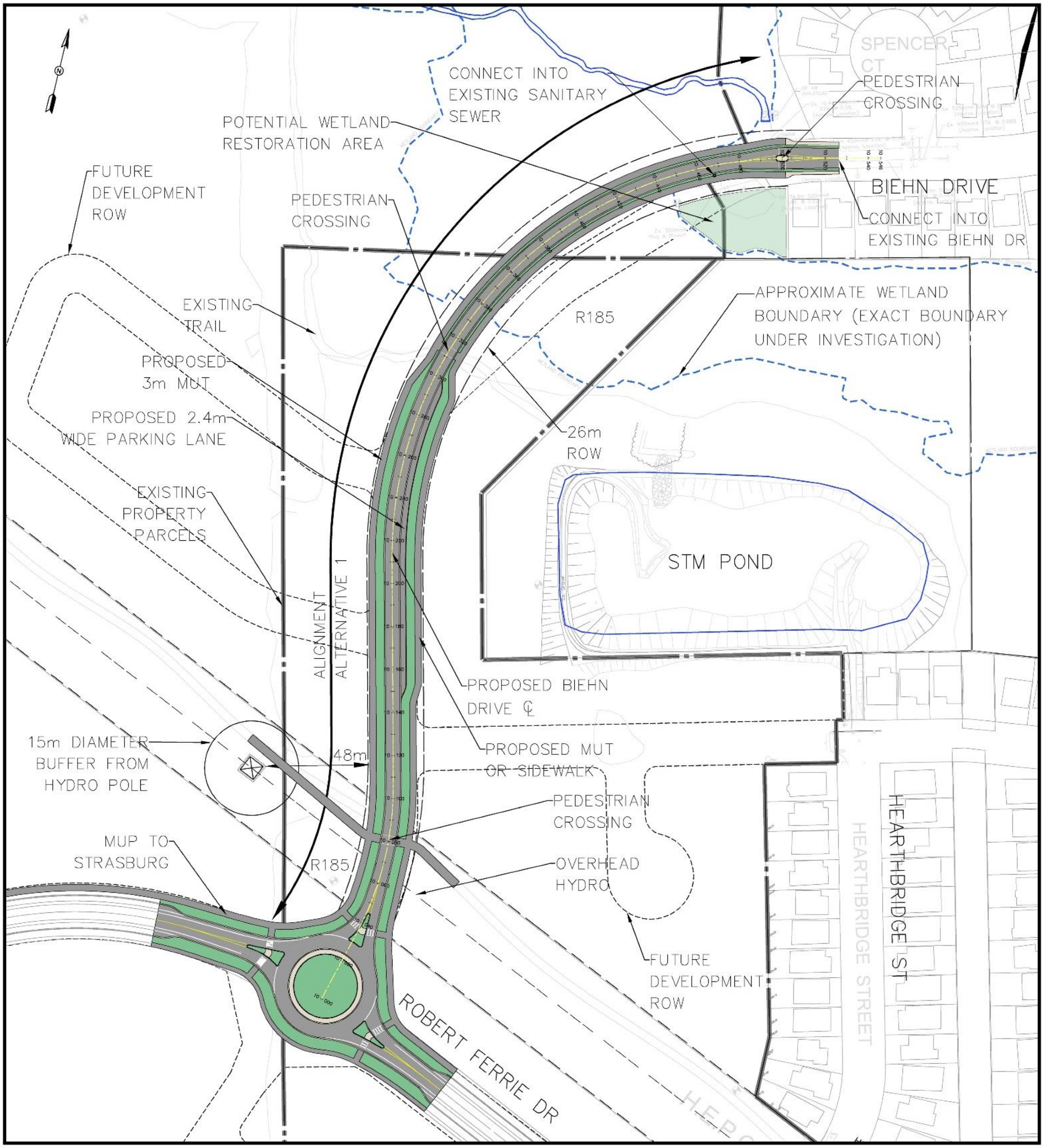
4.2 Technically Recommended Alternative

The Technically Recommended Alternative is shown in **Figure 7**. This recommendation conforms to the City of Kitchener's Official Plan and Integrated Transportation Master Plan and accommodates the associated municipal servicing. It minimizes the impacts to the Provincially Significant Wetland by eliminating the on-street parking and provides a high level of land use planning efficiency to the lands available for development. In addition, this alternative redistributes vehicles travelling to Robert Ferrie Drive from Caryndale Drive and Brigadoon Public School to Biehn Drive, a designated Major Collector in the City of Kitchener.

A MUT on the north side of RFD was not identified in the previous EA but we are recommending as part of this EA that it should be provided along the short section of RFD in place of a sidewalk noting:

- MUT's have already been placed on the portion of the east leg of the Strasburg roundabout which has been constructed
- It would provide better network continuity (providing a MUT connection between the MUTs on Strasburg Road and the MUTs on Biehn Drive)
- At the time the RFD EA was being completed MUTs on Biehn Drive had not been identified

Figure 7: Technically Preferred Alternative



4.3 Cross Section Alternatives

Two (2) cross section alternatives were considered for Biehn Drive outside the limits of the wet-land, refer to **Appendix C**:

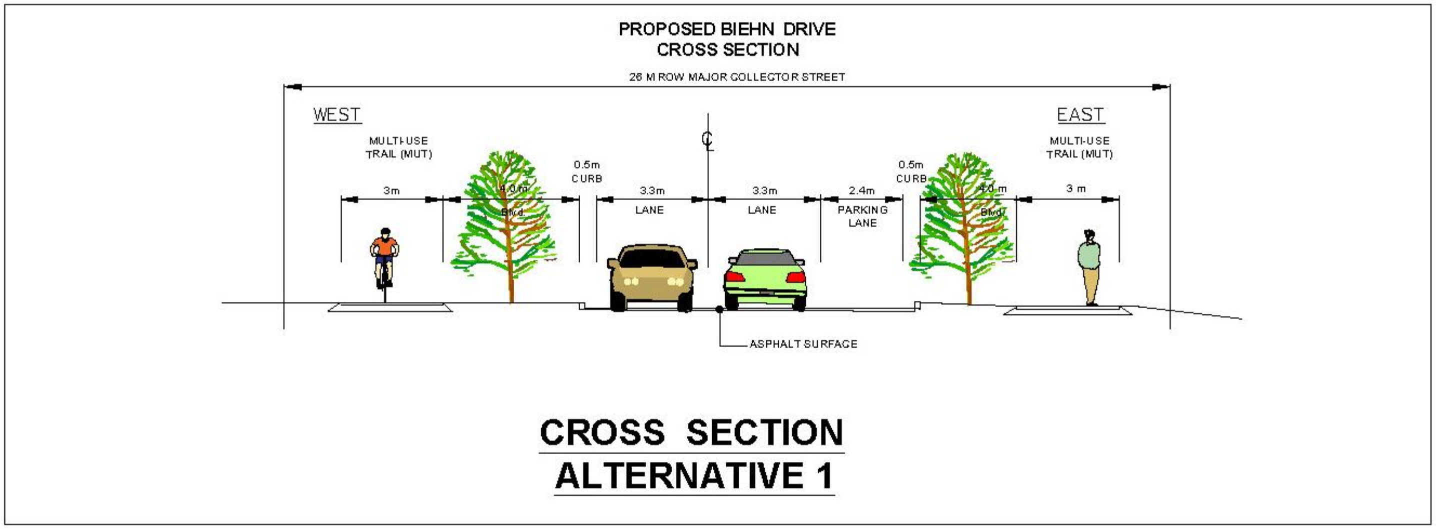
1. Alternative 1 – 26 m Major Collector with In-boulevard Cycling Facilities; and
2. Alternative 2 - 26 m Major Collector with Bike Lanes.

4.4 Technically Recommended Cross Section

The preliminary evaluation of the cross section alternatives is shown in **Table 5**. Alternatives were developed to reflect the City of Kitchener's Complete Streets guidelines. The recommended cross section is Alternative 1 with multi-use trails as shown in **Figure 8**.

Table 5: Cross Section Evaluation

Evaluation Criteria	Alternative 1 – 26 m ROW with Multi-use Trail	Alternative 2 – 26 m ROW with Bike Lanes
Active Transportation	MUTs are preferred by the greatest proportion of cyclists (interested but concerned). Greater network continuity for cyclists with the future MUT along the Hydro corridor and potential to connect to the MUTs along Strasburg Road. ✓	Better accommodates pedestrians by separating pedestrians and cyclists. Increased conflict between cyclists and access to/from parked vehicles. ✗
Traffic Calming	The reduced pavement width would better promote lower travel speeds. ✓	Wider asphalt surface would be less effective in reducing travel speeds. ✗
Impacts to Natural Environment / Storm Water Quality	All alternatives considered equal.	All alternatives considered equal.
Impacts to Developable Lands	All alternatives considered equal.	All alternatives considered equal.
Cost	MUTs are more cost effective to construct with reduced pavement thickness and granulars. ✓	Wider roadway pavement structure increases construction cost. ✗
Recommendation:	Carry Forward **Alternative 1** ✓	



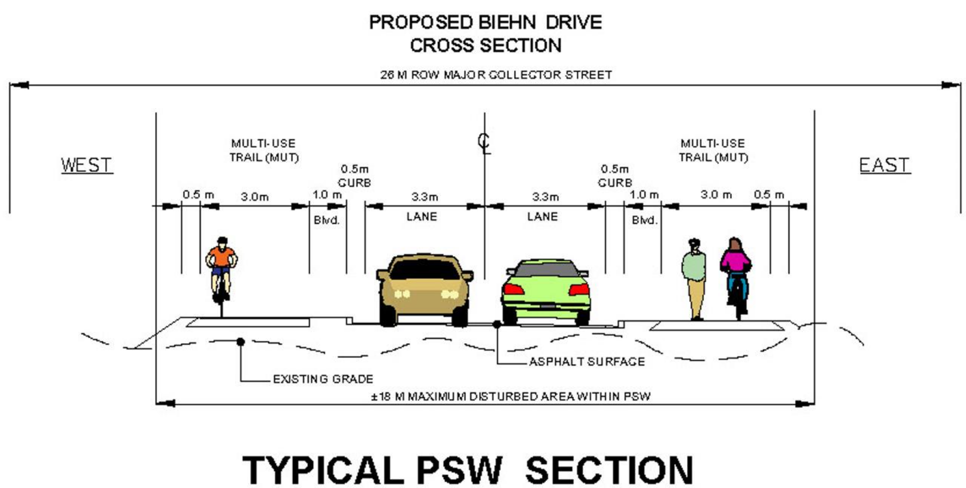


Figure 8: Recommended Cross Sections

Appendix A

Evaluation Methodology

Evaluation Methodology Report

Biehn Drive Municipal Class Environmental Assessment Study

September 2021

Submitted by:

BT Engineering Inc.

509 Talbot Street

London, ON N6A 2S5

Table of Contents

List of Figures

List of Tables

1.0 INTRODUCTION

The City of Kitchener (City) has initiated a Class Environmental Assessment (EA) Study to develop a transportation plan for the extension of Biehn Drive westerly to the Robert Ferrie Drive extension. The Biehn Drive extension will include municipal services including a trunk sanitary sewer, storm sewer/ditches and watermain. The focus of the Study will be to consider alternatives for the alignment of the Biehn Drive extension, intersection locations and designs and municipal services while minimizing environmental, social, and cultural impacts of the project.

1.0 STUDY PROCESS

This Study will complete the remaining phases of the Municipal Schedule C Class EA Study which was initiated by the TMP. The Study will meet all requirements of the Municipal Class EA by establishing the need and justification for the project, considering all reasonable alternatives with acceptable effects on the natural, social and cultural environments, and proactively involving the public in defining a Recommended Plan. The study will culminate in the filing of an Environmental Study Report (ESR) and provide environmental clearance to the City to proceed with the project, subject to permits and approvals that will occur during the future detail design stage of the project.

The Analysis and Evaluation process is a requirement of the EA process, based on the Ministry of the Environment, Conservation and Park's (MECP) Evaluation Methods in Environmental Assessment. [1]

This document describes the qualitative and quantitative methods of evaluation and which approaches will be utilized for different groups of alternatives for this study.

An evaluation method may be defined as a formal procedure for establishing an order of preference among alternatives. The use of a formal evaluation method has two main advantages: it provides a better basis for decision-making than would otherwise exist and it results in reasons for decisions that, on examination, can be traced.

The selection of an evaluation method should consider the following generic factors:

- Various evaluation methods have different capabilities which support different planning processes that may be better suited to a particular project or stage of the EA.
- With any particular planning process, all the steps (such as identifying alternatives, selecting criteria, consulting and involving interested parties, as well as evaluating)

[1] Evaluation Methods in Environmental Assessment, Ministry of Environment, 1990.

must be reasonable and provide a systematic assessment of the net effects of the project.

The selection of the appropriate evaluation methodology depends upon the:

- Complexity of the decision-making;
- Number of alternatives;
- Number of criteria; and
- Sensitivity of the decision.

These issues are described in the following sections which explain the rationale for utilizing the most appropriate evaluation methodology in each stage of the EA study.

2.0 STUDY AREA

The Study Area is located in the City of Kitchener and is illustrated on **Figure 1**.

The Local Study Area extends from the current terminus of Biehn Drive, approximately 60 m west of Spencer Court, southerly to the future Robert Ferrie Drive Extension.

Based on comments from the public at the Community Café and Public Information Centre No. 1, the Study Area was expanded to a Broader Study Area to consider traffic effects in adjacent neighbourhoods.

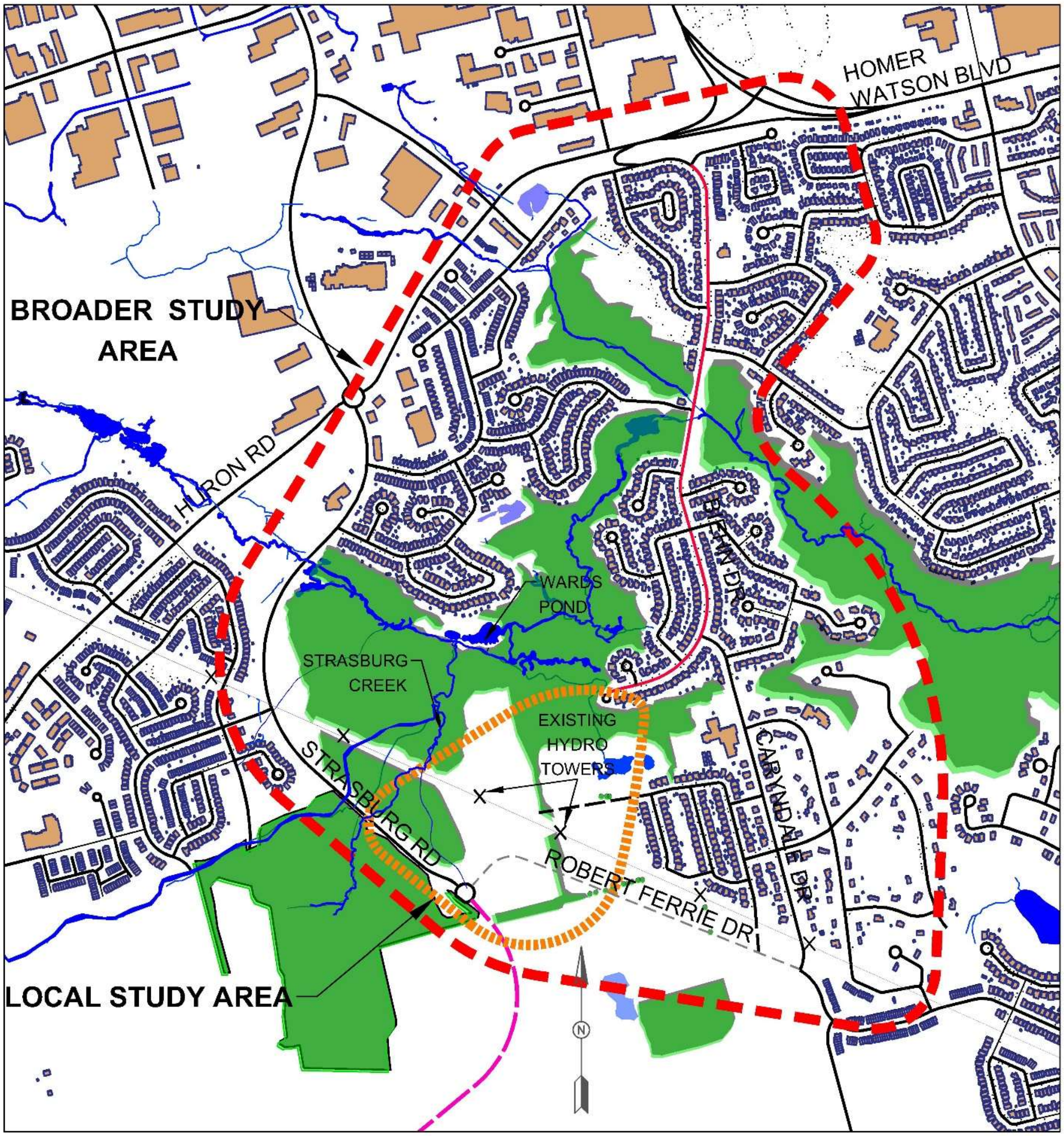


Figure 1: Study Area

3.0 PARTICIPATION

Public participation is a key component to the success of this project. Early public involvement is encouraged to establish a sound understanding of the public's concerns and views, to identify areas of concern and major study issues, and to establish a working relationship with the public that is amicable and cooperative rather than adversarial.

The City of Kitchener has a constitutional duty to consult with Indigenous Communities with traditional land use or interests within the Study Area. Clear, effective and timely consultation with Indigenous Communities is essential to ensure the success of the project.

3.1 Public, Property Owner, and Stakeholder Consultation

The public will be engaged through the use of two Public Information Centres (PIC) meetings and one-on-one meetings with directly affected property owners. This includes meetings and consultation with utilities, businesses and stakeholders that have an interest in providing comments on the design.

3.2 Indigenous Peoples Consultation

MECP has identified the Indigenous Peoples communities to be consulted during this study. Indigenous Peoples will be sent invitations by way of a notice to all public events such as the Community Café and PICs, and will also be extended the offer to be met separately, if desired.

4.0 QUALITATIVE EVALUATION METHODOLOGY

A qualitative evaluation method involves describing impacts in narrative terms, or through qualitative measures, without the explicit specification of criteria, ratings or weights. This method, also known as “professional judgment” is widely used in EA’s to assess “Alternative Planning Solutions”. For example, an EA involving the selection of a corridor might evaluate alternative routes in considerable detail using a formal quantitative evaluation, but the evaluation of “Alternatives To” might be done using a simpler qualitative approach. See **Table 1** for a sample qualitative evaluation.

A challenge of the qualitative approach is the difficulty in recognizing when a comparison will have intuitive choice or universal support (public), i.e. a simple decision easily accepted. A qualitative approach may also be less defensible and could be subject to criticism. Should the public or stakeholders question these early decisions, additional information may be required to substantiate or detail the rationale for the early decisions. When alternatives are not systematically compared against a specified set of criteria, it may be difficult to follow how the decision was made and what evidence supports it.

Some advantages of using a qualitative approach over a quantitative approach include greater simplicity, reduced time and cost, and ease of presentation to the public. A qualitative approach is often used to evaluate alternatives where there is a straightforward conclusion and low public concern. The qualitative approach is also suitable where there are few alternatives and few criteria where there are measurable and meaningful differences between alternatives being considered.

Table 1: Sample Qualitative Evaluation			
Factor Group	**Intersection Alternatives**		
	Alternative 1 Two Leg Stop Control	**Alternative 2 Three Leg Stop Control**	**Alternative 3 Roundabout**
Transportation			
Traffic Operations	-	-	✓
Safety	-	-	✓
Property/Land Use			
Property Impacts	✓	✓	×
Natural Environment			
Impacts to Natural Environment	-	-	-
Social/Cultural			
Social Environment	-	-	✓
Cost			
Cost	✓	✓	-
Evaluation Results	×	×	✓ Carried forward
✓ Good in Comparison	**-** Fair/Equal in Comparison	× Poor in Comparison	Preferred Alternative

Where there are few criteria, such as in **Table 1**, it is generally acceptable to use a qualitative analysis because the trade-offs are clear and understandable. The more rigorous definition of the attributes of each alternative, as would be possible using a quantitative approach, is not required because there are a limited number of evaluation factors.

For this study, the qualitative approach will be used to assess Alternatives to the Undertaking and for the Coarse Screening of the initial long list of Preliminary Design Alternatives.

The use of a more comprehensive evaluation technique becomes necessary as the complexity increases (i.e. number of alternatives and number of criteria). In these situations, as described in **Section 5.0**, this study will utilize a quantitative approach.

5.0 QUANTITATIVE EVALUATION METHODOLOGY

Key principles of the EA Act and MECP's Guidelines on Environmental Assessment Planning and Approval are that there be accountability and traceability. A quantitative evaluation method allows both of these key principles to be addressed. A quantitative method based on the "Weighted Additive Method" will be used for this study and is also referred to as the "Multi-Attribute Trade-off System" (MATS).

The Weighted Additive Method has proven to be well suited for the evaluation of complex groups of alternatives. The methodology allows for sensitivity testing and the ability to answer "what if" questions. It is used on projects where the decision-making process is faced with either a large number of alternatives or a large number of competing criteria for the alternatives being evaluated.

The Weighted Additive Method is consistent with MECP practices for the evaluation of alternatives. It avoids many of the pitfalls associated with qualitative assessments by using an analytical approach that measures scores based on a mathematical relationship, i.e. the degree of subjectivity by the evaluators (i.e. the Technical Advisory Committee (TAC)) is minimized. A traceable process allows the TAC and public an opportunity to assess trade-offs involved in the evaluation and use this information in the decision-making process. In addition, this quantitative method allows sensitivity tests to be performed to determine if the highest ranked alternative is affected by changing the weights (perspective of importance) of the assessment factors.

For this study, preliminary design alternatives will be compared and scores assigned to each of the various assessment factors, and a sensitivity-testing program will be completed in consultation with the public and external agency interaction.

When using the Weighted Additive Method, each member of the TAC assigns a weight to the global factors and sub-factors. The Average TAC Weight is assigned to each of the alternatives. The alternative with the highest score is selected as the Technically Preferred Alternative (TPA). The steps followed to arrive at an overall score for each alternative are shown in **Figure 2**.

This systematic approach includes the following steps:

- Collection of data/environmental inventories
- Development of a long list of reasonable alternatives (including coarse screening alternatives that are not feasible or unreasonable in comparison to those being carried forward)
- Community Open House No. 1
- Development of a long list of global evaluation criteria/performance sub-factors
- Short listing of sub-factors to those where there are meaningful differences among the alternatives to be compared
- Establishing Social Utility Functions (Performance Factors or Function Forms) for the short-listed sub-factors
- Weighting of Evaluation Criteria (assigning importance based on the specific set of alternatives)

- Rating of Alternatives
- Sensitivity Testing
- Selection of TPAs
- Community Open House No. 2
- Preliminary Design Alternatives for the Preferred Corridor Alternative
- Qualitative evaluation of the Preliminary Design Alternatives
- Community Open House No. 3
- Refinements to the Technically Preferred Plan (TPP)
- Recommended Plan
- Community Open House No. 4

These steps, as they relate to this project, are briefly described in the following sections.

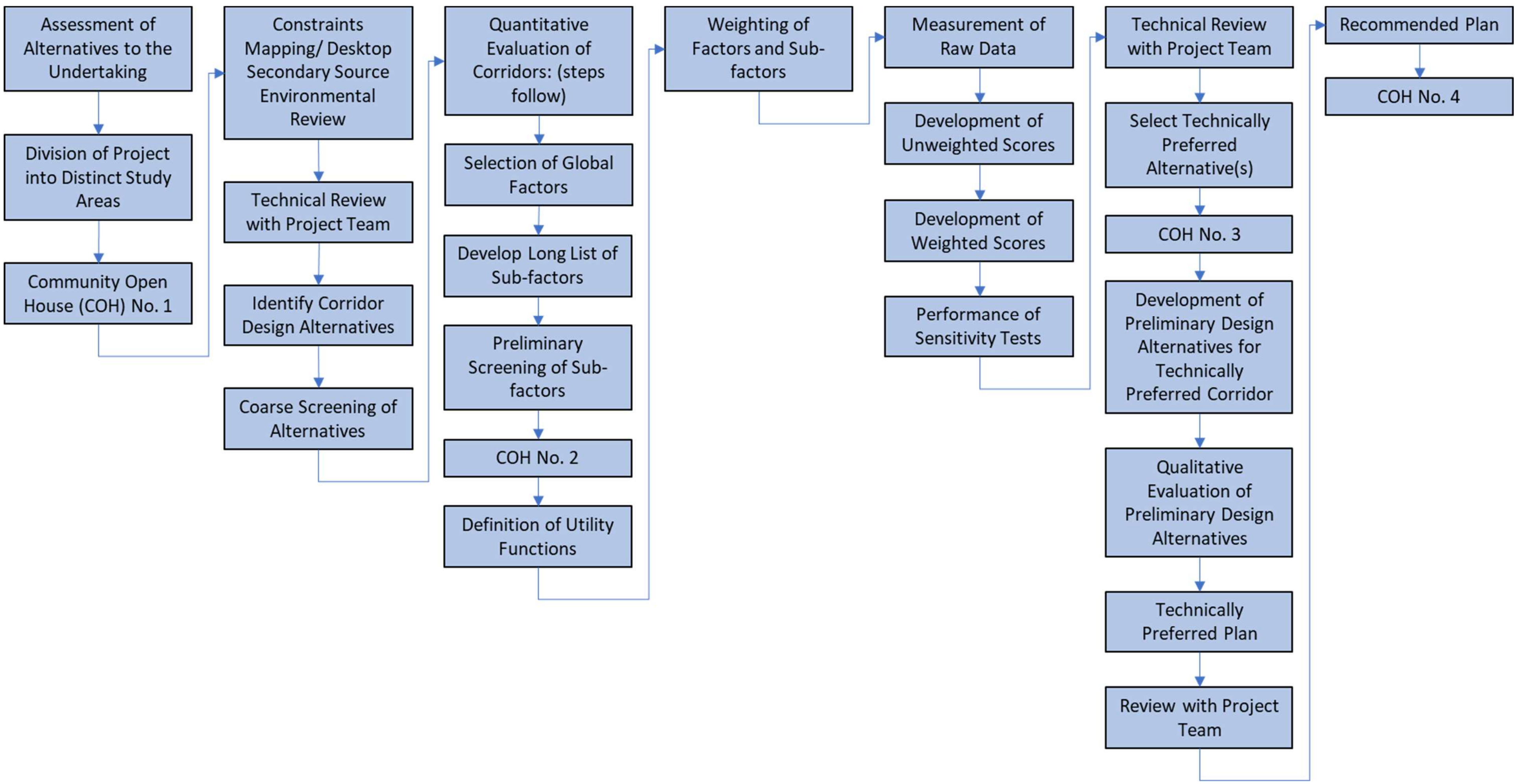


Figure 2: Study Evaluation Process

5.1 Evaluation Criteria – Factors

The initial step in the evaluation is to develop evaluation criteria from which alternatives will be assessed. This is a two-step process that involves the selection of a "global" group of factors and a number of "local" sub-factors under the global groups.

The global factors groups will be presented to the public and, following this consultation, will be accepted as describing the broad definition of the environment to be evaluated. Global factors considered for this study may include:

- Traffic and Transportation;
- Natural Environment;
- Cultural Environment;
- Socio-Economic Environment;
- Land Use and Property; and
- Cost.

While these factor groups are the starting point for the evaluation, one or more factors may be removed if it is determined that there is no sub-factor in this category i.e. there is not a meaningful and measurable difference between the alternatives being assessed in this category. When a particular factor is carried forward, then one or more sub-factors are considered under this group. These sub-factors are the individual descriptors for the evaluation. The selection of the sub-factors is very important to the decision-making process because they must adequately describe the issue to be evaluated and the alternatives being compared. See **Table 2** for a sample preliminary listing of sub-factors. Any information regarding an alternative, where there are differences among alternatives, is incorporated into the decision-making process by including it as a sub-factor. The benefit to incorporating two levels of evaluation criteria (global factors and local sub-factors) is the prevention of the unbalancing of the evaluation (that could occur by adding more criteria under one group). Weights are assigned to the global factors to eliminate any possibility of skewing the results by selecting a large number of sub-factors in one particular factor group.

Table 2: Sample Long List of Evaluation Criteria (Global Factors and Sub-factors)	
Traffic and Transportation	
1. Vehicular Safety	×
2. Vehicular Detour Duration	✓
3. Out-of-Way Travel	✓
4. Traffic Delay	×
5. Risk of Queuing	✓
6. Disruption to Bicycles and Pedestrians	✓
7. Design Standard	✓
8. Design Speed	×

Table 2: Sample Long List of Evaluation Criteria (Global Factors and Sub-factors)	
9. Radius of Horizontal Curves	✗
10. Radius of Vertical Curves	✗
11. Consistency with Adjacent Roadway Design Elements	✗
12. Safety of Residential Entrances	✗
13. Sight Distances	✗
14. Level of Service on Cross Streets	✗
15. Ability to be implemented for construction contract	✗
Natural Environment	
1. Area of Unevaluated Wetland Impacted	✗
2. Area of Provincially Significant Wetland Impacted	✓
3. Fish Habitat Impacted	✓
4. Impact to Natural Woodland Habitat	✗
5. Wildlife Corridors Impacted	✗
6. Number of Watercourse Crossings	✗
7. Number of Groundwater Wells Impacted	✗
8. Stormwater Impact	✓
Cultural Environment	
1. Areas of Archaeological Potential Impacted	✓
2. Loss of Visual Screening	✓
3. Cultural Landscape Features Impacted	✗
4. Built Heritage Features Impacted	✗
5. Community Cohesion	✗
6. Impact to Existing Bicycle Path	✗
7. Snowmobile Trails Impacted	✗
8. Vibration Impacts	✗
9. Bridge Aesthetics	✓
Socio-Economic Environment	
1. Out-of-way Travel to Businesses	✓
2. Impact to Township Roads	✓
3. Impact to Region Roads	✗
4. Impact to Community Uses (ski resorts, etc.)	✗
5. Impact to Aggregate Resources	✗
6. Impact to Farming Activities	✓
7. Impact to Existing Utilities	✓
8. Number of Noise-Sensitive Areas Impacted	✓
9. Out-of-Way Travel, Emergency Services	✗
10. Out-of-Way Travel, School Buses	✗
11. Potential to Support Regional Development	✗
Land Use and Property	
1. Temporary Limited Interest Required	✓
2. Number of Properties Impacted (Total)	✓
3. Number of Buyouts (Total)	✗

Table 2: Sample Long List of Evaluation Criteria (Global Factors and Sub-factors)	
4. Area of Residential Property Required	×
5. Number of Residential Buyouts	×
6. Area of Industrial Property Required	×
7. Number of Industrial Buyouts	×
8. Area of Institutional Land Required	×
9. Number of Institutional Buyouts	×
10. Area of Public Service Facility Land Required	×
11. Number of Public Service Facility Buyouts	×
12. Area of Prime Agricultural Land Required	×
13. Number of Agricultural Buyouts	×
14. Area of Commercial Land Required	×
15. Number of Commercial Buyouts	×
16. Parks/Open Space Area Required	×
17. Utility Corridors Impacted	×
18. Potentially Contaminated Sites Impacted	×
Cost	
1. Life Cycle Cost	✓
2. Durability	✓
3. Maintenance	✓
4. Constructability	✓
5. Long Term Lighting	✓
6. Potential for Settlement	×
Legend: ✓ Carried Forward × Not Carried Forward	

Generally, the process begins by establishing a long list of potential sub-factors through discussions with the public, community associations, the TAC and interest groups or from previous studies of the same nature. Then, for each group of alternatives being evaluated, the sub-factors are reviewed and screened by eliminating those that are considered equal among alternatives being considered as well as those that do not apply to the Study Area, based on the site inventories carried out.

Table 3 provides a sample of a typical Global Factor, Sub-Factor, Unit and Utility Function Type from a Transportation Study. Similar Global Factor, Sub-factor and Utility functions will be developed for this study.

Table 3: Typical Evaluation Factor and Sub-Factors			
Global Factor	**Sub-Factor**	**Unit**	**Utility Function Type**
Traffic and Transportation	• Level of Service (LOS)	Letter (A, B, C, D, E or F)	Stepped Function
	• Number of conflicts	Number	Linear
	• Number of intersections	Number	Linear
	• Number of entrances	Number	Linear
	• Out-of-way travel	Minutes	Linear
	• Flexibility for staged construction	Yes/No	Dichotomous
	• Ease to implement detour for new structure	Yes/No	Dichotomous
	• Design consistency	Yes/No	Dichotomous
	• Ability to stage construction	Yes/No	Dichotomous

5.2 Factor and Sub-factor Weights

The selection of weights for the factors and the sub-factors is based on assessments by the TAC of their relative importance. Within a group of factors, inevitably there is an ordering, with some factors having more importance than others. This is accounted for by each individual assigning a weight to each factor, which is reflected in the "Factor Weight" and "Sub-Factor Weight" columns. An example of typical results is shown in **Table 4**.

Table 4: Sample TAC Average Weights for a Factor Group and Sub-Factors in that Group		
Factors	**TAC**	
	Factor Weight	**Sub-Factor Weight**
Traffic and Transportation	40.9%	
• Level of Service (LOS)		27.6%
• Number of conflicts		13.5%
• Number of intersections		7.3%

Table 4: Sample TAC Average Weights for a Factor Group and Sub-Factors in that Group		
Factors	**TAC**	
	Factor Weight	**Sub-Factor Weight**
• Number of entrances		6.1%
• Out-of-way travel		2.6%
• Flexibility for staged construction		9.6%
• Ease to implement detour for new structure		13.9%
• Design consistency		9.2%
• Ability to stage construction		10.2%
	Total	**100%**

As shown in **Table 4** in this example, the group of evaluators judged the Traffic and Transportation Factor Group to be valued at 40.9% of the overall importance of the decision between the alternatives being considered.

Within each Factor Group the sum of the percentage weights of all sub-factors listed under each factor totals 100%. As shown in **Table 4** several of the sub-factors were judged to be more important/less important when compared to each other for this specific evaluation of alternatives being considered.

The weights for each factor and sub-factor are determined by averaging the weights assigned by the TAC (Evaluation Committee). Each member gives a judgement of the importance of each global factor and local sub-factor (a percentage value) based on his or her personal assessment and professional judgement, considering the net effects and input of stakeholders and the public.

There is usually a range of perspectives in deciding the weights (importance) of factors and sub-factors. Every person assigning weights has a personal perspective and understanding of the scope of the project. Hence, there is an advantage to having a diversified team of professionals with varied backgrounds performing the evaluation.

An example of the weighting of each of the global factors is shown in **Figure 3**. The weighting of sub-factors within each factor group would be a similar distribution among the available sub-factors.

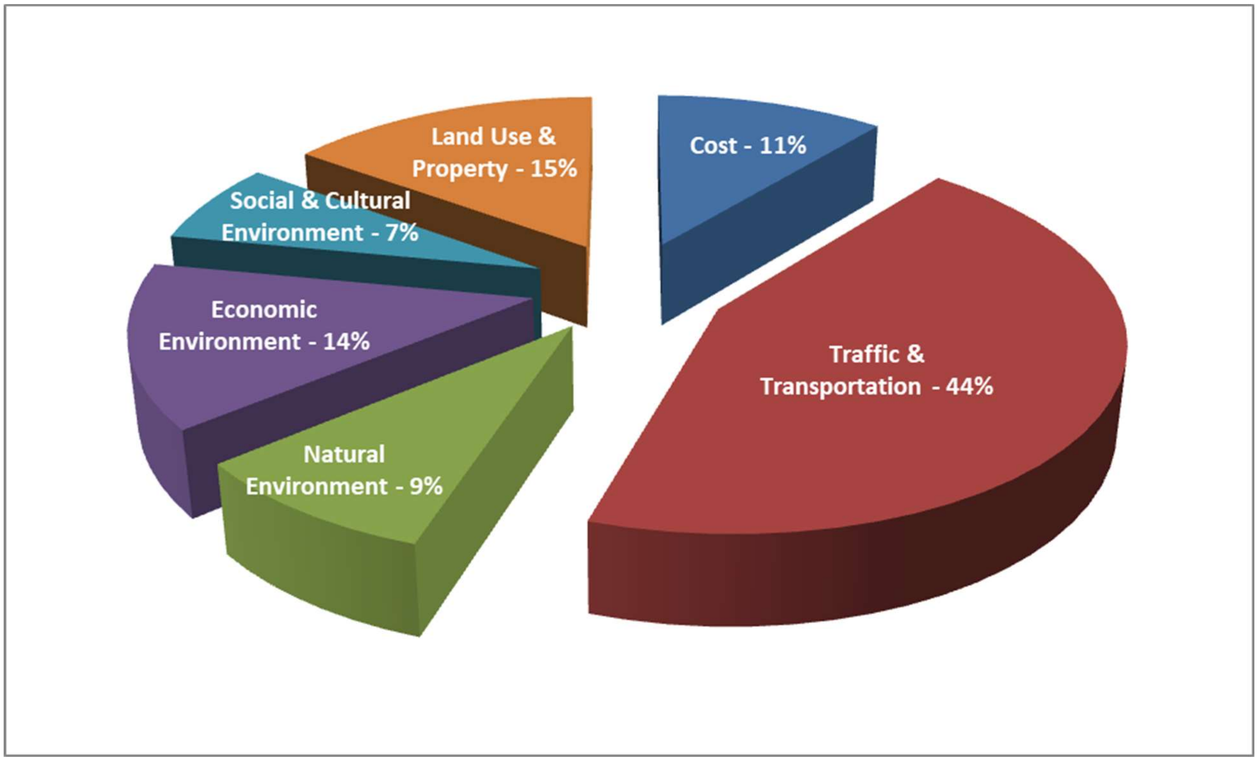


Figure 3: Sample Weighting of Global Factors

5.3 Social Utility Functions

The Weighted Additive Method used to evaluate alternatives relates the performance or attractiveness of alternatives using a mathematical relationship. This includes two variables: the first is the raw data or measured or modelled data, and the second is the utility or utility score, which is the measure of attractiveness of the alternative.

For this project, the relationship between these two variables is described, as shown in **Figure 4**, by either a dichotomous, stepped, or linear social utility function. A dimensionless utility score between zero (0) and 1 is assigned to an alternative for each sub-factor. The shape of this function can vary from linear to stepped or exponential and is defined by a subject area specialist.

The use of utility curves or functions is a step that transforms each of the measured effects to a dimensionless number and measure of utility. This step is required because the effects of each sub-factor are measured in different units (length, area, time, volume, dollars etc.). To produce a mathematical measure of the performance, each effect is translated to a measure of utility. The combined effect or performance of each alternative is a measure of utility (attractiveness) which is a dimensionless measure. The utility function (also commonly described as performance factor or function form) defines the relationship of effect to the attractiveness (utility). These utility functions are defined by subject area specialists in their field of study.

Examples of Social Utility Functions for the “Ease of Maintenance” sub-factor definition are shown in **Figure 5**.

A dichotomous utility function enables the decision-maker to establish criteria that presents an “either–or” situation (desirable or undesirable, negative or positive, present or absent). If it is decided beforehand that a “yes” answer is desirable, then a utility score of one would be assigned to this criterion, otherwise zero would be assigned. One or zero are the available alternatives; no other utility score is available.

A linear function is used to convert scores for sub-factors that have varying measurements. Given a measurement, a unique utility score between zero and one can be assigned to a sub-factor. The slope of the linear utility function can be negative or positive depending on the desirability of the impact.

Figure 4: Sample Utility Functions

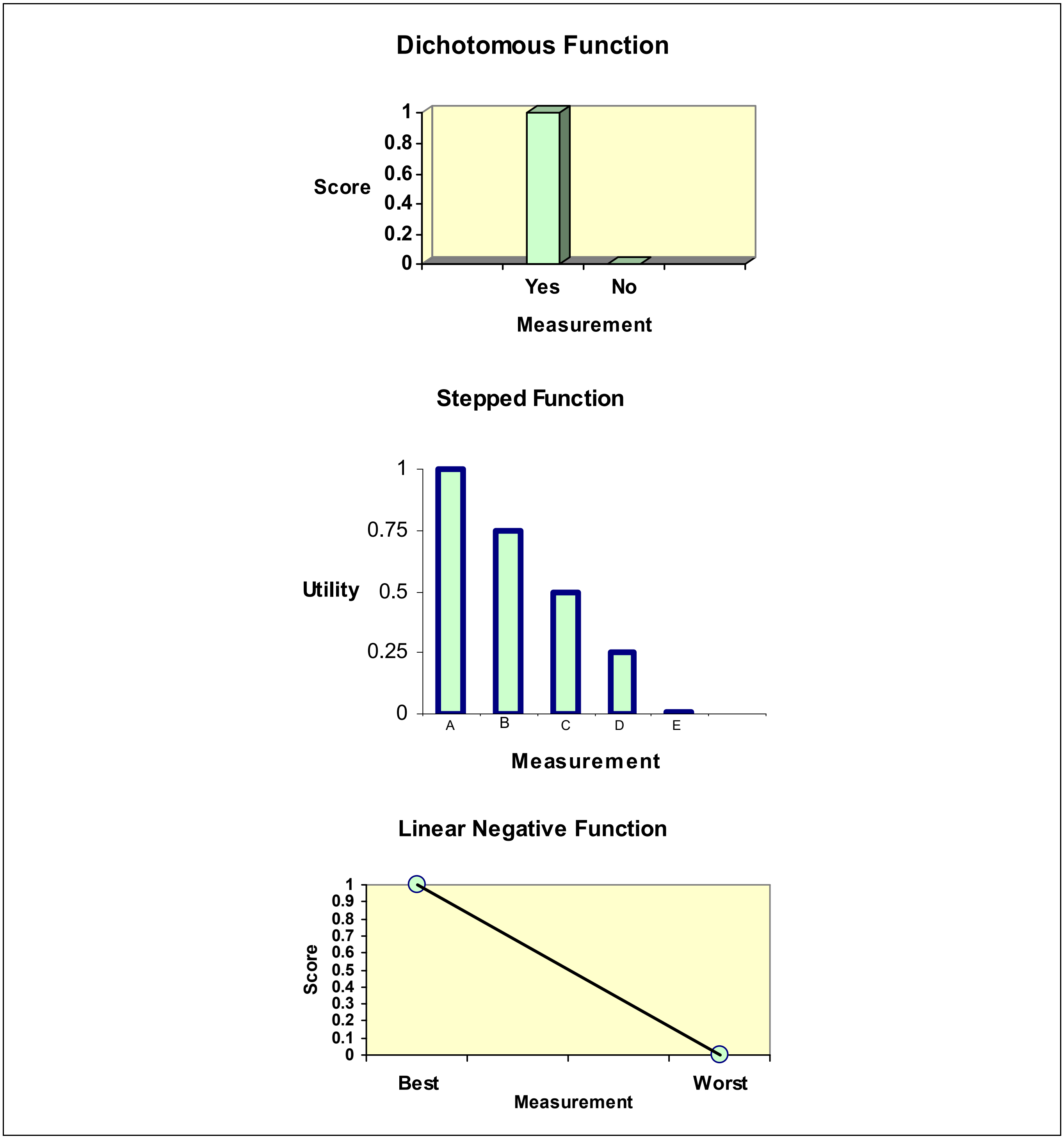
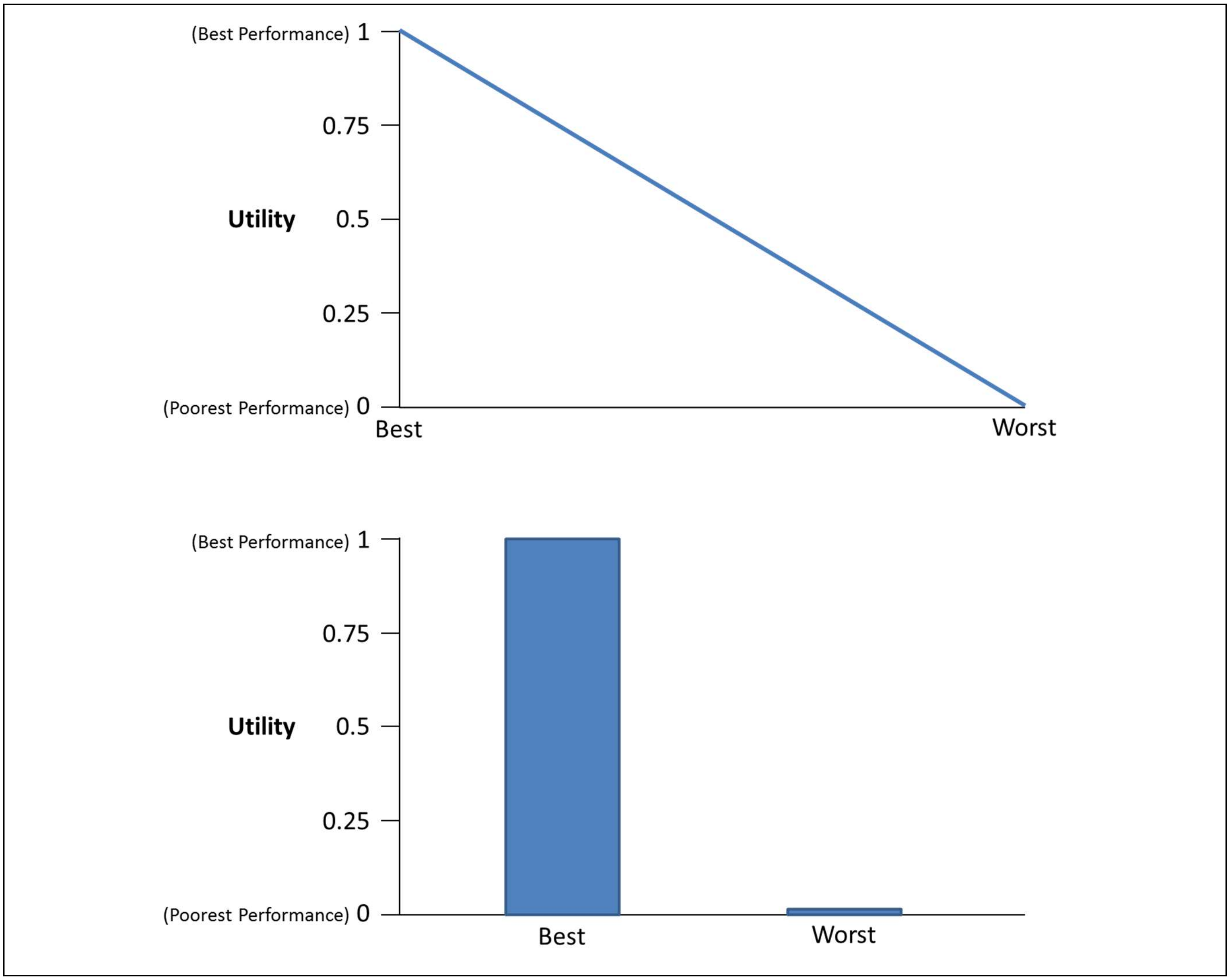


Figure 5: Social Utility Function



5.4 Weighted Score

The total un-weighted utility score of a given alternative can be expressed as:

U (Alternative A) = $\varnothing_1 X_1 + \varnothing_2 X_2 \ldots\ldots + \varnothing_n X_n$**, where**

U (A) = Total un-weighted utility score for Alternative A

$\varnothing_1$ **= attractiveness with respect to parameters**

X_1 **= measurement of parameter X**

Weighted scores are computed using the weights selected by the TAC. The weighted score for each alternative under a specific sub-factor is calculated as follows:

(weighted score) = (utility score x [(factor weight) x (sub-factor weight)])

Using this approach, a generic weighted attractiveness function can be expressed as:

U_w **(Alternative A) =** $U_1 W_1 + U_2 W_2 + \ldots. + U_n W_n$

OR

U_w **(Alternative A) =** $W_1 \varnothing_1 X_1 + W_2 \varnothing_2 X_2 \ldots. + W_n \varnothing_n X_n$

Where: U = Total un-weighted utility score for Alternative A

U_w (A) = Total weighted utility score for Alternative A

W_1= Weighted parameter (factor weight x sub-factor weight)

$\varnothing_1$ = Attractiveness with respect to parameter 1

X_1 = Measurement of parameter

The weighted scores of all the sub-factors are then added to give total score for each alternative.

$$U_w(A) = \sum_{X=1}^{n} W_n \varnothing_n X_n$$

5.5 Rating Alternatives

Following the selection of evaluation factors and sub-factors, measurements of the impacts are made using topographic plans, field surveys, and numerical modelling. These measurements result in data being available under each of the evaluation criteria from which ratings are made for each alternative.

The Weighted Additive Method focuses on the differences of the alternative, addresses the complexity of the base data collected and provides a traceable and defensible decision-making process. This process is a numerical calculation where alternative scores are determined through the use of a mathematical relationship to equate impacts to scores. It eliminates any possible subjective opinions of scores for alternatives because the team does not estimate the score for an alternative.

The scores for each alternative under each of the respective sub-factors are normalized based on measured impacts. Social utility functions are defined to relate impacts to the attractiveness of an alternative. This means that under each sub-factor, the alternative receives an un-weighted rating of between zero and one based on these measurements. The mathematical relationships for calculating scores are developed in consultation with the TAC.

5.6 Sensitivity Testing Program

It should be recognized that the scope of the evaluation and determination of weights for the evaluation criteria are a matter of personal and professional judgement. Accordingly, it is considered essential to conduct sensitivity testing to determine the effect of changing weights assigned to each criterion.

To test how sensitive the outcome of the evaluation is with respect to the assigned weights (i.e. would the result have changed if different weights were used), a sensitivity testing program is undertaken. This results in greater confidence in the selection process and reduces the potential that the average weights bias the outcome of the evaluation.

Often, there is a diversity of opinion in the group as to what weight is appropriate for a factor or sub-factor. When an average weight is used to capture the preferences of the group it loses valuable information on the range of values of the group. To test the range of perspective of the TAC, the highest and lowest weights suggested by anyone in the group are defined as a reasonable range of weights to test. A series of sensitivity tests are performed for the evaluation of alternatives. This allows the team an opportunity to assess the outcome of the evaluation if different weights (different perspectives of importance) are assigned to the factors and sub-factors from the average weights defined by the TAC members. In this way, trade-offs can be identified, credibility can be achieved with the public, and “what if” questions can be answered quickly. See **Figure 6** for an example of the typical range of project team weights and **Table 5** for a sample ranking of alternatives.

Following the above methodology, a series of tests can be performed varying the weights for each global factor. These tests include:

- Average TAC Team Weight
- Highest Weight by any Team Member
- Lowest Weight by any Team Member

Following this series of tests, the results can be reviewed to assess whether the preferred alternative changes when the weights are varied.

Using this information alone is not the only justification for selecting a particular alternative, but it does provide a level of confidence in the selection. This information is used in the decision-making process before the TPAs are recommended to be carried forward.

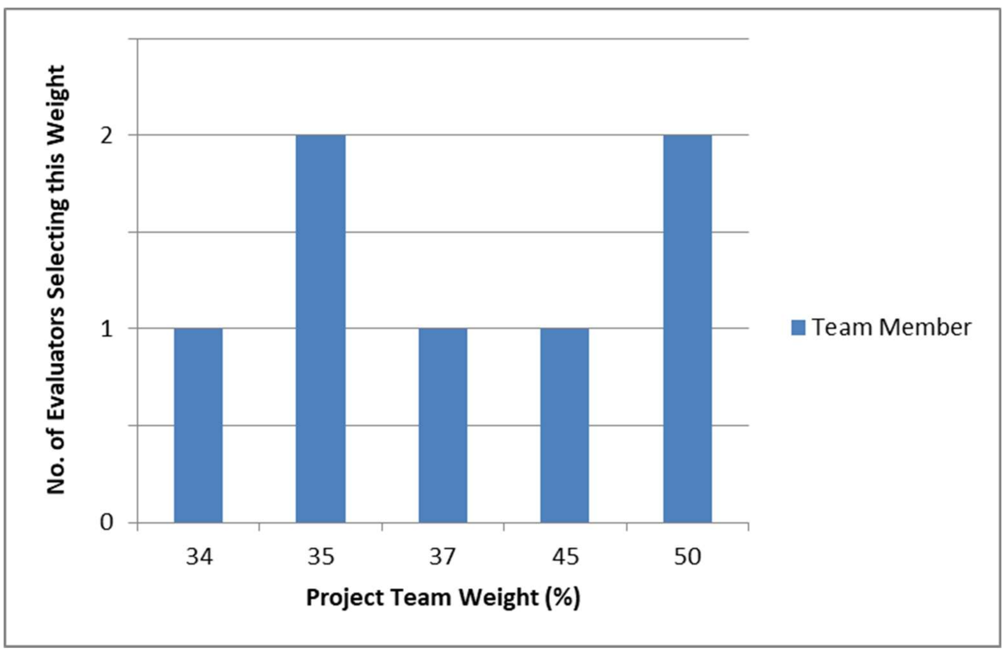


Figure 6: Sample Range of Weights for Traffic and Transportation

Table 5: Sample Ranking of Alternatives					
Testing	**Weight**	**Alt 1A**	**Alt 1A'**	**Alt 1B**	**Alt 1C**
TAC Average Team Scores	N/A	2	1	3	4
High Traffic and Transportation	65%	2	1	3	4
Low Traffic and Transportation	30%	2	1	3	4
High Natural Environment	20%	2	1	3	4
Low Natural Environment	5%	1	2	3	4
High Economic Environment	30%	1	2	3	4
Low Economic Environment	5%	2	1	3	4

5.7 Selection of Technically Preferred Alternative(s)

The TPA(s) identifies the preferred solution by considering the technical analysis, environmental considerations and comments of all study participants.

The TPA(s) is then presented to the public and external stakeholders. This allows for any comments or questions regarding the proposed design.

It should be recognized that the information and conclusions obtained using the evaluation method are only tools used to assist in the evaluation process and identifying trade-offs. In the end, it is the TAC (Evaluation Committee) which makes the final decision on the selection of the TPA(s), using both the information obtained throughout the evaluation process and their individual experience and expertise, and through additional input from senior management on funding availability or other program constraints.

The findings of the analysis and evaluation process will be included as a component of the EA Process and documented in the Transportation Environmental Study Report. The principles and methodology of the EA process assist the TAC in the analysis and evaluation of alternatives and the selection of the TPA. The public and government agencies have the opportunity to provide input throughout the course of the study.

Glossary of Terms

AASHTO	American Association of State and Highway Transportation Officials
Adjacent	Adjacent indicates lying near MTO or Municipal roadway rights-of-way, although not necessarily contiguous to them.
Aesthetics	Methods of providing visual relief and appealing characteristics to planned noise barriers thorough the application of landscaping designs.
Alternative	Well-defined and distinct course of action that fulfils a given set of requirements. The EA Act distinguishes between “Alternatives to the Undertaking” and “Alternative Methods of Carrying out the Undertaking”.
Coarse Screening	Initial screening of a group of alternatives. Also see Screening.
COH	Community Open House
Criterion (Criteria)	Explicit feature or consideration used for comparison of alternatives.
Dichotomous Utility Function	A utility function that represents a desirable or undesirable response from a criterion (yes/no, present/absent, true/false).
Dimensionless Number	A number that does not have a unit of measurement, such as length (m), time (s), mass (kg) associated with it. Examples include Utility Score and Overall Score.
Do Nothing Alternative	This alternative is a mandatory requirement of the Class EA. This alternative is the null or no action alternative and it becomes the baseline to which all alternatives are compared.
Double Counting	Unintentional accounting for a particular factor or attribute more than once in the evaluation.
EA	Environmental Assessment
Evaluation	The outcome of a process that appraises the advantages and disadvantages of alternatives.
Evaluation Criteria	See Criteria.
Evaluation Process	The process involving the identification of criteria, rating of predicted impacts, assignment of weights to criteria, aggregation of weights, and rating to produce an ordering of preference of alternatives.

Factor	See Global Factors.
Function Form	See Utility Function
Global Factors	The main categories of factors, (i.e. Transportation, Economic Environment, Natural Environment, Social and Cultural, Land Use and Property and Cost). All sub-factors are components or a subset of global factors.
Linear Utility Function	A function that can be defined using a linear equation of the form: $y = a + bx$, where y is the dependent variable (raw score) x is the independent variable (measurement) b is the slope of the function, and a is the y intercept, normalized in this study to be equal to one or zero
Matrix	A rectangular array of criteria and values.
MATS	Multi-Attribute Trade-off System
MECP	Ministry of the Environment, Conservation and Parks
Mitigation	Taking actions that either remove or alleviate to some degree the negative impacts associated with the implementation of alternatives.
MTO	Ministry of Transportation of Ontario
Overall Score	The final value of an alternative's score derived by summing all of the weighted scores.
Performance Factor	See Utility Function
Ranking	The ordering of alternatives from first to last for comparison purposes.
Raw Data	The measurement of the impact, or measured data, under each criterion.
Risk	Probability that a given outcome will or will not materialize. Distinct from uncertainty in that the alternative outcomes are known or defined and that the probability of each is measureable.
Screening	Process of eliminating alternatives from further consideration,

	which do not meet minimum conditions or categorical requirements.
Sensitivity Tests	A series of tests to assess the robustness of the evaluation and alternative scores.
Step Function	A utility function can be defined by several linear functions within separate ranges that have a slope equal to zero. For this study, two step functions are used: Case A: y = 1, for x = desirable and y = 0, for x = undesirable Case B: y = 1 for x = desirable, y = 0.5 for x = medium performance and y = o for x = undesirable
Sub-factor	A single criterion used for the evaluation. Each sub-factor is grouped under one of the factors.
TAC	Technical Advisory Committee
TPA	Technically Preferred Alternative
Traceability	Characteristic of an evaluation process which enables its development and implementation to be followed with ease.
Transportation Environmental Study Report (TESR)	This report is prepared in compliance with the EA Act requirements and the Ministry of the Environment and Climate Change for acceptance, approval, informational or monitoring purposes and the public record.
Utility Function	A function (linear, step, dichotomous) that represents the Utility Score versus the criterion measurement or desirableness.
Utility Score	The "y" value derived from the Utility Function of the measurement of the impact induced by a particular alternative's criterion. A measurement of the usefulness or attractiveness of an alternative with respect to an individual evaluation criterion based on its measured effect (a number between 0 and 1). The utility score is dimensionless.
Weight	The importance attributed to a criterion relative to other criterion. The value of the weight is expressed in a percentage and the sum of all criterion weights is equal to 100%.
Weighted Additive Method	The method used in the quantitative evaluation of alternatives, which reduces the project's numerous criteria into a dimensionless number for each alternative suitable for comparison.
Weighted Score	A raw score that has been multiplied by the criterion weights.

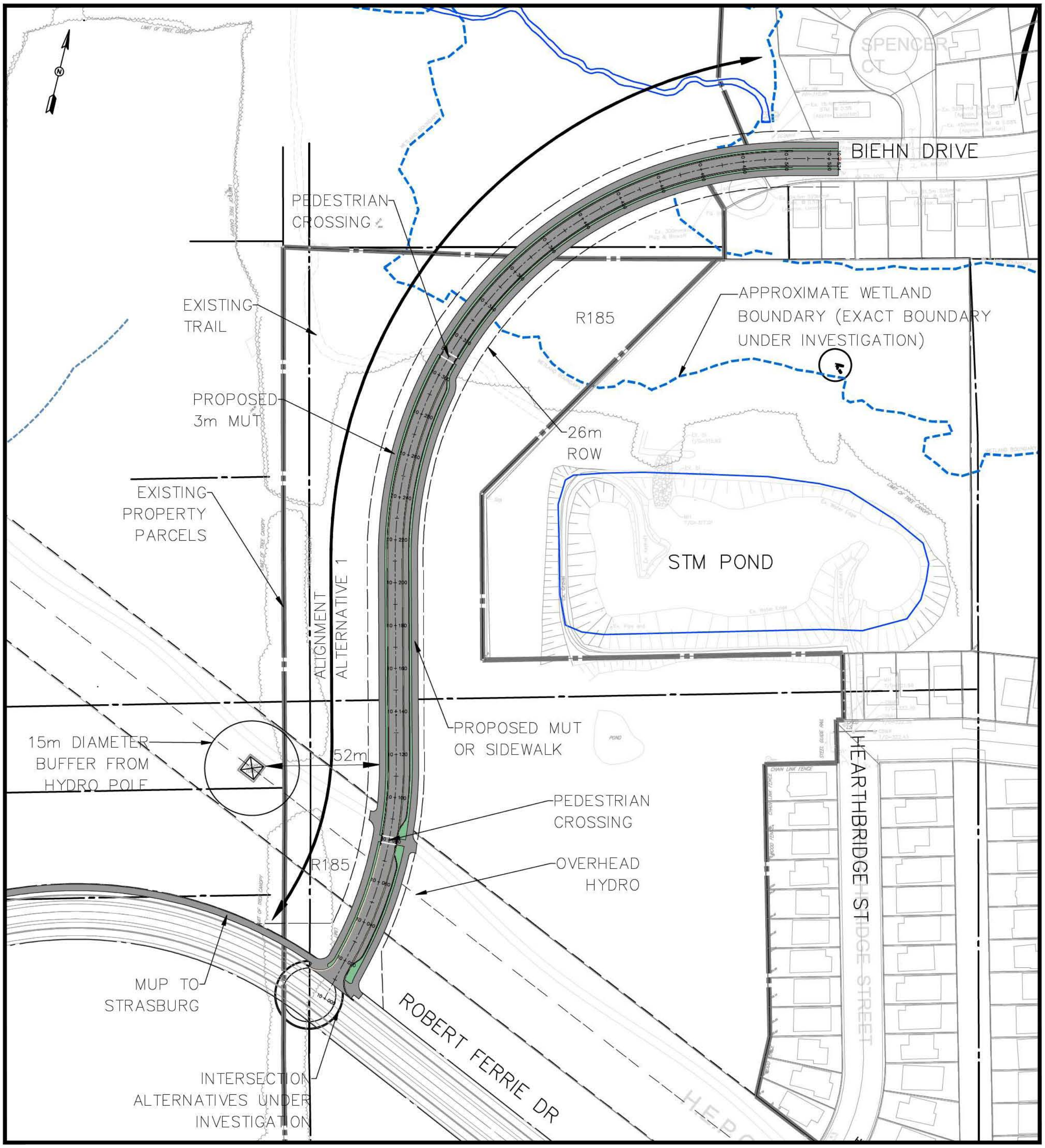
The weighted scores reflect the social value or importance of the specific group providing weights.

Appendix B

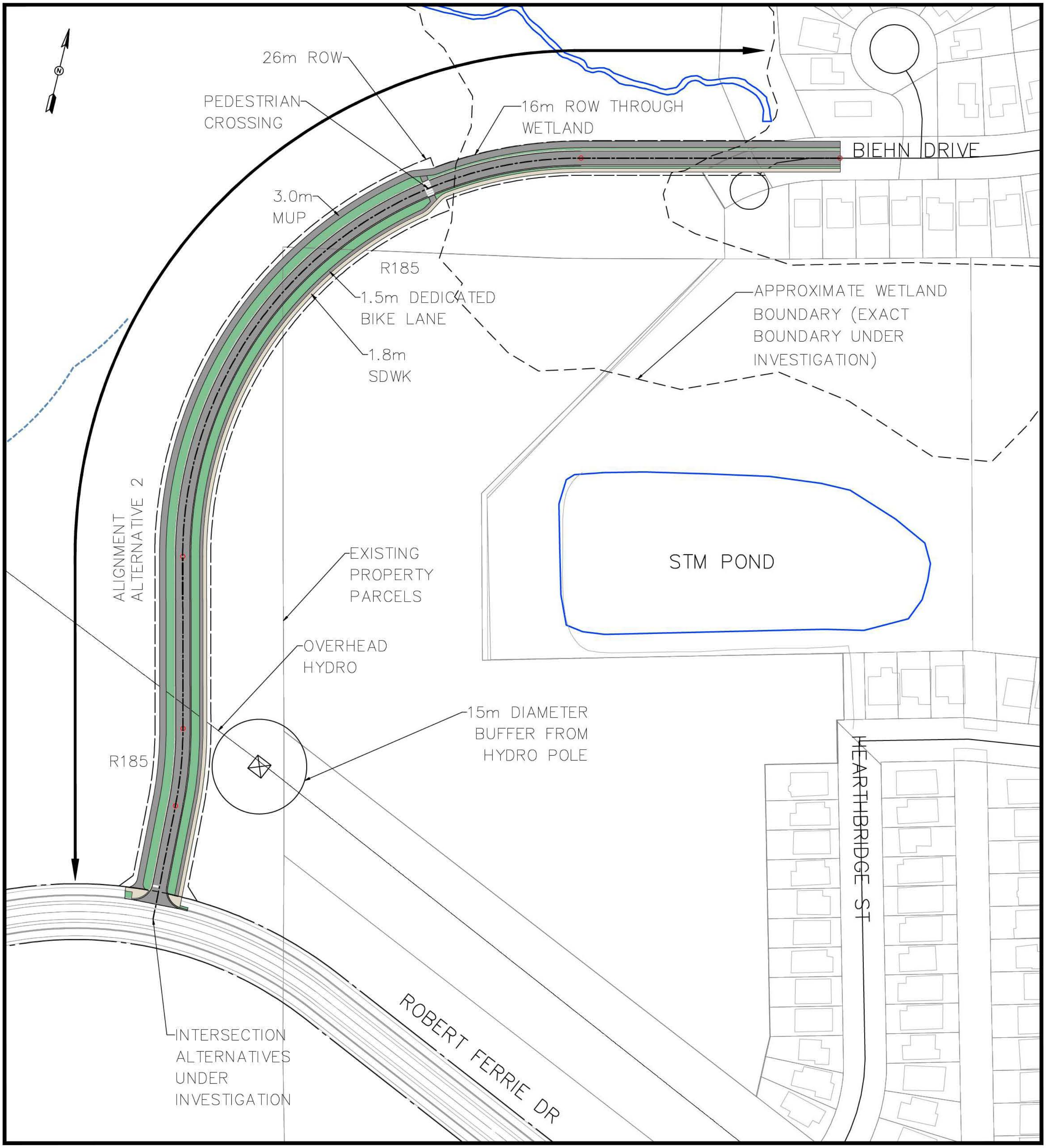
Short Listed Corridor Alternatives

BT ENGINEERING

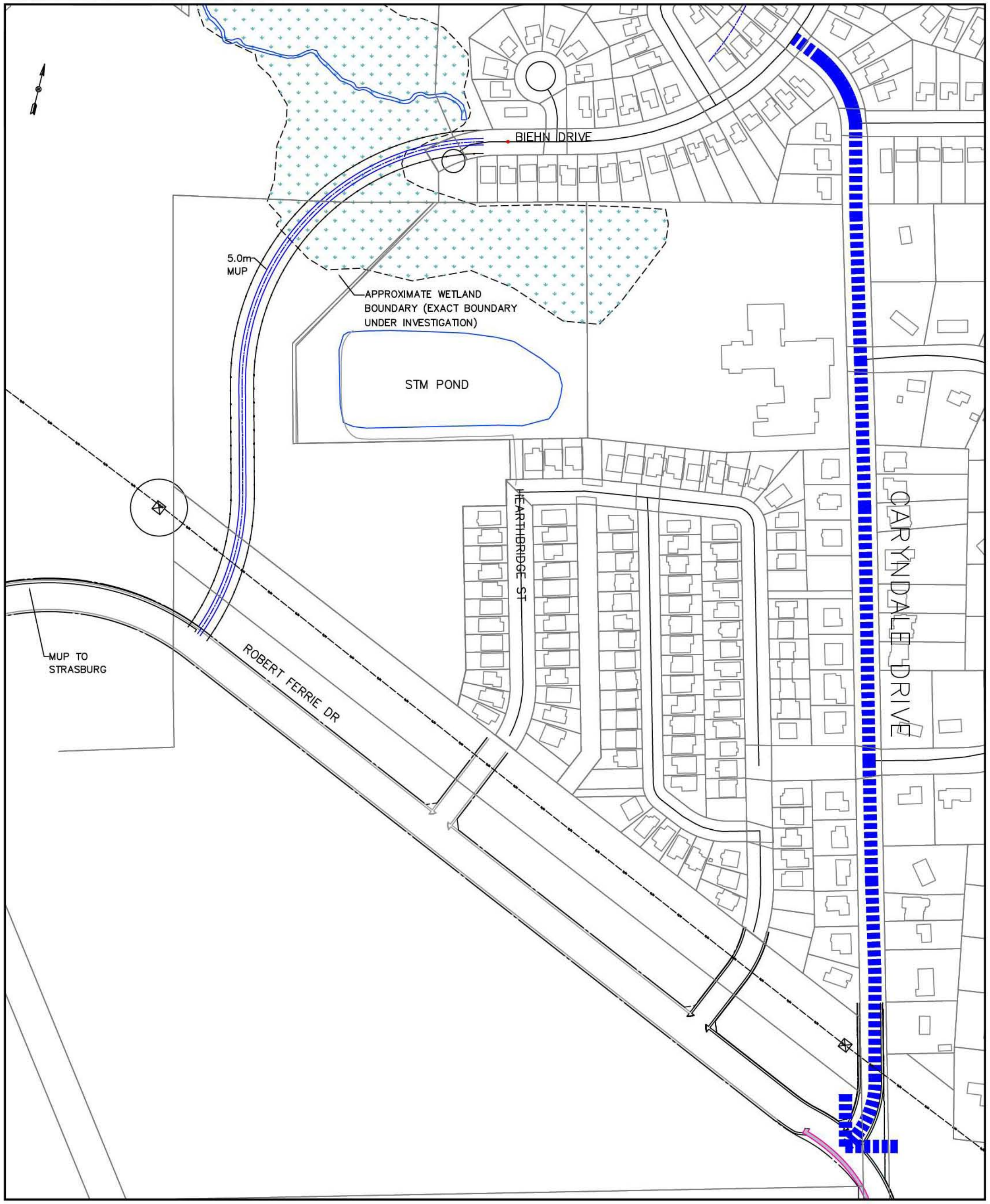
BIEHN DRIVE – ALTERNATIVE 1 – TPA



BIEHN DRIVE – ALTERNATIVE 2



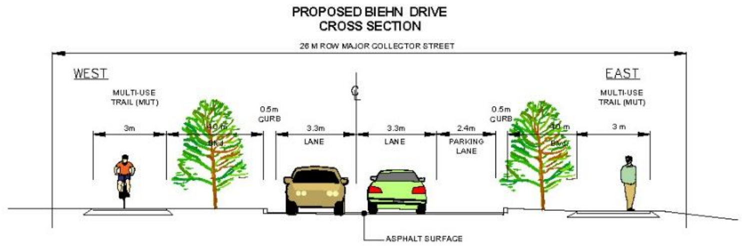
BIEHN DRIVE – ALTERNATIVE 4



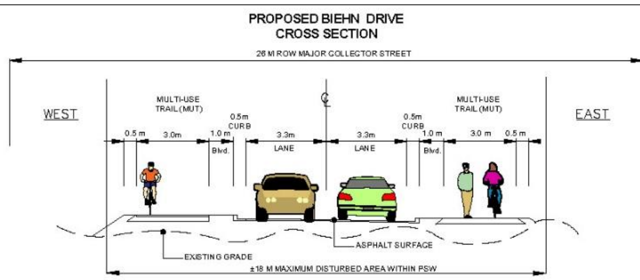
Appendix C

Cross Section Alternatives

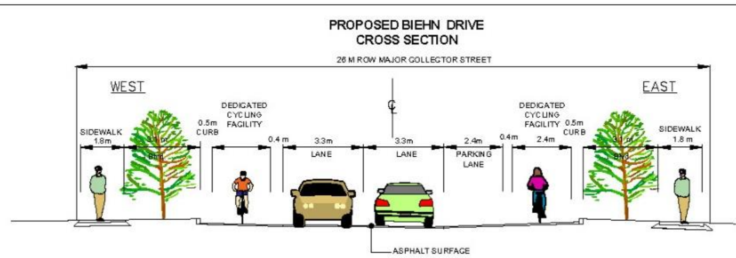
BT ENGINEERING



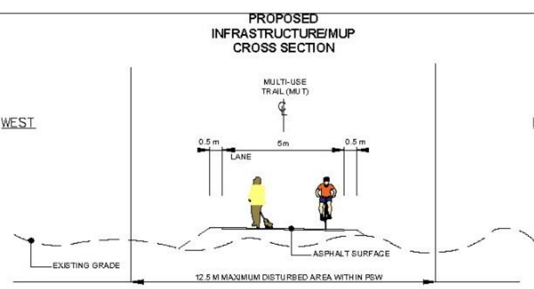
CROSS SECTION
ALTERNATIVE 1



TYPICAL PSW SECTION
ALTERNATIVE 1



CROSS SECTION
ALTERNATIVE 2



TYPICAL PSW SECTION
ALTERNATIVE 4

Appendix D

Long List of Criteria

BT ENGINEERING

Alignment Alternatives
Long List of Evaluation Criteria

Factors and Sub-Factors	Unit of Measure	Carried Forward ?	Remarks
Transportation			
Delays (during construction)	veh-h	✗	All equal
Supports Urban Transit Service	High/Medium / Low	✓	
Improved Emergency Response	Yes/No	✓	
Fuel Consumption	l (litres)	✗	Measured under travel time
Road User Costs	$	✗	Measured under travel time
Roadway Operation and Safety – Supports Area Traffic Calming Measures	Length (m)	✓	
Roadway Safety - Collision Potential at Intersections	Number	✗	
Active Transportation Connectivity – Conflicts through Communities	Length (km)	✗	All equal. All alternatives provide an active transportation link extension from Biehn Drive westerly.
Active Transportation – Proximity to Community Facilities	number	✗	Covered above
Bicycle – Conflicts with Existing Bicycle Routes	Length (km)	✗	See Active Transportation criterion
Flexibility for Future Expansion	Yes/No	✗	
Horizontal Curvature	degrees of deflection	✗	
Vertical Curves	Number	✗	Meets City standards
Minimum Radius of Curves	m	✗	Meets City standards
Skewed Intersections / Angle of Skewed Intersections	Number	✗	
Level of Service on Local Roads	High/Low	✗	Measured under Efficiency of Travel
Efficiency of Travel	High/Medium /Low	✓	

Factors and Sub-Factors	Unit of Measure	Carried Forward ?	Remarks
Compatibility with Integrated Transportation Master Plan	Yes/No	✓	
Safety of School Zone	Yes/No	✓	
Ability to Maintain Existing Roadway Classification	Yes/No	✗	
Bicycle and Pedestrian Safety – Conflicts with Planned Hydro Corridor Multi-Use Trail	No. of Crossings	✓	
Personal Security of Pedestrians and Cyclists	Yes/No	✓	
Intersection Spacing	Good Moderate Poor	✗	
Robert Ferrie Drive Intersection Location to Accommodate Future Development	Length (m)	✓	
Natural Environment			
Climate Change – Change in Greenhouse Gas Emissions	Tonnes/year	✗	
Sustainability - Use of Natural Resources to Construct Project	ha	✗	
Aquatic Species at Risk Potential Habitat Impacted	Number of Occurrences	✗	Confirmed by field inventories and mapping.
Potential Species at Risk Potential Habitat Impacted	Number	✗	Potential for Butternut, Black Ash and Myotis species.
Significant Woodlands Removed	ha	✗	
Other Woodlands and Woodlots Removed (does not include significant woodlands)	ha	✗	
Warm / Cool Water Fish Habitat Impacted	m^2	✗	Potential for ephemeral or intermittent watercourses in PSW.
Cold Water Fish Habitat Impacted	m^2	✗	Downstream impacts to Strasburg Creek cold water fish habitat. Confirmed in field that all are equal.

Factors and Sub-Factors	Unit of Measure	Carried Forward ?	Remarks
Loss of Fish Habitat	m^2	✗	Measured above.
Water Quality (Stormwater Surface Runoff)	ha	✗	All equal.
Drainage Courses Crossed	Number	✗	Included under Cool/Cold and Warm Water Fish Habitat Impacted and Warm water Fish Habitat Impacted above.
Stormwater Management Measures (Quantity and Quality Control)	Developed/ undeveloped	✗	All equal. Mitigation for stormwater (road and land development) will include temporal and LID technology.
Type of Soil for Stormwater Management	Type	✗	All equal
Drainage: Road Grades (Slope)	%	✗	All equal. Meets standards.
Wildlife Habitat	ha	✓	
Accommodating Wildlife Movement	Preferred/Not Preferred	✓	
Migratory Bird Nesting Impact	Yes/No	✗	Mitigation measures applied.
Area of Natural and Scientific Interest Removed	ha	✗	No ANSIs.
Provincially Significant Wetland (PSW) Removed	ha	✓	Strasburg Creek PSW
Infiltration of Rainwater	ha	✓	Strasburg Creek PSW
Conservation of Tree Canopy	ha	✗	Measured under Provincially Significant Wetland Removed
Adjacent Lands Removed	ha	✗	
Fragmentation of PSW	ha	✗	All equal. Each of the alternatives will cross the PSW in the approximate same location. As such, the resultant fragmentation will be nearly identical. Alternative 3 was not carried forward, in part, because it had a larger fragmentation and multiple wetland crossings.

Factors and Sub-Factors	Unit of Measure	Carried Forward ?	Remarks
Wetlands Removed	ha	X	See above.
Unevaluated Wetlands Removed	ha	X	
Aggregate Resource Area Removed	ha	X	
Groundwater – Wellhead Protection Sensitivity Areas (WHPA) Vulnerability (GRCA) Area 4	ha	X	All equal. Sanitary sewer trench to include mitigation (clay seals) to avoid groundwater flow.
Loss of Flood Plain Storage - Regulated Areas	ha	X	Outside the floodplain.
Kitchener Core Natural Heritage Features/Region Core Environmental Features Impacted, Map 6 Natural Heritage System City of Kitchener Official Plan	ha	X	Included in the PSW criteria.
Specimen Trees	Number	X	All equal
Cultural Environment			
Designated Heritage Property Impacted	ha	X	Not Applicable
Heritage Property Listed in Register Impacted	ha	X	Not Applicable
Heritage Property Impacted (not Designated or Listed)	ha	X	Not Applicable
Heritage Buildings Impacted	Number	X	Not Applicable
Impact to Heritage Landscape Features (fence rows, tree lines, etc.)	High/ Medium/ Low	X	Not Applicable
Cemeteries Impacted	Number	X	See Registered Archaeological Sites
Pre-contact Sites	Number	X	See Registered Archaeological Sites
Post-contact Sites	Number	X	See Registered Archaeological Sites
Mapped 19th Century Structures (no longer standing)	Number	X	Double counted with Post contact sites
Cultural Landscape Features Impacted (not Designated or Registered Historical Properties)	Number of Settlement Areas	X	Not Applicable

Factors and Sub-Factors	Unit of Measure	Carried Forward ?	Remarks
Area of Archaeological Potential	ha	✗	All equal.
Socio-Economic Environment			
Air Quality (Sensitive Receptors)	Number of Sensitive Receptors	✗	All equal.
Sound Level Increases (greater than 55 dBA)	Number	✗	No increase.
Sound Level Increases (less than 55 dBA)	Number	✗	No increase.
Vibration Impacts	Number	✗	Measured under Sound Level Increases
Proximity to Hearthwood Park	Number	✗	All equal, avoided.
Emergency Response	Yes/No	✗	Refer to Transportation
Community Festivals Impacted	Yes/No	✗	Avoided
Potential School Pick-up/Drop-off Locations	Number of schools	✗	See Community Disruption.
Community Disruption - Biehn Drive North	Distance (km) through Neighbour-hoods	✓	
Community Disruption - Biehn Drive South	Distance (km) through Neighbour-hoods	✓	
Community Disruption – Caryndale Drive	Distance (km) through Neighbour-hoods	✓	
Institutions Impacted	Number	✗	Brigadoon Public School Considered under Transportation subfactors.
Visual Intrusion to Adjacent Residents	Number	✗	Considered under community disruption.
Pits and Quarries Impacted	Number	✗	
Farming Activity Impacted	hectares	✗	Interim use only. To be redeveloped

Factors and Sub-Factors	Unit of Measure	Carried Forward ?	Remarks
Businesses Impacted	Number	✗	
Land Use and Property			
Supports City of Kitchener's Official Plan	Yes/No	✓	
Residences Partially Impacted	Number	✗	
Residential Buyouts	Number	✗	
Low Rise Residential Property Required	ha	✗	All equal. City of Kitchener Official Plan, supported by landowner.
Institutional Property Required	ha	✗	City of Kitchener Official Plan
Natural Heritage Conservation Property Required	ha	✗	City of Kitchener Official Plan, Measured under Natural Environment
Park Property (Hearthwood Park) Required	ha	✗	City of Kitchener Official Plan
Mineral Aggregate Resource Areas	ha	✗	City of Kitchener Official Plan
Commercial Property Required	ha	✗	Employment Areas are avoided. City of Kitchener Official Plan
Rural Property Required	ha	✗	City of Kitchener Official Plan
New Utility Corridor Crossing Required	Number	✗	Considered under Cost
Communication Towers Impacted	Number	✗	Communication towers are avoided.
Natural Heritage System/Major Open Space Required	ha	✗	Measured under Natural Environment
Hydrology/Hydraulics: Land Uses Upstream of Road	ha	✗	To be determined at a later date
Former Landfill Sites/Potential Site of Environmental Concern Impacted	Number	✗	To be determined at a later date.
Planned Primary Multi-Use Pathway/Connection (Type 1) Impacted, Map 11 Integrated Transportation System City of Kitchener OP	Number	✗	All equal. Trail system is accommodated.
Planned Secondary Multi-Use Pathway/Connection (Type 2) Impacted, Map 11 Integrated	Number	✗	All equal. Trail system is accommodated.

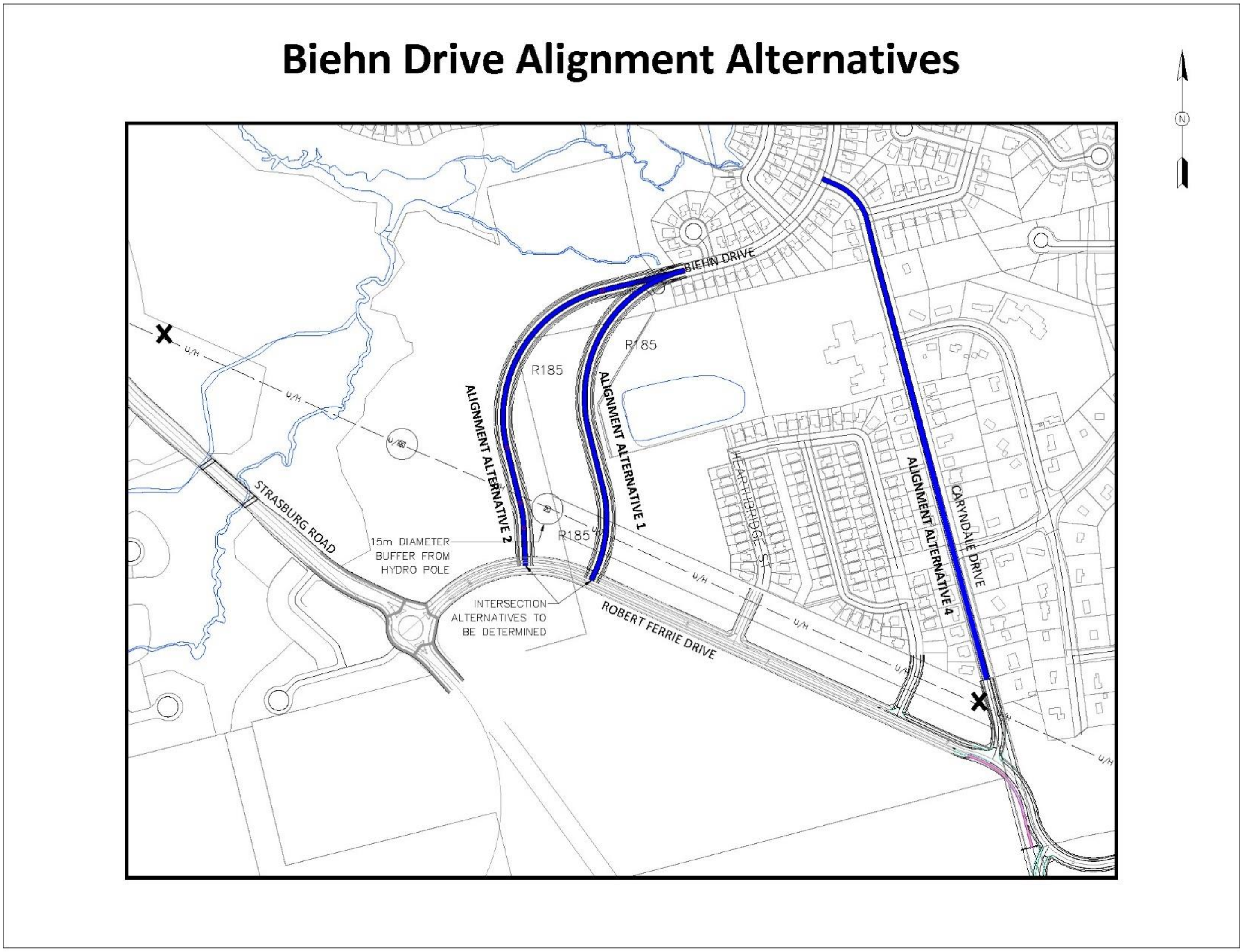
Factors and Sub-Factors	Unit of Measure	Carried Forward ?	Remarks
Transportation System City of Kitchener OP			
Efficient Utilization of Future Development Land	High/ Medium / Low	✓	Measures the efficiency for development.
Crossing of the Hydro Corridor	No. of Crossings	✓	
Cost			
Capital Cost	$	✓	
Operating Costs	$	✗	
Life Cycle Cost	$	✗	
Engineering			
Accommodating Stormwater Management	High / Medium / Low	✓	
Accessibility for maintenance of sanitary sewer	High/low	✗	
Biehn Drive Stormwater Enhancement	High/High-Medium /Low	✓	
Sanitary Sewer Alignment	Yes/No	✓	
Overland Stormwater Management Route	Order of Magnitude	✓	

Appendix E

Sub-Factor Definitions

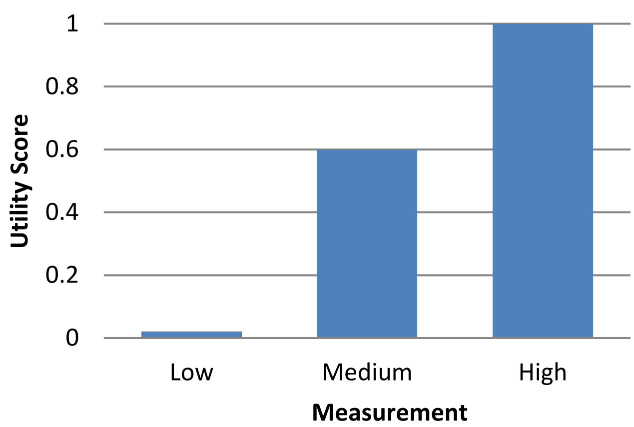
Biehn Drive Alignment Alternatives

Alternative	Description
Alternative 1	Connect Biehn Drive to Robert Ferrie Drive – East Alignment
Alternative 2	Connect Biehn Drive to Robert Ferrie Drive – Central Alignment
Alternative 4	Connect Biehn Drive to Robert Ferrie Drive – Via Caryndale Drive



Transportation

Supports Urban Transit Service



Definition: This sub-factor measures the ability to accommodate future transit service, supporting City and Regional Transportation Master Plan objectives to promote alternative travel modes and to support planned area development.

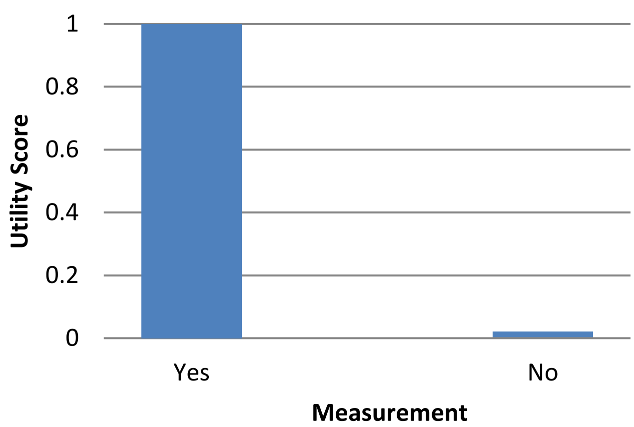
Mitigation: None.

Alternatives:

Alternative	High/Medium/Low	Utility Score
Alternative 1	High	1
Alternative 2	Medium	0.5
Alternative 4	Low	0

Transportation

Improved Emergency Response



Definition: This sub-factor considers the benefit to emergency response. To improve the emergency response to the neighbourhood, the provision of alternative routes with an additional access to the community is preferred.

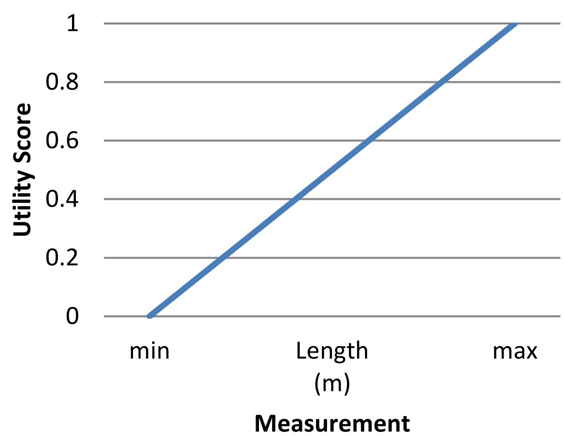
Mitigation: None.

Alternatives:

Alternative	Yes/No	Utility Score
Alternative 1	Yes	1
Alternative 2	Yes	1
Alternative 4	No	0

Transportation

Roadway Safety – Supports Area Traffic Calming Measures



Definition: This sub-factor measures the length of area collector roads where traffic volumes would be reduced, supporting existing and planned neighbourhood traffic calming measures to improve traffic safety. Alternatives which benefit the greatest length of existing collector roads are preferred.

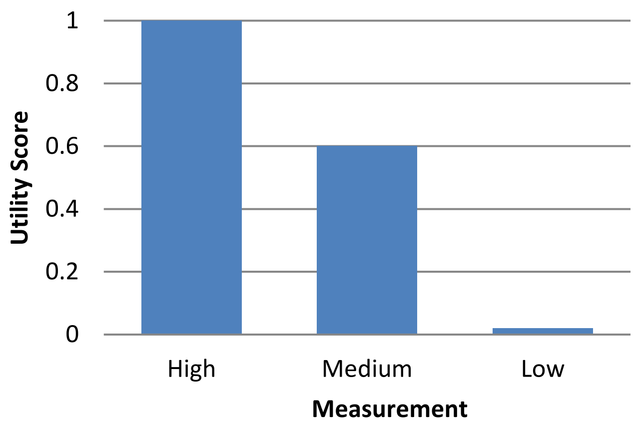
Mitigation: Implementation of additional traffic calming measures including the potential use of roundabout control can be considered where traffic volumes would not be reduced.

Alternatives:

Alternative	Length	Utility Score
Alternative 1	2200	1
Alternative 2	2200	1
Alternative 4	300	0

Transportation

Efficiency of Travel



Definition: This sub-factor measures the efficiency of travel. Alternatives that are more efficient are preferred. This subfactor will considers travel indicators, including:

- Reduced trip length;
- Alternative opportunities for travel; and
- Shortest path to arterial road network.

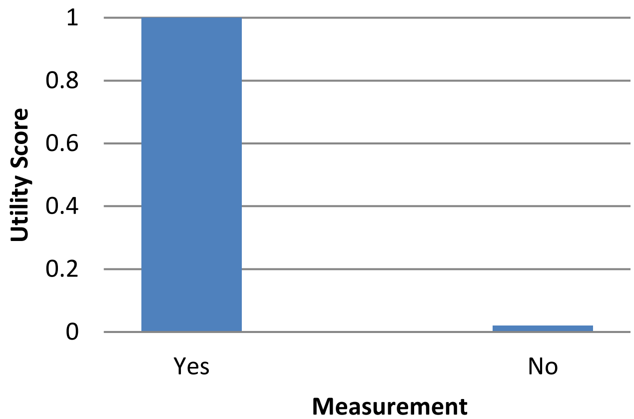
Mitigation: None.

Alternatives:

Alternative	High/Medium/Low	Utility Score
Alternative 1	High	1
Alternative 2	High	1
Alternative 4	Low	0

Transportation

Compatibility with Integrated Transportation Master Plan



Definition: This sub-factor measures the compatibility with the Integrated Transportation Master Plan which was the basis for the approval of all existing area development. Those alternatives which will result in a more even distribution of traffic consistent with the current roadway classifications are preferred.

This sub-factor considers the existing roadway classifications and the potential requirement to reclassify Caryndale Drive from a minor collector to a major collector. Those alternatives which would allow the existing classifications to be maintained and would not require Caryndale Drive to be reclassified to a major collector are preferred.

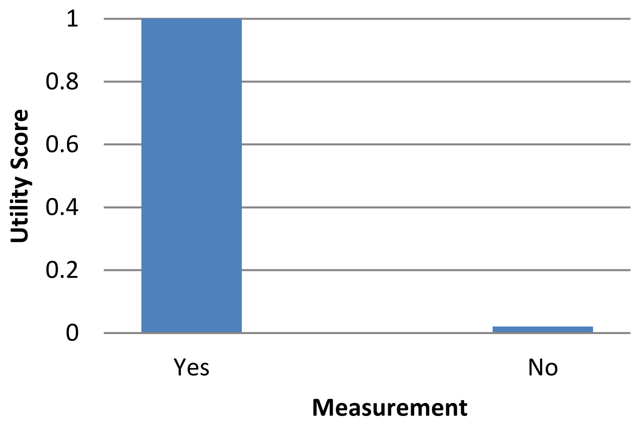
Mitigation: None.

Alternatives:

Alternative	Yes/No	Utility Score
Alternative 1	Yes	1
Alternative 2	Yes	1
Alternative 4	No	0

Transportation

Safety of School Zone



Definition: This sub-factor considers traffic safety within area School Safety zones. Those alternatives which avoid passing the Brigadoon Public School located on Caryndale Drive are preferred.

Mitigation: Additional traffic calming to further control traffic speeds and increased enforcement.

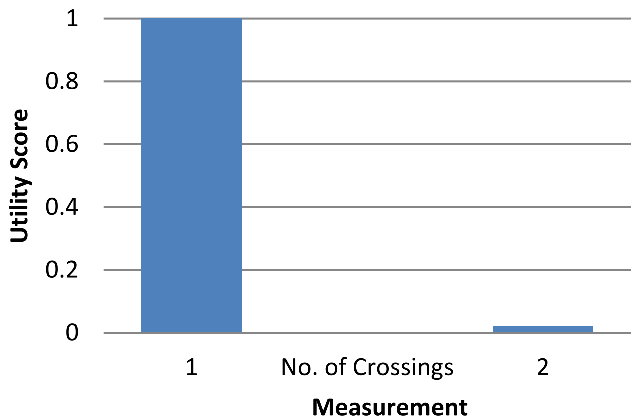
Mitigation: Use of school crossing guards.

Alternatives:

Alternative	Yes/No	Utility Score
Alternative 1	Yes	1
Alternative 2	Yes	1
Alternative 4	No	0

Transportation

Bicycle and Pedestrian Safety - Conflicts with Planned Hydro Corridor Multi-Use Trail



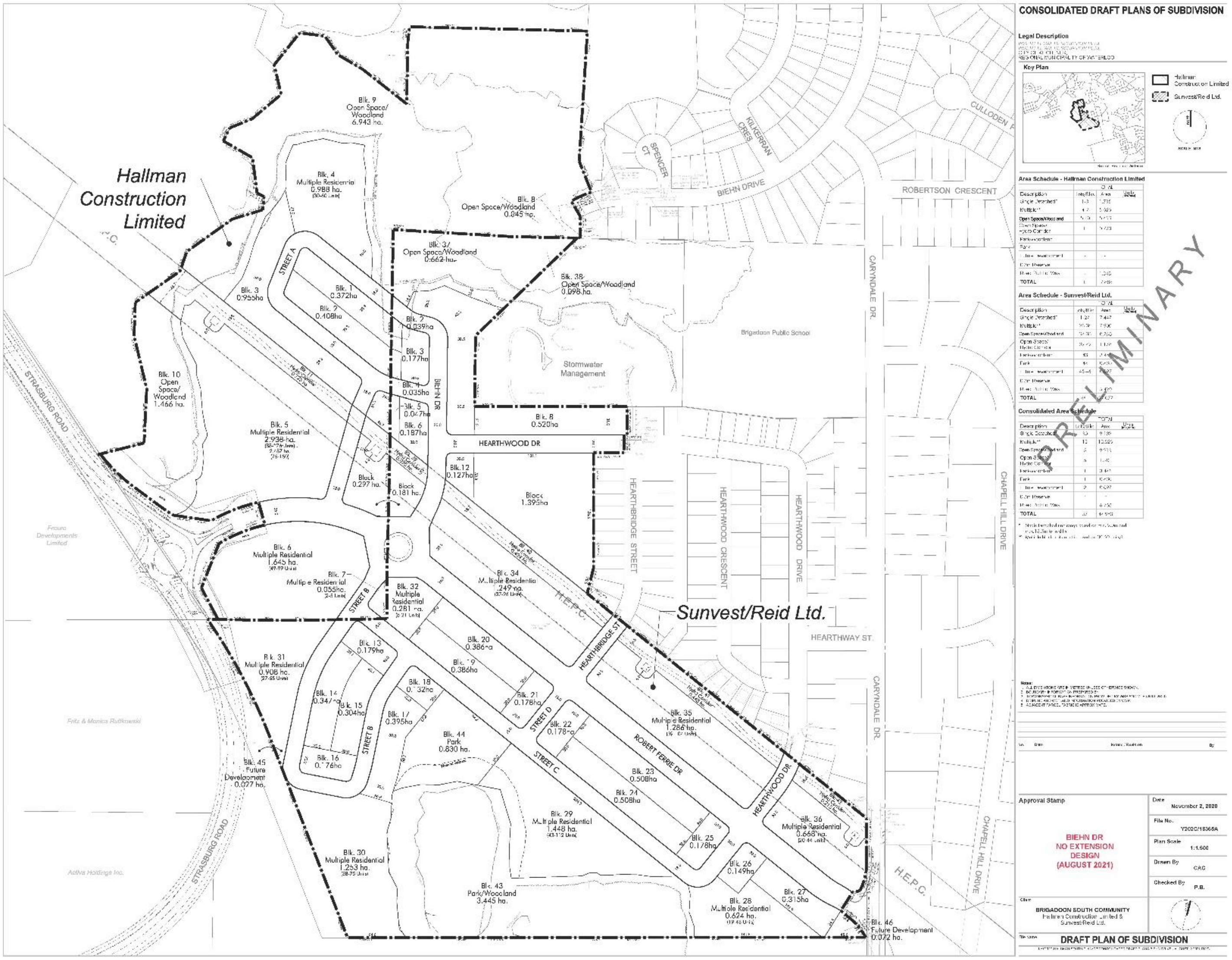
Definition: This sub-factor measures the number of crossings of the hydro corridor and the planned multi-use trail. The proposed extension of Biehn Drive would result in one crossing of the hydro corridor trail; refer to *Consolidated Draft Plans of Subdivision: Biehn Drive Alignment Extension Design (August 2021), by MHBC, Planning Urban Design and Landscape Architecture*. Without the extension of Biehn Drive the future development would require the creation of a crescent roadway to access the developable lands, with two crossings of the hydro corridor / multi-use trail; refer to *Consolidated Draft Plans of Subdivision: Biehn Drive No Extension Design (August 2021), by MHBC, Planning Urban Design and Landscape Architecture*. Alternatives with the least number of hydro corridor crossings/conflict points are preferred.

Mitigation: None

Alternatives:

Alternative	Number of Crossings	Utility Score
Alternative 1	1	1
Alternative 2	1	1
Alternative 4	2	0

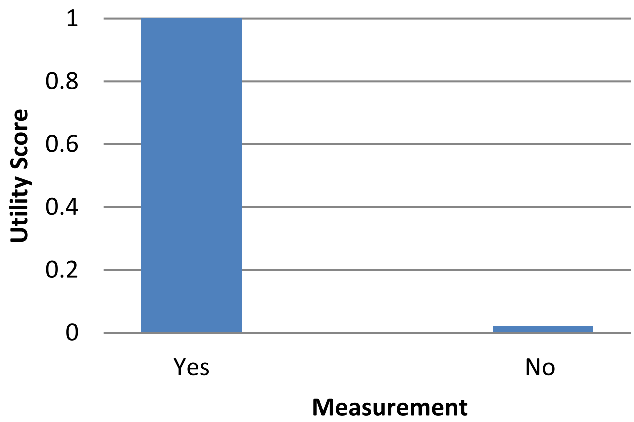
Note: The land use plans are preliminary and for comparison purposes only.



Note: The land use plans are preliminary and for comparison purposes only.

Transportation

Personal Security of Pedestrians and Cyclists



Definition: This sub-factor considers the personal security of pedestrians and cyclists. Each proposed alternative would include a Multi-Use Pathway (MUP) connection between existing Biehn Drive and the proposed Robert Ferrie Drive. Those alternatives that would locate the MUP adjacent to a public street would provide greater visibility of pedestrians and cyclists along the MUP improving their personal security. Alternatives with the MUP adjacent to a roadway are preferred.

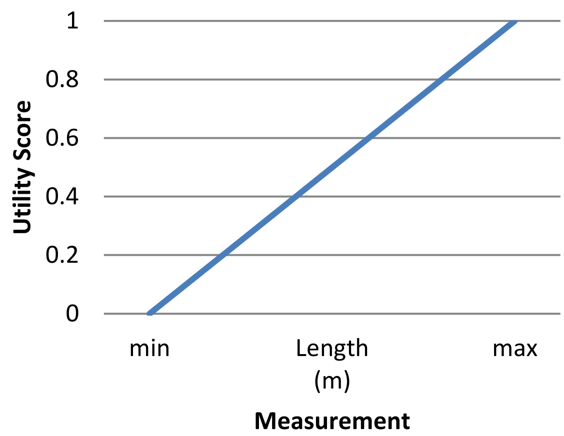
Mitigation: None

Alternatives:

Alternative	Number	Utility Score
Alternative 1	Yes	1
Alternative 2	Yes	1
Alternative 4	No	0

Transportation

Robert Ferrie Drive Intersection Spacing to Accommodate Future Development



Definition: This subfactor considers the standard spacing of intersections (250 m) along Robert Ferrie Drive and the effects that closely spaced intersections can have upon traffic operations and vehicle conflicts due to traffic queuing on future development north of Robert Ferrie Drive. The measurement for this sub-factor is in metres. Alternatives that satisfy intersection spacing standards and avoid directing traffic through closely spaced intersections are preferred.

Minimum TAC intersection spacing 250 m.

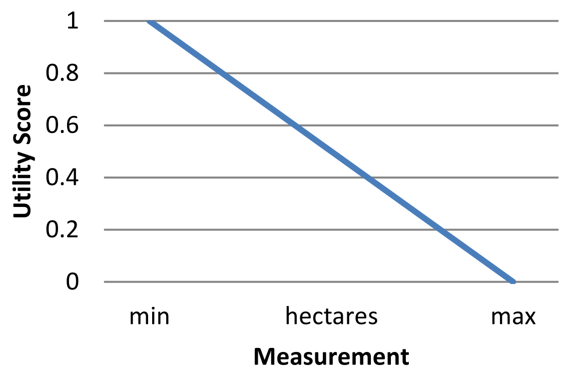
Mitigation: None.

Alternatives:

Alternative	Metres	Utility Score
Alternative 1	250	1
Alternative 2	150	0
Alternative 4	250	1

Natural Environment

Wildlife Habitat



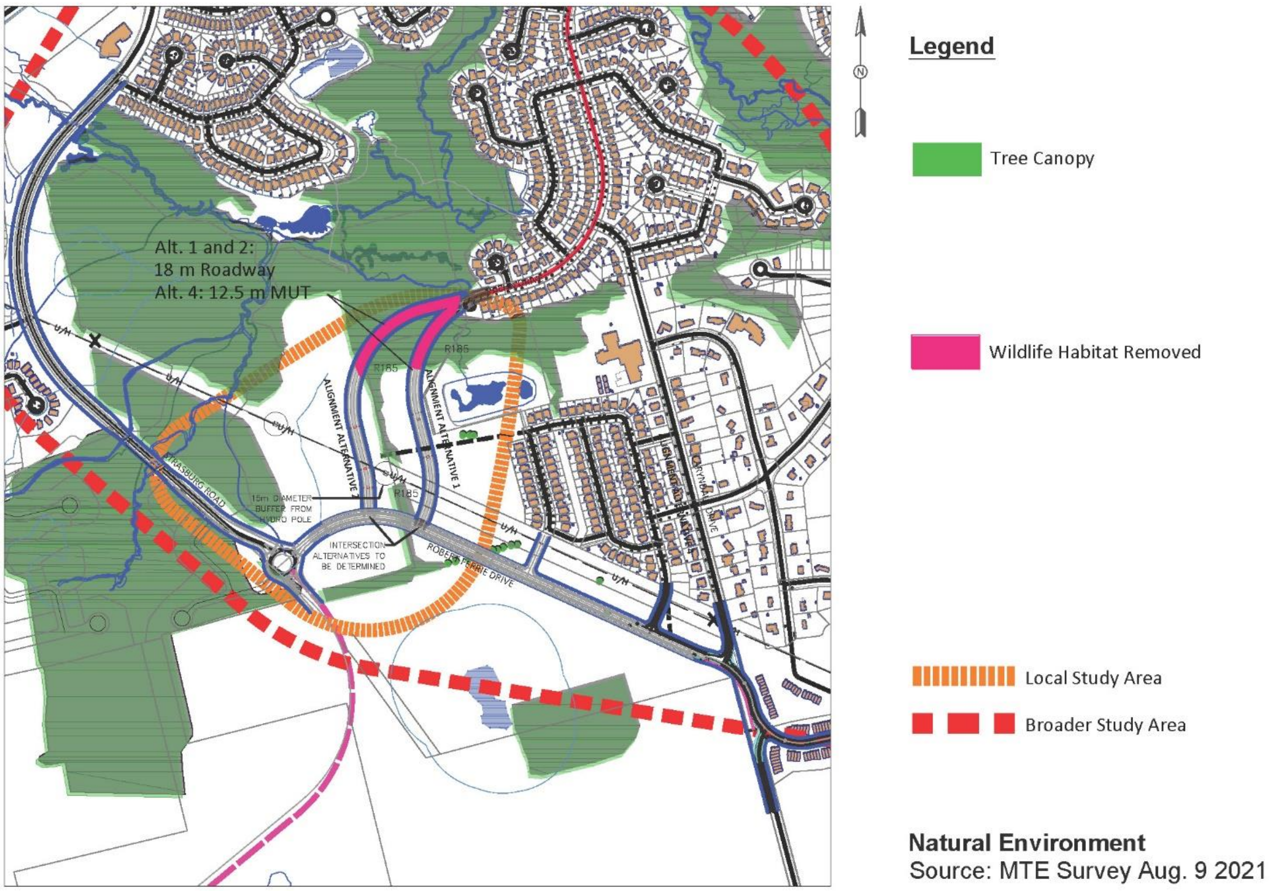
Definition: This sub-factor measures the removal of Wildlife Habitat within the right-of-way, along any of the proposed alternative Alignments.

The measurement for this sub-factor is in hectares. Those alternatives that remove the least amount of Wildlife Habitat are preferred.

Mitigation: To be considered for the Technically Preferred Alternative using Best Management Practises and identify enhancement opportunities.

Alternatives:

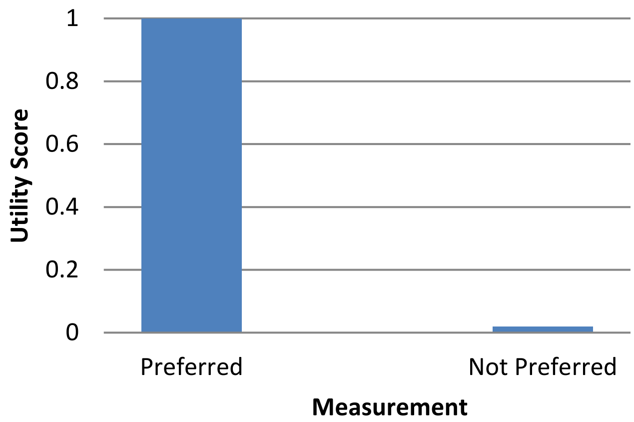
Alternative	Hectares	Utility Score
Alternative 1	0.23	0.63
Alternative 2	0.38	0
Alternative 4	0.14	1



City of Kitchener
Biehn Drive Extension Environmental Assessment Study
Municipal Class Environmental Assessment
NTS

Natural Environment

Accommodating Wildlife Movement



Definition: This sub-factor measures the impact on wildlife habitats crossings. The measurement for this sub-factor is the width of the right-of-way and level of traffic for each alternative. The alternative with a narrow right-of-way width and least amount of traffic is preferred.

Alternative 1: Traffic and 26 m ROW 6.6 m paved street.

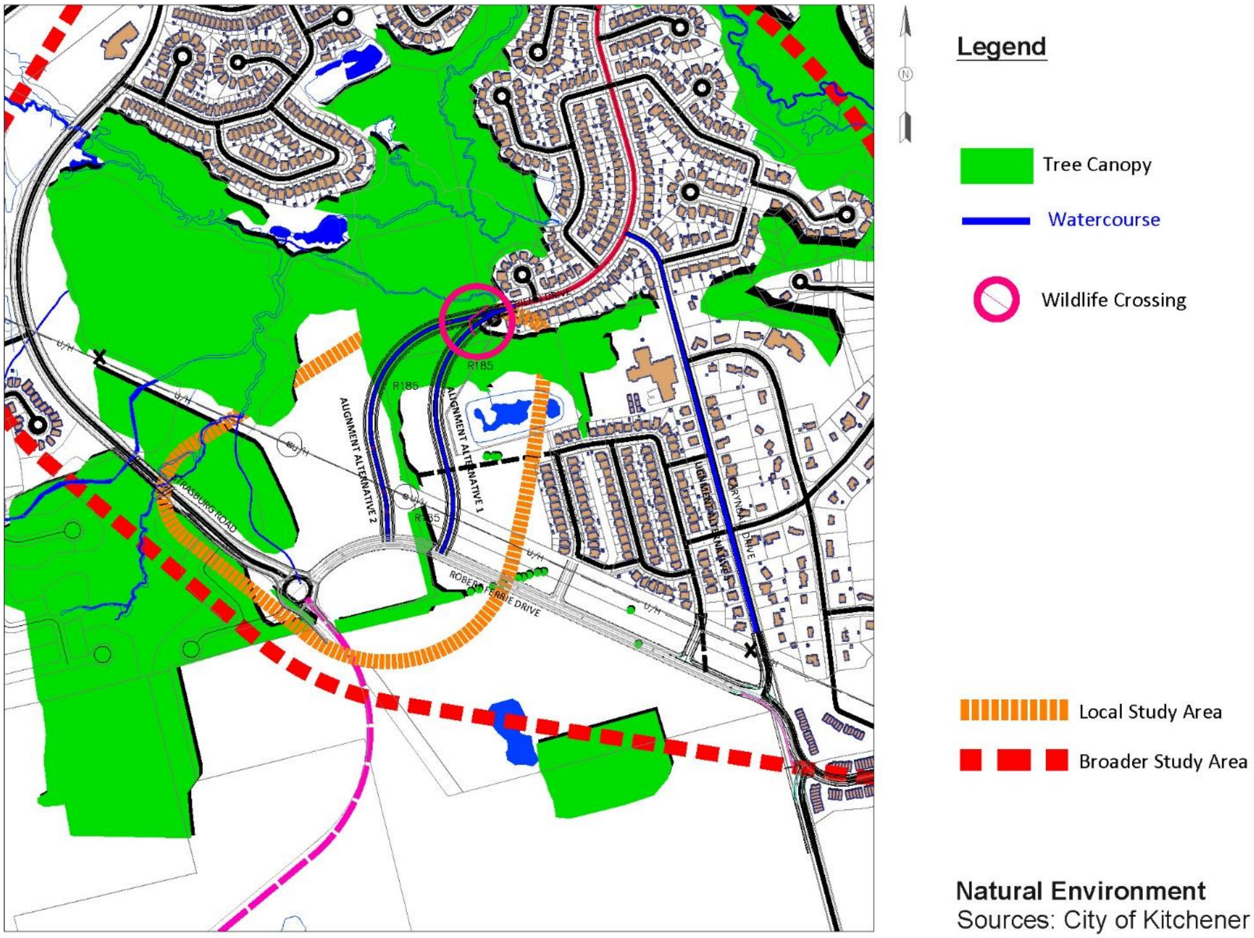
Alternative 2: Traffic and 26 m ROW 6.6 m paved street.

Alternative 4: No traffic and 10 m ROW, 5 m paved maintenance road/path.

Mitigation: Provide or enhance alternative wildlife crossings along the alignment.

Alternatives:

Alternative	Preferred / Not Preferred	Utility Score
Alternative 1	Not Preferred	0
Alternative 2	Not Preferred	0
Alternative 4	Preferred	1



City of Kitchener

Biehn Drive Extension Environmental Assessment Study

Municipal Class Environmental Assessment

NTS

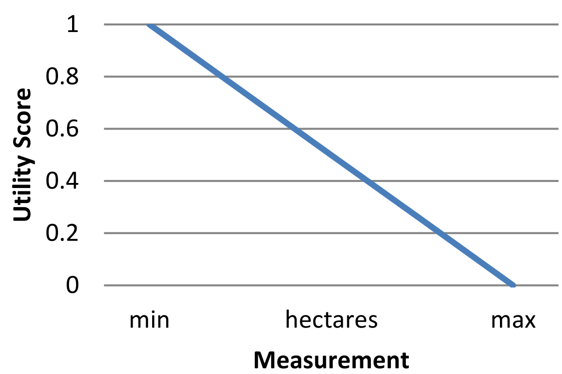
Natural Environment

Sources: City of Kitchener Official Plan Map 6 2014.

GRCA Open Data License V2 Regulatory Floodplain

Natural Environment

Provincially Significant Wetlands Removed



Definition: This sub-factor measures the removal of Provincially Significant wetlands, including the removal of the tree canopy. The removal of wetland and tree canopy can result in direct habitat loss, may contaminate adjacent habitat, and may also alter existing stream flow and hydrologic patterns. The measurement for this sub-factor is in hectares. Those alternatives that affect the least area of wetlands and tree canopy are preferred.

Mitigation: Develop a wetland mitigation plan prior to construction. The plan will detail pre- and post-construction methodology and practices to prevent contamination or alteration to existing wetland conditions and enhancements or creation opportunities.

Alternatives:

Alternative	Hectares	Utility Score
Alternative 1	0.18	0.62
Alternative 2	0.26	0
Alternative 4	0.13	1

Legend

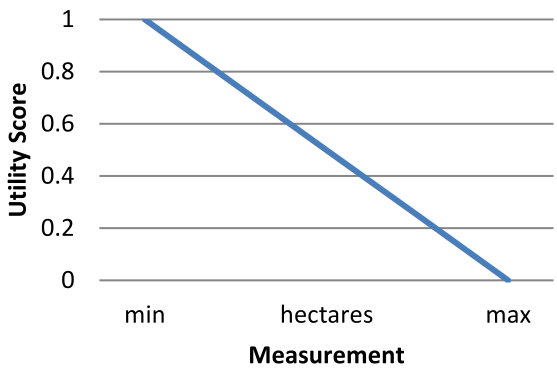
- Strasburg Provincially Significant Wetland (PSW)
- PSW Adjacent Lands (30m)
- Watercourse
- Alt. 1 and 2 ±18 m Wetland Disturbance
- Alt. 4 ±12.5 m Wetland Disturbance
- Local Study Area
- Broader Study Area

Natural Environment
Source: MTE Survey Aug. 9 2021

City of Kitchener
Biehn Drive Extension Environmental Assessment Study
Municipal Class Environmental Assessment
NTS

Natural Environment

Groundwater Infiltration



Definition: This sub-factor measures the loss of water permeable area within the Provincially Significant wetlands. The removal of permeable wetland area can result in direct reduction in groundwater and may also alter existing stream flow and hydrologic patterns. The measurement for this sub-factor is in hectares. Those alternatives that affect the least area are preferred.

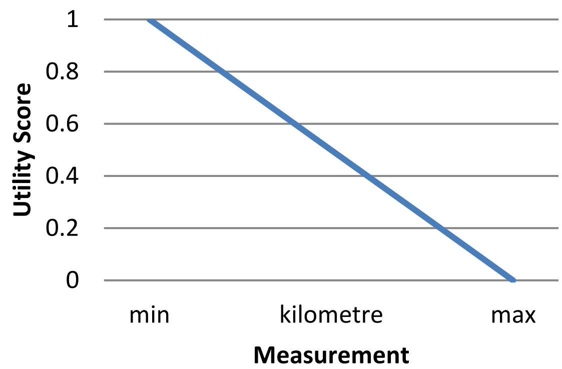
Mitigation: Introduce LID treatment to allow water infiltration.

Alternatives:

Alternative	Hectares	Utility Score
Alternative 1	0.18	0.62
Alternative 2	0.26	0
Alternative 4	0.13	1

Socio-Economic Environment

Community Disruption to Biehn Drive North

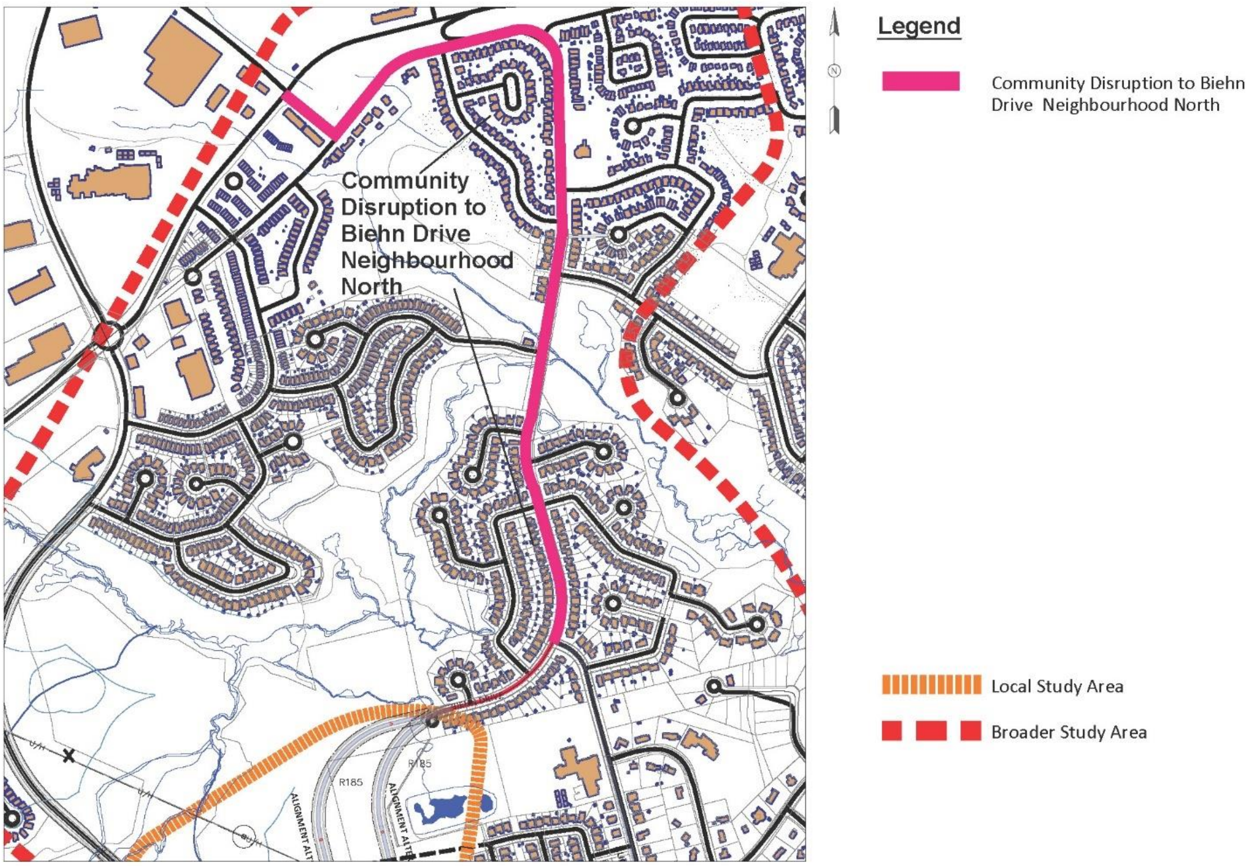


Definition: This sub-factor measures the impact to neighbourhoods. The measurement for this sub-factor is the length of corridor within the Biehn Drive north neighbourhood. Those alternatives that impact the least number of kilometres within the Biehn Drive north neighbourhood are preferred.

Mitigation: None. (Traffic calming measures are already being developed for implementation.)

Alternatives:

Alternative	Kilometres	Utility Score
Alternative 1	0	1
Alternative 2	0	1
Alternative 4	1.8	0

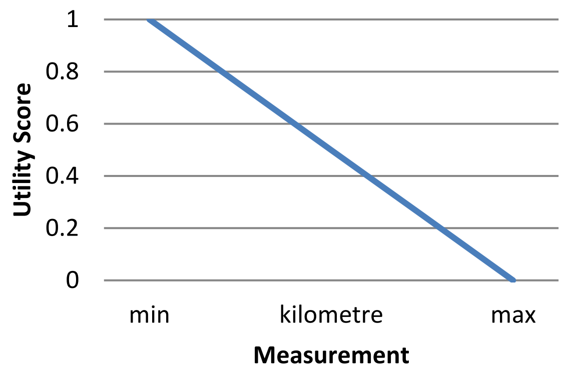


City of Kitchener
Biehn Drive Extension Environmental Assessment Study
Municipal Class Environmental Assessment
NTS

Socio-Economic Environment

Socio-Economic Environment

Community Disruption to Biehn Drive South

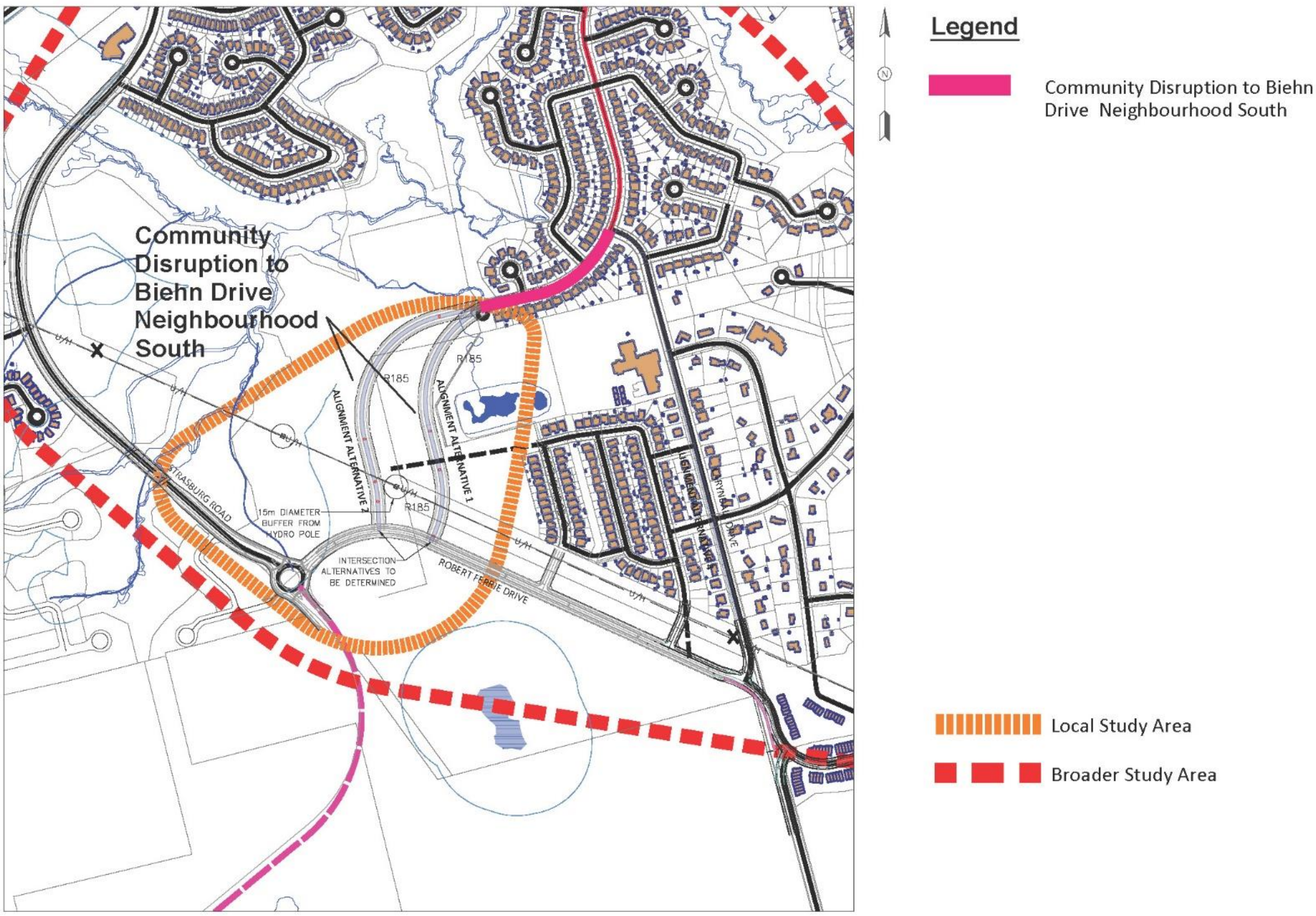


Definition: This sub-factor measures the impact to neighbourhoods. The measurement for this sub-factor is the length of corridor within the Biehn Drive south neighbourhood. Those alternatives that impact the shortest section within the Biehn Drive south neighbourhood are preferred.

Mitigation: Traffic calming measures.

Alternatives:

Alternative	Kilometres	Utility Score
Alternative 1	0.3	0
Alternative 2	0.3	0
Alternative 4	0	1

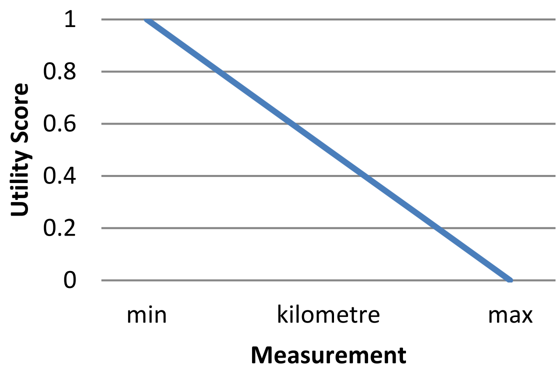


City of Kitchener
Biehn Drive Extension Environmental Assessment Study
Municipal Class Environmental Assessment
NTS

Socio-Economic Environment

Socio-Economic Environment

Community Disruption to Caryndale

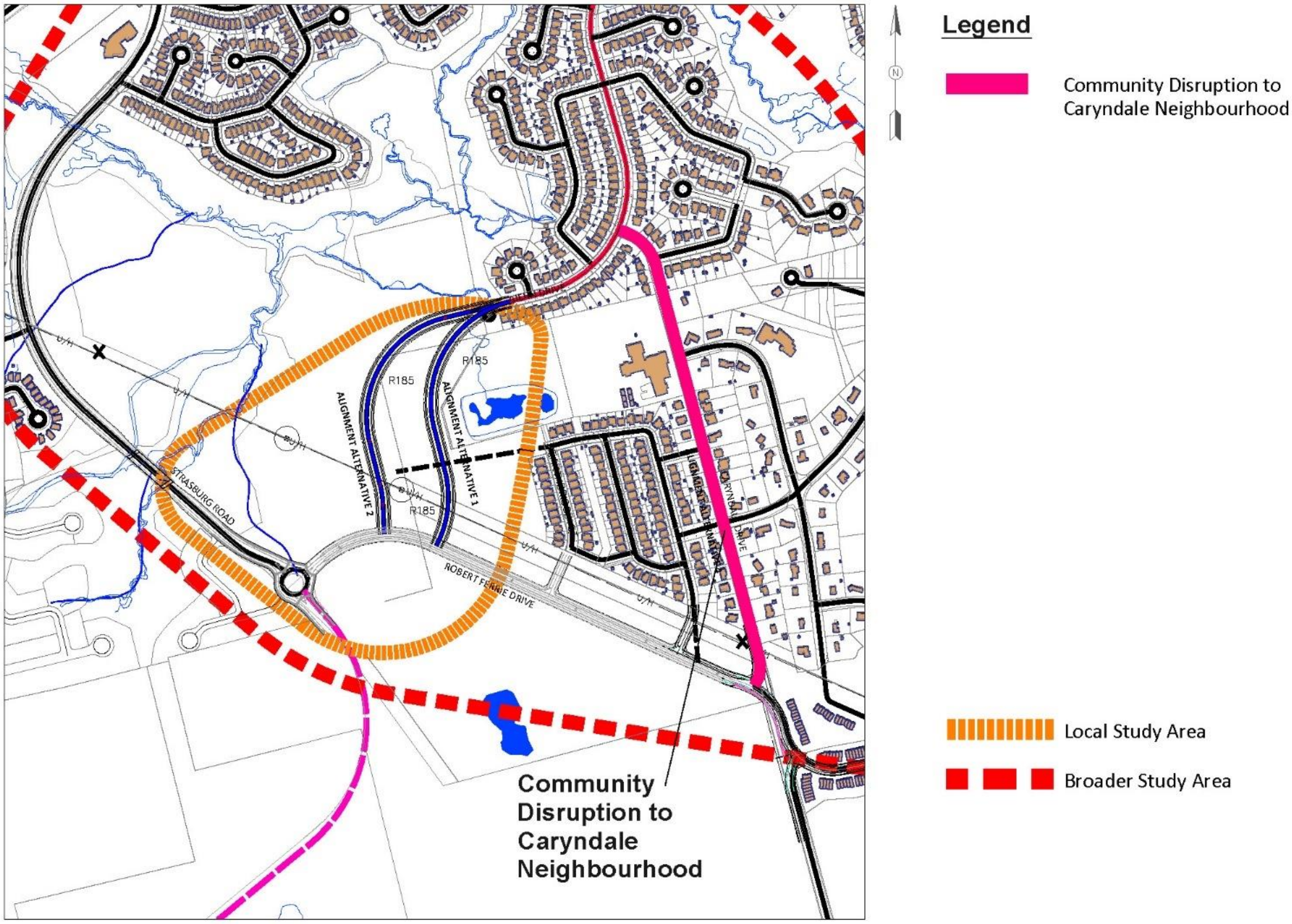


Definition: This sub-factor measures the impact to neighbourhoods. The measurement for this sub-factor is the length of corridor within the Caryndale neighbourhood. Those alternatives that impact the least number of kilometres within the Caryndale neighbourhood are preferred.

Mitigation: None. (Traffic calming measures have already been implemented.)

Alternatives:

Alternative	Kilometres	Utility Score
Alternative 1	0	1
Alternative 2	0	1
Alternative 4	0.88	0

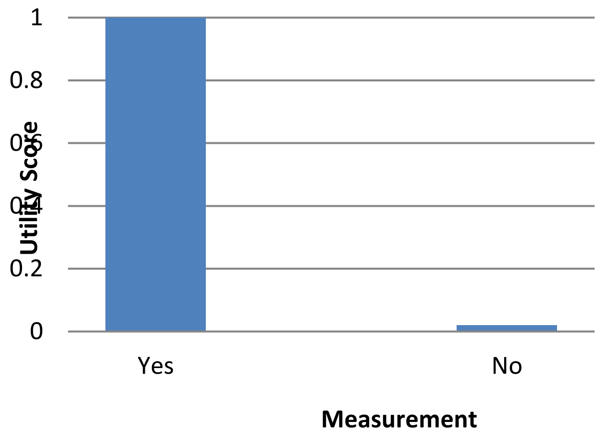


City of Kitchener
Biehn Drive Extension Environmental Assessment Study
Municipal Class Environmental Assessment
NTS

Socio-Economic Environment

Land Use and Property

Supports the City of Kitchener's Official Plan



Definition: This sub-factor measures whether the alignment alternative supports the City of Kitchener Official Plan. The measurement for this sub-factor is Yes/ No. Those alternatives that support the Official Plan, which was the basis for all existing development, are preferred.

Mitigation: None.

Alternatives:

Alternative	Yes/No	Utility Score
Alternative 1	Yes	1
Alternative 2	Yes	1
Alternative 4	No	0

Legend

Biehn Drive Extension Area
Source: City of Kitchener Official Plan Schedule B 2014.

Local Study Area

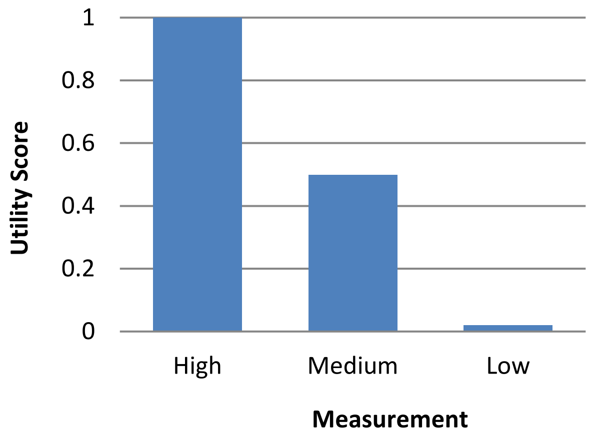
Broader Study Area

City of Kitchener
Biehn Drive Extension Environmental Assessment Study
Municipal Class Environmental Assessment
NTS

Land Use

Land Use and Property

Efficient Utilization of Future Development Land



Definition: This sub-factor measures whether the alignment alternative supports the efficient use of lands. Those alternatives that best support access and maximize the land available for development are preferred.

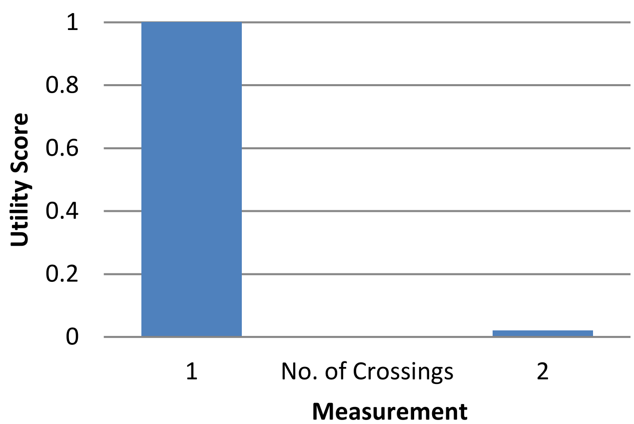
Mitigation: None.

Alternatives:

Alternative	High/Medium/Low	Utility Score
Alternative 1	High	1
Alternative 2	Medium	0.5
Alternative 4	Low	0

Land Use and Property

Crossing of the Hydro Corridor



Definition: This sub-factor measures the number of crossings of the hydro corridor. The hydro corridor is a high voltage transmission line. Each crossing/conflict with the hydro corridor will require additional approval from Hydro One. The proposed extension of Biehn Drive would result in one crossing of the hydro corridor. Without the extension of Biehn Drive the future development would require the creation of a crescent roadway to access the developable lands with two crossings of the hydro corridor. Alternatives with the least number of hydro corridor crossings are preferred.

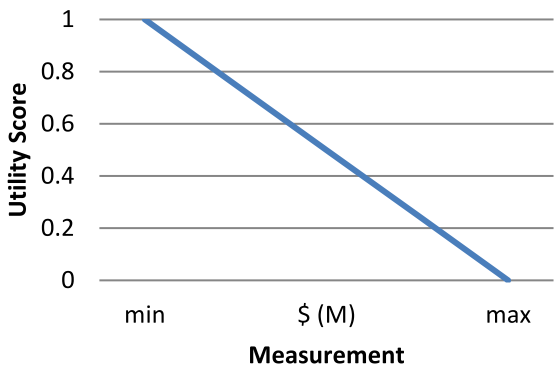
Mitigation: Limit parking under the transmission lines.

Alternatives:

Alternative	Number	Utility Score
Alternative 1	1	1
Alternative 2	1	1
Alternative 4	2	0

Cost

Capital Cost



Definition: This sub-factor measures the total capital cost of the alternative (including land purchasing, permitting, etc.). Cost estimates are for the alternative alignments in 2023. Those alternatives with the lowest capital cost are preferred.

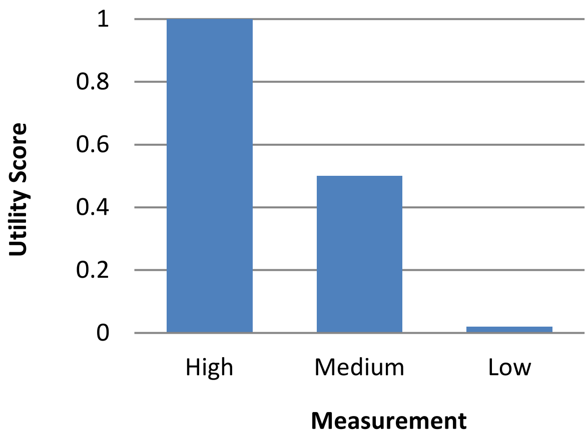
Mitigation: Not applicable.

Alternatives:

Alternative	$million	Utility Score
Alternative 1	3.98	0.15
Alternative 2	4.28	0
Alternative 4	2.23	1

Engineering

Accommodating Stormwater Management



Definition: This sub-factor measures whether the alignment can incorporate an efficient space for the expansion of the stormwater management pond to service the land use plan and road stormwater. The alignment alternatives providing an adjacent location to the existing pond are preferred as it allows for direct outlets following the road alignment to the adjacent stormwater pond and does not sterilize developable lands. The measurement for this sub-factor is High/ Medium/ Low. Those alternatives that support or allow expansion of the stormwater management pond are preferred.

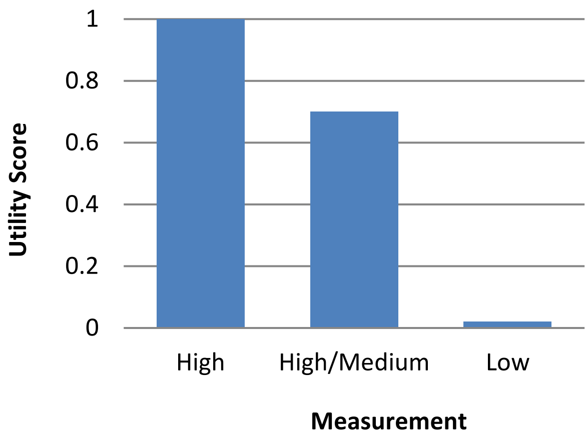
Mitigation: None.

Alternatives:

Alternative	High/Medium/Low	Utility Score
Alternative 1	High	1
Alternative 2	Medium	0.5
Alternative 4	Low	0

Engineering

Biehn Drive Stormwater Enhancement



Definition: This sub-factor measures the ability to enhance stormwater runoff from existing Biehn Drive that currently outlets into the PSW wetland. The measurement for this sub-factor is High/Medium/Low. Those alternatives that connect to Biehn Drive will provide a net enhancement of the stormwater treatment on Biehn Drive. Alternative 1 provides the shortest distance to the stormwater pond and Alternative 4 doesn't provide an opportunity for Best Management Practices.

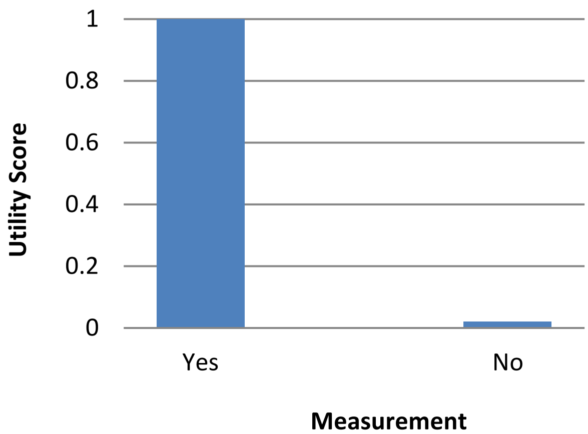
Mitigation: Best Management Practices.

Alternatives:

Alternative	High/High-Medium/Low	Utility Score
Alternative 1	High	1
Alternative 2	High/Medium	0.7
Alternative 4	Low	0

Engineering

Sanitary Sewer Alignment

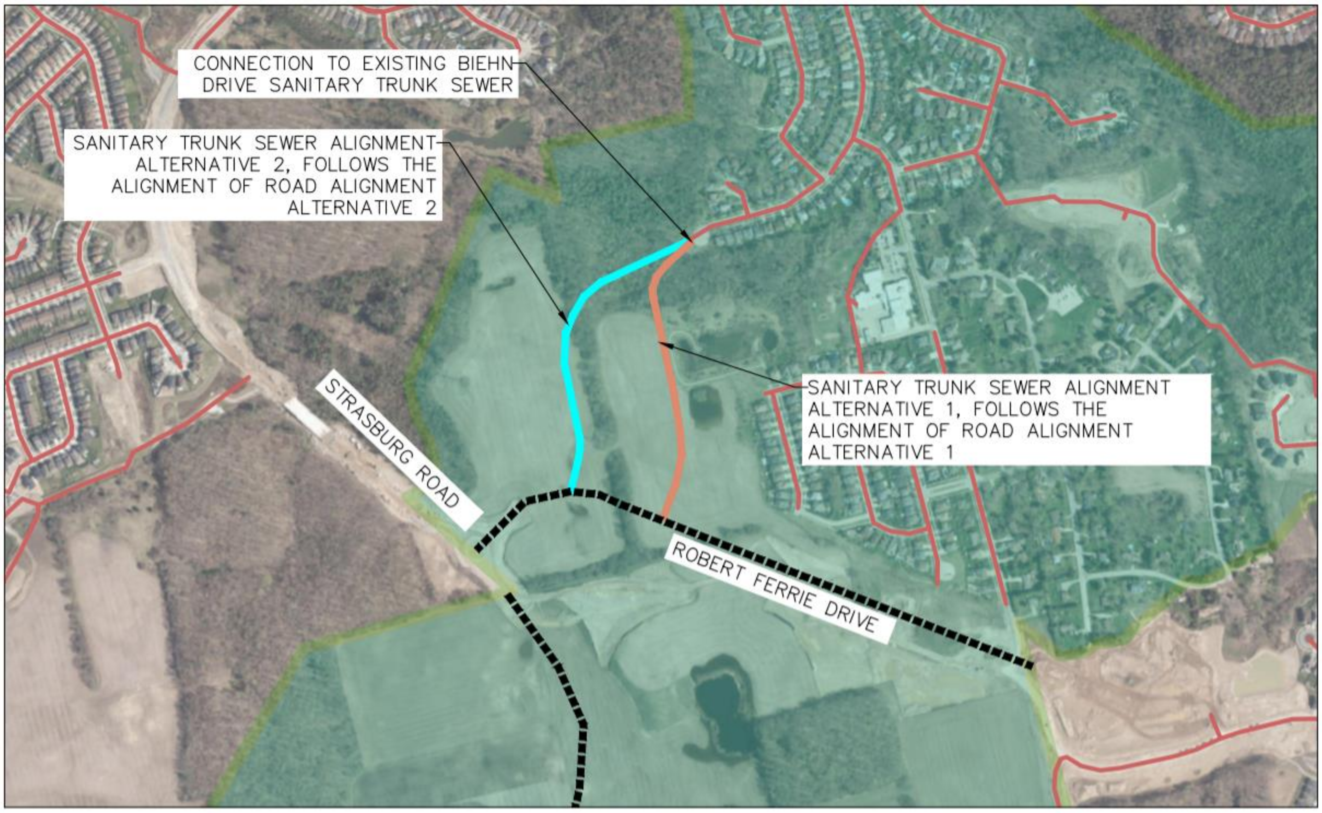


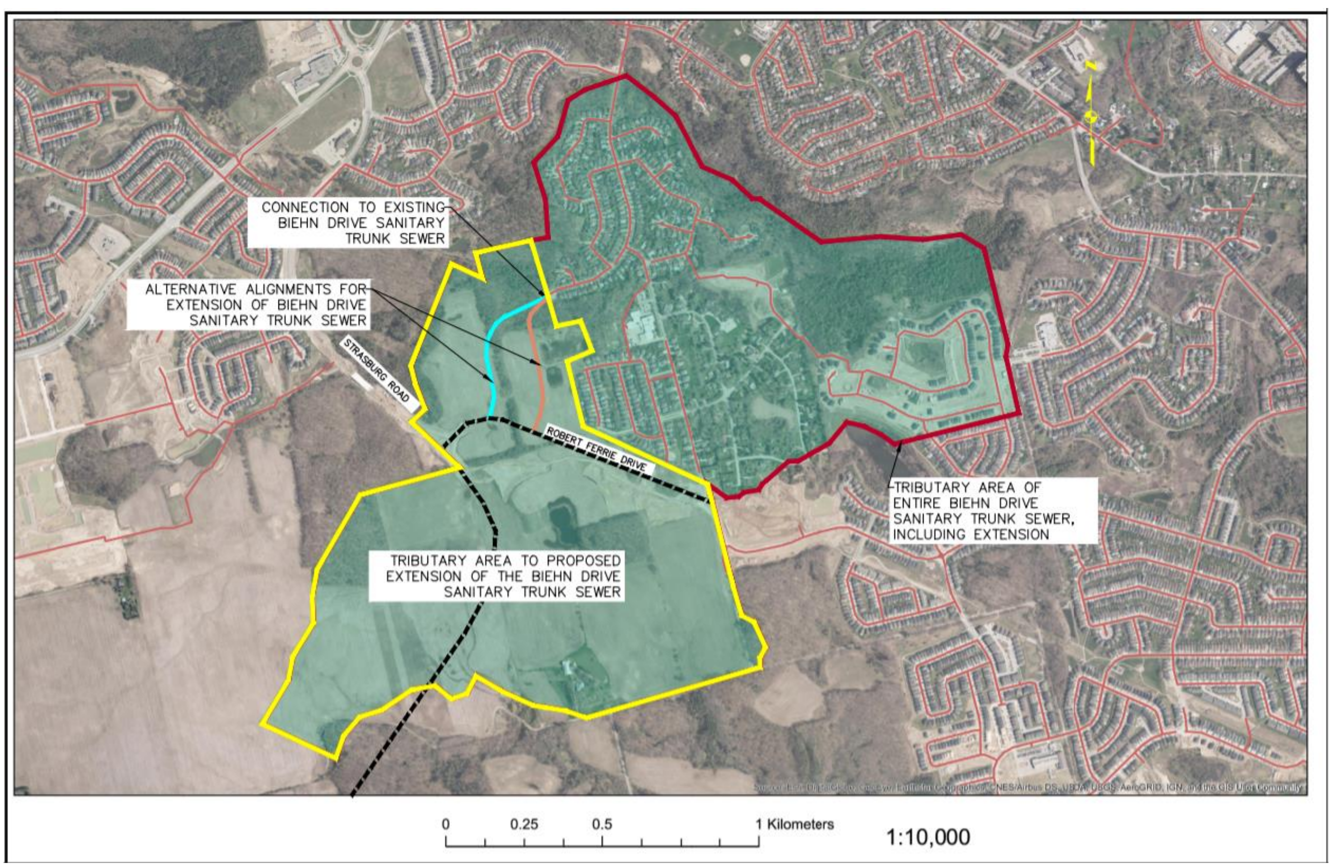
Definition: This sub-factor measures whether the alignment alternative can adequately accommodate the sanitary sewer. The measurement for this sub-factor is Yes/No. Those alternatives that would provide a lower road elevation and align the stormwater sewer and the sanitary sewer are preferred.

Mitigation: None.

Alternatives:

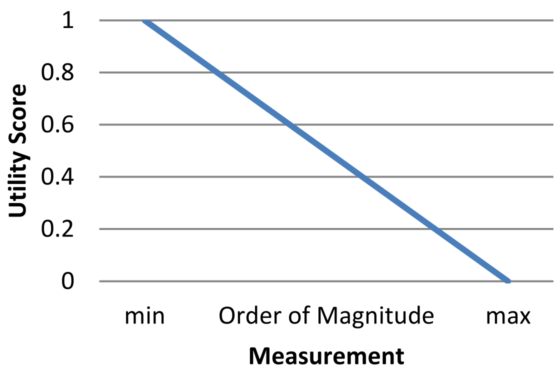
Alternative	Yes/No	Utility Score
Alternative 1	Yes	1
Alternative 2	No	0
Alternative 4	Yes	1


CONNECTION TO EXISTING BIEHN DRIVE SANITARY TRUNK SEWER
SANITARY TRUNK SEWER ALIGNMENT ALTERNATIVE 2, FOLLOWS THE ALIGNMENT OF ROAD ALIGNMENT ALTERNATIVE 2
SANITARY TRUNK SEWER ALIGNMENT ALTERNATIVE 1, FOLLOWS THE ALIGNMENT OF ROAD ALIGNMENT ALTERNATIVE 1
STRASBURG ROAD
ROBERT FERRIE DRIVE


CONNECTION TO EXISTING BIEHN DRIVE SANITARY TRUNK SEWER
ALTERNATIVE ALIGNMENTS FOR EXTENSION OF BIEHN DRIVE SANITARY TRUNK SEWER
STRASBURG ROAD
ROBERT FERRIE DRIVE
TRIBUTARY AREA OF ENTIRE BIEHN DRIVE SANITARY TRUNK SEWER, INCLUDING EXTENSION
TRIBUTARY AREA TO PROPOSED EXTENSION OF THE BIEHN DRIVE SANITARY TRUNK SEWER
0
0.25
0.5
1 Kilometers
1:10,000

Engineering

Overland Stormwater Management Route



Definition: This sub-factor measures whether the alignment alternative provides an overland stormwater route to the Stormwater Pond based on feasibility to direct drainage to the stormwater pond and outlet. Those alternatives that provide a route for stormwater to the Stormwater Pond are preferred.

Mitigation: None.

Alternatives:

Alternative	Order of Magnitude	Utility Score
Alternative 1	1	1
Alternative 2	0.4	0.4
Alternative 4	0	0

Appendix I

Biehn Drive Wildlife Crossing Technical Memorandum

BT ENGINEERING

509 Talbot Street
London, ON N6A 2S5
519-672-2222

MEMORANDUM

TO:	File	**DATE:**	March 30, 2022
CC:	Steven Taylor, BTE, Rudi Warmé, BTE Leonardo Sanchez, Sanchez Engineering	**PROJECT #:**	21-003
PROJECT:	Biehn Drive Municipal Class Environmental Assessment	**FROM:**	Zachery Wells, BTE
SUBJECT:	Biehn Drive Wildlife Crossing		

Overview

As a component of the Preliminary Design for the extension of Biehn Drive southerly to Robert Ferrie Drive, consultation has been undertaken with the Grand River Conservation Authority (GRCA), the City of Kitchener's Environmental Committee and Six Nations of the Grand River (SNGR) regarding the mitigation of impacts to the natural environment including the Strasburg Creek Provincially Significant Wetland (PSW). This consultation has identified an interest in the provision of one or more wildlife crossings under Biehn Drive within the limits of the PSW.

Previous surveys completed by WSP Canada Group Inc. and field work completed by BTE staff in 2021 and 2022 have identified the PSW as being ideal for mammalian and herptile habitat. As such, impacts to wildlife resulting from a new road crossing must be considered in the context sensitive design of the road extension. The following provides a high-level overview of the design requirements to be considered during preliminary and detail design.

Culvert Sizing

Evaluation of a suitable wildlife crossing structure has followed best practices identified in the following guides:

- Best Management Practices (BMP) for Mitigating the Effects of Roads on Amphibian and Reptile Species at Risk in Ontario (NDMNRF, 2016) (**Attachment 1**); and
- Credit Valley Conservation Fish and Wildlife Crossing Guidelines (CVC, 2017) (**Attachment 2**).

The guide developed by the Ministry of Northern Development, Mines, Natural Resources and Forestry (NDMNRF) is a general one which describes different mitigation measures meant to reduce the effects of roads on, although not limited to, Species at Risk (SAR) in Ontario. This guide describes different types of crossing structures and associated supplemental tools including fencing, dry ledges, light openings, etc. Specifications for herptiles, the focus of this document, are general and suggest minimum sizes for culvert dimensions based on passage length. For passages not exceeding 15 m such as the proposed Biehn Drive roadway width (10 m), the guide recommends a minimum structure width and height of 1.5 m x 1.0 m for turtles, and 1.0 m x 1.0 m for snakes, lizards, salamanders and frogs. The BMP suggest not installing passages where road widths exceed 25 m. Additionally, BTE does not advise installation of a corrugated steel pipe (CSP) culvert under Biehn Drive due to future issues associated with rehabilitation/replacement including costs, associated traffic staging and subsequent disturbance to the surrounding wetland.

As the length of the passage required under Biehn Drive will not exceed the 15 m condition set out in this guide, the minimum culvert dimensions listed are likely to be sufficient; however, Credit Valley Conservation's (CVC) more technical calculation of suitable culvert dimensions when targeting specific species is checked below to confirm.

CVC's Fish and Wildlife Crossing Guidelines identify Openness Ratios (ORs) as a method of calculating the dimensions of a wildlife crossing structure (CSP culvert, elliptical/arch culvert or concrete box culvert) such that the feature is useable by the target species. The intent of an OR is to maximize the height and width of a structure (culvert, bridge, etc.) opening to effectively encourage its use by local wildlife. A measure of safety for wildlife is their ability to see an exit, or in the context of survival, a way out or away. Critical to this is the animal's ability to not only fit in the wildlife crossing, but also to see light at the other end of the structure. The OR of a wildlife crossing is calculated as follows for different structures:

- Box culvert: $(\mathrm{Height} \times \mathrm{Width})/\mathrm{Length}$
- Corrugated Steel Pipe (CSP): $(\pi \times \mathrm{r}^2)/\mathrm{Length}$

CVC guidelines recommend a minimum OR of 0.05 for small mammals (e.g. mouse, vole, squirrel), 0.1 for mid-sized mammals (e.g. fox, raccoon, skunk) and 0.1 for herptiles (e.g. salamander, turtle, snake). Additionally, these guidelines recommend minimum dimensions of 1.0 m (height and span) for targeted species groups up to and including mid-sized mammals.

Based on the width of the roadway and the sensitivity of the surrounding PSW, one or more 1.0 m (span) by 1.0 m (rise) concrete box culverts are recommended for the provision of wildlife passage under Biehn Drive. These dimensions meet the minimum recommendations set out in CVC's guidelines and are close to those set out in the Province's BMP guide, providing an OR of 0.1. Consideration for multiple crossings should be investigated during detail design.

Wildlife Fencing

Best practices to accompany wildlife crossings include the installation of permanent wildlife fencing to direct target species to the crossing structure, tying into entrances. For small mammals, amphibians and reptiles, it is recommended that fencing extend a minimum of 100 m on either side of the crossing, be buried a minimum depth of 10 cm, be a minimum height of 1.0 m and have a maximum mesh size of 0.6 cm. Some of the recommendations for fencing in areas where mid-sized mammals are the target species are likely unattainable in the Biehn Drive study area. These recommendations include extending the fencing 500 m on either side of the crossing and incorporating one-way gates every 0.5-1.0 km. The primary measure targeting mid-sized mammals that is achievable given site conditions would be to bury fencing to a depth of 20 cm – doubling the buried depth in comparison to fencing targeting only small mammals and herptiles. All fencing must include a curved lip at the top to ensure that it is impassible to wildlife climbing the fence. A design specification and installation guide for a suitable fencing option is included in **Attachment 3**. This product, or an equivalent, should be investigated during detail design.

Should it be determined that the PSW will continue to function as an informal trail system after the construction of the Biehn Drive extension, provision of access points for the public should be considered along the permanent exclusion fencing. For this reason, the use of permanent exclusion fencing should be further discussed in consultation with the City of Kitchener, GRCA and Indigenous Communities during detail design.

Additional Considerations During Detail Design

In addition to implementing targeted ORs and permanent fencing, other components of the crossing must be considered. Design considerations are summarized in the following table, adapted from guidelines produced by CVC (see **Table 1**Error! Reference source not found.).

Table 1: Wildlife Crossing Specifications

Wildlife	OR	Dimensions	Substrate	Approach	Fencing	Other
Small mammals (muskrat, beaver, mink, raccoon)	0.05	Width & height both >0.3 - 1.0 m	Dry ledges/banks (avoid rip-rap)	Natural cover not obstructing entrance	<1/4 inch mesh, 15 cm curved lip, buried 10-20 cm, 1-1.8 m tall, 100 m on either side of structure	Incorporate dry ledges for terrestrial passage
Mid-sized mammals (fox, raccoon, skunk)	>0.1	Width & height both >1.0 m	Dry ledges/banks (avoid rip-rap)	Natural cover not obstructing entrance	Buried 20-40 cm, 1-2 m tall*	Incorporate dry ledges for terrestrial passage
Amphibians / reptiles (turtle, snake, frog)	>0.1	Width & height both >0.5 m	Moist (avoid rip-rap)	Natural cover not obstructing entrance	<1/4 inch mesh, 15 cm curved lip, 0.4-1.2 m tall, buried 10-20 cm, 100 m on either side of structure	Steel materials are undesirable due to cold conductivity

*Other design recommendations such as fencing extending 500 m on either side of the crossing are not achievable in the study area.

Additional measures to be considered include the provision of an open top (grates, grooves, etc.) to allow for more natural moisture levels, light penetration and temperature. Open-bottom culvert design should be incorporated to allow for natural substrate (e.g., moss, woody debris), or at minimum, placement of natural substrate along the bottom of a closed-bottom structure. Considerations should be made for the efficacy of snow removal such that fencing is set back far enough to not be damaged during the winter months.

Conclusions

Based on a review of provincial best practices, BTE recommends that one or more concrete box culverts with a 1.0 m span and 1.0 m rise be considered for the provision of wildlife passage under the Biehn Drive extension in the area of the Strasburg Creek PSW. Additional consultation with GRCA should be undertaken to investigate additional alternatives to both reduce the cost of the structures and minimize the road grade elevation required for sufficient cover overtop of the culvert and ultimately, a shorter toe of slope and smaller impact to the PSW. The 1.0 m by 1.0 m crossing would meet the minimum OR which, in conjunction with the possible implementation of permanent wildlife fencing, will function to minimize wildlife mortality associated with the construction of the road extension. Additional design considerations should be investigated during detail design.

Best Management Practices for Mitigating the Effects of Roads on Amphibian and Reptile Species at Risk in Ontario

April 2016

Written by Kari Gunson, David Seburn, Julia Kintsch and Joe Crowley

ontario.ca/speciesatrisk

Ontario

Suggested Citation

Ontario Ministry of Natural Resources and Forestry. April 2016. Best Management Practices for Mitigating the Effects of Roads on Amphibians and Reptile Species at Risk in Ontario. Queen's Printer for Ontario. 112 pp.

Acknowledgements

This document was written and reviewed by: K. Gunson, Eco-Kare International; D. Seburn, Seburn Ecological Services; J. Kintsch, Eco-Resolutions; and J. Crowley, Ontario Ministry of Natural Resources and Forestry (MNRF). This document benefitted from reviews by MNRF SAR biologists and staff. Many thanks to Trina Rytwinski for her contribution to the Study Design and Road Impacts sections. Picture contributions and credits are denoted throughout the document. Thank you to the MNRF Species at Risk Branch project management team (Joe Crowley, Darlene Dove, Amanda Eddington, Natasha Leahy, Megan McAndrew, Roxanne St. Martin, Lara Griffin) for leading the project to completion. Special thanks to the Ontario Ministry of Transportation (MTO) Environmental Policy Office for their review of several draft versions of this document. Many thanks to those that provided input on costs and other advisement from specific mitigation projects, namely Andrew Healy with Northeast Region MTO, and Rick Levick with the Longpoint Causeway Improvement Committee. Kevin Williams with Atlantic Industries Limited provided expertise on engineering considerations for using culverts as wildlife crossing structures. This document is meant to be a first edition within a cutting-edge and fast evolving field of applied science.

Cover photo provided by Joe Crowley

TABLE OF CONTENTS

9 APPENDICES

1 INTRODUCTION

1.1 Purpose

The purpose of the Ontario Ministry of Natural Resources and Forestry (OMNRF) Best Management Practices for Mitigating the Effects of Roads on Amphibian and Reptile Species at Risk in Ontario (hereafter referred to as the best management practice (BMP) document) is to provide information on designing, implementing and monitoring mitigation measures to restore connectivity and reduce road mortality for species at risk (SAR) amphibians and reptiles. This information will assist in providing information on mitigation planning for amphibians and reptiles at risk in Ontario in order to meet the requirements of the *Endangered Species Act, 2007* (ESA) or its associated regulations. The intended audience includes planning authorities (local or provincial government), individuals applying ESA requirements on the landscape, consultants working on their behalf and conservation organizations involved in the planning and design of impact mitigation for all new roads and road rehabilitation (improvement) projects.

The focus of this BMP document is on crossing structures and fencing. While there is no singular solution for mitigating road effects on amphibians and reptiles, this document offers information for developing site-specific mitigation based on best practices and findings from current peer-reviewed and grey literature (e.g., websites and conference proceedings), government documents, academic theses and personal communication surveys with experts in road ecology and other areas of relevance (e.g., engineering, species biology). When knowledge gaps were identified, the recommendations are based on the best available information and expert opinion, as well as logical interpretation from species-specific needs and life-history traits.

This document presents current information as of the date of publication and is meant to be updated through time as improved information becomes available. If you are interested in providing pertinent information for consideration in updates of this document, please email esapermits@ontario.ca.

1.2 Endangered Species Act, 2007 (ESA)

The ESA provides the legislative framework for the protection of species at risk in Ontario. Section 9 of the ESA includes prohibitions against activities such as killing, harming, harassing, capturing or taking a living member of a species that is listed as extirpated, endangered or threatened on the Species at Risk in Ontario (SARO) List. Section 10 of the ESA includes prohibitions against damage or destruction of the habitat of an endangered or threatened species.

The ESA contains provisions that enable the Minister to issue permits and enter into agreements to authorize activities that would otherwise be prohibited and Ontario Regulation 242/08 sets out conditional exemptions from prohibitions under the Act for certain activities. For additional information, visit the government website or read the full text of the legislation on e-Laws using the links provided below.

How species at risk are protected:
https://www.ontario.ca/page/how-species-risk-are-protected

Endangered Species Act, 2007 on e-Laws:
http://www.ontario.ca/laws/statute/07e06

Ontario Regulation 242/08 on e-Laws:
http://www.ontario.ca/laws/regulation/080242

1.3 Document Outline

This document is organized into the following sections:

Section 1 (Introduction) provides background information on the threats of roads to amphibian and reptile species and the overall objectives of the document.

Section 2 (The Impacts of Roads) details background information on the impacts of roads on amphibians and reptiles and the need for road mitigation measures.

Section 3 (Mitigation Planning) provides information about considerations for developing a mitigation plan in a landscape context within project planning processes.

Section 4 (Road Mitigation BMPs) addresses design variations and applications of three crossing systems for amphibians and reptiles, in addition to detailed considerations for siting, designing, enhancing and maintaining crossing structure and fencing systems.

Section 5 (Supplementary Measures) provides recommendations about using mitigation measures other than crossing structures and fencing systems to reduce road impacts on amphibians and reptiles. These measures may be used when crossing structures are not required, or as a complement to an effective mitigation plan.

Section 6 (Temporary Mitigation During Road Construction) provides considerations for reducing impacts from construction activities, including timing construction activities to avoid construction-related impacts, and considerations regarding the use of temporary mitigation measures to minimize impacts during construction.

Section 7 (Monitoring) highlights where there are knowledge gaps about effectiveness of mitigation measures for reducing road impacts on amphibians and reptiles. Study design and monitoring techniques for measuring crossing structure and fencing effectiveness, in an adaptive approach, are discussed.

References

Appendix A (SAR Amphibian and Reptile Habitat Use and Movement) provides a general summary of seasonal habitat use, general movement distances within and between habitat and when this occurs for species at risk amphibians and reptiles in Ontario.

Appendix B (Definitions) provides a glossary of terms used throughout the document.

Appendix C (Crossing Structure Summary from Literature) summarizes the findings from the literature-based review that informed the recommendations throughout the document.

Appendix D (Links and Other Resources) contains a list of useful references, which may be cross-referenced when developing a mitigation plan for SAR amphibians and reptiles.

Appendix E (Sample Tunnel Cost Table (2014) contains the cost per metre for round and box tunnels, as well as special installation considerations.

2 IMPACTS OF ROADS

Globally, there are significantly more amphibian and reptile species at risk than either mammals or birds (IUCN 2010). Amphibians and reptiles were the most negatively affected species groups in a meta-analysis using data from 75 studies that quantitatively measured the relationship between roads or traffic and population size (Rytwinski and Fahrig 2012). The threats of roads to amphibian and reptile populations in Ontario are well-documented, and primarily include direct mortality of animals as well as habitat loss, degradation and fragmentation (e.g., Fahrig et al. 1995, Ashley and Robinson 1996, Findlay and Houlahan 1997, Vos and Chardon 1998, Haxton 2000, MacKinnon et al. 2005, Crowley 2006, Seburn 2007, Eigenbrod et al. 2008a, Eberhardt et al. 2013).

In southern Ontario the network of major roads increased from 7000 km to over 35 000 km from 1935 to 1995 (Fenech et al. 2001). Consequently, there is no point in southern Ontario that is further than 1.5 km from a road (Gunson et al. 2012), and remaining natural habitat is isolated into patches. In addition, human population growth is projected to increase by at least 30% over the next 20 years in the Greater Golden Horseshoe, increasing traffic volume and pressure for road expansions and rehabilitation. With properly planned and implemented road ecology solutions, these impacts can be lessened across Ontario.

Monitoring has documented significant levels of road mortality (van Gelder 1973, Rosen and Lowe 1994, Ashley and Robinson 1996, Aresco 2005) and road barrier effects (Andrews and Gibbons 2005) for amphibians and reptiles. Snakes are particularly vulnerable to road mortality because some species immobilize in response to a passing vehicle (Andrews and Gibbons 2005), or may bask on the roadway for thermoregulation (Andrews et al. 2008). Snakes may also avoid crossing roads altogether, which may disrupt normal behaviours, prevent access to key habitats, and lead to reduced genetic diversity (Shine et al. 2004, Rouse et al. 2011, Robson and Blouin-Demers 2013). Road mortality of more than three adult females per year can lead to declines for some long-lived snake populations such as the Gray Ratsnake (Row et al. 2007).

Modelling studies suggest that populations of many turtle species are declining because of the high rates of annual traffic mortality in some areas (Gibbs and Shriver 2002). Turtles are particularly vulnerable to traffic mortality because their life history strategy is characterized by long life spans, delayed maturity (sometimes taking more than 20 years), and very high adult survivorship. As a result even small, but ongoing, increases in adult mortality can lead to population declines (Congdon et al. 1993) and recovery is slow (Brooks et al. 1991). Females are threatened by traffic mortality because of overland movements to nesting areas (Steen et al. 2012) and populations of some species have been found to be male-biased in wetlands in areas with high road density (Marchand and Litvaitis 2004, Steen and Gibbs 2004).

Amphibians are subject to road mortality when migrating to wetland breeding sites and this can range from 19% (Gibbs and Shriver, 2005) to as high as 98% (Hels and Buchwald, 2001) depending on traffic volumes (Bouchard et al. 2009). Road mortality of just 10% of the adult population can lead to population extinctions (Gibbs and Shriver, 2005), resulting in lower species richness and abundance of individuals near roads (e.g., Carr and Fahrig, 2001; Eigenbrod et al., 2008). In addition, Karraker and Gibbs (2011) found road mortality reduced the life expectancy of Spotted Salamanders (*Ambystoma maculatum*) next to roads, and because younger salamanders lay smaller egg masses this also reduced reproductive output. In addition to road mortality, roads also inhibit movements of amphibians (deMaynadier and Hunter 2000) which can potentially restrict gene flow (Marsh et al. 2008).

3 MITIGATION PLANNING

3.1. Project-Level Impact Avoidance and Mitigation

Project planning and design for roads is a stepwise process that begins with defining the study area for new road construction or other major road rehabilitation projects. Meese et al. (2009) identifies the potential impacts of different types of road projects on wildlife species in general (Table 1). The list of project types is not meant to be exhaustive but rather to include major road improvements and rehabilitations within the scope of this document. There are other impacts to SAR during road operations and maintenance activities such as shoulder grading and paving that are not covered in this document. Projects should be designed to avoid impacts whenever possible, and this is best achieved by locating roads to avoid species at risk habitat altogether. When impacts are unavoidable, appropriate authorizations need to be obtained and the necessary mitigation measures incorporated into the project design.

3.2 Project Planning Considerations and Sources of Information

The information in this document outlines considerations for devising and integrating a mitigation plan into the road planning process in situations when avoidance cannot be achieved. New roads or road improvements present opportunities to lessen the impacts on SAR by integrating mitigation measures. These mitigation measures include specialized tunnels for wildlife passage as well as modifying or retrofitting existing drainage crossings for both water and wildlife use.

Table 1: A summary of project types during road improvement and rehabilitation activities, and potential impacts on amphibians and reptiles (adapted from Meese et al. 2009).

Road Activity	Project Type	Impacts on SAR
Road improvement	New road alignment or extension	Bisection of existing habitat and movement routes; genetic isolation of populations; road mortality; habitat loss
Road improvement	Road widening	Increased traffic volumes and road width increase risk of road mortality (Gibbs and Shriver 2002); habitat loss
Road improvements	Creation of median and installation of shoulder barriers	Increased barriers and road corridor width increase risk of road mortality
Road rehabilitation	Culvert or bridge improvements	May provide opportunities or barriers to movement, depending on resulting permeability of structure (Kintsch and Cramer 2011); risk of destroying turtle nests if work is carried out during the nesting period
Road rehabilitation	Improved road pavements	Increased risk of road mortality and disturbance of animals

Implementation of the mitigation plan begins during the construction phase, and particular attention to design details is important for amphibians and reptiles. It is important for all individuals involved in construction projects, including road crews, to be aware of the mitigation measures to be implemented for the project. Oversight by individuals with the greatest understanding of the mitigation measures is imperative to ensure that effective road mitigation solutions are implemented. For example, a fence with a gap or a fence buried improperly can render the mitigation measures ineffective. Quality assurance and adherence to the mitigation specifications needs to be practiced for each project. Routine quality checks to ensure that implementation of mitigation measures is not misinterpreted during construction, and routine maintenance of mitigation measures following construction is required.

Compiling field and geographic information system (GIS) data can support the development of an effective mitigation plan. Standard data compilations include species occurrence data obtained from the MNRF or other sources; these data are best supplemented with additional road survey data and species presence data collected in the project study area using standard survey techniques (see section 7.2.1). In the case of larger road projects, the duration of the environmental assessment (EA) process can last up to ten years, especially if there are time lapses between the preliminary assessment, detail design and construction. This provides opportunities for formal data collection within the project study area that can inform both mitigation planning and assessments of the effectiveness of mitigation.

Georeferenced data that may be available to support project planning and design may include the following:

- Existing and future land use and ownership maps,
- Habitat mapping (e.g., Southern Ontario Land Resource Information System, or Ecological Land Classifications),
- Species at risk occurrence information (Natural Heritage Information Centre),
- Terrain features,
- Natural Heritage Systems, and
- Existing and future road network and other infrastructure (i.e., existing barriers or passageways, including culverts, median and shoulder barriers, and adjacent railroads, local or private roads).

3.3 Recommended Process

The recommended steps for developing a comprehensive mitigation plan for SAR amphibians and reptiles are outlined in Figure 1 and described below.

Step 1: Identify and prioritize sections of roads that will impede connectivity and/or pose mortality risk to amphibians and reptiles using field data collections and additional landscape information (see section 3.4). Defined road impacts and objectives for mitigation will provide the content and scope of the mitigation plan.

Step 2: Design and determine the location of mitigation measures such as crossing structures and fencing by combining ecological data (e.g., species, habitat and landscape information) with engineering data (e.g., geomorphological, hydrological and topographical). This step requires collaboration between the ecological and engineering design team to ensure fluid integration of information into the mitigation plan. For a road rehabilitation project, there may be opportunities to retrofit existing infrastructure. Through careful evaluation, existing bridges and drainage culverts may be used or adapted for amphibians and reptiles (see section 4.1.4).

Step 3: Consider a multi-species perspective to ensure that a strategy for an individual species does not create unintended impacts for other wildlife species. Supplementary measures such as warning signs at fence ends may complement a multi-species strategy (see section 5).

Step 4: Identify temporary mitigation measures. This could include carrying out road construction when animals are not active, timing construction at particular road sections when animal activity is minimal (see section 6.1) and installing temporary mitigation measures (see section 6.2).

Step 5: Develop a monitoring plan for evaluating the effectiveness of the mitigation. Refer to section 7 for information on developing a complete monitoring plan that addresses the uncertainty with respect to mitigation design.

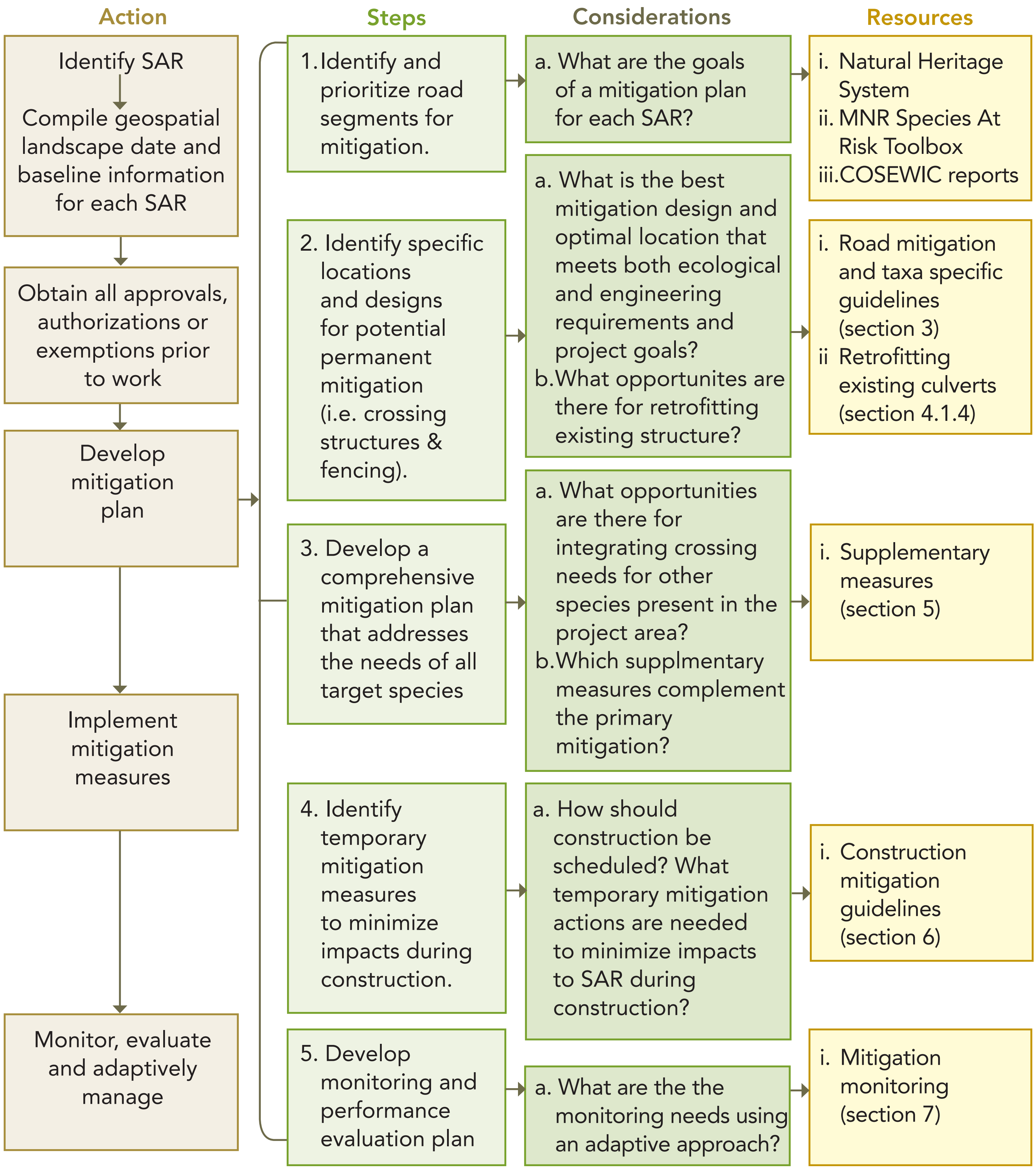


Figure 1: Flowchart summarizing the development of a mitigation plan (individual steps, considerations and supporting resources) within the established authorization processes for major road activities.

3.4 Landscape Considerations

Consideration of the larger landscape context is a vital component of effective mitigation planning for transportation projects because amphibians and reptiles require protection from adverse impacts at both the local and landscape scales (Semlitsch 2008). In other words, animals need to move within habitat patches to access resources (local scale), but also between habitats at different times of year, when habitat becomes inhospitable or to maintain genetic interchange (regional metapopulation scale).

In Ontario, natural heritage systems (NHS) have been developed at a variety of scales. Some are local in scale, while others span multiple jurisdictions, such as the systems in the Greenbelt Plan which span multiple regional municipalities. Natural heritage systems will often include a variety of habitat types including important amphibian and reptile habitat. The natural heritage system identified in the Greenbelt Plan 2005 is an example of a landscape level system approach to cores and linkages for natural heritage conservation. NHS can connect important natural heritage features and areas used by amphibians and reptiles, such as wetlands and upland habitat. Applicable conservation planning efforts, such as NHS, can be refined with taxa specific models for amphibians and reptiles (Gunson et al. 2012) and identified SAR habitat. This information can be used to identify where roads will pose the highest risk for road mortality and isolation of habitat, and should be integrated into early phases of mitigation plan development.

Consideration of the broader landscape context is required because impacts to wildlife are rarely caused by transportation alone (Clevenger 2012). The following landscape level considerations will contribute to the development of a comprehensive mitigation plan:

- Identifying the location of SAR populations and their habitat, including seasonal habitat usage and movement routes (described in Appendix A);
- Identifying connectivity at a regional scale that integrates an ecosystem approach (e.g., natural heritage systems);
- Understanding adjacent land security (i.e., the condition and ownership of land adjacent to a project, and the potential for land-use change); and
- Coordination with other jurisdictions (e.g., municipalities and conservation authorities that own adjacent infrastructure and land).

4 ROAD MITIGATION BMPS

This section provides a summary of BMPs specific to crossing structures and fencing (see sections 4.1 and 4.2). The focus is on the best structural design for all amphibians and reptiles, with species-specific considerations noted when relevant. Following these BMPs, taxa specific (turtles, snakes and lizards, salamanders, frogs and toads; see section 4.1.5) considerations are summarized and supplemented with a rationale section based on a comprehensive literature review. All BMPs are further illustrated and supported with relevant examples, photos, references, and caveats specified throughout. Although SAR amphibians and reptiles found in Ontario are the focus for this document, information also derives from research on related species in other regions for each taxa. This document provides the minimum recommended design specifications (e.g., height, length and width for crossing tunnels and fencing) based on the best available information. All mitigation plans will be subject to trade-offs as presented by engineering, budget, public safety, and site specific constraints.

To date, crossing structures (see section 4.1) combined with fencing (see section 4.2) offer the most effective mitigation of road impacts for amphibians and reptiles by facilitating landscape connectivity and reducing road mortality by excluding animals from the road (Dodd et al. 2004, Aresco 2005). Crossing structures and fencing integrated into road improvement and rehabilitation projects provide the greatest opportunity for creating functional passages, although, in some cases, existing structures may be retrofitted to facilitate wildlife passage (see section 4.1.4). The recommendations herein focus primarily on crossing structure tunnels less than 3 m wide because these structures are typically used for amphibians and reptiles and are available as precast or prefabricated structures. When a tunnel exceeds 25 m in length, a larger structure such as an overpass, multi-span bridge, or viaduct should be considered (see section 4.1.1). Larger structures can be integrated into a multi-species design strategy to increase effectiveness for both large and small species. Multi-species considerations are provided in this document, in addition to approaches for combining mitigation measures to achieve an overall mitigation plan.

4.1. Crossing Structures

Crossing structures can play an integral role in mitigating the impacts of roads on SAR amphibian and reptiles in Ontario. Recommendations regarding the use of different types of crossing structures, design considerations, location and spacing of crossing structures and taxa specific guidelines are provided. The retrofitting of existing drainage culverts and associated considerations are also covered.

In this document, the term tunnel is used to differentiate between crossing structures intended for amphibian and reptile use as opposed to culverts that are designed to transport water under the road. Box tunnels with natural substrate, arch tunnels and round tunnels buried 0.3-0.4 m into the ground are the primary recommended tunnel types because they meet essential criteria, such as providing natural substrate bottoms and a flat crossing surface.

4.1.1 Types of Crossing Structures for Amphibians and Reptilesa

<table>
<tr><th colspan="2">BOX TUNNEL</th></tr>
<tr><td colspan="2">
• Traditionally used for drainage, but also increasingly being placed and modified specifically for amphibian and reptile passage.
• Tunnels up to 3 m wide or high typically made from precast concrete (Photo 1).
• Maximum recommended tunnel length of 25 m.
• Variations include open-top (Photo 2) or open-grate (Photo 3), open-bottom (Photos 4) or variations of these (Photos 5 - 7).
• Straight walls may be perceived by target species as increased openness.
• Provide more cross sectional area or openness than round or elliptical culverts with the same width.
</td></tr>
<tr><td rowspan="2">STRUCTURAL VARIATIONS</td><td>
OPEN-TOP
• Achieved with slots or grooves along the top (Photo 2), or open-grate set upon two concrete footings (Photo 5).
• Allows for more consistent ambient conditions, including moisture, light and temperature (Photo 8).
• Possible concerns with influx of road debris, pollutants, or traffic noise.
• Installation at a downward incline from middle of road to road edge to allow for drainage and natural cleaning of the tunnel.
</td></tr>
<tr><td>
OPEN-BOTTOM
• Three-sided structures (Photo 4).
• Allows natural substrate conditions to be retained (e.g., streambed or grass floor) (Photo 9).
</td></tr>
<tr><td>APPLICATION</td><td>
• A smaller sized open-top tunnel may increase crossing success or provide microhabitat conditions equivalent to the openness created by larger tunnels.
• Open-top grate tunnels have previously been used on low-use cottage roads or roads in protected areas (e.g., Wild Rice Trail, Algonquin Provincial Park, Killbear Provincial Park (Photos 5 and 6)).
• For divided highways with two structures that end in the median, tunnels should be connected with a fence (Photo 10).
• Headwalls may be used at entrance to shorten length of structure or for a seamless join to a concrete guide wall (Photo 11).
• For box culverts, the tunnel floor should be buried with natural substrate and cover objects (Photos 12 and 13).
• An open-top in the road shoulder and a closed-top along the road pavement may be more suitable for high volume roads (Photo 7).
</td></tr>
</table>

BOX TUNNEL	
ENGINEERING CONSIDERATIONS	• Open-top tunnels must be at grade with road surface. • Design variations may require special design drawings if not prefabricated. • Size of tunnel must fit within the vertical road profile so that top load is adequate for structural stability.
MAINTENANCE CONSIDERATIONS	• Smaller tunnels will be more difficult to keep clear of debris. • Open-top tunnels may have to be periodically flushed with water (e.g., with a fire hose) to clean build-up of road pollutants. • Larger structures allow better maintenance accessibility while having relatively minor cost increases relative to cost of road project. • Open-top tunnels are thought to interfere with snow removal; however, this has not been the case in other tunnel installations in cold countries and the top of the tunnel wears away with the road surface (see review in Langton 2014). • Natural substrate and other cover objects must be maintained.
COST (relative material comparison in 2014)	• Costs/m vary from CAN $800.00 for prefabricated open-top ACO tunnel (0.5 m x 0.5 m) to CAN $3,000 for enclosed box tunnel (1.8 m x 1.8 m).

Photo 1. Precast box culvert along highway 69, Ontario. © K. Gunson

Photo 2. Open-top tunnel in Waterton Lakes National Park, Alberta. © K. Gunson

BOX TUNNEL

Photo 3. Open-grate tunnel at Killbear Provincial Park, Ontario. © K. Gunson

Photo 4. Open-bottom tunnel along highway 69, Ontario. © K. Gunson

Photo 5. Open-bottom and open-top grate tunnel at Killbear Provincial Park, Ontario. © K. Gunson

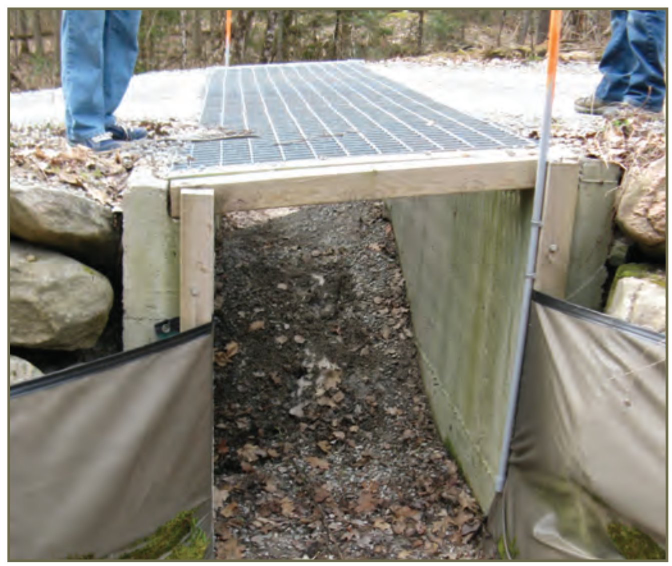


Photo 6 Open-top and open-bottom at Wild Rice Trail, Six Mile Lake. © K. Gunson

BOX TUNNEL

Photo 7. Open- and closed-top variation, Germany. © ACO International

Photo 8. ACO open-top tunnel allowing light into tunnel. © Kari Gunson

Photo 9. Open-bottom box tunnel with natural stream on Trans Canada Highway in Banff National Park, Alberta. © K. Gunson

Photo 10. Box tunnels in median that should be connected with a fence when intended for wildlife passage. © K. Gunson

BOX TUNNEL

Photo 11. Tunnel with headwalls connected to concrete guide fencing in Cuba. © G. Barrett

Photo 12. Adding soil to box tunnel near Ucluelet, B.C. © Barb Beasely

Photo 13. Soil and branches inside tunnel bottom, Ucluelet, B.C. ©Barb Beasley

ARCH/ROUND TUNNEL	
• Arch tunnels have natural bottoms (Photos 14 and 15) and are recommended for tunnels greater than or equal to 1.5 m diameter (common widths 1.8, 2.4 and 3.0 m). • Round tunnels work well in aquatic conditions for turtles and semi-aquatic snakes. • In terrestrial conditions, round tunnels should be filled 0.3-0.4 m with local soil/debris to create a level crossing surface, and it is recommended that the size be increased from the minimum recommendations in section 4.1.5 to compensate for this area that is lost due to infilling. • Maximum recommended tunnel length of 25 m. • Terrestrial pathways alongside stream or creek bed are possible with additional structural width. • Recommended design specifications for arch tunnels are slightly larger than box tunnels to compensate for the loss of openness as a result of tunnel shape.	
STRUCTURAL VARIATIONS	**OPEN-TOP** • Slotted open-top (Photos 16 and 17) or vertical skylight risers along the length of the tunnel to provide natural light.
	OPEN-BOTTOM • Achieved by burying round tunnels (0.3 to 0.4 m) to accommodate natural terrestrial floor (Photo 18).
APPLICATION	• Arch structure may be preassembled and dropped in place or assembled at site (Photo 19). • Corrugated steel arch or concrete side slabs are placed on footings (Photo 15).
ENGINEERING CONSIDERATIONS	• Footings required for arch tunnels. • Buried tunnels may be more suitable when tall footings are required.
MAINTENANCE CONSIDERATIONS	• Larger structures allow better maintenance accessibility while having minor cost increases relative to cost of road project. • Natural substrate and other cover objects must be maintained.
COST (relative material comparison in 2014)	• Costs/m vary from CAN $145.00 for corrugated steel pipe (CSP) (1.2 m) to CAN $990.00 for arch (0.6 m rise; 1.22 m span). • Costs/m vary from CAN $500.00 for CSP (3.0 m) to $1500.00 for arch (1.45 m rise; 2.99 m span).

ARCH/ROUND TUNNEL


Photo 14. Arched tunnel allowing natural stream crossing. © D. Seburn


Photo 15. Aluminum arch culvert on metal footings. © K. Williams


Photo 16. Pipe culvert with slotted top installed for Timber Rattlesnakes in Illinois, U.S. © S. Ballard


Photo 17. Zoom-in of open-top pipe culvert at road for Timber Rattlesnakes in Illinois, U.S. © S. Ballard

Photo 18. Buried plastic round culvert allowing terrestrial flat floor in Sweden © K. Gunson


Photo 19. Arch culvert preassembled off site © K. Williams

<table>
<tr><th colspan="2">LARGE UNDERPASS OR WILDLIFE OVERPASS</th></tr>
<tr><td colspan="2">Larger multi-species crossing structures greater than 3 m wide such as tunnels (Photo 20) and bridges, viaducts or overpasses (Photo 21) that are generally not prefabricated or precast.
Possible to maintain natural landscape if road is tunneled, (e.g., Herb Gray Parkway in Windsor) or elevated (e.g., viaduct).
Consider when tunnel length will exceed 25 m.
Integrated as a multi-species strategy for both large and smaller animals.</td></tr>
<tr><td rowspan="2">STRUCTURAL VARIATIONS</td><td>UNDERPASS
Designs include crossing structures that are below grade (e.g., tunnel, single or multi-span bridge, arches, and viaducts).
Larger multi-span bridge, arches and viaducts have opportunity to maintain natural ecosystem and physical properties.
Allows for the integration of dry pathways at creek and river crossings.
Two structures that open in median allow more openness (Photo 22).</td></tr>
<tr><td>OVERPASS
Design includes bridge deck spanning over road.
Requires natural landscape planting strategy and drainage system on top of structure.
Slope on approach ramps should be minimized for greatest visibility.
Overpass width has varied from 20 m to > 70 m.</td></tr>
<tr><td>APPLICATION</td><td>Large structures provide greater opportunity to provide cover objects such as flat rocks, vegetated mounds composed of branches and logs and covered with sod, or rock piles (Photos 23 and 24).
Design enhancements for amphibians and reptiles include small ponds as ‘stepping-stones’ along or through the length of a structure. Natural or artificial substrate may be used to retain pond water or natural rainfall (Van der Grift et al. 2003; Figure 2).
For multi-use structures, wildlife and human use should be separated or human use should be mitigated. For example, the Rt. Hon. Herb Gray Parkway, which leads to the international crossing between Ontario and Michigan, incorporates a crossing structure for Butler’s Gartersnake and Eastern Foxsnake into the multi-use trail system to minimize disturbance impacts from recreational trail users.
Multi-species fencing designs should be used. For example, the Highway 69 fencing combines ¼ inch mesh with 2.4 m high, large animal mesh fence (Photo 25).</td></tr>
</table>

LARGE UNDERPASS OR WILDLIFE OVERPASS	
ENGINEERING CONSIDERATIONS	• Overpass decks can integrate natural footings such as rock cliffs (Photo 26). • Engineering measurements and road design will determine best options for large crossing structure type in the road.
MAINTENANCE CONSIDERATIONS	• Require maintenance checks for initial establishment of vegetation on overpass structures; may require irrigation for pools and vegetation.
COST (relative material comparison in 2014)	• Approximately CAN $7,800 for large concrete box culvert (2.8 m x 3.3 m, Appendix E); range from CAN $2-4 million for installation, design, and materials of wildlife overpass.

LARGE UNDERPASS OR WILDLIFE OVERPASS

Photo 20. 3.4 x 2.4 m concrete box culvert connecting wetland habitat used by turtles on highway 69. © K. Gunson

Photo 21. 30 m wide overpass installed near Sudbury on highway 69. © K. Gunson

LARGE UNDERPASS OR WILDLIFE OVERPASS

Photo 22. 3.4 m x 2.4 m tunnel on Highway 69. © K. Gunson

Photo 23. Brush piles on top of overpass on highway 69. © K. Gunson

Photo 24. Rock and wood piles on top of overpass in Brandenburg, Germany. © K. Gunson

Photo 25. Small animal fence attached to the base of large animal barrier fence. © K. Gunson

Photo 26. Wildlife overpass on highway 69 showing rock footing K. Gunson.

LARGE UNDERPASS OR WILDLIFE OVERPASS

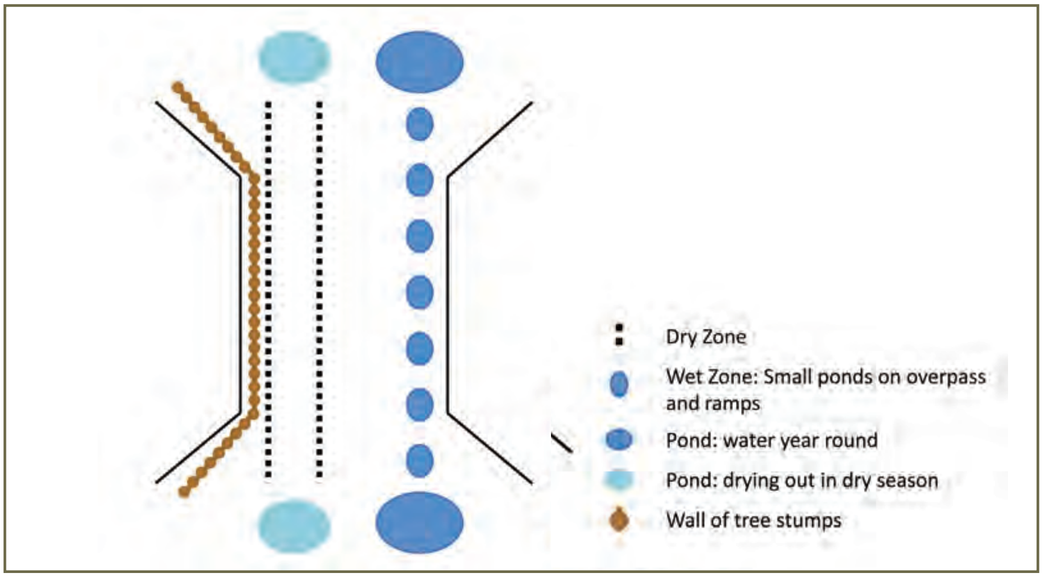


Figure 2: Example of a series of pools created along one side of an overpass (50 m long x 65 m wide). Amphibian passage was at least 1.5 times higher through the wetland zone than the dry zone. Adapted from van der Grift et al. 2009

4.1.2 Crossing Structure Design

Design of effective crossing structures must account for the ecology, behaviour and movement patterns of amphibians and reptiles. For example, amphibians and reptiles possess a number of physiological vulnerabilities that require particular microhabitat conditions when using tunnels to cross roads (Andrews et al. 2008). High skin permeability and vulnerability to water loss necessitates warm and damp conditions in tunnels for amphibians. These microhabitat specializations require additional design modifications (e.g., natural substrate, cover) in and near crossing structures. General recommendations based on the literature and expert opinion for tunnel design (<3 m wide), to facilitate amphibian and reptile use, are outlined below:

Design Specifications

- Refer to minimum design specifications and tunnel types summarized in structural (see section 4.1.1) and taxa recommendations (see section 4.1.5) for each species group; where existing culverts are being replaced, upsize tunnels to at least minimum design specifications and tunnel type.
- Tunnels should be as open as possible to maximize air flow and light inside the tunnel. This may be achieved by designing tunnels with larger (typically wider) openings, using two structures connected with fencing when a median is present (Photo 22), or with an open-top or partial open-top tunnel (Photos 2 and 7).
- Artificial and ambient lighting inside a culvert has been shown to encourage tunnel use by turtles (Yorks et al. 2011) and entry by salamanders (Jackson et al. 2006).
- Generally, larger tunnel dimensions are more effective for amphibians and reptiles. For example, Smith (2003) showed amphibians and reptiles in Florida used tunnels more often that were at least 1.5 m wide and 0.6 m high as compared to smaller tunnels. See section 4.1.5 for additional information on tunnel dimensions for each taxa group.

- In general, the recommended tunnel length for SAR amphibians and reptiles is less than 25 m. There is reduced crossing success as tunnels get longer (e.g.,Yorks et al. 2011) and other jurisdictions suggest tunnels are less effective beyond 20-25 m in length (e.g., British Columbia Ministry of Forests, Lands and Natural Resource Operations 2004).
- In locations where tunnels will be longer than 25 m, consider the following:
- A large underpass (> 3 m) or overpass
- Elevating or tunneling the road
- Using two separate, shorter tunnels under each of the opposing traffic lanes with head walls; ensure the tunnels are connected with appropriate fencing in the median (Photo 22).
- On divided highways, crossing structures should never end in the center median (Photo 27) unless they are connected to other structures through fencing.
- When possible include skylights, or fenced gaps at medians and shoulders (Photos 28 and 29).

Microhabitat and Cover:

- All terrestrial crossings should have a natural substrate that consists of soil, sand, branches and other natural materials on the tunnel floor to increase structure use (Photos 13 and 35). The use of local soil in crossing structures is widely recommended for amphibians (e.g., Jackson 2003, Smith 2003, Schmidt and Zumbach 2008, Amphibian and Reptile Conservation 2009, Beasley 2013). For example, salamanders will cross through tunnels with or without natural substrate, but fewer individuals cross through bare concrete tunnels (Patrick et al. 2010). Considerations for substrates:
- Soils should be from the local area
- Soils that consist of large stones should be avoided
- Sediment baffles such as open plate may be used to 'hold' natural substrate in place (Photo 36).
- Cover objects (flat rocks and/or woody debris) should be placed in larger tunnels along the sides to provide shelter and escape from predators. These cover objects should not block sightlines or impede individuals from crossing straight through the tunnel. Sufficient cover objects (1 large or 2-3 small per 10 m^2) should be present near the entrances to all terrestrial crossing structures to provide shelter and cover. Cover objects should be used for all crossing structures to encourage multi-species use. Retain as much natural vegetation as possible during construction; where needed, additional planting should occur after construction.

Other Design Considerations:

- Terrestrial tunnels should be as level as possible for the entire length of the structure. One exception to this is that open-top tunnels should be installed with the highest point in the middle of the tunnel to allow for drainage and natural cleaning of the tunnel.
- Tunnel entrance bottoms should be at ground-level so animals do not need to 'step up' or 'step down' to enter the structure (Photo 30).
- At terrestrial tunnels, water should be diverted away from the entrances with drainage ditches or sloped excavation (Photo 31).
- If culverts are intended for drainage, or tunnels are large enough, a dry bench placed above the water mark can be integrated into the tunnel, in which case the bench must access dry ground at both entrances to be effective (Photo 32).
- When new highway alignments will bisect provincially significant wetlands and SAR habitat, consider elevating or tunneling the

road (e.g., Rt. Hon. Herb Gray Parkway road mitigation project for Butler's Gartersnake and Eastern Foxsnake).

- When arch tunnels are used at road-stream crossings, terrestrial pathways can be created along the stream by using wider tunnels (Photo 14). This design can better accommodate seasonal high water and flooding events (Lesbarrères and Fahrig 2012).
- When dealing with multi-species issues and variable site conditions, a mixed array of structure types and sizes should be provided along the site (see section 4.1). Structural diversity can compensate for landscape variations, such as land use change, and can also provide an experimental setting to test species-specific crossing preferences (see section 7).

Photo 27. Drainage box tunnel left open in median along highway 69 © K. Gunson

Photo 28. Open grate skylight in median on Terry Fox Extension, Ottawa, Ontario. © D. Seburn

Photo 29. Zoom-in of skylight in median on Terry Fox Extension, Ottawa, Ontario. © D. Seburn

- Aquatic crossing structures should never be fully submerged (e.g., Caverhill et. al. 2011, Photo 37).
- Water in aquatic tunnels should be standing or have low flow rates.
- Many crossing structures are no longer effective due to a lack of maintenance (Iuell et al. 2003). Regular maintenance is required for long-term effectiveness of all tunnels to ensure the microhabitat is intact, passageways are clear of debris, and that suitable substrate remains.


Photo 30. Earth excavated to allow at grade entrance to tunnel. © D. Filip


Photo 31. Water accumulation at tunnel entrance. © K. Gunson


Photo 32. Dry bench in drainage culvert for small animals, could be modified for snakes. © K. Foresman

BOX 1. OPENNESS OR OPENNESS RATIO

Openness Ratio (OR) was first conceived by Reed et al. (1979) as a threshold measure for comparing the relative openness of box culverts for use by Mule Deer (*Odocoileus hemionus*), given their preference for a clear line of site through a structure. This measure has since been extrapolated beyond this original use and applied to a variety of species and structure shapes; see review of OR application to small mammals, deer, and amphibians and reptiles in Gartner Lee and Ecoplans (2009). The ratio is defined as the cross-sectional area of a structure (square metres) divided by the length of the tunnel (metres) ([rise x span] / length). The intent of OR is to provide a measure of the tunnel effect of a structure, which may influence use by various wildlife species.

BOX 1. OPENNESS OR OPENNESS RATIO

The use of OR as a sole measure to inform road mitigation design should be used with caution, especially for amphibians and reptiles, because of the following:

- Cross sectional definition needs to be modified to account for shape.
- OR does not account for the effect that a structure's width versus its rise has on openness and whether this influences wildlife use (Jacobson 2007). For example, once a minimum height has been achieved, wider rather than taller structures may be recommended to enhance openness for some wildlife, such as turtles (Smith 2003) and elk (Kintsch and Cramer 2011).
- Tunnel effectiveness may be improved beyond manipulating structural dimensions by providing natural cover, substrate and light via open-tops into the tunnel design (Woltz et al. 2008, Yorks et al. 2012).
- Openness may be less important for tunnel use when animals become more familiar with new structures then when encountering a structure for the first time (Clevenger et al. 2002).

4.1.3 Crossing Structure Location and Spacing

Species that need to move between different habitats are also particularly susceptible to road mortality and landscape fragmentation by roads. Amphibian and reptile species need to move among breeding sites, summer foraging areas and overwintering sites during their active seasons. When these habitats are not adjacent, animals must move up to several kilometers to find necessary habitat. In areas with high road density, it is likely these movements will cross roads, putting animals at higher risk of road mortality (Gibbs and Shriver 2002, Beaudry et al. 2008).

An effective crossing structure should function as a movement corridor connecting suitable habitat on both sides of a road. Tunnels and fencing are best located where SAR movement paths cross existing and planned roads as determined from field surveys or spatial analyses (see examples in Gunson et al. 2012, Patrick et al. 2012). Examples of predictable movements include an annual spring migration of amphibians from upland forest to breeding ponds (Patrick et al. 2010, Faggyas and Puky 2012, Pagnucco et al. 2012) or an annual snake migration to and from overwintering hibernaculum (e.g., Fortney et al. 2012). Turtles are likely to interact with roads during terrestrial nesting migrations and inter-wetland movements (Gunson et al. 2012).

Amphibians and reptiles have specific microhabitat needs, smaller home ranges and restricted movement capabilities relative to larger fauna (Jochimsen et al. 2004). The following considerations are outlined below to assist with siting the optimal placement and number of crossing structures along a road improvement or rehabilitation project:

- In general, crossing structures should be considered when the road bisects habitat used by the target species (photo 33), when the road is between seasonal habitat used by a species (e.g., wetland and upland forested habitat for Jefferson Salamanders), or when the road bisects a movement corridor (e.g., riparian pathway, hedgerow, or ridge valley). Appendix A provides a general summary of movement distances, home range areas, and habitat used by each species, but more detailed species-specific information should be used to inform mitigation plans.

- When roads bisect large expanses of continuous habitat (e.g., forest), crossing structures should generally be spaced 300 m apart for small animals depending on species, budget, and site-specific engineering and ecological considerations (Carsignol 2005). This is generally applicable to most turtles and snakes; however, Schmidt and Zumbach (2008) recommend that tunnels be spaced no more than 50 m apart for amphibians.
- Species with smaller home ranges usually require crossing structures to be placed closer together and the numbers of crossing structures will depend upon the road length where animals are interacting with the road (preferably measured with road encounter data, see section 7.2.1). The approximate distance between crossing structures can be determined based on the average home range size of the species in question. Another, similar approach is to use the square root of the home range area (Bissonette and Adair 2008).
- Man-made features (e.g., ditches, retaining walls) in the right-of-way may influence species movement and access to crossing structures (Gartner Lee and Ecoplans 2009).
- Likely crossing locations for turtle and amphibian SAR are where aquatic features and wetlands intersect with roads (Photo 34).
- Hydraulic and engineering information should be used to determine the amount of water and flow through the tunnel and whether this is appropriate for the target species. Refer to taxa specific BMPs for aquatic and terrestrial crossing types in section 4.1.5, in addition to site-specific conditions measured in the field.
- Vertical alignment and location of the tunnel should be based on environmental conditions at the site, such as water level. For example, terrestrial tunnels should be above high water marks defined by wetlands and riparian corridors.
- Integrate crossing structures with the natural landscape. For example, take advantage of valleys for crossings under roads and incorporating fencing into natural landscape features, such as existing steep rock faces.

Photo 33. Road bisecting open water wetlands, Victoria Street, Whitby, Ontario. © K. Gunson.

Photo 34. Where drainage meets road would be likely location for tunnel for SAR amphibians and reptiles. © K. Gunson.

Photo 35. Turtle using open-grate tunnel with natural substrate at bottom© A. Mui

Photo 36. Tunnel structure with sediment baffles at bottom © B. Steinberg

4.1.4 Retrofitting Existing Drainage Culverts

Historically, culverts have been used to convey water under roads, and these structures have also been used by some species of amphibians and reptiles (e.g., Caverhill et al. 2011). Road improvement and rehabilitation projects provide opportunities to retrofit or enhance existing drainage culverts to facilitate use by amphibians and reptiles. When replacing a culvert, consider implementing a tunnel-fencing system with specifications for the target species (see section 4.1.5). In some cases, existing drainage culverts may already be sited and designed correctly for use by the target species and may only require

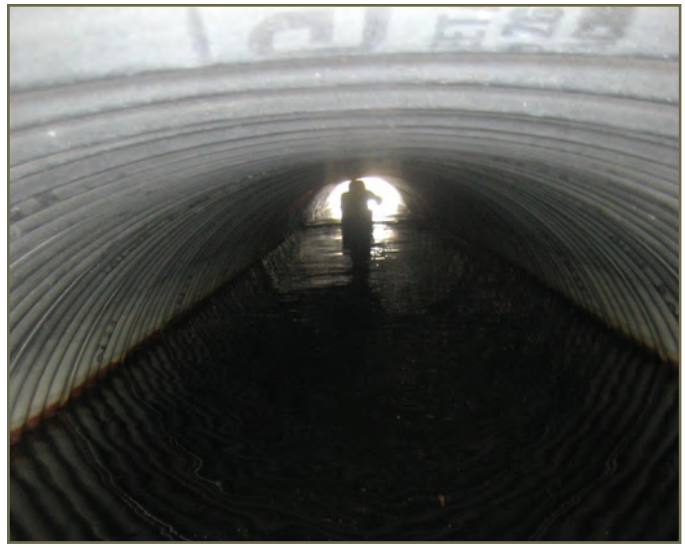


Photo 37. Large 1.8 m drainage culvert partially filled with standing water allows light into tunnel, Highway 24, Aurora, Ontario. © K. Gunson

guide fencing to facilitate crossing use and reduce road mortality (Caverhill et al. 2011). A formal evaluation of existing wildlife crossing structures for wildlife passage for the intended species is recommended (Kintsch and Cramer 2011, Central Lake Ontario Conservation Authority 2015).

4.1.5 Taxa-specific Recommendations

In addition to the general design considerations for reptiles and amphibians that are outlined in section 4.1.2, the following are specific recommendations that are unique to each taxa group. The following sections focus on the threatened and endangered SAR in each taxa group; however, the information is generally applicable to all other reptile and amphibian species in Ontario. In general, these recommendations make the assumption that as tunnels get longer an increase in width is more important than an increase in height (see Box 1).

The salamander section only addresses the Jefferson Salamander. The Jefferson Salamander is the only SAR salamander that is likely to be affected by road development in Ontario. In Ontario, the Small-mouthed Salamander and the two Dusky Salamanders have extremely small distributions (only a few isolated sites) and are unlikely to be affected by road construction. To date, the Fowler's Toad is the only endangered or threatened frog or toad species in Ontario, so the information in this section is specific to that species.

SPECIFICATIONS FOR TURTLES

Structure type and minimum size based on tunnel length				
Tunnel Length	**Box Tunnel (w x h)**	**Arch Tunnel (w x h)**	**Round Tunnel (diameter)**	**Overpass**
15 m	1.5 x 1.0 m	1.8 x 0.9 m	1.5 m	NA
15-25 m	1.8 x 1.0 m	2.0 x 1.0 m	1.8 m	NA
> 25 m	NA	NA	NA	Yes

ADDITIONAL DESIGN CONSIDERATIONS

- Terrestrial and aquatic structures are suitable for most turtle species; terrestrial crossing structures are not appropriate for Eastern Musk Turtle or the Spiny Softshell, which are highly aquatic and rarely move over terrestrial areas.
- Open and closed top tunnels have been used by turtles; open-top tunnels may increase crossing success.

RATIONALE

- Turtles have used a variety of crossing structures under roads (e.g., Dodd et al. 2004, Aresco 2005, Caverhill et al. 2011)
- Several studies have demonstrated relatively high use of large (>1.5 m width) crossing structures by turtles:
  - A drainage culvert 1.8 m in diameter in Ontario that was approximately half full of water (Caverhill et al. 2011) was used regularly by Blanding's Turtles and was also used by an unknown number of Snapping Turtles
  - Multiple Spotted Turtles were confirmed to cross through a tunnel 1.8 x 1.8 m (Kaye et al. 2005)
  - Aresco (2005) documented over 200 turtle crossings through a 3.5 m diameter drainage culvert

SPECIFICATIONS FOR TURTLES

RATIONALE

  - Wood Turtles continued to use a stream that passed through a culvert that was 3 m in diameter and 26 m long (Parren 2013).
- In a simulated tunnel experiment, more turtles crossed through a tunnel that let in at least 75% ambient light through the top (Yorks et al. 2011).
- Turtles will cross through tunnels 25 m long (Caverhill et al. 2011), although crossing success may be lower as length increases (Yorks et al. 2011).
- Turtles have used closed-top tunnels (e.g., Dodd et al. 2004, Aresco 2005, Kaye et al. 2005, Caverhill et al. 2011) and Wood Turtles (Photo 54) and Snapping Turtles (Whitelock 2014) have crossed through open-top tunnels in Ontario).
- Substrate type may not be as important in terrestrial tunnels for turtles as with other taxa. Blanding's and Spotted Turtles have been documented to cross through tunnels with natural substrates (e.g., Kaye et al. 2005, Caverhill et al. 2011), but in a simulated crossing structure experiment, Painted and Snapping Turtles did not demonstrate a substrate preference (Woltz et al. 2008).

Photo 54. Wood Turtle using open-grate tunnel © A. Mui

SNAKE AND LIZARD SPECIFICATIONS				
Structure type and minimum size based on tunnel length				
Tunnel Length	Box Tunnel (w x h)	Arch/Round Tunnel (w x h)	Round Tunnel (diameter)	Overpass
15 m	1.0 x 1.0 m	1.5 x 0.75 m	1.0 m	NA
15-25 m	1.5 x 1.0 m	1.8 x 0.9 m	1.5 m	NA
> 25 m	NA	NA	NA	Yes

ADDITIONAL DESIGN CONSIDERATIONS

- Open and closed-top tunnels have been used by snakes; open-top tunnels may increase crossing success.
- Open-top tunnels should not be used for lizards because they may be able to crawl onto the road surface.
- Aquatic tunnels will likely be used by highly aquatic SAR, such as Eastern Ribbonsnake, Queensnake, and Lake Erie Watersnake; however, they are unlikely to be used by other snake and lizard SAR and are not recommended for those species.

RATIONALE

- Snakes (e.g., Taylor and Goldingay 2003, Laidig and Golden 2004, Roberts 2010, Eads 2013) and lizards (e.g., Taylor and Goldingay 2003, Painter and Ingraldi 2007, Arizona Game and Fish 2010) have used a variety of crossing structures under roads. However, compared to other taxa, there is less certainty about crossing structure design preference for snakes and lizards, particularly for the species that occur in Ontario.
- Snakes have crossed through tunnels as small as 0.25 m in diameter (Roberts 2010), but tunnels 1.0 m in diameter had a greater crossing success than smaller tunnels for the Eastern Gartersnake and Eastern Ribbonsnake in an experimental set-up (Eads 2013).
- Both closed-top (Taylor and Goldingay 2003, Laidig and Golden 2004, Roberts 2010, Eads 2013) and open-top (Pagnucco et al. 2011, M. Colley pers. comm.) crossing structures have been used by snakes.
- Open-bottom box tunnels with cross-sectional dimensions of 1.0 x 1.0 m in Killbear Provincial Park were used by many (11) Massasaugas and 2 Eastern Foxsnakes in 2014 (M. Colley pers. comm.).
- Timber Rattlesnakes have crossed through concrete-bottom structures without natural substrate bottoms (Laidig and Golden 2004), but natural substrate or habitat conditions may enhance use (Laidig and Golden 2004; M. Colley pers. comm.).

SALAMANDER SPECIFICATIONS				
Structure type and minimum size based on tunnel length				
Tunnel Length	Box Tunnel (w x h)	Arch Tunnel (w x h)	Round Tunnel (diameter)	Overpass
15 m	1.0 x 1.0 m	1.5 x 0.75 m	1.0 m	NA
15-25 m	1.5 x 1.0 m	1.8 x 0.9 m	1.5 m	NA
> 25 m	NA	NA	NA	Yes

ADDITIONAL DESIGN CONSIDERATIONS

- Terrestrial tunnels should be used for salamanders; high moisture content and even small pools of standing water may be beneficial but the tunnel should not be flooded with water.
- Open or closed-top tunnels can be effective. Open-top tunnels allow more light into the tunnel and may increase moisture levels; the latter being important in longer tunnels where salamanders are at risk of desiccation. Consequently, open-top tunnels may offer suitable conditions for salamanders even when the dimensions are smaller than those listed above.
- Despite the potential advantages of open-top tunnels, they may result in higher levels of road salt and other pollutants in the tunnel, but these may be washed away with storm events.
- Soils and leaf litter substrates should be used as opposed to larger gravel or stone substrates.
- Mole salamanders make focused migrations to breeding ponds, and it is important to have multiple tunnels where migration paths cross roads. Tunnels for salamanders should not be more than 50 m apart (Schmidt and Zumbach 2008) as salamanders will not follow a fence for long distances (e.g. Pagnucco et al. 2012).

RATIONALE

- The best size of tunnel to encourage crossing by Jefferson Salamanders is not known, although there have been studies of crossing structures used by other salamanders in the same family (mole salamanders), which share similar life history traits.
- All documented use of tunnels by salamanders has been in terrestrial tunnels.
- Both closed-top (Patrick et al. 2010, Beasley 2013, Bain 2014) and open-top (Jackson and Tyning 1989, Allaback and Laabs 2002, Pagnucco et al. 2012) crossing structures have been used by other mole salamanders.
- Rectangular box culverts with local damp soil conditions are recommended for amphibians (see Jackson 2003, Smith 2003, Schmidt and Zumbach 2008, Amphibian and Reptile Conservation 2009, Beasley 2013).

SALAMANDER SPECIFICATIONS

RATIONALE

- Other mole salamanders have crossed through round tunnels as small as 0.25 m in diameter (Bain 2014) and 0.2 m wide; however, salamanders demonstrate hesitancy entering into small tunnels (Jackson 1996) and the percentage of salamanders that successfully cross through small tunnels may be low (e.g., Allaback and Laabs 2002, Pagnucco et al. 2012). Larger tunnels are required to ensure there is space for natural substrate and cover objects. In general, tunnels for amphibians are recommended to be at least 1 x 1 m in size (Schmidt and Zumbach 2008).
- Salamanders will cross through tunnels with or without natural substrate, but fewer individuals cross through bare concrete tunnels (Patrick et al. 2010). Natural soil substrate will retain moisture longer, lessening the risk of salamanders dehydrating or not entering structures.

FROG AND TOAD SPECIFICATIONS

Structure type and minimum size based on tunnel length

Tunnel Length	Box Tunnel (w x h)	Arch Tunnel (w x h)	Round Tunnel (diameter)	Overpass
15 m	1.0 x 1.0 m	1.5 x 0.75 m	1.0 m	NA
15-25 m	1.5 x 1.0 m	1.8 x 0.9 m	1.5 m	NA
> 25 m	NA	NA	NA	Yes

ADDITIONAL DESIGN CONSIDERATIONS

- Terrestrial tunnels should be used for frogs and toads; high moisture content and even small pools of standing water may be beneficial but the tunnel should not be flooded with water.
- Open or closed-top tunnels may be used.
- Open-top tunnels will provide moisture and air flow in the tunnel; however road salt or other pollutants may also enter into the tunnel but are most likely washed away during storm events.
- Soils and leaf litter substrates should be used as opposed to larger gravel or stone substrates.

RATIONALE

- There is no documented information available for crossing structure preferences for Fowler's Toads, however there is literature available for other species of toads and amphibians. Frogs and toads have used a wide variety of crossing structures under roads (reviewed in Schmidt and Zumbach 2008; Puky et al. 2013).
- Wide crossing surfaces with local soil are recommended for amphibians (e.g., Jackson 2003, Smith 2003, Schmidt and Zumbach 2008, Amphibian and Reptile Conservation 2009, Beasley 2013).

FROG AND TOAD SPECIFICATIONS
RATIONALE
• Although toads have been documented to use tunnels <1.0 m wide (e.g., Lesbarrères et al. 2004, Ottburg and van der Grift 2013, Puky et al. 2013, Wind 2014), larger tunnels tend to be more effective (e.g., Puky et al. 2013). There was very high toad crossing rates through tunnels 1.8 m wide (Biolinx (2013). • Guidelines for road crossing structures in England have been developed for the Common Toad (*Bufo bufo*). These guidelines recommend a rectangular crossing structure at least 1.0 x 0.75 m (w x h) for tunnels up to 20 m long and 1.5 x 1.0 m (w x h) for longer tunnels (Amphibian and Reptile Conservation 2009). • Both closed-top (Biolinx 2013, Puky et al. 2013, Wind 2014) and open-top (Pagnucco et al. 2012, Ottburg and van der Grift 2013) crossing structures have been used successfully by other toads.

4.2 Fencing for Reptile and Amphibian Crossings

Fencing in conjunction with crossing structures serves two purposes: 1) directing animals towards structure entrances and 2) providing a barrier to exclude animals from the road. Fencing can be used with crossing structures or as a stand-alone measure to prevent mortality along roads where connectivity is not a concern; this may include situations such as when suitable habitat is adjacent to, but not bisected by the road, or where animals are unlikely to cross successfully due to high traffic volumes (Jackson et al. 2015).

The following BMPs are divided into fencing design, placement, and maintenance considerations and are applicable to all amphibian and reptile SAR. For additional best practices for amphibian and reptile exclusion fencing, refer to Reptile and Amphibian Exclusion Fencing: Best Practices (OMNR 2013).

4.2.1 Fence Design

The primary objective of a fence design is to minimize fence breaches because animals that get through a fence can be trapped on the road and killed (e.g., Wilson and Topham 2009). Therefore these BMPs focus on providing recommendations for designing and installing a gap-free, permanent fence. Permanent fencing may have higher initial costs; however, when ongoing maintenance of temporary fencing is considered, permanent fences are less expensive in the long-run. A number of projects have experimented with fencing effectiveness for amphibians and reptiles (e.g., Woltz et al. 2008; Langen 2011; Smith and Noss 2011), and it is important to recognize that new cost-effective designs are continually being engineered and tested, and are strongly encouraged.

Fencing design should consist of a solid durable framework (stakes, posts, and sheeting) that is able to withstand weight and impact from snow removal and effectively exclude the target species. Recommended durable fencing materials include hardware cloth, chain link fencing, concrete barriers, and heavy-duty plastic fencing designed for wildlife (Table 2; Photos 38-44). Light-duty geotextile fence (lifespan up to 1 year; Photo 45), heavy-duty geotextile fence (2-3 years), or wood lath snow fencing (< 3 years), are not recommend for long-term use.

Standard chain link large animal fencing (e.g., 2.5 m high wildlife exclusion fencing with 4" mesh) does not work for many amphibians and reptiles as individuals can pass through the large mesh holes. In locations requiring guide or barrier fencing for both large animals and amphibians and reptiles, additional fencing material, such as hardware cloth at the appropriate height, can be attached to the base of the large animal fencing (Photo 25). When more than one species is targeted for mitigation, fencing height should be the tallest height recommended for all target species.

Table 2: **Summary of fence materials that have been used for long-term projects to exclude amphibians and reptiles from the road and/or guide animals to tunnels. For additional fencing specifications, refer to OMNR 2013.**

Fence Type	Benefits	Drawbacks	Considerations
Hardware mesh cloth (Photos 38 and 39)	Relatively durable; relatively low maintenance; allows drainage; available in rolls.	Susceptible to rust in seasonally wet areas unless heavy gauge wire used.	Use ¼" or smaller gauge to reduce the risk of small snakes getting stuck; requires attachment to post at regular intervals to avoid collapse.
Chain link fence (Photo 40)	Very durable; low maintenance; allows drainage; available in rolls.	Mesh size typically larger than species specifications.	Use buried hardware cloth with recommended mesh at the base of the fence to provide multi-species use for large and small animals (Photo 25); lip extension may increase effectiveness for some species (Photos 39 and 40).
Concrete (Photo 41), corrugated steel (Photo 43), aluminum sheeting (Photo 44), or vinyl walls	Very durable; low maintenance; vertical smooth surfaces prevent climbing.	Inhibits drainage and may cause pooling.	Aluminum sheeting and vinyl walls are less durable than concrete; corrugated steel can be obtained from corrugated steel pipes cut in half and are curved providing lip extension.

Fence Type	Benefits	Drawbacks	Considerations
Prefabricated plastic sheeting fence (Photo 42)	Very durable designs available, e.g., ACO fencing, available in 1 metre sections OR Animex fencing, available in rolls depending on thickness.	Inhibits drainage and may cause pooling.	Back-fill at road-side of fence to provide escape route for animals (Photo 49); fencing best suited for flat dirt terrain such as in drainage ditch (Photo 42); 1 m sections may not be suitable for long fences greater than 1 km.

Photo 38. Animex plastic sheeting made from post-consumer products ©K. Gunson

Photo 39. Hardwire cloth with ¼ inch mesh, wood frame, and top lip © K.Gunson

Photo 40. Chain link guide fencing and lip extension, Terry Fox Extension, Ottawa, Ontario © D. Seburn.

Photo 41. Concrete wall in Aurora, Ontario © K. Gunson

Photo 42. ACO fencing on highway near, Oliver, B.C. © R. Guse

Photo 43. Angled fence for salamanders at Waterton Lakes National Park© K. Gunson

Photo 44. Example of aluminum sheet fencing © K. Gunson

Photo 45. Fence end U design to deter animals following fence line from entering roadway in Haliburton County © K. Gunson

General considerations for fence design are as follows (see Figure 4 for further illustration):

- Steel posts will not break with snow load.
- Posts that are closer together (e.g., between 2-3 metres) will prevent fence sag and collapse during severe weather events and snow removal along roads.
- Stakes or posts should be placed along the road-side of the fence to deter climbing and be buried 30 cm into the ground (OMNR 2013).
- Use of materials that allow drainage at wet sites to avoid pooling at or near a crossing structure (Smith and Noss 2011; Photo 46).
- Mesh size needs to be appropriate for the target species (Photo 47). Refer to Table 3 for species-specific fence types. Many snakes can pass through ½" mesh fencing and some small snakes can even pass through or get stuck in ¼" mesh (Smith and Noss 2011, S. Marks pers. comm. 2014). A mesh size of ¼" or smaller should be used to help reduce the risk of small snakes getting stuck in the fence (Photo 47). The fence should be buried to deter animals from digging; the recommended depth is 10-20 cm where feasible. If rock cannot be avoided, the bottom of the fence can be folded and covered with gravel to hold it in place (Photo 48).
- The fence height should be higher than the high water level in spring.
- For reptiles, the fence should include an overhang lip extended away from the road to deter climbing (Photo 40).
- Backfill on the road-side of the fence can be used as escape ramps to assist trapped animals to climb to the safe side (e.g., ACO wildlife fence; Photo 49).
- Nylon mesh fencing or erosion materials should not be used along the right-of-way as snakes can become entangled and die in this material.
- Fence end treatments can be used to deter amphibians and reptiles from accessing the road at the fence ends:
    - The fence can be extended away from the road in a curved or 90 degree U design (Photo 45; Figure 4) to redirect animals away from the road
    - The fence should extend along the entire habitat and end at a point where habitat types transition (e.g., wetland-forest edge)
    - Rocks or other inhospitable materials at the fence end can help deter movement onto the road.


Photo 46. Pooling at culvert entrance that should be avoided at terrestrial wildlife tunnels © K. Gunson


Photo 47. Snake caught in ½ inch wire mesh; © M. Patrikeev

Photo 48. Fence along rock with gravel used to hold bottom of fence in place © K. Gunson

Photo 49. Backfill along ACO wildlife fence that can provide an escape ramp for animals on the roadside of the fence © V. D'elia

Table 3: **Fence design specifications for SAR reptile and amphibian species are based on OMNR 2013, Woltz et al. 2008 and expert advice.**

Taxonomic Group	Species	Fencing	
		Fence/wall Material	Minimum Height (above ground)
Salamanders, Frogs, Toads	Jefferson Salamander	• Hardware cloth with ¼ " mesh or smaller, concrete, aluminum, prefabricated plastic fence, or vinyl wall. • Salamanders are generally poor climbers (T. Bain pers. comm.) so a small mesh fence will work and also allow some drainage.	30 cm
	Fowler's Toad	• Solid, permanent material (e.g., cement, plastic panels), or hardware cloth with ¼" mesh or smaller. • Avoid using netted fencing because they can climb (Smith and Noss 2011).	50 cm
Lizards	Five-Lined Skink	• Aluminum flashing; skinks can easily climb most other fencing materials.	50 cm

Taxonomic Group	Species	Fencing: Fence/wall Material	Fencing: Minimum Height (above ground)
Snakes	Eastern Foxsnake, Gray Ratsnake	• Concrete, aluminum, or vinyl wall.	200 cm
	Blue Racer, Milksnake	• Hardware cloth (¼″ mesh or smaller), concrete, aluminum or vinyl walls.	100 cm
	All other snake species	• Hardware cloth (¼″ mesh or smaller), concrete, aluminum or vinyl walls.	60 cm
Turtles	All species	• Hardware cloth, chain link fence (½″ mesh or smaller), concrete, aluminum, vinyl wall, or prefabricated plastic wildlife fence • Combining chain link and hardware cloth will be effective for adults, juveniles, and hatchlings. • When fencing is used for both turtles and snakes, mesh size larger than ¼″ is discouraged as snakes can become entrapped.	60 cm

4.2.2 Fence Placement

Right-of-way considerations:

- Fencing should be placed as far as possible from the road edge to minimize impacts from snow removal, mowing or other road-side maintenance practices.
- Fencing cannot interfere with road interchanges or driveway access.
- Permissions and permits must be obtained from the road authority.
- When the fence will extend beyond the right-of-way, permission must be obtained from property owners, or in the case of Crown land, from the Ministry of Natural Resources and Forestry.

Fence Length and Placement:

Fence length depends on the species' movement abilities as well as the interface of the surrounding habitat with the road. Spatial analyses of where species are found on the road, in the road shoulder and in the road verge can help determine how much fencing is required and where it should be placed (Gunson and Teixeira 2015). However, when roads bisect continuous expanses of SAR habitat, fencing is often required along the entire stretch of a road to prevent mortality. The following should be considered when evaluating fence and crossing structure placement:

- Data collected from field and on-road surveys, expert opinion and other sources such as the NHIC to understand species presence, habitat use, and movements in relation to the road (see Appendix A).
- Maximum and mean movement distances of the target species should be used to inform fencing length. For example, salamanders generally will not move distances greater than a couple hundred metres, while turtles and snakes may move several kilometers (see Appendix A). Some species will move considerable distances along the fence and access the road at the fence ends; this can only be avoided if the fence is longer than the distances that the species will move.
- Gullies, uneven terrain and solid rock areas should be avoided when possible; if rocky areas cannot be avoided, gravel can be used to hold fence in place (Photo 50).
- When multiple crossing structures are used, fencing should span between structures (and angle away from the tunnel opening in a 'V' pattern: Photo 43 and Figure 4).
- To be effective, fencing must connect to the tunnel entrances without gaps (Photo 51) or go over top of the tunnel (Photo 52) in a 'V' pattern (Photo 53; Figure 3).

Photo 50. Fence with gap at bottom due to erosion from water draining under fence © K. Gunson

Photo 51. Fence tying into tunnel at Rice Lake Trail, Note shadecloth not recommended for permanent fencing © K. Gunson

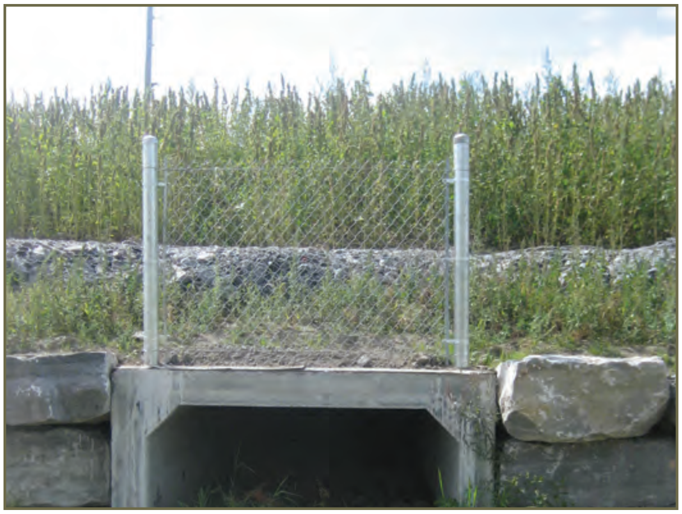


Photo 52. Fencing above tunnel, Terry Fox Drive extension © K. Gunson

Photo 53. Fencing approaching tunnel entrance in a 'V' pattern © K. Gunson

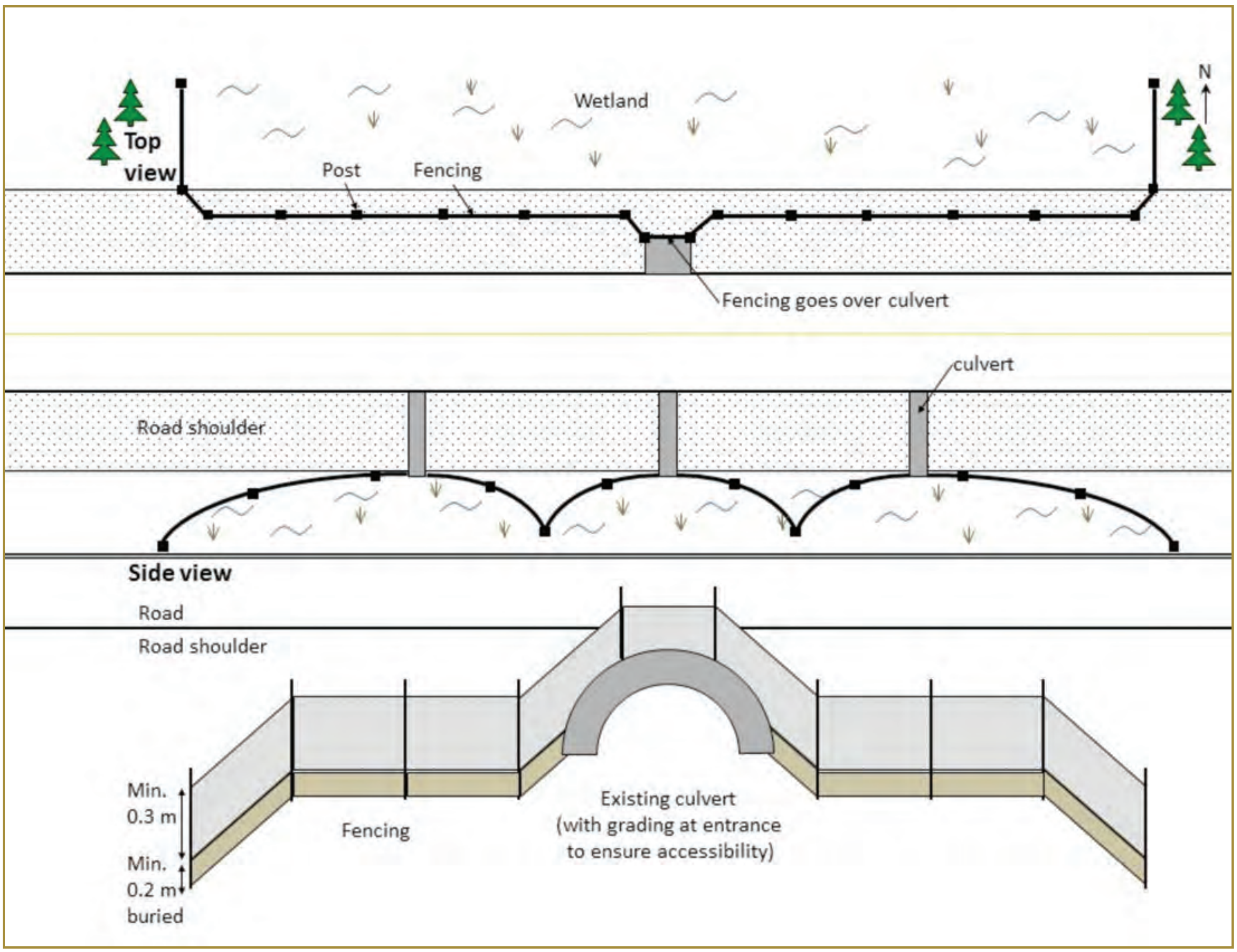


Figure 3. **Top view and side view of fencing design and siting options along the right-of-way. Figure adapted from Nature Conservancy Canada schematic.**

4.2.3 Fence Maintenance

All fencing requires routine survey checks and subsequent maintenance repairs and this should be planned and budgeted for. The frequency of maintenance checks and repairs will vary with the durability of the fence. After snowmelt, a thorough survey and follow-up fence repairs are essential prior to animals emerging from hibernation. The following are recommended considerations for fence maintenance:

- Woody vegetation, leaves, thick grasses, and other debris that pile up along fence may provide a `ladder` or puncture the fence allowing animals access to the road. Regular maintenance is required to clear vegetation from all fences.
- Fences should be marked with long posts and flagging tape to warn maintenance crews about its presence, especially where mowing will occur.
- Routine fence surveys should be done using a checklist approach to identify where repairs are required, including a description of the damage and the location. Checklist items should include that the fence has not collapsed, fence is still in the ground, fence abuts crossing tunnels, vegetation is not near the fence, and that there are no holes in the fence. Repair crews need to fix the fence in a timely manner to minimize fence breaches during the active season for amphibians and reptiles.

5 SUPPLEMENTARY MEASURES

Specifically designed crossing structures, combined with fencing, are the most effective mitigation strategy to reduce road mortality and enhance habitat connectivity (Dodd et al. 2004, Aresco 2005); however supplementary mitigation measures may be used in association with crossing structures and fencing (i.e., installing signage or reduced speed zones at fence ends). In addition, supplementary measures may be used as temporary measures during construction, or prior to road upgrade and rehabilitation projects, or on existing roads where there would otherwise be no mitigation. The effectiveness of some of these strategies at reducing road mortality and improving connectivity is difficult to measure and largely unknown; therefore implementation of these measures should proceed with caution using an adaptive management approach.

This section classifies each measure as those that influence driver behaviour, and those that influence wildlife movement as defined by Huijser et al. 2007. The following list of measures is not exhaustive, but instead summarizes what has been used in Ontario and elsewhere, with specific consideration for how each strategy may be applied to amphibians and reptiles.

5.1 Influencing Driver Behaviour

The strategies outlined in this section have relatively low effectiveness when used in isolation and several of these approaches should be used concurrently whenever possible. For example, a good strategy may include a reduced speed limit, traffic calming measures to reinforce the low speed limit, high quality signage to warn drivers, and a public education program to help drivers understand the measures that have been put in place.

With the exception of road closures, strategies that influence driver behavior rarely result in a significant reduction in road mortality. This is in part because, despite these measures, many reptiles and amphibians are small and difficult to see and/or avoid. Further, Ashley et al. (2007) found that approximately 2.7% of drivers intentionally ran over reptiles, and such behavior severely limits the success of these strategies.

Reduced speed zones allow drivers more time to react to an animal on the road, and subsequently safely avoid a collision. They have been implemented in Banff National Park to reduce collisions with larger wildlife, such as Grizzly bears (Banff National Park, unpublished data 2011-2014). Speed limits may be reduced seasonally and/or at specified times of day. This methodology is only suitable for amphibians and reptiles on low volume roads or roads in protected areas. A reduced speed zone is typically combined with a public awareness strategy and/or signage to educate motorists about the need to minimize road mortality for amphibians and reptiles. Enforcement or traffic calming mechanisms (see below) are usually necessary for the effective implementation of lower speed limits. This strategy can have a high cost given the need for regular enforcement.

Seasonal road closures offer an effective mechanism for reducing road mortality by eliminating vehicles from a road. Although this is a very effective solution, such closures are typically only feasible for a few days per year and they must be timed precisely to coincide with amphibian and reptile migrations. This method is most easily implemented in protected areas, on low volume roads where access to residences or businesses is minimal, or on roads where alternate access exists. A good example is King Road on the Niagara escarpment (Photo 55), where a seasonal road closure has been implemented for several years for the endangered Jefferson Salamander. Salamanders typically move across a defined road segment within a 2-3 week time period in early spring during a warm, rainy period. This type of strategy requires both buy-in from the road authority as well as the community using the roads. A public relations campaign is a useful tool to inform and gather support from local residents. This strategy has a relatively low cost.

Traffic calming refers to the installation of road features designed to decrease vehicle speeds without interfering with the flow of traffic. Some traffic calming methods, such as speed bumps (Photo 56), traffic circles, and raised medians, can only be implemented on low speed roads; whereas other methods, such as narrow lane widths, and rumble strip patches may be used on moderate to high speed roads. In some cases, speed bumps may interfere with snow removal; however installations can be used seasonally. This strategy has low to moderate costs dependent on the measure used.

Signage is a low-cost, widespread method of road-side messaging that is relatively easy to implement (Photo 57). The key objective for sign use is to instill awareness so motorists can avoid hitting wildlife along roads where the signs are placed. Effectiveness may be improved with a well thought-out strategy that avoids driver habituation and includes the following criteria (see Gunson and Schueler 2012; Kintsch et al. 2015):

- Seasonal placement of signs, or use of text indicating when target animals are likely crossing;
- Enhancement of signs with flags, flashing lights, or unique art work (Pojar et al. 1975, Hardy et al. 2006);
- Use of science and data to inform effective placement;

- Use of signs on moderate to high volume roads to deter theft;
- Strategic placement of signs and at the ends of exclusion fencing;
- Use of signs as temporary measures and markers in advance of more permanent mitigation measures (Ontario Ministry of Transportation 2012).

As with all of the other measures in this section, the effectiveness of signage can also be increased by combining it with other measures (e.g. reduced speeds, traffic calming). Benefits of signage for SAR amphibians and reptiles include driver awareness of wildlife on the road and heightened understanding of the importance of conservation efforts when used with a public awareness and education campaign (see example in Joyce and Mahoney 2001). In Ontario, signage has commonly been used on municipal and provincial park roads (Photo 58), and more recently on provincial roads (Ontario Ministry of Transportation 2012; Photo 59).

Public awareness and education campaigns are designed to inform drivers about wildlife and road issues and how they can help minimize or avoid wildlife road collisions. For amphibians and reptiles, public awareness campaigns typically target local communities near known high-risk road mortality locations, such as at Heart Lake Road in Brampton, Ontario. Local media attention generated awareness of the issue from local residents and subsequently a volunteer task force of 20-40 individuals was used to conduct on-road mortality surveys in 2011 and in 2013 (TRCA 2014).

While it is difficult to draw a direct correlation between heightened driver awareness and a decrease in road mortality, this strategy has the potential to improve effectiveness and public acceptance of other mitigation efforts, such as signage, reduced speed zones, or traffic calming measures. The cost of conducting a local-based public awareness campaign is comparable to that of the other strategies discussed; however, a regional, coordinated, long-term strategy (i.e. similar to the well-known Drinking and Driving Campaign) would entail greater funding and long-term commitment.

5.2 Influencing Wildlife Movement

Ramped curbs and escape gaps are used along roads (typically local, municipal roads) to replace vertical curbs that are too high for amphibians and reptiles to climb over. A good example is in Waterton Lakes National Park, where right-angle curbs were replaced with sloped curbs to allow Long-toed Salamanders to successfully escape the road (Photo 60). Additionally, escape gaps can be used where the structures meet the road (e.g., Banff National Park; Photo 61). Escape gaps would work well along high volume roads where continuous sections of jersey barriers divide opposing lanes of traffic and animals that enter the right-of-way cannot cross the road (e.g. Highway 401 and 417). This strategy has a relatively low cost.

Assisted migration can be used where a concentrated amphibian migration crosses a defined stretch of road. Temporary traps (typically drift fencing and buckets) may be used to prevent animals from crossing the road, which are then collected and moved across the road by volunteers. Alternatively, volunteers can survey the road during peak times and move any animals that are encountered. This strategy is labour-intensive and relies on having local volunteers to monitor traps during a migration event, and it requires safety precautions for the volunteers. However, if timed and coordinated effectively, facilitated migrations can be effective in reducing road mortality for amphibians (Photo 62).

Habitat creation can be used to reduce the need for individuals to access habitat close to the road or cross the road to access habitat on the other side. Since reptiles and amphibians often show high fidelity to specific habitats, many individuals will continue using historical habitat features and a population-level transition to the new habitat can take decades. Consequently, road-side barrier fencing is still necessary to prevent dispersing animals from accessing the road. The cost, feasibility and effectiveness of creating new habitat is variable and will be site and species specific (B.C. Ministry of Forests, Lands and Natural Resource Operations 2004).

New habitat creation may include wetlands as breeding sites for amphibians (e.g., Merrow 2007), artificial nesting sites for turtles; (Clarke and Gruenig 2002; Paterson et al. 2013); or gestation sites (Rouse 2005; Parent and Black 2006) and hibernacula (Willson 2005) for snakes. The B.C. Ministry of Forests, Lands and Natural Resource Operations BMP document (2004) describes the applicability of habitat restoration (or creation in this case) for amphibians and reptiles. General recommendations are as follows:

- A thorough understanding of the habitat use and movements of the target species is necessary.
- New habitat should be in close proximity and on the same side of the road as other habitat used by the target species.
- The created microhabitat should be suitable for the target populations.
- Other important habitats should not be manipulated to create new habitat.

Photo 55. Road Closure on King Road, Halton Region. © N. Finney

Photo 56. Speed bumps used to reduce speed on Cyprus Lake Road, Bruce Peninsula, Ontario. ©K. Gunson

Photo 57. Awareness sign on provincial park road in Point Pelee National Park. ©K. Gunson

Photo 60. Sloped curve in Waterton Lakes National Park, ©B. Johnstonh

Photo 58. Turtle signs used on municipal roads in Ontario. ©K. Gunson

Photo 61. Jersey barrier with gaps at the road surface ©K. Gunson

Photo 59. Provincial Wildlife Habitat Awareness Sign on Highway 654. ©K. Gunson

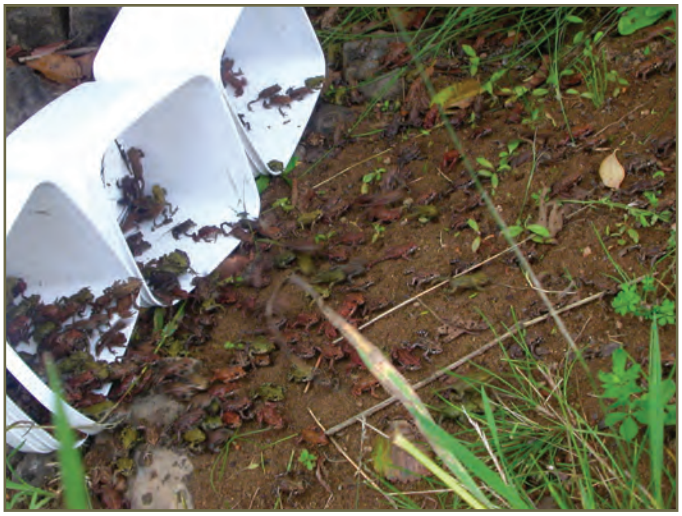


Photo 62. Assisted migration of toadlets in British Columbia. © E. Winde

6 TEMPORARY MITIGATION DURING ROAD CONSTRUCTION

This section provides general considerations for mitigation during construction when working in areas with SAR amphibians and reptiles. The following considerations address two components, timing construction activities to avoid construction-related impacts, and installing mitigation measures to minimize interactions with amphibians and reptiles and their habitat during construction.

Effective implementation of construction mitigation BMPs requires both oversight and consultation with experts. Regular consultation with local species experts is strongly recommended because active times for the target species will vary annually with changing climatic conditions and is site-specific especially in a landscape as large as Ontario.

6.1 Timing of Construction Activities

When road construction will occur within or near amphibian and reptile habitat, some impacts can be minimized by carefully scheduling the timing of the work to avoid habitats when they are occupied or during sensitive periods. Construction during the overwintering periods should avoid wetlands and other sites that are used for hibernation. This includes direct disturbance as well as indirect disturbance such as decreasing water levels in overwintering wetlands. Construction during the active season should avoid key habitat features or times when the species is most sensitive (see Appendix A). For example, avoiding work at breeding wetlands being used by Jefferson Salamander and Fowler's Toad in late March to June. Amphibian and reptile populations are active from March to October in southern Ontario and this time period lessens for more northern populations (Appendix A). Consultation with a local species expert and the district MNRF office may be required to assess annual variations of site-specific movements for the target species during construction activities.

6.2 Mitigation Measures for Construction Activities

On-site, temporary measures for all road projects that occur within, or adjacent to amphibian and reptile habitat help to avoid harming or killing individuals. BMPs for temporary measures include:

- Installation of exclusion fencing between the road construction zone and SAR habitat;
  - Use fencing that will last the duration of the road construction project (i.e., light-duty geotextile fence with a lifespan of up to one year)or, for longer projects, heavy-duty geotextile fence should be used (see section 5.2, OMNR 2013);
  - If permanent fencing is going to be installed as part of the mitigation plan (i.e. along roads), the permanent fence can be installed instead of temporary construction fence to avoid extra costs (Photo 63);
  - Fencing should be inspected and repaired daily to maintain effectiveness and avoid potential breaches; and
  - Fencing should be installed so that construction sediment does enter into wetlands or aquatic systems.
- When possible, alternative measures (e.g., rock barriers) should be integrated to create a sufficient barrier between construction sites and adjacent SAR habitat;
- Blast mats and other measures to control blast size and vibrations should be used within or adjacent (up to 250 m) to snake habitat (OMNR 2011);

- A qualified species expert should be present or available at all times to conduct searches, handle encounters, and translocate animals during construction;
- Searches should be conducted daily prior to and during construction activities;
- When SAR amphibians and reptiles are found on a construction site, proper handling, translocation and reporting protocols should be followed. Specific protocols for SAR encounters are available in the Ontario Species at Risk Handling Manual in addition to the Georgian Bay Biosphere Reserve BMP document (Clayton and Bywater 2012); and
- Project-specific reporting and handling protocols should be developed in coordination with the appropriate agency personnel. Observation records should include the observer's name, date and time, species, location (descriptive and georeferenced), photographs, and action taken.

Photo 63. Temporary fencing installed prior to installation of more permanent fencing along highway 69, note permanent fencing completed in Photo 48. © W. Kowbasniuk

7 MONITORING

Substantial research has been conducted to monitor the effectiveness of mitigation for large animals (e.g., Ford et al. 2010; Dodd et al. 2007); however, there exists a significant knowledge gap for amphibians and reptiles, and many mitigation projects have had no monitoring at all (Paulson 2010). This section provides recommendations for monitoring the effectiveness of road mitigation projects.

7.1 Study Design

Most studies that have evaluated the effectiveness of mitigation structures to-date are of low inferential strength due to poor study design, and this has resulted in results with high uncertainty (van der Grift et al. 2013). This uncertainty impedes implementation of mitigation measures and leads to inefficient use of limited financial resources.

Many monitoring plans only consider whether a specific species uses a structure at a specific location. However it is essential to monitor the viability of populations affected by a mitigated road (Figure 4). For example, if particular individuals, such as breeding females do not use a crossing structure to access breeding sites, this will lead to reduced breeding success and population declines, even though traffic mortality has been reduced and some individuals were observed using the tunnel.

Ideally, the population size (or density) of the target population should be measured at or near the road mitigation project to assess how the species responds (van der Grift et al. 2013). The population may increase, decrease or show no change in abundance after the road construction project (Rodenbeck et al. 2007). For example, Torres et al. (2011) performed visual census surveys for the Great Bustard

(*Otis tarda*), a globally threatened bird in Spain, and compared population trends in a Before-After-Control-Impact (BACI) design (see description below).

When it is not possible to measure a change in population size, the research questions should ask, "Is the current rate of road mortality sufficiently low, and/or is the rate of crossing sufficiently high to ensure a viable population?" If the answer to that question is no or possibly not, the next question is, "Which parameter of the road, traffic, or mitigation structure should be modified to improve viability to an acceptable level?" This question is more easily answered by assessing crossing and road mortality rates at different mitigation designs while controlling for habitat and road conditions.

Up to three years of monitoring data (from both before and after a road mitigation project) is likely necessary to measure changes in the ecological response (e.g. population size or road mortality rate) of the target species and reduce the influence of random, one-time events. The appropriate time-frame will depend on the ecological response and target species characteristics (e.g. longer-term monitoring for species that have longer generation times). This requires an understanding of the research goals among both the road planners and monitoring team early in the planning process to ensure the study design is adequately implemented in the road construction phase.

The optimal study design consists of data collected before and after the impact at sites where the impact has occurred and at control sites which have not been affected by the impact (Rodenbeck et al. 2007). This study design is referred to as a Before-After-Control-Impact (BACI) design and provides the highest level of inferential strength to measure the ability of the study to detect a change in the parameter of interest (e.g. population size, and rate of wildlife mortality on roads). A properly implemented BACI design allows the monitoring objectives to change from, "Are animals using crossing structures?" to "Has the mitigation prevented population decline?".

Other considerations for a study design are to select specific mitigation treatments at each monitoring site as well as carrying out consistent and repeatable sampling to ensure results are broadly applicable (van der Ree et al. 2015). Design elements are described below as well as in Figure 4:

- Treatments that can be manipulated allow for different structural features to be assessed (e.g. open-top vs. closed-top or varied fencing type and length) while controlling for other variables.
- Replication of treatments and controls among sites is important, as is monitoring each treatment in more than one location.
- Treatments that are randomly assigned will help to reduce bias and allow for a rigorous statistical analysis.
- Appropriate covariates need to be selected and controlled for. Examples of covariates include spatial and temporal variability in road design and traffic levels, mitigation structure design and the features of the surrounding landscape (van der Grift et al. 2013).
- Sampling and field protocols that are repeatable and consistent at monitoring locations before and after road mitigation help to ensure unbiased data collection.
- Inclusion of impact (mitigated) and control sites is essential to ensure that the apparent effects of mitigation (reduced mortality or increased permeability) are due to the mitigation and not a confounding variable such as weather, differences in habitat or road and terrain conditions.
- The variables being monitored (e.g. relative abundance) should be clearly identified prior to the commencement of the project.

Research Questions

Monitoring Goal
1. Maintain and restore population viability
   a. Measure trend in population size/density

Fencing
1. Reduce road mortality
   a. Ask is the reduced mortality sufficient to maintain or restore population viability?

Crossing Structures
1. Crossing use by population (e.g. male and females)
   a. Ask is use enough to maintain or restore population viability?

Planning

Long-term Monitoring
1. Multiple seasons
2. Multiple years (3 or more) prior to AND after mitigation measures have been installed or modified, e.g. Beofre, after and control impact (BACI studies).
   a. To reduce influence of random, one-time events

Expertise & Collaboration
1. SAR biologist
2. Road authority
3. Road developer
4. Monitoring team

Other
1. Obtain funds
2. Obtain permits
3. Start collaborating early!

Study Design

Treatments
1. Measure trend in population size/density
2. Vary crossing structure design
3. Combination of both

Site Selection
1. Obtain pool of potential treatment and control sites
2. Random assignment of treatment at impact sites
3. Replication of treatments and controls among sites
4. Include before, after, and control sites

Sampling
1. Repeatable
2. Consistent

Figure 4. **Study design recommendations for developing research questions, and a rigorous study design that will inform road mitigation effectiveness for amphibians and reptiles.**

7.2 Monitoring Techniques

This section outlines monitoring techniques that are used to evaluate crossing structure and fencing effectiveness for amphibians and reptiles. All techniques may be combined in a monitoring plan depending on budget, timelines, and the specific objectives.

7.2.1 Road Surveys

Road surveys are the most common method used to evaluate where amphibians and reptiles road mortality and interactions occur along roads (see Langen et al. 2007 for a description of methods). This information can be used to evaluate road impacts on wildlife, where animals are interacting with roads, and the effectiveness of crossing structures and fencing systems.

Data is collected by driving, cycling, or walking along a selected length of road looking for alive or dead individuals. The sampling method will vary depending on the objectives, road conditions, and the degree of detectability desired (Langen et al. 2007, Collinson et al. 2014). Driving surveys allow greater distances of road travelled over a sampling period, however the detectability of small vertebrates may be underestimated (Slater 2002; Langen et al. 2007).

General monitoring considerations for documenting amphibian and reptile SAR on roads include the following:

- Surveys should be conducted at least three years prior to the construction phase of a road improvement or rehabilitation project:
    - When a species is common, road surveys may generate a lot of data in 1 or 2 seasons (Ashley and Robinson 1996), however for SAR that are inherently rare, more time will be required to understand movements in relation to the project area.
- Surveys should take place during the active season or movement period for the target species (Appendix A).
- The frequency of surveys will depend on the goal of the study, the target species, traffic volume, rates of scavenging, carcass persistence, and when the species is moving (Slater 2002; Barthelmess and Brooks 2010; Santos et al. 2011). When the goal is to survey the majority of species on a road in an active season, the following recommendations should be considered for each taxon:
    - For species that move in well-defined time periods such as salamanders and toads that migrate to breeding ponds, surveys should be timed during peak movements (e.g., rainy, warm spring nights) because carcasses will be obliterated with rain and from traffic in a few hours even on low traffic roads.
    - Greater than 50% of snake carcasses will disappear in 24 hours so surveys should be conducted daily during peak movements in spring and fall (Antworth et al. 2006).
    - Dead turtles persist the longest on roads, so surveys two to three times a week during nesting season are recommended.
- Weather conditions, time of day and traffic volumes will all impact detectability of carcasses. For animals that move on rainy nights, such as the Jefferson Salamander, surveys must be conducted at night before rainfall and morning traffic obliterates carcass remains.
- Note that road surveys may not detect rare species where road mortality has already depleted the number of individuals adjacent to the road (Fahrig and Rytwinski 2009), or species that avoid crossing roads all together (Andrews and Gibbons 2005):
    - Other visual encounter survey techniques may be required to detect rare and elusive animals surrounding roads (Konze and McLaren 1997). Examples include cover boards for snakes (Patrick and Gibbs 2009), pit-fall traps for amphibians and toads (Gibbs and Shriver 2005), and hoop-net traps for turtles (Beaudry et al. 2009).
    - When information is lacking for rare species, data from common species (e.g. Painted Turtles) may supplement sample size.
- Surveys should be conducted with consistent and repeatable methods so the road can be surveyed the same way in a before and after mitigation design. Smith et al. (2015) discusses methods as well as how to avoid observer bias.
- Each specimen should be carefully examined and photographed to determine the species and, if possible, the sex and length of the animal should be recorded (e.g. plastron of a turtle, total length of snakes) (Photos 82 and 83). Depending on the project, it may also be important to collect a DNA sample or to mark live individuals.

Photo 64. Identifying amphibian specimen peeled off the road. ©K. Gunson

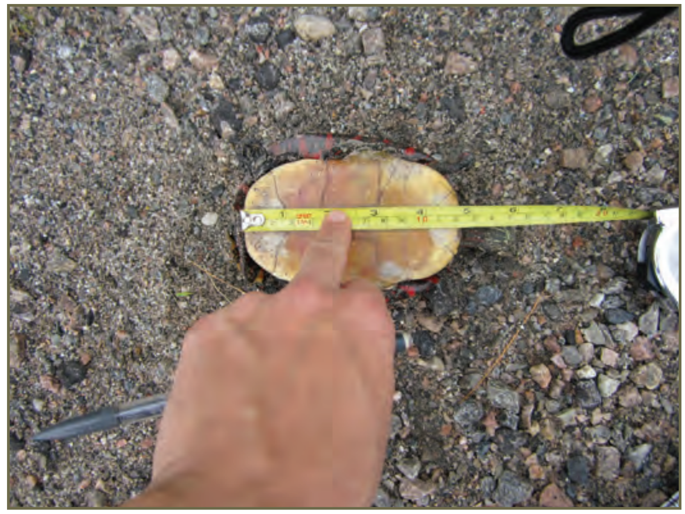


Photo 65. Measuring mid-plastron length for dead Painted Turtle found on the road. © K. Gunson

7.2.2 Crossing Structure and Fencing Effectiveness

This section focuses on monitoring techniques for measuring whether crossing structures and fence designs are effective at providing connectivity across roads. Previously the majority of studies that have monitored crossing structures have assessed use of tunnels by amphibians and reptiles (see review in Appendix C). Studies that assess fence-efficiency (proportion of animals encountering the fence that enter into the tunnel) and tunnel-efficiency (proportion of animals that enter tunnels and go through them) are needed to better inform mitigation designs (Jackson and Tyning 1989).

Smith et al. (2015) offer information for developing a monitoring plan to measure mitigation effectiveness for small vertebrates including reptiles and amphibians, and Clevenger and Huijser (2011) provide information on monitoring techniques based on mark-recapture methods. Further information regarding methods for surveying amphibians and/or reptiles can be found in Heyer et al. (1994), Konze et al. (1997) and McDiarmid et al. (2012). The Canadian Council on Animal Care (CCAC 2004) provides an excellent manual for handling and capturing amphibians and reptiles that can be integrated into the following monitoring techniques (http://www.ccac.ca/Documents/Standards/Guidelines/Add_PDFs/Wildlife_Amphibians_Reptiles.pdf)

Digital cameras are currently the most commonly used technique for measuring crossing structure use for animals in Ontario. Motion-activated cameras work well for large and medium-sized animals; however, they are not very effective at capturing pictures of ectothermic animals, such as amphibians and reptiles. This is because motion-triggered cameras only take a photograph when there is a temperature differential between the animal and the ambient temperature (Reconyx 2010). For example, Pagnucco (2012) found Reconyx infra-red motion triggered cameras only documented approximately 19% of salamanders in a 0.5 m by 0.5 m ACO tunnel. Since the motion-activated feature is not effective, the time lapse setting should be used instead to take pictures at regularly spaced intervals (e.g. every minute). Approximately 20,000 images are taken in a two week period with a one-minute interval and camera detection software can help to efficiently find wildlife in images (Dillon et al. 2011). Setting the camera to take photos over shorter intervals (e.g. every 10 seconds) will improve the quality of the data but would require the cameras to be checked more regularly. Cameras should be placed at both ends of the tunnel, securely fastened and locked to the undersurface of the tunnel top (photo 84). At larger tunnels, cameras can be mounted close to the ground to capture snakes and turtles.

Pitfall Traps: Pitfall traps consist of buckets, cans, or other containers that are buried flush with the ground and are set up along a fence that directs animals to the traps. Pitfall traps need to be large enough so that the target species cannot climb or jump out of the containers. In addition, once traps are set they need to be checked regularly (at least every day) to avoid drowning, desiccation or predation of individuals. They can be used at or near amphibian habitat to assess where animals are moving in relation to a road. For example, Gibbs et al. (2005) used metal cans

Photo 66. Camera securely fastened to top of culvert; note difficult to capture animals when water in culvert or tunnel. © K. Gunson

Photo 67. Using hand-held receiver to locate Blanding's turtles around highway 24 © K. Gunson

Photo 68. Blanding's turtle with radio transmitter on back of shell. © K. Gunson

Photo 69. Passive data logger receiver used to record turtle passage at culvert on highway 24. ©K. Gunson

50 cm deep and 7.5 cm in circumference to assess movements of salamanders across a road. Furthermore, pitfall traps have been used at entry and exit points of crossing structures to assess use of structures (Pagnucco et al. 2012). This also provides a useful technique to capture and mark individuals.

Mark-recapture: This technique involves capturing, marking and recapturing animals to determine if they cross the road. Several methods exist for marking amphibians and reptiles, including inserting Passive Integrated Transponders (PIT), notching scutes on turtles, marking salamanders with visible implant elastomer (e.g., MacNeil et al. 2011) and using image-recognition software. Some of these techniques are discussed in more detail in the CCAC (2004) manual. Mark-recapture methods for turtles are discussed in detail in Robertson et al. (2013) and for all reptiles in McDiarmid et al. (2012).

Radio-Telemetry and passive data loggers/ PIT tag readers: Radio-telemetry can be used to monitor animal movements using a hand-held receiver (photos 85 and 86) without the need to recapture the animals. Further, passive data loggers (photo 87) or PIT tag readers can be mounted near crossing structure entrances (James et al. 2011; Caverhill et al. 2011) to record the movement of marked individuals through them.

Table 4 provides a comparison of the advantages and disadvantages of these methodologies. A combination of several methods will provide the most robust data set and eliminate most of the disadvantages of any one method. For example, using both hand-held radio telemetry and passive receivers mounted in the crossing structures will provide high quality data on crossing events as well as the detailed movements of the individuals in relation to the crossing structures/road.

Table 4: **Advantages and disadvantages of the techniques used to monitor road crossing structures**

Technique	Advantages	Disadvantages
Mounted digital cameras	• Provides information on the time and date of the crossing event • Provides direct evidence that the structures are used • Should detect most individuals using the crossing structure if cameras are set to take photos regularly (e.g. every minute)	• Does not provide information on the individuals using the structure (e.g. sex) • Effective cameras are expensive, and there is a risk of theft • It can be very time-consuming to review photographs and maintain cameras (downloading pictures, adjustments, batteries, water levels, etc.) • Cameras typically do not work under aquatic conditions

Technique	Advantages	Disadvantages
Pitfall traps	• Provides information on the individuals using the structure (e.g. sex) and the date of the crossing event • Provides direct evidence that the crossing structures are used • Should detect most individuals using the crossing structure • Can use trapped animals for genetic sampling and mark-recapture	• Labour-intensive for set up and sampling as the traps should be checked a minimum of every day • Risk of animals dying in traps • Method is less suitable for reptiles
Mark-recapture	• Provides information on the individuals using the structure (e.g. sex) • Allows for estimates of population abundance (with enough sampling)	• May not provide information on the time and date of crossings • Does not provide direct evidence that animals used crossing structures (e.g. it is not possible to rule out crossing through holes in fence or at fence ends) • Detection of individuals crossing the road is limited to the number of animals captured and subsequently recaptured
Radio-telemetry and passive data loggers	• Provides information on the individuals using the structure (e.g. sex) and the time and date of crossing • Passive data loggers and PIT tag readers in the structure provide direct evidence that the structures are used • Hand held radio-telemetry receiver can track movements in relation to the road (e.g. home range size, etc.) • Will work under aquatic conditions	• Considerable field time, effort and cost can be required to capture, handle and monitor animals • Detection of individuals crossing the road is limited to the number of animals that are captured and tagged or tracked • Radio-telemetry with a hand-held receiver is unlikely to provide direct evidence that the structure is used, so it is ideal to combine this with passive readers mounted in the structure

7.2.3 Population Estimates

Monitoring that measures changes in population abundance, animal distribution, and genetic relatedness before and after a road mitigation project can answer questions related to how new road mitigation maintained or improved the long-term persistence of wildlife populations, especially when used in a BACI design. This section generally outlines inventory and survey techniques to measure whether a population is stable, increasing or decreasing as a result of the road mitigation measures and road construction project.

Mark-recapture studies may be used to estimate population size, but a large number of individuals need to be marked to produce statistically significant estimates.

Relative Abundance surveys are carried out using standardized methods, such as timed searches, grids or transects, that allow for comparisons over time or between sites. In addition to free searches, these surveys may consist of cover boards for snakes and salamanders or pit-fall traps for toads and frogs along. Abundance surveys (counts of animals per area and standardized by search effort) require a systematic study design with regular surveys by the same trained volunteers to reduce observer bias.

Call surveys may be used to collect relative abundance data for toads and frogs near roads, and do not require direct observation of the animals (Eigenbrod et al. 2008b). With respect to SAR amphibians and reptiles in Ontario this monitoring technique would only be applicable to the Fowler's Toad.

Genetic Sampling involves taking from blood or tissue samples from live or dead individuals to compare genetic relatedness and structuring (e.g. sex and age ratios) before and after a road mitigation project (e.g. James et al. 2011). For example, Clark et al. (2010) found roads have an effect on the genetic structure, connectivity and gene flow on Timber Rattlesnakes. In another study, Row et al. (2010) genetically analyzed blood samples from Eastern Foxsnake populations bisected by highways in Ontario, Ohio and Michigan. Notably, some populations bisected by Highway 401 were not genetically distinct, possibly because of underpasses that allowed snake passage.

7.3 Adaptive Management

Adaptive management consists of using the results from monitoring to inform decision making with regard to planning and designing subsequent phases of a project (Holling 1978). The Environmental Impact Assessment (EIA) process is meant to be a flexible, iterative and adaptive process that can adjust for uncertainty and preferences that emerge during the process (Lawrence 2003). With this in mind, and the typical long-term nature of road projects, there is an opportunity to integrate long-term and adaptive monitoring into the road planning processes.

Road construction and the implementation of mitigation strategies typically occurs in phases. The phased construction process allows for mitigation designs to be implemented in the initial section of highway so that lessons learned via monitoring can be integrated into subsequent phases of the road project. For example, the improvement of the Trans-Canada Highway in Banff National Park was conducted in 4 phases over 30 years, and long-term monitoring of crossing structures enabled lessons learned to be applied in each subsequent phase to improve crossing structure designs (Ford et al. 2010). Adaptive management of the project design based on monitoring results requires regular and close communication between the people conducting the monitoring and the transportation agency. Ongoing communication will permit timely changes to design plans that reflect the most current results from monitoring activities (Clevenger and Ford 2010).

8 REFERENCES

Allaback, M. L., and D. M. Laabs. 2002. Effectiveness of road tunnels for the Santa Cruz Long-toed Salamander. Transactions of the Western Section of the Wildlife Society 38:5–8.

Amphibian and Reptile Conservation. 2009. Common toads and roads: Guidance for planners and highways engineers (England). Booklet, published by Amphibian and Reptile Conservation.

Andrews, K. M., and J. W. Gibbons. 2005. How do highways influence snake movement? Behavioral responses to roads and vehicles. Copeia 2005:772–782.

Andrews, K. M., J. W. Gibbons, and D. M. Jochimsen. 2008. Ecological effects of roads on amphibians and reptiles: a literature review. Pages 121–143 in R. E. Mitchell, J. Brown, and B. Bartholomew, editors. Urban Herpetology, Society for the Study of Amphibians and Reptiles.

Antworth, R. L., D.A. Pike, and E.E. Stevens. 2005. Hit and Run: Effects of scavenging on estimates of roadkilled vertebrates. Southeastern Naturalist 4:647-656

Aresco, M. J. 2005. Mitigation measures to reduce highway mortality of turtles and other herpetofauna at a north Florida lake. Journal of Wildlife Management 69:549–560.

Arizona Game and Fish. 2010. Safe roads for people and wildlife: culverts and fencing to reduce wildlife-vehicle collisions and maintain permeability. Available from http://www.rtamobility.com/images/stories/pdfs/RTAWLL/2010/RTAWLL-2010-05-14-Presentation%20Safe%20Roads%20for%20%20People%20and%20Wildlife.pdf.

Ascensão, F., and A. Mira. 2007. Factors affecting culvert use by vertebrates along two stretches of road in southern Portugal. Ecological Research 22:57–66.

Ashley, E. P., and J. T. Robinson. 1996. Road mortality of amphibians, reptiles and other wildlife on the Long Point Causeway, Lake Erie, Ontario. Canadian Field Naturalist 110:403–412.

Ashley, E. P., A. Kosloski, and S. A. Petrie. 2007. Incidence of intentional vehicle-reptile collisions. Human Dimensions of Wildlife 12:137–143.

Bain, T.K. 2014.Evaluating the effect of moisture in wildlife crossing tunnels on the migration of the California tiger salamander, *Ambystoma californiense*. Master of Science thesis. Sonoma State University, Rohnert Park, California.

Barthelmess, E. L., and M. S. Brooks. 2010. The influence of body-size and diet on road-kill trends in mammals. Biodiversity and Conservation 19:1611–1629.

Baxter-Gilbert, J. H. 2014. The long road ahead: understanding road-related threats to reptiles and testing if current mitigation measures are effective at minimizing impacts. Master of Science thesis. Laurentian University.

British Columbia Ministry of Forests, Lands and Natural Resource Operations. 2004. Guidelines for Amphibians and Reptiles conservation during urban and rural land development in British Columbia. Victoria, British Columbia. 156 pp. http://www.env.gov.bc.ca/wld/BMP/bmpintro.html#second

Beasley, B. A. 2013. The SPLAT project: Mitigating amphibian road mortality in the Clayoquot Sound UNESCO Biosphere Reserve. FrogLog 21:20–22.

Beaudry, F., P. G. deMaynadier, and M. L. Hunter. 2008. Identifying road mortality threat at multiple spatial scales for semi-aquatic turtles. Biological Conservation 141:2550–2563.

Beaudry, F., P. G. deMaynadier, and M. L. Hunter. 2009. Seasonally dynamic habitat use by Spotted (*Clemmys guttata*) and Blanding's turtles (*Emydoidea blandingii*) in Maine. Journal of Herpetology 43:636–645.

Beaudry, F., P. G. deMaynadier, and M. L. Hunter. 2010. Nesting movements and the use of anthropogenic nesting sites by Spotted Turtles (*Clemmys guttata*) and Blanding's Turtles (*Emydoidea blandingii*). Herpetological Conservation and Biology 5:1–8.

Bellis, M., S. Jackson, C. Griffin, P. Warren, and A. Thompson. 2007. Utilizing a multi-technique, multi-taxa approach to monitoring wildlife passageways on the Bennington Bypass in Southern Vermont. Proceedings of the 2007 International Conference on Ecology and Transportation. Center for Transportation and the Environment, North Carolina State University, Raleigh, NC.

Biolinx Environmental Research. 2013. Western Toad monitoring study in Kentucky Alleyne Provincial Park, July - August 2013. Unpublished report to BC Parks.

Bissonette, J., C. A. Kassar, and L. J. Cook. 2008. Assessment of costs associated with deer–vehicle collisions: human death and injury, vehicle damage, and deer loss. Human-Wildlife Conflicts 2:122-130.

Bissonette, J. A., and W. Adair. 2008. Restoring habitat permeability to roaded landscapes with isometrically-scaled wildlife crossings. Biological Conservation 141: 482-488.

Bouchard, J., A. T. Ford, F. E. Eigenbrod, and L. Fahrig. 2009. Behavioral responses of Northern Leopard Frogs (*Rana pipiens*) to roads and traffic: Implications for population persistence. Ecology and Society 14. [online] URL: http://www.ecologyandsociety.org/vol14/iss2/art23/.

Brooks, R. J., G. P. Brown, and D. A. Galbraith. 1991. Effects of a sudden increase in natural mortality of adults on a population of the Common Snapping Turtle (*Chelydra serpentina*). Canadian Journal of Zoology 69:1314–1320.

Buchanan, I. D., and D. Basso. 2007. Under the boardwalk – case history – St. John's sideroad at the Mckenzie wetland, Aurora, Ontario, Canada. Pages 100–113 in C. L. Irwin, D. A. Nelson, and K. P. McDermott, editors. Proceedings of the 2007 International Conference on Ecology and Transportation. Center for Transportation and the Environment, North Carolina State University, Raleigh, NC. Available from http://escholarship.org/uc/item/6vr0n5bq (accessed February 25, 2014).

CCAC. 2004. CCAC species-specific recommendations on: AMPHIBIANS AND REPTILES. Canadian Council on Animal Care, Ottawa, Ontario. Available from http://www.ccac.ca/Documents/Standards/Guidelines/Add_PDFs/Wildlife_Amphibians_Reptiles.pdf.

Carr, L. W., and L. Fahrig, 2001. Effect of road traffic on two amphibian species of differing vagility. Conservation Biology 15: 1071–1078.

Carsignol. J. 2005 (translated to English 2007). Facilities and measures for small fauna: technical guide. Ministry of Transportation and Infrastructure, Technical Department for Transport, Road and Bridges Engineering and Road Safety. Bagneux Cedex, France.

Caverhill, B., B. Johnson, J. Phillips, E. Nadeau, M. Kula, and R. Holmes. 2011. Blanding's Turtle (*Emydoidea blandingii*) and Snapping Turtle (*Chelydra serpentina*) habitat use and movements in the Oakland Swamp wetland complex, Ontario, Canada, and their response to the Provincial Highway 24 exclusion fence and aquatic culvert ecopassage from 2010-2011. Report prepared by the Toronto Zoo, Adopt-A-Pond Programme, Toronto, ON.

Central Lake Ontario Conservation Authority March 2015. Watershed Wildlife and Corridors Protection and Enhancement Plan - Action Plan #5. Oshawa, ON.

Clark, R. W., W.S. Brown, R. Stechert, and K.R. Zamudio. 2010. Roads, interrupted dispersal, and genetic diversity in timber rattlesnakes. Conservation Biology 24:1059-1069.

Clarke, R. and A. Gruenig 2002. Summary Report: Painted Turtle (*Chrysemys picta belli*) nest site enhancement and monitoring Elizabeth Lake, Cranbrook, B.C. Unpublished report for Columbia Basin Fish and Wildlife Compensation Program Rocky Mountain Naturalists, Nelson, B.C.

Clayton, G. and D. Bywater. 2012. BMPs for Public Works Department working within the Georgian Bay Biosphere Reserve. Georgian Bay Biosphere Reserve. Parry Sound, Ontario. 16 pp. http://www.gbbr.ca/download/Species%20at%20Risk/BMPs%20Working%20in%20SAR%20Habitat.pdf

Clevenger, A. P. 2012. Mitigating continental-scale bottlenecks: How small-scale highway mitigation has large-scale impacts. Ecological Restoration 30:300–307.

Clevenger, A. P., and M. Huijser. 2011. Wildlife crossing structures handbook: Design and evaluation in North America. Report # FHWA-CFL/TD-11-003. Federal Highway Administration, Washington, D.C. 223 pp.

Clevenger, A. P., B. Churszcz, K. Gunson, and J. Wierzchowski. 2002. Roads and wildlife in the Canadian Rocky Mountain Parks – movement, mortality, and mitigation. Final Report to Parks Canada. Banff, AB.

Clevenger, A. P., M. McIvor, D. McIvor, B. Chruszcz, and K. Gunson. 2001. Tiger salamander, *Ambystoma tigrinum*, movements and mortality on the Trans-Canada Highway in southwestern Alberta. Canadian Field-Naturalist 115:199–204.

Collinson, W. J., D.M. Parker, R.T. Bernard, B.K. Reilly, and H.T. Davies-Mostert. 2014. Wildlife road traffic accidents: a standardized protocol for counting flattened fauna. Ecology and Evolution, 4:3060-3071.

Compton, B. W., and P. R. Sievert. 2002. An evaluation of turtle tunnels and curbs at Towermarc Office Park. Unpublished report. University of Massachusetts, Amherst, MA, USA.

Congdon, J. D., A. E. Dunham, and R. C. van Loben Sels. 1993. Delayed sexual maturity and demographics of Blanding's Turtles (*Emydoidea blandingii*): Implications for conservation and management of long-lived organisms. Conservation Biology 7:826–833.

COSEWIC. 2002a. COSEWIC assessment and update status report on the Spiny Softshell Turtle *Apalone spinifera* in Canada. Page vii + 17. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2002b. COSEWIC assessment and status report on the Milksnake *Lampropeltis triangulum* in Canada. Page vi + 29. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2004. COSEWIC assessment and update status report on the Spotted Turtle *Clemmys guttata* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2005. COSEWIC assessment and update status report on the Blanding's Turtle *Emydoidea blandingii* in Canada. Page viii + 40. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2006. COSEWIC assessment and update status report on the Lake Erie watersnake *Nerodia sipedon insularum* Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2007a. COSEWIC assessment and update status report on the Eastern Hog-nosed Snake *Heterodon platirhinos* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2007b. COSEWIC assessment and update status report on the Wood Turtle *Glyptemys insculpta* in Canada. Page vii + 42. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2007c. COSEWIC assessment and update status report on the Gray Ratsnake *Elaphe spiloides* (Great Lakes/St. Lawrence population and Carolinian population) in Canada. Page vii + 33. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2007d. COSEWIC assessment and update status report on the Five-lined Skink *Eumeces fasciatus* (Carolinian population and Great Lakes/St. Lawrence population) in Canada. Page vii + 50. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2008a. COSEWIC assessment and status report on the Snapping Turtle *Chelydra serpentina* in Canada. Page vii + 47. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2008b. COSEWIC assessment and update status report on the Eastern Foxsnake *Elaphe gloydi*, Carolinian population and Great Lakes/St. Lawrence population, in Canada. Page vii + 45. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2010a. COSEWIC assessment and status report on the Jefferson Salamander *Ambystoma jeffersonianum* in Canada. Page xi + 38. Committee on the Status of Endangered Wildlife in Canadaa. Ottawa.

COSEWIC. 2010b. COSEWIC assessment and status report on the Fowler's Toad *Anaxyrus fowleri* in Canada. Page vii + 58. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2010c. COSEWIC assessment and status report on the Butler's Gartersnake *Thamnophis butleri* in Canada. Page xi + 51. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2010d. COSEWIC assessment and status report on the Queensnake *Regina septemvittata* in Canada. Page vii + 34. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2012a. COSEWIC assessment and status report on the Eastern Musk Turtle *Sternotherus odoratus* in Canada. Page xiii + 68. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2012b. COSEWIC assessment and status report on the Eastern Ribbonsnake *Thamnophis sauritus* Atlantic population, Great Lakes population in Canada. Page xii + 39. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2012c. COSEWIC assessment and status report on the Massasauga *Sistrurus catenatus* in Canada. Page xiii + 84. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2013. COSEWIC assessment and status report on the Northern Map Turtle *Graptemys geographica* in Canada. Page xi + 63. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

Crowley, J. F. 2006. Are Ontario reptiles on the road to extinction? Anthropogenic disturbance and reptile distributions within Ontario. Master's thesis. University of Guelph, Guelph, Ontario.

deMaynadier, P. G., and M. L. Hunter Jr., 2000. Road effects on amphibian movements in a forested landscape. Natural Areas Journal 20: 56–65.

De Rivera, C. E., and L. L. Bliss-Ketchum. 2010. The effectiveness of vertebrate passage and prevention structures: a study of Boeckman Road in Wilsonville. Final report for Oregon Transportation Research and Education Consortium.

Dillon Consulting Limited. 2011. Terry Fox Drive extension project wildlife guide system monitoring report, Year 1 of 3. 10-3663. City of Ottawa, Ottawa, Ontario.

Dillon Consulting Limited. 2013. Terry Fox Drive extension project wildlife guide system monitoring report, Year 3 of 3; and, three year summary. 12-6019. City of Ottawa, Ottawa, Ontario.

Dodd, N. L., J. W. Gagnon, A.L. Manzo, and R. E. Schweinsburg. 2007. Video surveillance to assess highway underpass use by elk in Arizona. The Journal of Wildlife Management 71: 637-645.

Dodd, K. J., W. J. Barichivich, and L. L. Smith. 2004. Effectiveness of a barrier wall and culverts in reducing wildlife mortality on a heavily traveled highway in Florida. Biological Conservation 118:619–631.

Eads, B. 2013. Behavioral responses of two syntopic snakes (*genus Thamnophis*) to roads and culverts. Master of Science thesis. Purdue University, Fort Wayne, Indiana.

Eads, B., L. Hayter, and B. Kingsbury. 2012. Road responses and culverts as a tool for increasing habitat connectivity for the federally threatened Copper-bellied Watersnake (*Nerodia erythrogaster neglecta*) and other wetland snakes. Conference abstract, World Congress of Herpetology. Victoria, BC.

Eastern Foxsnake Recovery Team. 2010. Recovery strategy for the Eastern Foxsnake (*Pantherophis gloydi*) – Carolinian and Georgian Bay populations in Ontario. Page vi + 39. Ontario Recovery Strategy Series. Ontario Ministry of Natural Resources, Peterborough, Ontario.

Eberhardt, E., S. Mitchell, and L. Fahrig. 2013. Road kill hotspots do not effectively indicate mitigation locations when past road kill has depressed populations. The Journal of Wildlife Management 77:1353–1359.

EcoPlans. 2006. Environmental guide for wildlife in the Oak Ridges Moraine. Environmental Standards and Practices. Ontario Ministry of Transportation.

Eigenbrod, F., S. J. Hecnar, and L. Fahrig. 2008a. Accessible habitat: an improved measure of the effects of habitat loss and roads on wildlife populations. Landscape Ecology 23:159–168.

Eigenbrod, F., S. J. Hecnar, and L. Fahrig. 2008b. The relative effects of road traffic and forest cover on anuran populations. Biological conservation 141:35–46.

Ernst, C.H., and J.E. Lovich. 2009. Turtles of the United States and Canada. Second edition. Johns Hopkins University Press.

Faggyas, S., and M. Puky. 2012. Construction and preliminary monitoring results of the first ACO Wildlife Pro amphibian mitigation system on roads in Hungary. Állattani Közlemények 97: 85–93.

Fahrig, L., J. H. Pedlar, S. E. Pope, P. D. Taylor, and J. F. Wegner. 1995. Effect of road traffic on amphibian density. Biological Conservation 73:177–182.

Farmer, R. G., and R.J. Brooks. 2012. Integrated risk factors for vertebrate roadkill in southern Ontario. The Journal of Wildlife Management 76:1215-1224.

Fenech, A., B. Taylor, R. Hansell, and G. Whitelaw. 2001. Major road changes in southern Ontario 1935–1995: Implications for protected areas. Available from http://www.utoronto.ca/imap/papers/road_changes.htm (accessed April 10, 2014).

Findlay, C. S., and J. Houlahan. 1997. Anthropogenic correlates of species richness in southeastern Ontario wetlands. Conservation Biology 11:1000–1009.

Ford, A. T., A. P. Clevenger, and K. Rettie. 2010. The Banff Wildlife Crossings Project: an international public-private partnership. Pages 157–173 in J.P. Beckmann, A.P. Clevenger, M.P. Huijser, J.A. Hilty, editors. Safe passages—highways, wildlife and habitat connectivity. Island Press, Washington, DC. Island Press, Washington, DC.

Fortney, A. N., R. G. Poulin, J.A. Martino, D.L. Parker, and C.M. Somers. 2013. Proximity to hibernacula and road type influence potential road mortality of snakes in southwestern Saskatchewan. Canadian Field-Naturalist 126:194-203.

Garrah, E. 2012. Wildlife road mortality on the 1000 islands parkway in southeastern Ontario: peak times, hot spots, and mitigation using drainage culverts. Master of Environmental Studies thesis. Queen's University, Kingston, Ontario.

Gartner Lee, and EcoPlans. 2009. 407 East individual Environmental Assessment and preliminary design study: Natural environmental (terrestrial) impact assessment of the recommended design. Report to the Ministry of Transportation.

Gartshore, R. G., M. Purchase, R. I. Rook, and L. Scott. 2005. Bayview Avenue extension, Richmond Hill, Ontario, Canada habitat creation and wildlife crossings in a contentious environmental setting: a case study. Pages 55-76 in C.L. Irwin, P. Garrett, and K.P. McDermott, editors. Proceedings of the 2005 International Conference on Ecology and Transportation, Raleigh, NC.: Center for Transportation and the Environment, North Carolina State University.

Gates, J. E., and J. L. J. Sparks. 2012. An investigation into the use of road drainage structures by wildlife in Maryland, USA. Human-Wildlife Interactions 6:311–326.

Gibbs, J. P., and W. G. Shriver. 2002. Estimating the effects of road mortality on turtle populations. Conservation Biology 16:1647–1652.

Gibbs, J. P., and W. G. Shriver. 2005. Can road mortality limit populations of pool-breeding amphibians? Wetlands Ecology and Management 13:281–289.

Gillingwater, S. D. 2011. Recovery strategy for the Queensnake (*Regina septemvittata*) in Ontario. Page vi + 34. Ontario Recovery Strategy Series. Ontario Ministry of Natural Resources, Peterborough, Ontario.

Glenside Ecological Services. 2011. Community mobilization and habitat modelling. Pages 24 – 109. Species at Risk. Ontario Ministry of Natural Resources, Haliburton Highlands Land Trust.

Griffin, K. 2005. Use of low fencing with aluminum flashing as a barrier for turtles. Pages 366-368 in C.L. Irwin, P. Garrett, and K.P. McDermott, eds. Proceedings of the 2005 International Conference on Ecology and Transportation, Raleigh, NC: Center for Transportation and the Environment, North Carolina State University.

Gunson, K. E., G. Mountrakis, and L. J. Quackenbush. 2011. Spatial wildlife-vehicle collision models: A review of current work and its application to transportation mitigation projects. Journal of Environmental Management 92:1074–1082.

Gunson, K. E., and F. W. Schueler. 2012. Effective placement of road mitigation using lessons learned from turtle crossing signs in Ontario. Ecological Restoration 30:329–334.

Gunson, K.E., Ireland, D., Schueler, F.W. 2012. A tool to prioritize high-risk road mortality locations for wetland-forest herpetofauna in southern Ontario, Canada. NorthWestern Journal of Zoology 8:409-413.

Gunson, K. E., D. Lesbarrères, and D. C. Seburn. 2013. Monitoring turtle movements across highways 7 and 41: Final report. Unpublished report to Highway Infrastructure Innovation Funding Program. Ontario Ministry of Transportation.

Gunson, K.E., and F.Z. Teixeira. 2015. Road-wildlife mitigation planning can be improved by identifying the patterns and processes associated with wildlife-vehicle collisions. Pages 101-019 in R. van der Ree, D. Smith, C. Grilo, editors. Handbook of Road Ecology. Wiley-Blackwell Publications.

Hagood, S., and M. J. Bartels. 2008. Use of existing culverts by eastern box turtles (*Terrapene c. carolina*) to safely navigate roads. Pages 169–170 in J. C. Mitchell, R. E. J. Brown, and B. Bartholomew, editors. Urban Herpetology, Society for the Study of Amphibians and Reptiles.

Hardy, A., S. Lee, and A.F. Al-Kaisy. 2006. Effectiveness of animal advisory messages on dynamic message signs as a speed reduction tool: case study in Rural Montana. Transportation Research Record: Journal of the Transportation Research Board 1973:64-72.

Haxton, T. 2000. Road mortality of Snapping Turtles, *Chelydra serpentina*, in central Ontario during their nesting period. Canadian Field-Naturalist 114:106–110.

Helferty, N. J. 2002. Natural Heritage Planning for amphibians and their habitats with reference to populations on the south slope of the Oak Ridges Moraine. Page 71. Supplementary Report for Oak Ridges Moraine Richmond Hill, Ontario Municipal Board Hearing. Save the Rouge Valley System Inc. and the City of Toronto.

Hels, T., and E. Buchwald, 2001. The effect of road kills on amphibian populations. Biological Conservation 99: 331–340.

Heyer, W. R., M. A., Donnelly, R. W. McDiarmid, L. C. Hayek, and M. S. Foster (eds). 1994. Measuring and monitoring biological diversity. Standard methods for amphibians. Smithsonian Institution Press, Washington, D. C. 364 pp.

Holling, C. S. 1978. Adaptive environmental assessment and management. Adaptive environmental assessment and management. Available from http://www.cabdirect.org/abstracts/19800666996.html (accessed April 10, 2014).

Huijser, M. P., P. T. McGowen, J. Fuller, A. Hardy, and A. Kociolek. 2007. Wildlife-vehicle collision reduction study: report to congress. U.S. Department of Transportation, Federal Highway Administration, Washington, DC, USA. Available from http://trid.trb.org/view.aspx?id=884083 (accessed April 10, 2014).

IUCN. 2010. IUCN Red list of threatened species 2010. International Union for the Conservation of Nature (IUCN), Gland, Switzerland. [online] URL: http://www.iucn.org

Iuell, B. 2003. COST 341: Wildlife and Traffic: A European handbook for identifying conflicts and designing solutions. Utrecht, The Netherlands: KNNV Publishers.

Jackson, S. D., and T. F. Tyning. 1989. Effectiveness of drift fences and tunnels for moving spotted salamanders *Ambystoma maculatum* under roads. Pages 93–99 in T. E. S. Langton, editor. Amphibians and Roads, Proceedings of the toad tunnel conference. ACO Polymer Products, Shefford, England. Available from http://works.bepress.com/cgi/viewcontent.cgi?article=1017andcontext=scott_jackson (accessed April 10, 2014).

Jackson, S. D. 1996. Underpass systems for amphibians. In G. L. Evink, P. Garrett, D. Zeigler, and J. Berry, editors. Trends in Addressing Transportation Related Wildlife Mortality: Proceedings of the transportation related wildlife mortality seminar. State of Florida Department of Transportation, Environmental Management Office. Tallahassee, FL. FL-ER-58-96.

Jackson, S. D., and M. N. Marchand. 1998. Use of a prototype tunnel by Painted Turtles, *Chrysemys picta*. Unpublished report.

Jackson, S. D. 2003. Ecological considerations in the design of river and stream crossings. Page 10 in C. L. Irwin, P. Garrett, and K. P. McDermott, editors. 2003 Proceedings of the International Conference on Ecology and Transportation. Center for Transportation and the Environment, North Carolina State University, Raleigh, North Carolina. Available from http://works.bepress.com/scott_jackson/11/ (accessed April 10, 2014).

Jackson, S. D., D. J. Smith, and K. E. Gunson. 2015. Sharing the road: Mitigating road impacts on small vertebrates. Pages 177-208 in K. M. Andrews, P. Nanjappa, and S. P. D. Riley, editors. Roads and Ecological Infrastructure: Concepts and Applications for Small Animals. Johns Hopkins University Press, Baltimore, MD.

James, P.W., R.S. Wagner, K.A. Ernest, D. Beck, and J. Irwin. 2011. Monitoring fish and low-mobility vertebrates along a major mountain highway: a snapshot before construction of I-90 wildlife crossing structures. Pages 527-533 in P.J. Wagner, D. Nelson, and E. Murray, editors. Proceedings of the 2011 International Conference on Ecology and Transportation. Center for Transportation and the Environment, North Carolina State University, Raleigh, NC.

Jochimsen, D. M., C. R. Peterson, K. M. Andrews, and J. W. Gibbons. 2004. A literature review of the effects of roads on amphibians and reptiles and the measures used to minimize those effects. US Forest Service report. 79 pp.

Jacobson, S. L. 2007. An alternative to the openness "ratio" using underpass physical attributes and behavioral implications of deer vision and hearing capabilities. Page 605 in C.L. Irwin, D. Nelson, and K.P. McDermott, editors.Proceedings of the 2007 International Conference on Ecology and Transportation. Raleigh, NC.: Center for Transportation and the Environment, North Carolina State University.

Joyce, T. L., and S. P. Mahoney. 2001. Spatial and temporal distributions of moose-vehicle collisions in Newfoundland. Wildlife Society Bulletin 29:281–291.

Karraker, N. E., and J. P. Gibbs. 2011. Contrasting road effect signals in reproduction of long-versus short-lived amphibians. Hydrobiologia 664:213–218.

Kaye, D. R., K. M. Walsh, E. L. Rulison, and C. C. Ross. 2005. Spotted Turtle use of a culvert under relocated Route 44 in Carver, Massachusetts. Pages 426-432 in C.L. Irwin, P. Garrett, and K.P. McDermott, editors. Proceedings of the 2005 International Conference on Ecology and Transportation. Raleigh, NC.: Center for Transportation and the Environment, North Carolina State University.

Kintsch, J., and P. C. Cramer. 2011. Permeability of existing structures for terrestrial wildlife: A passage assessment system. WA-RD 777.1. Washington State Department of Transportation, Olympia, WA.

Kintsch, J., K. E. Gunson, and T. A. Langen. 2015. Engaging the public through public education and citizen science. Pages 94-110 in K. M. Andrews, P. Nanjappa, and S. P. D. Riley, editors. Roads and Ecological Infrastructure: Concepts and Applications for Small Animals. Johns Hopkins University Press, Baltimore, MD.

Konze, K. and McLaren, M. 1997. Wildlife monitoring programs and inventory techniques for Ontario. Ontario Ministry of Natural Resources. Northeast Science and Technology. Technical Manual TM-009. 139 pp.

Kraus, T., B. Hutchinson, S. Thompson, and K. Prior. 2010. Recovery strategy for the Gray Ratsnake (*Pantherophis spiloides*) – Carolinian and Frontenac Axis populations in Ontario. Page vi + 23. Ontario Recovery Strategy Series. Ontario Ministry of Natural Resources, Peterborough, Ontario.

Laidig, K. J., and D. M. Golden. 2004. Assessing Timber Rattlesnake movements near a residential development and locating new hibernacula in the New Jersey Pinelands. Unpublished report to the Pinelands Commission, New Lisbon, NJ. Available from http://199.20.64.195/pinelands/images/pdf%20files/final%20Sanctuary%20report.pdf (accessed April 10, 2014).

Lang, J. W. 2000. Blanding's turtles, roads and culverts at Weaver Dunes. File report on culvert utilization, The Nature Conservancy and Minnesota Department of Natural Resources, Contract# CFMS AO 9492.

Langen, T. A., A. Machniak, E. K. Crowe, C. Mangan, D. F. Marker, N. Liddle, and B. Roden. 2007. Methodologies for surveying herpetofauna mortality on rural highways. The Journal of Wildlife Management 71:1361–1368.

Langen, T. A. 2011. Design considerations and effectiveness of fencing for turtles: three case studies along northeastern New York State highways. Pages 521-532 in P.J. Wagner, D. Nelson, and E. Murray, editors. Proceedings of the 2011 International Conference on Ecology and Transportation. Center for Transportation and the Environment, North Carolina State University, Raleigh, NC.

Langton, T. 2014. Safe passage for all: A review of the adoption of surface tunnels and stop channels on roadways for wildlife/road impact mitigation worldwide. Report prepard for ACO Tunnel Safety Review July 2014.

Lawrence, D.P. 2003. Environmental Impact Assessment: Practical solutions to recurrent problems. John Wiley and Sons, Hoboken, New Jersey.

Lesbarrères, D., T. Lodé, and J. Merilä. 2004. What type of amphibian tunnel could reduce road kills? Oryx 38:220–223.

Lesbarrères, D., and L. Fahrig. 2012. Measures to reduce population fragmentation by roads: what has worked and how do we know? Trends in Ecology and Evolution 27:374–380.

Lininger, M., and M. Perlik. 2014. Effectiveness of the TRU-88 wildlife roadway crossing culverts and exclusion fencing. Unpublished report to the Ohio Department of Transportation.

MacKinnon, C. A., L. A. Moore, R. J. Brooks, G. Nelson, T. Nudds, M. Beveridge, and B. Dempster. 2005. Why did the reptile cross the road? Landscape factors associated with road mortality of snakes and turtles in the southeastern Georgian Bay area. Pages 18–25 Parks and Research Forum. Available from http://casiopa.mediamouse.ca/wp-content/uploads/2010/05/PRFO-2005-Proceedings-p153-166-MacKinnon-Moore-and-Brooks.pdf (accessed February 27, 2014).

MacNeil, J. E., G. Dharmarajan, and R.N. Williams. 2011. Salamarker: A code generator and standardized marking system for use with visible implant elastomers. Herpetological Conservation and Biology 6:260-265.

Marchand, M. N., and J. A. Litvaitis. 2004. Effects of habitat features and landscape composition on the population structure of a common aquatic turtle in a region undergoing rapid development. Conservation Biology 18:758–767.

Marsh, D., R. Page, T. Hanlon, R. Corritone, E. Little, D. Seifert, and P. Cabe, 2008. Effects of roads on patterns of genetic differentiation in red-backed salamanders, *Plethodon cinereus*. Conservation Genetics 9: 603–613.

McDiarmid, R.W., M.S. Foster, C. Guyer, J.W. Gibbons, and N. Chernoff (Eds.). 2012. Reptile Biodiversity: Standard Methods for Inventory and Monitoring. Berkeley: University of California Press.

Meese, R.G., F.M. Shilling, and J.F. Quinn. 2009. Wildlife crossings guidance manual. Report to the California Department of Transportation. Sacramento, CA. 111 pp.

Merrow, J. 2007. Effectiveness of amphibian mitigation measures along a new highway. Pages 370-376 n C.L. Irwin, D. Nelson, and K.P. McDermott, editors. Proceedings of the 2007 International Conference on Ecology and Transportation. Raleigh, NC.: Center for Transportation and the Environment, North Carolina State University.

Ontario Ministry of Natural Resources. 2011. Massasauga search protocol where site alteration will occur in gestation habitat for Hwy 69/400 ESA authorization requirements. Ontario Ministry of Natural Resources, Parry Sound Sudbury District. 5pp.

Ontario Ministry of Natural Resources. 2013. Reptile and Amphibian Exclusion Fencing: Best Practices, Version 1.0. Species at Risk Branch technical note. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. 11 pp. Available from http://files.ontario.ca/environment-and-energy/species-at-risk/mnr_sar_tx_rptl_amp_fnc_en.pdf (accessed February 26, 2014).

Ontario Ministry of Transportation. 2012. Wildlife Habitat Awareness Signs. Policy Number 2012-03. Traffic Office, St. Catharines, Ontario.

Ontario Wood Turtle Recovery Team. 2010. Recovery strategy for the Wood Turtle (*Glyptemys insculpta*) in Ontario. Page vi + 25. Ontario Recovery Strategy Series. Ontario Ministry of Natural Resources, Peterborough, Ontario.

Ottburg, F. G. W. A., and E. A. van der Grift. 2013. Effectiveness of road mitigation for preserving a common toad population. Proceedings of the 2013 International Conference on Ecology and Transportation. Poster. Retrieved from http://www.icoet.net/ICOET_2013/proceedings.asp.

Pagnucco, K. S., C. A. Paszkowski, and G. J. Scrimgeour. 2011. Using cameras to monitor tunnel use by Long-toed Salamanders (*Ambystoma macrodactylum*): an informative, cost-efficient technique. Herpetological Conservation and Biology 6:277–286.

Pagnucco, K. S., C. A. Paszkowski, and G. J. Scrimgeour. 2012. Characterizing movement patterns and spatio-temporal use of under-road tunnels by long-toed salamanders in Waterton Lakes National Park, Canada. Copeia 2012:331–340.

Painter, M. L., and M. F. Ingraldi. 2007. Use of simulated highway underpass crossing structures by flat-tailed horned lizards (*Phrynosoma mcallii*). Final Report 594. Arizona Department of Transportation, Phoenix, AZ.

Parent, C and R. Black. 2006. Construction of artificial gestation sites for the Massasauga, Eastern Georgina Bay Population. Unpublished report submitted to the Ministry of Natural Resources.

Parren, S. G. 2013. A twenty-five year study of the Wood Turtle (*Glyptemys insculpta*) in Vermont: Movements, behavior, injuries, and death. Herpetological Conservation and Biology 8:176–190.

Paterson, J. E., B.D. Steinberg, and J.D. Litzgus. 2013. Not just any old pile of dirt: evaluating the use of artificial nesting mounds as conservation tools for freshwater turtles. Oryx 47:607-615.

Patrick, D.A., and Gibbs, J.P. 2009. Snake occurrences in grassland associated with road versus forest edges. Journal of Herpetology 43:716-720.

Patrick, D. A., C. M. Schalk, J. P. Gibbs, and H. W. Woltz. 2010. Effective culvert placement and design to facilitate passage of amphibians across roads. Journal of Herpetology 44:618–626.

Patrick, D. A., J. P. Gibbs, V. D. Popescu, and D. A. Nelson. 2012. Multi-scale habitat-resistance models for predicting road mortality "hotspots" for turtles and amphibians. Herpetological Conservation and Biology 7:407–426.

Paulson, D. J. 2010. Evaluating the effectiveness of road passage structures for freshwater turtles in Massachusetts. Master of Science thesis. University of Massachusetts, Amherst, Amherst, MA.

Pojar, T.M., D. F. Reed, and T.C. Reseigh. 1975. Effectiveness of a lighted, animated deer crossing sign. Journal of Wildlife Management 39:87-91.

Puky, M., J. Farkas, and M. T. Ronkay. 2007. Use of existing mitigation measures by amphibians, reptiles, and small to medium-size mammals in Hungary: crossing structures can function as multiple species-oriented measures. Pages 521-530 in C.L. Irwin, D. Nelson, and K.P. McDermott, editors. Proceedings of the 2007 International Conference on Ecology and Transportation, . Raleigh, NC.: Center for Transportation and the Environment, North Carolina State University.

Puky, M., B. Mester, and T. Mechura. 2013. How much does size matter? Tunnel size significantly influence amphibian crossings at Parassapuszta, Hungary according to mid-term monitoring used to delineate mitigation measure improvement plans. Proceedings of the 2013 International Conference on Ecology and Transportation. Available from http://www.icoet.net/ICOET_2013/proceedings-poster-sessions.asp.

Reconyx. 2010. HyperFireTM instruction manual. Holman, Wisconsin.

Reed, D. F., T. D. I. Beck, and T. N. Woodward. 1979. Regional deer-vehicle accident research. FHWA-RD-79-11. US Department of Transportation, Federal Highway Administration, Washington, DC.

Riley, J. L., J. H. Baxter-Gilbert, and J. D. Litzgus. 2013. A trifecta of insight: merging field biology, infrastructure planning and aboriginal community knowledge to design successful highway mitigation for at-risk reptiles. Proceedings of the 2013 International Conference on Ecology and Transportation. Available from http://www.icoet.net/ICOET_2013/proceedings.asp (accessed February 27, 2014).

Roberts, D. 2010. Mitigation of Red-sided Garter Snake mortality on provincial trunk Highway #17 at the Narcisse snake dens: A progress report. Unpublished report to Manitoba Conservation.

Robertson, C., N. Richards and M. Karch. 2013. Standard turtle handling and research practices and protocols. Prepared for the Ontario Turtle Conservation Group.

Robson, L. E., and G. Blouin-Demers. 2013. Eastern Hognose Snakes (*Heterodon platirhinos*) avoid crossing paved roads, but not unpaved roads. Copeia 2013:507–577.

Roedenbeck, I. A., L. Fahrig, C. S. Findlay, J.E. Houlahan, J. A. G. Jaeger, N. Klar, S. Kramer- Schadt and E. A. van der Grift. 2007. The Rauischholzhausen agenda for road ecology. Ecology and Society 12: 11. [online] URL: http://www.ecologyandsociety.org /vol12/iss1/art11/

Rogers, L., D. Stimson, K. Holden, D. Kay, D. Kaye, R. McAdow, B. Metcalfe, B. Windmiller, and N. Charney. 2009. Wildlife tunnels under a busy, suburban Boston roadway. Pages 102-115 in P.J. Wagner, D. Nelson, and E. Murray, editors. Proceedings of the 2009 International Conference on Ecology and Transportation. Raleigh, NC: Center for Transportation and the Environment, North Carolina State University.

Rosen, P. C., and C. H. Lowe. 1994. Highway mortality of snakes in the Sonoran Desert of southern Arizona. Biological Conservation 68:143–148.

Rouse, J. 2005. Monitoring the Eastern Massasauga and Eastern Hog-nosed Snake along the Highway 69 Extension. Ontario Ministry of Natural Resources, Parry Sound, ON.

Rouse, J. D., R. J. Willson, R. Black, and R. J. Brooks. 2011. Movement and spatial dispersion of *Sistrurus catenatus* and *Heterodon platirhinos*: implications for interactions with roads. Copeia 2011: 443–456.

Row, J. R., G. Blouin-Demers, and P. J. Weatherhead. 2007. Demographic effects of road mortality in Black Ratsnakes (*Elaphe obsoleta*). Biological Conservation 137:117–124.

Rytwinski, T., and L. Fahrig. 2012. Do species life history traits explain population responses to roads? A meta-analysis. Biological Conservation 147:87–98.

Santos, S. M., F. Carvalho, and A. Mira. 2011. How long do the dead survive on the road? Carcass persistence probability and implications for road-kill monitoring surveys. PloS one [electronic resource] 6:e25383–e25383.

Schmidt, B. R., and S. Zumbach. 2008. Amphibian road mortality and how to prevent it: A review. Pages 157–167 in J. C. Mitchell, R. E. Jung Brown, and B. Bartolomew, editors. Urban Herpetology. Society for the Study of Amphibians and Reptiles.

Seburn, D. C. 2007. Recovery strategy for species at risk turtles in Ontario. Draft Report for the Ontario Multi-species Turtles at Risk Recovery Team, Ontario, Canada.

Semlitsch, R. D. 2008. Differentiating migration and dispersal processes for pond-breeding amphibians. Journal of Wildlife Management 72:260-267.

Shine, R., M. Lemaster, M. Wall, T. Langkilde, and R. Mason. 2004. Why did the snake cross the road? Effects of roads on movement and location of mates by garter snakes (*Thamnophis sirtalis parietalis*). Ecology and Society 9:9.

Slater, F. M. 2002. An assessment of wildlife road casualties–the potential discrepancy between numbers counted and numbers killed. Web Ecology 3:33–42.

Smith, D. J. 2003. Monitoring wildlife use and determining standards for culvert design. Unpublished report to Florida Department of Transportation.

Smith, D. J., D. Marsh, K. E. Gunson, and S. Tonjes. 2015. Monitoring and adaptive management of road impacts and mitigation. Pages 240-261 in K. M. Andrews, P. Nanjappa, and S. P. D. Riley, editors. Roads and Ecological Infrastructure: Concepts and Applications for Small Animals. Johns Hopkins University Press, Baltimore, MD.

Smith, D. J., and R. F. Noss. 2011. A reconnaissance study of actual and potential wildlife crossing structures in Central Florida, final report. UCF-FDOT Contract No. BDB-10. Florida Department of Transportation.

Steen, D. A., and J. P. Gibbs. 2004. Effects of roads on the structure of freshwater turtle populations. Conservation Biology 18: 1143–1148.

Steen, D.A., J.P. Gibbs, K.A. Buhlmann, J.L. Carr, B.W. Compton, J.D. Congdon, J.S. Doody, J.C. Godwin, K.L. Holcomb, D.R. Jackson, F.J. Janzen, G. Johnson, M.T. Jones, J.T. Lamer, T. Langen, M.V. Plummer, J.W. Rowe, R.A. Saumure, J.K. Tucker, and D.S. Wilson. 2012. Terrestrial habitat requirements of nesting freshwater turtles. Biological Conservation 150:121–128.

Taylor, B. D., and R. L. Goldingay. 2003. Cutting the carnage: wildlife usage of road culverts in north-eastern New South Wales. Wildlife Research 30:529–537.

Taylor, P. D., L. Fahrig, K. Henein, and G. Merriam. 1993. Connectivity is a vital element of landscape structure. Oikos 68:571–573.

Torres, A., C. Palacín, J. Seoane, and J.C. Alonso. 2011. Assessing the effects of a highway on a threatened species using Before–During–After and Before–During–After-Control–Impact designs. Biological conservation 144, 2223–2232.

TRCA. 2013. Heart Lake Road Ecology Volunteer Monitoring Project, Phase II. Toronto and Region Conservation Authority (TRCA), Toronto, Ontario. Available from http://www.trca.on.ca/dotAsset/187823.pdf

van der Grift, E., F. Ottburg, and R. Snep. 2009. Monitoring wildlife overpass use by amphibians: Do artificially maintained humid conditions enhance crossing rates? Pages 341-347 in P.J. Wagner, D. Nelson, and E. Murray, editors. Proceedings of the 2009 International Conference on Ecology and Transportation. Raleigh, NC: Center for Transportation and the Environment, North Carolina State University.

van der Grift, E. A., S. Findlay, R. van der Ree, L. Fahrig, J. Houlahan, L. F. Madriñan, J.A.G. Jaeger, Nina Klar, and L. Olson. 2013. Evaluating the effectiveness of road mitigation measures. Biodiversity Conservation DOI 10.1007/s10531-012-0421-0.

van der Ree R., J.A.G. Jaeger, T. Rytwinski, and E. van der Grift. 2015. Good science and experimentation are needed in road ecology. Pages 71-81 in: R. van der Ree, C. Grilo, and D. Smith, editors. Handbook of Road Ecology. Wiley Publications.

van Gelder, J.J. 1973. A quantitative approach to the mortality resulting from traffic in a population of *Bufo bufo* L. Oecologia 13: 93-95.

Vos, C. C., and J. P. Chardon. 1998. Effects of habitat fragmentation and road density on the distribution pattern of the moor frog *Rana arvalis*. Journal of Applied Ecology 35:44–56.

Whitelock, C. 2014. 2013 Long Point causeway monitoring and adaptive management report. Unpublished report.

Willson, R. J., and G. M. Cunnington. 2014. DRAFT Recovery strategy for the Blue Racer (*Coluber constrictor foxii*) in Ontario. Page vi + 35. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario.

Willson, R.J. 2005. Artificial hibernation site construction for Eastern Massasaugas in Georgian Bay. Report submitted to the Ontario Ministry of Natural Resources.

Wilson, J.S. and S. Topham. 2009. The negative effects of barrier fencing on the Desert Tortoise (*Gopherus agassizii*) and non-target species: is there room for improvement? Contemporary Herpetology 2009:1-4.

Wind, E. 2014. Amphibian road surveys and mitigation assessments at Wake Lake on Vancouver Island in 2012. Unpublished report to the BC Ministry of Transportation and Infrastructure.

Woltz, H. W., J. P. Gibbs, and P. K. Ducey. 2008. Road crossing structures for amphibians and reptiles: informing design through behavioral analysis. Biological Conservation 141:2745–2750.

Yannis, I. 2011. Effectiveness of road barriers and underpasses for reptiles: The case of Milos viper (*Macrovipera schweizeri*). Proceedings of the 2011 IENE conference.

Yorks, D. T., P. R. Sievert, and D. J. Paulson. 2011. Experimental tests of tunnel and barrier options for reducing road mortalities of freshwater turtles. Pages 1034 in P.J. Wagner, D. Nelson, and E. Murray, editors. Proceedings of the 2011 International Conference on Ecology and Transportation. Center for Transportation and the Environment, Raleigh, NC.

9 APPENDICES

Appendix A: SAR Amphibian and Reptile Habitat Use and Movements

General summary of seasonal habitat use, general movement distances within and between habitat and when this occurs for species at risk amphibians and reptiles in Ontario. Bold text indicates high risk of road mortality for the species during months indicated. Summary based on review of COSEWIC reports, Recovery Strategies, ESA Habitat Regulations, and ESA Habitat Descriptions. All of the COSEWIC reports that were used to inform this table are listed in the references section of the document. In some cases information was obtained from other sources and is indicated. More detailed summaries should be conducted for each target species on a project specific basis.

Species	Scientific name	Habitat		Home range	Movement	When movement occurs
		Spring and Summer	Winter			
Salamander						
Jefferson Salaman-der	*Ambystoma jeffersonia-num*	Spring Breeding habitat: ephemeral ponds or other ponds without fish (Helferty 2002); Summer: Deciduous or mixed upland forest	Deep rock fissures and burrows below the frost line in upland forest habitat	Generally within 300 m of wetland	Adults may move up to 1 km, usually 300 m from breeding habitat; Juveniles up to 100 m	Explosive adult breeding migration from late March to late April; juvenile dispersal in July and August
Toad						
Fowler's Toad	*Anaxyrus fowleri*	Spring Breeding habitat: shallow ponds, sandy lakeshore bays and wetlands, ephemeral ponds, bedrock pools; Summer: Sand dunes, sand bars and beaches along Lake Erie shore	Burrows in moist sand along Lake Erie shore to just above water table and below frost line	Within a few hundred metres of of Lake Erie shoreline	Usually only move a few hundred metres during summer; seasonal migrations up to 1 km are typical	Adult breeding migration in May and June; juvenile dispersal in August and September
Turtles						
Blanding's Turtle	*Emydoidea blandingii*	Eutrophic, shallow lakes, ponds, slow-flowing rivers, streams, marshes, bog, open fens with basking sites and thick vegetation, upland woods; nest in loose soils (including road shoulders)	Permanent wetlands and other bodies of water, occasionally temporary ponds (Glenside Ecological Services 2011)	Up to 3 km^2	Typical adult movement to and from hibernation and nesting sites is 2 km, although longer migrations have been documented; hatchlings move 400m to water (M. Gartshore, F. Schueler pers. comm.)	Spring migration from hibernation sites to summer habitat (April – early May); Adult nesting migration from late May to early July; Inter-wetland movements in the summer; hatchling and adult overwintering movements in fall months

Species	Scientific name	Habitat: Spring and Summer	Habitat: Winter	Home range	Movement	When movement occurs
Eastern Musk	*Sternotherus odoratus*	Shallow water with abundant floating and submerged vegetation; nest near water in direct sun	Similar to summer; buried in 30 cm of mud	Confined to single bodies of water	Overland movement limited; tend to nest at shorelines	Adult nesting migration from June to early July
Snapping Turtle	*Chelydra serpentina*	Slow-moving water with soft mud substrate and dense vegetation; nest on sand and gravel banks, roads (Patrick et al. 2012, M. Karch, F. Schueler pers. comm.)	Under floating vegetative mats, logs, overhanging banks in streams and lakes, or buried in mud	Up to 0.09 km^2	Adults move from 0.5km up to 5 km to and from hibernation site and in search of nesting sites	Spring migration from hibernation sites to summer habitat in April – early May; Adult nesting migration from late May to early July; hatchlings move to water in early fall
Spiny Softshell	*Apalone spinifera*	Rivers or lakes with shallow water and muddy or sandy substrate, deep pools, riffles, and inlets; nest in sunny areas with fine gravel or sandy substrate close to water	deep pools in rivers (>1 m in depth)	Confined to one body of water	Rarely leave water; nest close to water	Adult nesting from June to early July
Spotted Turtle	*Clemmys guttata*	Slow-moving or still shallow water wetlands with aquatic vegetation (fens, bogs, marshes and rocky pools); upland woods used for aestivation and movement; Mate in woodland pools connected to hibernacula; nest in sunny upland locations (Glenside Ecological Services 2011, Patrick et al. 2012)	Rock caverns in lakes, under hummocks and in burrows in sphagnum-rich wetlands, and in root cavities in swamps	Home range: 0.04 km^2	Adults can move on average 1120 m to and from hibernation site, in search of nesting site, and during inter- wetland movements; move on average 250 m from wetland to nest (Joyal et al. 2001).	Adult nesting migration from late May to June; inter-wetland movements in summer; spring and fall migration from and to hibernation sites

Species	Scientific name	Habitat		Home range	Movement	When movement occurs
		Spring and Summer	Winter			
Northern Map Turtle	*Graptemys geographica*	Well-oxygenated, shallow rivers, streams, creeks, and lakes with basking sites adjacent to deep water; nest in soft sand beaches or soil in full sun	Bottom of lakes or rivers in deep hollows	Home range: 1.2 – 13.5 km^2 (usually within waterways)	Travel inland in search of nesting sites 35-100 m from water	Adult nesting season in early June – late July; Migration to and from hibernation sites in April - early May and late August - October
Wood Turtle	*Glyptemys insculpta*	Clear-water streams with sand or gravel substrate, alder thickets, upland forested areas; nest on sand or gravel-sand beaches and farm fields, road shoulders (Glenside Ecological Services 2011)	Bottom of deep pools in streams	Home range up to 1.5 km^2	Female adults move to nesting sites; typical home range length of 2 km; extensive movement in upland habitats throughout active season, typically within 300 m of water (K. Barrett pers. comm.)	Adult nesting migration from late May to early July
Snakes						
Blue Racer	*Coluber constrictor foxii*	Edge habitat, open fields, woodlands with sunny vegetation piles or rocks; nests in decaying organic matter, logs and under rocks in full sun	Crevices in Pelee Island's limestone plain and in piles of rock and soil	Confined to Pelee Island	Adults travel up to 2.7 km from hibernacula to find mates, nesting locations; hatchlings cross roads from nests	Adult mating season in April and May; neonate dispersal in July and August; movement to hibernaculum in September and October
Butler's Garter-snake	*Thamnophis butleri*	Open prairies, grasslands, old fields and other open habitats; bask on roads; live birth under cover	Small mammal burrows, ant mounds, rocky dikes, possibly crayfish burrows (M. Gartshore pers. comm.)	Within specialized habitat confined by roads	Most adults only move a few hundred metres from hibernacula in active season, but some move > 1 km	Adult mating season in April and May; neonate dispersal in July and August; movement to hibernaculum in September and October

Species	Scientific name	Habitat: Spring and Summer	Habitat: Winter	Home range	Movement	When movement occurs
Eastern Foxsnake, Georgian Bay population	*Pantherophis gloydi*	Open rock barrens, coastal meadow marshes, woodlands and forest clearings; nest in decaying vegetation piles, rock crevices	Granite or limestone fissures	3.5 km linear home range	Move extensively throughout active season to foraging, nesting and hibernation sites; Carolinian snakes move through vegetated corridors to find habitat	Adult mating season in April and May; neonate dispersal in July and August; movement to hibernaculum in September and October
Eastern Foxsnake, Carolinian population	*Pantherophis gloydi*	Wetlands complexes, unforested, early successional lands, hedgerows, riparian zones, woodlands; nest in decaying vegetation piles and fallen trees, road-side burrows, under concrete slabs	limestone bedrock fissures, mammalian burrows, tree root crevices, various man-made features	Up to 1.5 km linear home range, but varies with extent of habitat available		
Eastern Hog-nosed Snake	*Heterodon platirhinos*	Sandy areas or well-drained soil in open forests, forest edges or brushy habitats; sometimes wetlands close to conifer plantations; nest in south-facing open areas, under driftwood, or rock crevices in Shield (Glenside Ecological Services 2011)	Hibernate in upland burrows excavated by the snake, root cavities or abandoned mammal burrows (Glenside Ecological Services 2011)	Home range > 1 km^2	Very mobile throughout season; adults can move >4 km from hibernacula; max. adult movement 6.2 km	Adult mating season in spring and late summer; neonate dispersal and movement to hibernaculum in fall
Eastern Ribbon-snake	*Thamnophis sauritus*	Wetlands, shorelines, sloughs, and swamps. Sometimes give birth or seek cover in upland areas. Live-bearing.	Underground animal burrows and cracks and crevices ranging from well-drained to completely	Home range small, e.g. < 0.007 km^2 within their wetland	Typically found within 10 m of water; may move up to 200 m from water for birthing and hibernation	Adult mating season in spring, and birthing in July and August; neonate dispersal and movement to hibernacula in September and October

Species	Scientific name	Habitat: Spring and Summer	Habitat: Winter	Home range	Movement	When movement occurs
Gray Ratsnake	*Pantherophis spiloides*	Forest edge and open forests; hide in hollow logs and trees, under rocks and in rock crevices; Gravid females prefer large trees; nest communally in standing snags, stumps, logs and compost piles (S. Thompson pers. comm.)	Moist hibernacula (rock fissures) below the frost line	On average 0.18 km^2	Adults move up to 4 km to and from hibernacula	Adult mating season late May to early June; neonate dispersal and movement to hibernacula in fall
Lake Erie Water-snake	*Nerodia sipedon insularum*	Limestone shorelines with ledges and cracks, cobblestone beaches, gravelly or sandy areas with debris. Will also use flooded quarries and drainage ditches in summer. Live-bearing.	Inland communal hibernacula are used: cavities and crevices in quarries, soil and rock piles, cracks in bedrock, tree root masses and animal dens	Generally found along shorelines	Generally restricted to the shoreline during the active season, but may travel several hundred metres inland to hibernacula	Adult mating season early May to early June; neonate dispersal and movement to hibernacula in fall
Massa-sauga, Great Lakes population	*Sistrurus catenatus*	Habitats with low canopy cover (rock barrens, forest clearings, alvars, beaver meadows, fens, bogs and shorelines); Live-bearing: gestation sites are in open habitat (e.g. rock barren), often with large table rocks and low vegetation	Forested areas on the Northern Bruce Peninsula; Wetlands on the Eastern Side of Georgian Bay; mammal burrows, old roots and rock crevices that extend below the frost line with access to the water table	Home range: 0.25 km^2	Can move >1 km to and from hibernacula; max. adult movement: 4 km; max. juvenile movement: 400 m	Mating season from July - August; Neonate dispersal in July - August; Movement to and from hibernacula in early May and September
Massa-sauga, Carolinian population	*Sistrurus catenatus*	Open shrubby areas and man-made piles of woody debris. Will also use grassy, prairie-like fields, wetlands and hedgerows in summer. Live-bearing.	Mammal burrows tree root cavities below the frost line with access to the water table			

Species	Scientific name	Habitat: Spring and Summer	Habitat: Winter	Home range	Movement	When movement occurs
Milksnake	*Lampropeltis triangulum*	Forests, woodlands, fields, rocky outcrops, forest clearings and edges of wetlands	Mammal burrows, old foundations, old wells, gravel and dirt banks, hollow logs, rotting stumps	Home range up to 0.02 km^2	Adult movement: 400 m or more within the active season	Mating season in the spring; Neonate dispersal in July and August; Movement to hibernacula in September and October
Queen-snake	*Regina septemvittata*	Rocky streams, rivers and lake shorelines, wetlands, ponds, meadow marshes with full sun exposure	Underground and close to water	Linear home range (along waterways) 250m	Movement along waterways typically no more than 250m, but longer dispersal movements of > 1 km may occur; found within 15m of water during active season, but inland movements to hibernacula may be several hundred metres	Migrate to and from hibernacula in early April - mid-May and again in fall
Lizard						
Five-lined Skink	*Plestiodon fasciatus*	Great Lakes: open rocky areas in forests Carolinian: woody debris-strewn stable sand dunes, open forests, wetlands	same as spring, hibernate in rock crevices or buried in soil	Home range 270 – 578 m^2	Generally move short distances and adults move up to 210 m and juveniles up to 110 m	Breed in May or early June

Appendix B: Definitions

Connectivity - the degree to which the landscape facilitates or impedes movement among resource patches (Taylor et al. 1993)

Corrugated Steel Pipe (CSP) - round or elliptical culvert made with corrugated steel

Crossing Structure - general term for mitigation measures placed in roads to allow wildlife to cross safely

Culvert - general term for underpass structure type, traditionally used for conveyance of water under a road; in context of this document can be box or round
- **Arch Culvert** - portion of round culvert that allows natural bottom
- **Drainage Culvert** - a drain or pipe that allows water to flow under a road or railroad

Field-based information - Information measured within or near (few hundred metres) the road corridor used to inform impacts

Landscape scale - larger study area that may include an entire jurisdiction where information is available for an entire jurisdiction that is typically available in a GIS and informs broader level impacts of roads

Major road improvements - include road extensions, new alignments, and upgrades such as twinning from two to four lanes.

Population viability - the ability of a population to persist and avoid local extinction

Range length - maximum distance within animal's home range

Regional assessment - Integrate all multi-jurisdictional stakeholders and landscape information within the impact study area to develop a mitigation plan

Road-habitat interface - suitable habitat used by target species that is adjacent to the road

Road rehabilitation project - includes replacing bridges and pavements which are done under our capital program as opposed to our maintenance program

Skylight - structure on tunnel that permits ambient light to enter the structure

Target species – the species that the road mitigation measures are designed for; may include one, two or several species that are impacted by roads

Tunnel - type of crossing structure that is placed under the road surface for wildlife passage; in context of this document specifications are < 3 m width
- **Closed-bottom tunnels** - tunnel bottom is structural material
- **Open-bottom tunnels** - tunnel bottom is not structural material, provided by 3-sided concrete structure, arch pipe aluminum or corrugated steel
- **Open-grate tunnels** - provide ambient light through traditional metal grate structure that is placed on footings
- **Open-top tunnels** - provide ambient light through openings or slots at the top of the tunnel; openings must be at grade with road surface
- **Terrestrial tunnels** - dry tunnels installed for amphibians and reptiles undergoing overland movements

Underpass - general term for structural measures, e.g., culverts, bridge, viaducts, placed under roads to allow wildlife to cross safely

Appendix C: Crossing Structure Summary from Literature

Mole Salamander Crossing Structure and Fencing Review			
Species	**Comments**	**Crossing Structure**	**Crossing Structure Reference**
Projects with confirmed crossings			
Long-toed Salamander (*Ambystoma macrodactylum*)	No salamander >16 m from a tunnel was confirmed to cross. Tunnels ~200 m apart. Fences not angled to tunnels.	Six structures installed, two monitored. Two sizes of open-topped ACO Polymer tunnels: 0.47x0.32m (WxH); 0.23 x 0.21 (WxH). Did not indicate which size they monitored. Tunnels 11.1 m and 12.0 m long.	Allaback and Laabs 2002
California Tiger Salamander (*Ambystoma californiense*)	Salamanders readily used tunnels. Some individuals showed hesitancy to enter tunnels.	Three 0.25 m dia steel pipes, ~20 m long. Tunnels ~35 m apart.	Bain 2014
Northwestern Salamander (*Ambystoma gracile*), Rough-skinned Newt (*Taricha granulosa*), and Western Redback Salamander (*Plethodon vehiculum*)	Known Red-legged Frog (Rana aurora) migration route but also used by these spp. Juvenile newts and Redbacks could climb fence.	Concrete box culvert 1.8 x 0.9m (WxH). Half filled with soil and downed woody debris.	Beasley 2013
Spotted Salamander (*Ambystoma maculatum*)	At least 76% of salamanders that reached the tunnel entrances successfully crossed. Dark tunnel entrances may keep some salamanders from entering tunnels.	Two ACO open-topped tunnels, size not specified. Tunnels 7m long and ~60 m apart.	Jackson and Tyning 1989, Jackson 1996

Species	Comments	Crossing Structure	Crossing Structure Reference
Long-toed Salamander	More than 100 salamanders caught in tunnel exit traps in 2009, but only 23% of salamanders marked at the drift fence were caught exiting the tunnels.	Four open-topped ACO tunnels, 0.5 x 0.33m (WxH) and ~12 m long. Tunnels 80-110 m apart.	Pagnucco et al. 2011, 2012
Projects with no confirmed crossings			
Jefferson Salamander (*Ambystoma jeffersonianum*)	Not detected crossing through tunnels. Very few detected away from roads as well. Guidewalls not angled toward tunnel entrances.	5 tunnels installed. Four 1.2 m diameter CSP or concrete, and one 1.7m wide elliptical culvert. Tunnels 25-31 m long.	Gartshore et al. 2005
Spotted Salamander	Three years of monitoring failed to confirm usage by any amphibians. Migration routes not confirmed before construction.	2 bridges, 1 concrete box culvert 1.2 x 1.2m. Structure 17 m long and lined with soil.	Merrow 2007
Outdoor lab experiments			
Spotted Salamander	Found no major statistical differences in culvert crossing comparing the lengths, diameters and substrates tested. Thirty percent more salamanders crossed through the largest tunnel compared with the smallest.	Experimental culverts along migration route, not under road. Tested 0.3, 0.6, and 0.8 m diameter corrugated PVC pipes, 3, 6, or 9 m long. Also tested three kinds of substrate: bare plastic, sand/gravel and concrete.	Patrick et al. 2010

Toad Crossing Structure and Fencing Review			
Species	**Comments**	**Crossing Structure**	**Crossing Structure Reference**
Projects with confirmed crossings			
Western Toad (*Anaxyrus boreas*)	Tunnel used by 1700-7000+ toadlets leaving breeding pond. Significant road kill at fence ends.	One semi-circular, closed-topped culvert with earthen floor. 1.8 x 0.5 m (WxH) x 3.7 m long.	Biolinx 2013
American Toad (*Anaxyrus americanus*)	Confirmed tunnel crossing by American Toads.	5 closed-topped tunnels, mainly 1.2 m diameter CSP or concrete, but one 1.7 m wide elliptical culvert; 25-31 m long.	Gartshore et al. 2005
Common Toad (*Bufo bufo*)	Marked all toads. 40% used tunnels, 27% got around fence, 33% did not cross.	2 ACO open-topped concrete tunnels, ~0.5 m wide on bottom, 0.33 m high. No soil on bottom.	Ottburg and van der Grift 2013
Western Toad	7 caught in exit traps.	4 ACO open-topped box culverts, 0.5 m wide and 0.33 m high and ~12 m long. Slots along the top. Tunnels 80-110 m apart.	Pagnucco et al. 2012
Common Toad (*Bufo bufo*) Western Toad	Greater usage of larger rectangular culverts than smaller round culverts. Dispersing toadlets from breeding pond crossed through culverts in the thousands.	4 types. 0.4 and 0.6 m diameter concrete culverts; box culverts 1.6 and 1.7 m high (width not given, but appears variable in photos). 2 CSP culverts, both 0.4 m in diameter.	Puky et al. 2013 Wind 2014
Outdoor lab experiments			
Frogs and Toads of France	Toads showed no difference in use of tunnels with or without soil.	0.5 m diameter concrete culvert. Compared bare concrete with layer of soil.	Lesbarrères et al 2004

Turtle Crossing Structure Research			
Species	**Comments**	**Crossing Structure**	**Crossing Structure Reference**
Projects with confirmed crossings			
Florida Cooter (*Pseudemys floridana floridana*), Slider (*Trachemys scripta*), and Florida Softshell (*Apalone ferox*)	Primarily Cooters and Sliders crossed through culvert.	Drainage culvert 3.5 m in diameter (46.6 m long).	Aresco 2005
Blanding's Turtle (*Emydoidea blandingii*), Snapping Turtle (*Chelydra serpentina*)	Individual Blanding's Turtles used culvert up to 13 times. Snapping Turtles also crossed using the culvert, no numbers provided. Virtually no roadkill (2 in 2 years).	1.8 m diameter corrugated steel culvert, 25 m long, pre-existing, with sediment and year round water.	Caverhill et al. 2011
Spotted Turtle (*Clemmys guttata*)	At least 7 turtles confirmed to cross through tunnel. Other turtles likely crossed as well.	1.8 x 1.8m concrete box tunnel, ~13m long; 0.1-0.15 m organic substrate in culvert.	Kaye et al. 2005
Blanding's Turtle	Blanding's Turtles showed no strong preference for culvert size. Turtles more apt to cross through culvert when light visible at end of culvert.	Tested 1.0 and 1.2 m diameter corrugated steel culverts and 1.1 m diameter arch culverts; length unspecified. Culverts tested in pairs along known in outdoor lab.	Lang 2000
Snapping Turtle	Crossed through culvert. No details on amount of usage. Fence end roadkill. Hatchling could get through 5x10cm mesh fence. Effectiveness of fence increased after first yr or two, as vegetation held bottom of fence better.	1.3 m diameter corrugated steel culvert.	Langen 2011

Species	Comments	Crossing Structure	Crossing Structure Reference
Wood Turtle (*Glyptemys insculpta*)	Long term study found turtles moved along a stream that passed through the culvert .	3 m diameter culvert, 26 m long.	Parren 2013
Wood Turtle	At least one Wood Turtle observed to cross through tunnel.	Open-top (grate) tunnel ~1.5 x 1.0 m (WxH) on dirt logging road.	Steinberg pers. comm.
Projects with unconfirmed crossings			
Painted Turtle (*Chrysemys picta*), Snapping Turtle	6 Painted Turtles, 1 Snapping Turtle photographed in culverts. Plus Snapper tracks in culverts observed but no photos. Crossing not confirmed.	3 crossing structures, each consisting of 2 culverts connected with fenced open area between. Size: 3.4 x 2.4 m box culvert, 24.1 m long, then 15.3 m fenced opening and then another culvert 24.1 m long.	Baxter-Gilbert 2014
Snapping Turtle and Painted Turtle	No turtles detected in dry culvert with trail camera.	1 dry culvert 1.2m diameter CSP; 2 wet culverts, one was 4m wide concrete box culvert, second unspecified.	Buchanan and Basso 2007
Blanding's Turtle, Painted Turtle	Turtles could climb over 0.2 m high curb. Tunnel used by at least 1 Painted Turtle.	Three 4.6 x 0.9m (WxH) and 17.1 m long, open-top, 3-sided box culverts.	Compton and Seivert 2002
Blanding's Turtle, Snapping Turtle, Painted Turtle	Blanding's Turtles commonly observed in dry and wet culverts. Snapping Turtles used wet culverts mainly, but one dry. Only 1 Painted found in a wet culvert.	4 dry and 6 wet culverts, multiple sizes, with skylights. Minimum size 1.8 x 0.9m (WxH) and ~50 m long.	Dillon 2011, 2013
Eastern Musk Turtle (*Sternotherus odoratus*), Florida Softshell	1 Musk Turtle and 3 Softshells detected in 0.9m culvert. No turtles detected in other tunnels.	3 sizes of tunnels: 0.9m diameter; 1.8x1.8 m box culvert, with 3 light boxes; 2.7 x 2.7m box culvert. All tunnels 44 m long.	Dodd et al. 2004

Species	Comments	Crossing Structure	Crossing Structure Reference
Turtles	Monitored culverts in area with little roadkill before mitigation. Turtle roadkill went from 1 to 0. No turtles photographed in culverts.	1 and 2 m diameter culverts (although described as square sometimes).	Garrah 2012
Painted Turtle	No sex difference in climbing ability. In trials ~4% of turtles climbed over 0.45m tall fence with no flashing, while no turtles climbed fence with flashing.	n/a	Griffin 2005
Eastern Box Turtle (*Terrapene carolina carolina*)	At least 3 turtles used pre-existing drainage culverts.	No details.	Hagood and Bartels 2008
Snapping Turtle, Painted Turtle	Snapping Turtle photographed in both 0.8 and 0.9m culverts. Painted Turtle photographed in 0.8 m culvert.	Two culverts: 0.8 and 0.9 m diameter CSP.	Gunson et al. 2013
Spotted Turtle	Review of other crossing structures. Reported Spotted Turtles using an arch culvert and a box culvert at two sites in Mass.	Arch culvert: 11 x 3.4m (WxH) and 12m long; Box culvert: 1.8 x 1.8 m and 16.8 m long.	Paulson 2010
Blanding's Turtle	No mitigation. Studied roadill hotspots and movement patterns. Suggested crossing structures be an average of 500 m apart and no more than 1.5 km apart.	n/a	Riley et al. 2013

Species	Comments	Crossing Structure	Crossing Structure Reference
Snapping Turtle	Detected by trail camera in at least one tunnel. No details on which tunnel.	4 sizes, from 1.5 x 0.9m (WxH) to 2.7 x 1.8m. ~5 cm soil spread in bottom of culverts.	Rogers et al. 2009
Snapping Turtle and other herps	Pooled use of all frogs, snakes, lizards and turtles. Most use of culverts 1.5m or more in width and 0.6-1.5m high.	Variety of existing culverts.	Smith 2003
Snapping Turtle, Painted Turtle, Map Turtle (*Graptemys geographica*)(?)	At least 7 Snapping and 1 Painted Turtle used culverts. Map Turtle may have been seen swimming in one culvert. All but one reptile detected in ACO tunnel.	1.8 m x 0.9 m concrete box culvert; 0.5 x 0.48 open-top ACO tunnel.	Whitelock 2014
Outdoor lab experiments			
Painted Turtle	Tunnel placed on path of females on nesting forays. All turtles that reached the tunnel crossed through. Mean crossing time 113 sec (range: 60-197 sec).	0.6 x 0.6m wooden tunnel, ~6 m long in field.	Jackson and Marchand 1998
Painted Turtles	>85% of turtles used all tunnels. Largest tunnel had highest success rate and fastest crossing times. Turtles more hesitant to enter tunnels below grade.	Outdoor lab with 3 types of culverts: 0.6 x 0.6m, 0.6 x 1.2m, 1.2 x 1.2 m all 12.2 m long. Plywood with soil bottom.	Paulson 2010
Snapping Turtle, Painted Turtle	Outdoor lab. No turtle climbed 0.6m fence. Turtles more apt to use tunnels at least 0.5m dia. All substrates used about equally. Longest tunnel had slightly less usage. Light did not affect usage.	Black PVC pipe culverts. Varied length (3-9.1 m), aperture size (0.3-0.8 m), substrate (bare, soil, gravel, concrete) and light permeability (0-4%).	Woltz et al 2008

Species	Comments	Crossing Structure	Crossing Structure Reference
Painted Turtle, Blanding's Turtle, Spotted Turtle	Outdoor lab. Increased light increased crossing success. In closed-topped tunnels, the percentage of turtles crossing increased with increased culvert size. Low crossing rate (54% or less) with 80' culverts.	3 tunnels sizes: 0.6 x 0.6m, 1.2 x 1.2m, 2.4 x 1.2m; two lengths: 40' and 80'. Varied light through ceiling (0, 75, 100%).	Yorks et al. 2011
Snake Crossing Structure Research			
Projects with confirmed crossings			
Eastern Massasauga (*Sistrurus catenatus*)	4 snakes detected under crossing structures (likely crossing) in 2013.	4 open-grate crossing structures. ~1 x 1m (WxH) under 2-lane gravel roads.	Colley pers. comm.
Eastern Garter Snake (*Thamnophis sirtalis sirtalis*), Ribbon Snake (*Thamnophis sauritus sauritus*)	Outdoor lab. At least 70% of Ribbons and 90% Garters crossed at all widths. All Garters crossed whether substrate was soil or water. In 1.3m culvert >90% of Ribbons crossed regardless of substrate. In 0.33 m culverts Ribbons had lower crossing success with soil (50%), compared with water (70%). In real culverts, Ribbons had low crossing success (<30%) in small culverts but high success (~80%) in large culverts.	Outdoor lab box culverts 0.66 m high and variable width (0.33-1.33m) and 5 m long. Also examined crossing of real culverts ~1 m and ~0.5 m in diameter and 10 m long. Some culverts dry (soil bottom) and some with liner with ~7 cm of water.	Eads 2013
Northern Watersnake (*Nerodia sipedon sipedon*)	>80% crossing success with both size culverts.	0.5 and 1.0 m culverts. No other detail.	Eads et al. 2012

Species	Comments	Crossing Structure	Crossing Structure Reference
Timber Rattlesnake (*Crotalus horridus*), Ratsnake (*Pantherophis spiloides*)	Two radio-tracked rattlesnakes used one culvert during the culvert's first year. Snakes spent 10-14 days near fence before crossing through culvert. Some snakes went around fence and others used gaps in fence. 1 possible Ratsnake (or Racer) was also detected in one culvert.	5 concrete closed-top box culverts 0.91 x 0.41 m (WxH) and 15 m long.	Laidig and Golden 2004
Eastern Garter Snake	Tunnels used commonly. Fence end roadkill, some snakes got over fence.	0.25-0.30 m diameter steel pipe.	Roberts 2010
Unidentified snakes	3 crossings by a snake detected in sand tracking.	Concrete box culvert 2.74 (W) x1.83 (H)m and 30.5 m long.	Rogers et al. 2009
Snakes	Used sand tracking to detect usage. 1 snake crossing over 8 days in spring, and 1 crossing over 8 days in summer.	9 concrete box culverts, 2.4 x 1.2m and 18 m long. Culvert bottoms scattered with small stones and a thin layer of silt.	Taylor and Goldingay 2003
Milos Viper (*Macrovipera schweizeri*)	No snakes found on roads in areas with barriers. Snakes crossed through underpasses. Mean of 77% of snakes that encountered an underpass crossed through.	6 underpasses, 4 types. No details.	Yannis 2011

Species	Comments	Crossing Structure	Crossing Structure Reference
Projects with unconfirmed crossings			
Various species	Snakes found in both sizes of round culvert.	looked at use of existing culverts: 0.6 m and 1.0 m diameter CSP, concrete box culverts (size not given).	Arizona Game and Fish 2010
Snakes and lizards pooled; no species named	In general, reptile use of culverts was negatively correlated with culvert length.	Existing drainage culverts, no specs provided.	Ascensão and Mira 2007
Northern Watersnake, Red-bellied Snakes (*Storeria occipitomaculata*)	3 Watersnakes photographed in culvert, 1 juvenile Red-bellied observed in culvert.	3 crossing structures, each consisting of 2 culverts connected with fenced open area between: 3.4 x 2.4 m box culvert, 24.1 m long, then 15.3 m fenced opening and then another culvert 24.1 m long.	Baxter-Gilbert 2014
Eastern Garter Snake	No confirmed crossing by any snake, and very few captures away from road.	2 bridges, 1 culvert 1.65m wide.	Bellis et al. 2007
Unspecified species of Garter Snake	20 detected under bridge via sand tracking. Culverts not well monitored.	Bridge 5-9'aboveground, 400' long; multiple size tunnels, as small as 0.5m diameter culverts.	de Rivera and Bliss-Ketchum 2010
Unidentified snakes (likely Garter and Northern Watersnake)	39-50 snakes per yr (3 yr) in wet and dry culverts. Largest percentage in dry culverts, but may have been easier to photograph in those culverts. Snakes photographed basking in light from skylights.	4 dry and 6 wet culverts, multiple sizes, with skylights. Smallest tunnel 1.8 x 0.9m (WxH).	Dillon 2011, 2013

Species	Comments	Crossing Structure	Crossing Structure Reference
Eastern Racer (*Coluber constrictor*), Eastern Ratsnake (*Pantherophis alleghaniensis*), Eastern Ribbonsnake, plus other non SAR spp	1 Racer, 1 Ratsnake and 4 Ribbonsnakes detected in 1.8 x1.8m tunnels but crossing not confirmed. Not detected in other size culverts.	3 sizes of tunnels: 0.9m diameter; 1.8 x 1.8 m box culvert, with 3 light boxes; 2.7 x 2.7m box culvert. All tunnels 44 m long.	Dodd et al. 2004
Snakes	Monitored culverts in an area with little road kill before mitigation. No change in roadkill. Snakes not photographed in culverts.	1 and 2 m diameter culverts (although described as square sometimes).	Garrah 2012
Northern Watersnake, Eastern Gartersnake, Black Ratsnake	Watersnake found in association with 6 culverts, Ratsnake with 3, and Gartersnake with 2 (sizes of culverts not given).	Monitored 265 culverts of various sizes.	Gates and Sparks 2011
Timber Rattlesnake	Used by some snakes.	~0.3m diameter culvert.	Jacobson pers. comm.
Snakes	To prevent snakes getting through fence attached a fine mesh (0.6x0.6 cm) to turtle fencing. 30 cm high mesh did not prevent all passage, but 60 cm high mesh was more successful. No monitoring of culvert for snakes.	1.3 m diameter corrugated steel culvert.	Langen 2011
Northern Watersnake, Eastern Gartersnake	Watersnake entered and turned around in 0.9 m culvert. Gartersnake observed in 0.9 m culvert.	Two culverts: 0.8 and 0.9m diameter CSP.	Lesbarrères Gunson et al. 2013

Species	Comments	Crossing Structure	Crossing Structure Reference
Massasauga	No proof of crossing, but no DOR snakes in 4 years of monitoring road.	6 open-topped structures, with rock substrate, ~1.0 x 1.5m (WxH) and ~6 m long.	Lewis pers. comm.
Wandering Garter Snake (*Thamnophis elegans vagrans*)	Photographed in tunnels 48 times.	4 ACO box culverts, 0.5 m wide and 0.33 m high and ~12 m long. Slots along the top. Tunnels 80-110 m apart.	Pagnucco et al 2011, 2012
Grass Snake (*Natrix natrix*)	Detected in culverts. Believed to be hunting frogs in wet culvert.	Three 1m dia concrete culverts, 34 m long. Opening in middle of culvert to allow in light and water.	Puky et al. 2007
Grass Snake	Shed skins found in tunnels.	Eight 0.6-0.9 m diameter culverts, 8-9 m long. Five culverts had light shafts.	Puky et al. 2007
Massasauga, Eastern Hog-nosed Snake, Milksnake (*Lampropeltis elapsoides*), Northern Ribbonsnake (*Thamnophis sauritus septentrionalis*)	Milksnake and Northern Ribbonsnake confirmed in tunnels. Possible Hog-nosed, but photo blurry.	Concrete box culvert 1.8 x 1.2 m (WxH).	Rouse 2005
Eastern Garter Snake and other herps	Pooled use of all frogs, snakes, lizards and turtles. Most use of culverts 1.5m or more in width and 0.6-1.5m high.	Variety of existing culverts.	Smith 2003
Eastern Garter, unidentified snakes	At least 2 Garter and 2 unidentified snakes used culverts. All but one reptile detected in ACO tunnel. May have been more use but trail cameras set to shoot every 15 min.	1.8 m x 0.9 m concrete box culvert; 0.5 x 0.48 open-top ACO tunnel.	Whitelock 2014

Species	Comments	Crossing Structure	Crossing Structure Reference
Outdoor lab experiments			
Small (<20g) and medium-sized (75-250g) snakes	No snake able to climb over any fence. Medium-sized snakes could escape through ½" mesh. Small snakes could escape through ½ and ¼" mesh. Some snakes got caught in ½" mesh and had to be cut free.	n/a Tested fencing types.	Smith and Noss 2011
Lizard Crossing Structure and Fencing Review			
Projects with confirmed crossings			
Various lizards (no skinks)	Lizards found in all 3 types of culverts. More spp in smallest size culvert. Highest crossing rate (0.4) in box culverts.	looked at use of existing culverts: 0.6m and 1.0m dia CSP, concrete box culverts (size not given).	Arizona Game and Fish 2010
Flat-tailed Horned Lizards (*Phrynosoma mcallii*)	Experimental tests of simulated culverts. 12 of 54 lizards crossed. All size tunnels used, but the 1.0m CSP without skylights was used by more lizards. Dark culverts were used more frequently than culverts with skylights.	tested 3 sizes of tunnel: 0.6 m and 1.0 m CSP, and 2.6 x 1.3m (WxH) plywood box culverts. Two of each culvert size, one with skylights and one without. All tunnels were ~13 m long and had 2.5-7.5 cm of sand in the bottom of the tunnels.	Painter and Ingraldi 2007
Lace Monitor (*Varanus varius*) and other unidentified lizards	Australian study. 11 crossings by lizards during limited monitoring.	9 concrete box culverts, 2.4 x 1.2m and 18 m long. Culvert bottoms scattered with small stones and a thin layer of silt.	Taylor and Goldingay 2003

Species	Comments	Crossing Structure	Crossing Structure Reference
Projects with unconfirmed crossings			
Snakes and lizards pooled; no species named	In general, reptile use of culverts was negatively correlated with culvert length.	Existing drainage culverts, no specs provided.	Ascensão and Mira 2007
Five-lined Skink (*Plestiodon fasciatus*)	Skinks observed around the entrance of 5 culverts (sizes not given). Apparently used culvert entrances for basking and foraging but did not appear to cross through culverts.	Monitored 265 culverts of various sizes.	Gates and Sparks 2011
Northern Fence Lizard (*Sceloporus undulatus hyacinthinus*)	Detected in culverts 12 times during two month period.	5 concrete closed-topped box culverts 0.91 x 0.41m (WxH) and 15 m long.	Laidig and Golden 2004
Sand Lizard (*Lacerta agilis*)	Lizards lived on overpasses, using them for hiding places, basking sites and foraging habitat.	Wildlife overpass. Details not provided. Shrubs planted at side of overpass.	Puky et al. 2007
Five-lined Skink and other herps (pooled all amphibians and reptiles)	In general, amphibians and reptiles made most use of culverts 1.5m or more in width and 0.6-1.5m high.	Variety of existing culverts.	Smith 2003
Outdoor lab experiments			
Five-lined Skink	Skinks able to crawl through ¼ mesh fence. The aluminum flashing was the only fence that stopped all skinks from escaping.	n/a Tested fencing types.	Smith and Noss 2011

Appendix D: Links and Other Resources

Applicable Legislation and MNRF policies

General Regulation under the Endangered Species Act, 2007: Ontario Regulation 242/08
https://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_080242_e.htm

Permits under the Endangered Species Act
http://www.ontario.ca/environment-and-energy/endangered-species-permits-and-authorizations

Overall Benefit Permit
http://www.ontario.ca/environment-and-energy/endangered-species-act-overall-benefit-permits

Step-by-step guide to applying for an overall benefit permit
http://www.ontario.ca/environment-and-energy/endangered-species-act-overall-benefit-permits (click link on right side of above page: "How to apply")

Streamlined approvals under the Endangered Species Act
(also known as Registering online for Natural Resources activities)
https://www.ontario.ca/environment-and-energy/natural-resources-registration-guide

Development and infrastructure projects and endangered or threatened species
http://www.ontario.ca/environment-and-energy/development-and-infrastructure-projects-and-endangered-or-threatened-species

Ontario Species at Risk Information

Ontario Species at Risk website
http://www.ontario.ca/environment-and-energy/species-risk

Species at Risk Reference Toolbox
http://www.ontario.ca/environment-and-energy/species-risk-guides-and-resources

Best Practices and Guidance

Reptile and Amphibian Exclusion Fencing: Best Practices
http://files.ontario.ca/environment-and-energy/species-at-risk/mnr_sar_tx_rptl_amp_fnc_en.pdf

Passage Assessment System for Evaluating the Permeability of Existing Structures
http://www.wsdot.wa.gov/research/reports/fullreports/777.1.pdf

Design Examples

Amphibian Tunnel Project in Waterton Lakes National Park, Vancouver
http://naturevancouver.ca/sites/naturevancouver.ca/VNHS%20files/Amphibian%20Tunnel%20Project.pdf

Appendix E: Sample Tunnel Costs Table (2014)

Tunnel type	Model Number	Provider	Size of culvert	Length (m) (estimate)	Cost	Installation costs (very approximate)	Cost/m (culvert only)
Terrestrial concrete box culvert	Reinforced non-standard concrete box culvert	M-CON Pipe and products Inc.	1.8m x 0.9m	16.3	$25,000	$15,000	$1,533
Terrestrial open-top culvert	ACO AT500	ACO Systems Ltd.	0.50m x 0.48m	16.2	$13,000	$11,000	$802
Hydraulic Concrete Box culvert	Reinforced non-standard concrete box culvert	M-CON Pipe and products Inc.	3.0 m x 2.1m	18.3	$65,000	$45,000	$3,551
Concrete Box culvert	Includes all materials	MTO	1.8m x 1.8m	48	$225,000		$4,687
Concrete Box culvert	Considered a structure, so includes only the cost of culvert	MTO	3.3m x 2.8m	48	$375,000	$325,000	$7,812
Concrete Box culvert		MTO	1.0m x 1.0m	48	$150,000		$3,125

Cost/m (installed)	Comments (installation limitations)	Additional information:	Source
$2,453		Additional fixed costs associated with each mobilization, special environmental precautions and insurances -Soil conditions play a crucial part in costs; -Generally, add 20% per project over $150,000, add 30% for smaller projects- Add $250,000 per site for special shoring-.	Rick Levick, Longpoint Improvement Committee
$1,481			
$6,010	Cost about 30% more than typical installation reflected in table due to digging to connect channels to marsh on one side and the bay on the other.		
		Actually for 2 culverts (= 1 eco-passage) for 4-lane hwy 69: each culvert is 24m long (spanning 2 lanes of highway, plus shoulders), and they're separated by a 15.3m gap (the median)	Andrew Healy, MTO
$14,583	True cost is much greater than structure alone due to blasting, footings etc., costs could be up to 700 K with installation		
$3,125	This is a guess and can range from 100 - 200 K		

Tunnel type	Model Number	Provider	Size of culvert	Length (m) (estimate)	Cost	Installation costs (very approximate)	Cost/m (culvert only)
Corrugated steel Pipe culverts		Atlantic Industries Ltd.	1.2 m round	16.5	$2,392	+	$145.00
Corrugated Metal Arch c/w metal footings		Atlantic Industries Ltd.	0.6 m rise x 1.22 m span	16.5	$16,360	+	$991.56
Corrugated steel Pipe culverts		Atlantic Industries Ltd.	3 m round	16.5	$9,240	+	$560.00
Corrugated Metal Arch c/w metal footings		Atlantic Industries Ltd.	2.99 m span x 1.45 m rise	16.5	$24,024	+	$1,456

Cost/m (installed)	Comments (installation limitations)	Additional information:	Source
+	Minimal assembly required.	Various coatings available. Price based on a coating common on low volume roads. Pipe material is subjective to enviornmental conditions. Reference Ontario Gravity Pipe Study for more specific detail.	Kevin Williams, Atlantic Industries Ltd.
+	Available preassembled or assembled in place. Can be assembled by person (no hoisting equipment) for a rough estimated cost of $50/m.	Open-bottom which can be constructed to maintain a more natural environment. Pricing based on low to moderate covers (0.6 m to 2 m cover). Greater covers are permitted but price will vary.	Kevin Williams, Atlantic Industries Ltd.
+	Minimal assembly required.	Various coatings available. Price based on a coating common on low volume roads. Pipe material is subjective to environmental conditions. Reference Ontario Gravity Pipe Study for more specific detail.	Kevin Williams, Atlantic Industries Ltd.
+	Available preassembled or assembled in place. Can be assembled by person (no hoisting equipment) for a rough estimated cost of $50/m.	Open-bottom which can be constructed to maintain a more natural environment. Pricing based on low to moderate covers (0.6 m to 2 m cover). Greater covers are permitted but price will vary.	Kevin Williams, Atlantic Industries Ltd.

Tunnel type	Model Number	Provider	Size of culvert	Length (m) (estimate)	Cost	Installation costs (very approximate)	Cost/m (culvert only)
Corrugated Metal Arch c/w concrete footings and headwall	Includes headwall costs. Shorter lengths conduits required with headwalls.	Atlantic Industries Ltd.	2.99 m span x 1.45 m rise	10	$29,617	+	$2,961

Cost/m (installed)	Comments (installation limitations)	Additional information:	Source
+	Available preassembled or assembled in place. Hoisting equipment required for headwalls and footings.	Open-bottom which can be constructed to maintain a more natural environment. Price/m value is inflated by inclusion of headwalls but headwalls permit shorter length conduits. Pricing based on low to moderate covers (0.6 m to 2.5 m cover). Greater covers are permitted but price will vary. Headwalls are intended for more aesthetically pleasing requirements.	Kevin Williams, Atlantic Industries Ltd.

Credit Valley Conservation

Fish and Wildlife Crossing Guidelines

CREDIT VALLEY CONSERVATION

April 28th, 2017

Acknowledgements

The following is a list of supporters and contributors that assisted us in completing this guideline. We would like to sincerely thank the following organizations and their dedicated staff:

City of Brampton
City of Mississauga
City of Oakville
Conservation Halton
Dougan & Associates
Halton Region
MMM Group/WSP
North-South Environmental
Ontario Ministry of Natural Resources and Forestry
Region of Peel
Savanta Inc.
Toronto and Region Conservation Authority
University of Ottawa

Comments and Suggestions:

This document and the recommendations provided herein was developed based on the most recent scientific research available to Credit Valley Conservation (CVC) as well as professional opinion and experience. CVC recognizes that road ecology is an evolving science with new information becoming available regularly. As a result, CVC will review any new information or technologies that support wildlife crossing provided by the proponent or their consultants in support of their specific project.

If you have any questions regarding the guidelines contact a CVC Planning Ecologist.

1 Executive Summary

Credit Valley Conservation's (CVC) Fish and Wildlife Crossing Guideline provides guidance on reducing impacts to wildlife and incorporating best management practices (BMP) within transportation planning and development projects. The document summarizes the current state of scientific knowledge on road ecology, crossing system design and best management practices in order to:

- Improve the function of natural heritage systems (including municipal, regional and the Credit Valley watershed natural heritage systems)
- Promote land conservation by protecting wildlife species, habitat and movement corridors required for lifecycle processes
- Encourage collaboration and proper consultation with all relevant agencies in order to promote effective and timely project planning, development and review
- Allow proponents to incorporate BMPs, mitigation measures and crossing systems from project initiation
- Improve human and wildlife safety within CVC's jurisdiction and reduce costs associated with vehicular-wildlife collisions

Proponents are responsible for familiarizing themselves with all relevant information and ensuring compliance with the legislation and policies of all applicable agencies. The information provided within this guideline is not authoritative, but recommended in order to minimize application review time and ensure the protection of significant ecological features and their associated functions within CVC jurisdiction.

Part of CVC's mandate is to conserve, restore and manage the natural resources in the Credit River watershed. CVC has Memorandums of Understanding (MOUs) with many of our member municipalities to identify significant natural features and functions, and to review environmental studies for any development that may impact natural features and functions. Under Ontario Regulation 160/06 (Development, Interference with Wetlands and Alteration to Watercourses and Shorelines Regulation), CVC reviews development proposals to ensure any interference with wetlands or alterations to a watercourse is acceptable and that any development within a regulated area meets all CVC requirements under the Regulation including conservation of land.

Table of Contents

2 Overview

Road ecology studies the impacts of roads and traffic on fish and wildlife, and their habitat. It is an important discipline that informs conservation efforts in light of the negative impacts roads can have on fish and wildlife populations. The impacts of roads can be direct or indirect. Direct impacts include habitat loss, road mortality and injury. Indirect impacts include habitat fragmentation, wildlife population decline, habitat degradation, barriers to fish passage and road avoidance behaviour by wildlife.

Fish, mammals, birds, reptiles and amphibians are all vulnerable to the impacts of roads, which includes effects to species abundance and diversity. These impacts have been particularly detrimental to reptiles and amphibians due to their biology and behaviour (e.g. thermoregulation on warm asphalt, nesting on gravel roads and shoulders, slow moving, low fecundity and late age of maturity). Poorly designed crossings impact fish by limiting access spawning, feeding, nursery or refuge areas. It is important to consider that the roads do not impact all species similarly and it may take several generations for impacts to be realized. Long and short term effects of transportation design on wildlife must be considered in order to minimize future impacts.

Wildlife-vehicular collisions cause substantial damage to motor vehicles and have an impact on human safety and the economy. Each year, an estimated six per cent of motor vehicle collisions involve wildlife, sometimes resulting in human fatalities and injuries. There can be substantial costs associated with repairing damaged property (MTO, 2016). More vehicle-wildlife interactions can be expected due to future population growth and increased development. This makes appropriate road design increasingly necessary.

When properly designed, culverts and bridges can function as crossing structures to safely and effectively allow fish and wildlife to cross beneath a road. This reduces the number of wildlife-vehicle interactions and enables fish and wildlife to access habitat that may otherwise be inaccessible. Crossing structures tied in with fencing to funnel wildlife to the structure are even more effective since they prevent wildlife from crossing a road overland. Studies indicate that fencing that extends beyond the natural area can further reduce wildlife-vehicle collisions. For the purpose of this document a fish and/or wildlife crossing structure coupled with fencing is considered a *crossing system.*

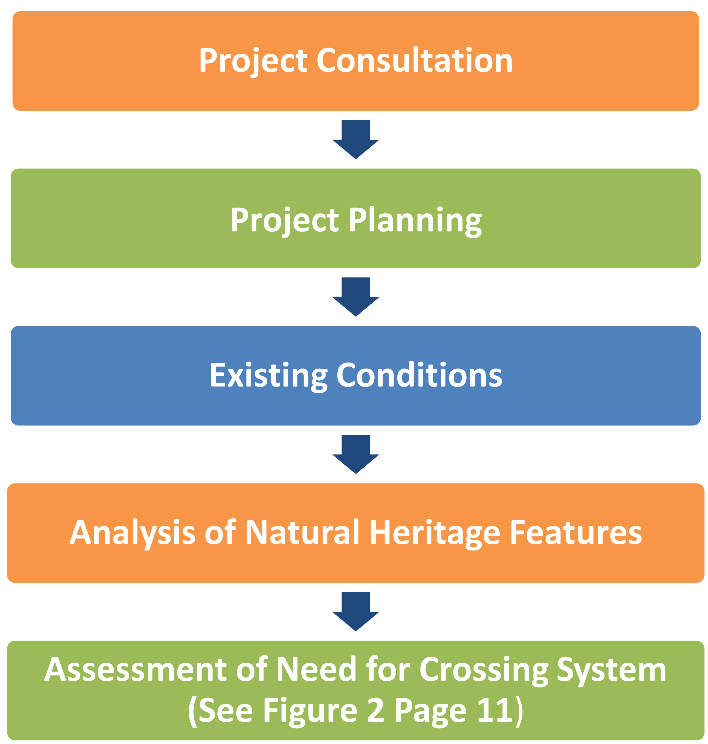
Assessing the natural heritage features of a site can inform when and what type of crossing system is recommended. These guidelines apply to terrestrial and aquatic species and help proponents determine what surveys are required, when and what types of design features and/or mitigation measures are warranted and for what particular group of species or habitat type. While this document describes best management practices for crossing system design, CVC prefers options that avoid natural heritage features altogether. Where this is not possible, best management practices and mitigation measures should be considered.

Part of CVC's mandate is to conserve, restore and manage the natural resources in the Credit River watershed. CVC has memorandums of understanding (MOUs) with many member municipalities to identify significant natural features and functions and to review environmental studies for any development that may impact them. Under Ontario Regulation 160/06 (Development, Interference with Wetlands and Alteration to Watercourses and Shorelines

Regulation), CVC reviews development proposals to ensure any interference with wetlands or alterations to a watercourse is acceptable and that any development within a regulated area meets all CVC requirements under the Regulation including conservation of land.

Figure 1 can be used by the proponent to determine when a crossing system is necessary, and how to design for target species or habitat type. CVC recommends using the Fish and Wildlife Crossing Guidelines for all private and public linear infrastructure and crossing proposals within CVC's jurisdiction that go through the *Environmental Assessment Act, Planning Act* or CVC Regulations process. This includes new roads, road widenings, culvert and bridge replacements, and fish and wildlife impact mitigation retrofits. Given the dynamic nature of transportation projects and their approvals process, the following recommendations do not act as a blueprint approach for all projects. Proper consultation with all involved stakeholders is still required. Although most of CVC's review of crossings is for roadworks, these crossing guidelines can be applied to projects involving railroads, trails and laneways.

Figure 1: *Steps to determine when to incorporate fish and wildlife crossing systems and best management practices in new roads and upgrades to existing roads. Please refer to sections 4-9 of this document for more information on assessing the need for a crossing system, determining target wildlife species, analyzing the natural heritage features, best management practices and design considerations.*



3 Project Consultation

Consulting with CVC, municipalities and other regulatory agencies throughout all phases of a project can ensure the preservation and enhancement of habitat connectivity and safe and effective fish and wildlife passage. It will also encourage a timely review of the submissions.

CVC recommends the proponent consult with CVC, municipalities and other regulatory agencies in order to:

- review current legislative and policy requirements
- co-ordinate and integrate the Fish and Wildlife Crossing Guidelines with other local and/or regional municipal environmental report requirements
- scope any environmental study requirements based on the scale of the project and the significance and sensitivity of natural heritage features
- identify the required practitioners who should undertake the appropriate environmental studies

4 Project Planning

It is important to consider fish and wildlife at each stage in a road project, starting with the planning phase. When assessing preferred alternatives, new roads should avoid the Credit River Watershed Natural Heritage System (CRWNHS), municipal natural heritage systems (NHS) and significant habitats (e.g. wetlands, woodlands, watercourses, valleylands, habitat for species at risk (SAR) and known migration routes/wildlife movement corridors). Collecting field data and reviewing existing background data can provide the proponent with information to create a constraints map.

Where roads cannot avoid significant habitats, they must be designed to minimize potential impacts to fish and wildlife, incorporating crossing and mitigation measures as appropriate. Crossing systems can help maintain and support local and regional biodiversity.

Best management practices that minimize wildlife-vehicular interactions and promote fish and wildlife passage should also be considered at the planning stage. This includes traffic calming measures, downcast lighting, and timing road construction and maintenance activities to avoid sensitive timing windows for wildlife.

The majority of road-related projects CVC reviews are for existing roads that require modification or upgrading (e.g. widening, culvert replacement, changes from rural to urban cross section). These projects should be viewed as opportunities to enhance existing crossing structures or apply new mitigation measures in cases where they were previously absent. Installing crossing structures and wildlife fencing during the construction phase of a new road or upgrade of an existing road is more cost effective than retro-fitting the road with these design features post-construction.

The cost of mitigation measures must be considered when evaluating alternatives during the route planning stage. Taking the precautionary approach and incorporating crossing systems at the planning stage can limit the need for detailed fish and wildlife, or road mortality surveys.

> Taking the **precautionary approach** and incorporating crossing systems and/or best management practices designed to safely pass the anticipated or target wildlife at the planning stage can save the client the expense and effort of completing detailed fish and wildlife, or road mortality surveys.

5 Existing Conditions

Identifying fish and wildlife passage needs for both existing and new roads may involve a combination of desktop analysis and fieldwork. Detailed surveys may not be required if the precautionary approach is taken and crossing systems are installed when a road crosses the CRWNHS, Municipal NHS, a known or potential significant habitat (e.g. wetlands, Significant Woodlands, aquatic or terrestrial habitat for SAR), or in known hot spots of wildlife road mortality. In order to minimize the time and costs associated with completing surveys, field data collection and reporting, CVC recommends that proponents assume the presence of wildlife species in areas with identified significant habitat features. Please note that some projects may require the completion of these surveys for purposes other than fish and wildlife crossing considerations as a result of the regulatory/ legislative process (i.e. as defined in Environmental Impact Study (EIS) Terms of Reference (TOR) or Environmental Assessment (EA) process). If a proponent wishes to implement the precautionary approach within their project, appropriate consultation with CVC and all applicable agencies is still necessary to identify site features and target wildlife, as well as to scope project requirements in order to support successful wildlife passage.

5.1 Background Assessment/Desktop Analysis

Background data is to be collected and analysed before the start of field surveys. This information can be used to identify and map features that are likely to provide habitat connectivity or wildlife movement opportunities, including watercourses and natural areas bisected by roads.

- Natural Heritage: Contact CVC and Ministry of Natural Resources and Forestry (MNRF) for existing natural heritage data, including CRWNHS and features mapping and fish community mapping.

- Species at Risk (SAR): Contact the MNRF to request a SAR screening. If SAR are identified in the area, provide a statement about each SAR, as it relates to habitat suitability on the site and potential impacts on the species and/or habitat as related to roads (e.g. direct road mortality, habitat fragmentation, etc.).

- Road Mortality/Wildlife-Vehicle Collision Records: For existing roads, Municipal (Road Departments) and Provincial (MTO) data can be used to identify potential road mortality hot spots (for one possible method, see Gunson et al. 2012 - https://www.rom.on.ca/sites/default/files/publication/pdf/nwjz.121401.Gunson.pdf

- Traffic Volume – Information Request: Contact the MTO, local municipality or region to request traffic volume data (existing and forecast). Traffic volume can have a significant impact on the ability of wildlife to successfully cross a road. Roads with an average annual daily traffic (AADT) of >300 cars have been shown to have a substantial impact on wildlife. Aquatic species will not be affected by traffic volume; successful passage is dependent upon the proper design of a bridge or culvert.

- Land Use: Consider existing and future land uses. Wildlife crossing systems may not be appropriate in locations where natural heritage features have been permitted for removal on one or both sides of the road or where future development will negate the benefits of their construction.

Table 1 provides a summary of data type and sources that can be consulted in the completion of background assessments.

Table 1: *Type, source, and spatial extent of data for background assessments*

DATA TYPE	DATA SOURCES	SPATIAL EXTENT OF DATA
Ecological Land Classification (ELC)	CVC	CVC Jurisdiction
Corridor mapping	CVC	CVC Jurisdiction
Waterbodies and watercourses (including related hazard considerations such as floodplain etc)	CVC	CVC Jurisdiction
Natural features and systems (e.g. woodlands, wetlands, CRWNHS, Municipal NHS etc.)	CVC	CVC Jurisdiction
	MNRF	Ontario
	Municipal NHS	Municipal Jurisdiction
Fish communities	CVC	CVC Jurisdiction
	MNRF	Ontario
Fish spawning records	CVC	CVC Jurisdiction
Species at Risk records	MNRF	Ontario
Road kill observations	Regional and local municipalities (Roads Department)	Municipal Jurisdiction
	MTO (Annual Road Safety Reports)	Ontario
	Ontario Reptile and Amphibian Atlas	Ontario
Wildlife-vehicle collisions	Police	Police Jurisdiction
Culvert data (may also include species usage, incidental wildlife observations and flows).	CVC	CVC Jurisdiction
	Local municipalities	Municipal Jurisdiction

5.2 Supporting Field Surveys

If the proponent chooses not to take the precautionary approach, ecological surveys and field studies must be conducted prior to the design and evaluation of alternative solutions. Some or all of the following surveys may be necessary depending on the scale of the project and the natural heritage features present. The scope will be determined during pre-consultation. These surveys must be done by qualified individuals who carry out the approved protocols at an appropriate scale, in the appropriate season and at the appropriate time. This document provides recommendations for wildlife crossing systemBMP's, but certain projects may require some or all of the aforementioned surveys for purposes other than wildlife crossing system assessments (i.e. as defined in the EIS TOR/ EA Planning Phase). Where it is not possible to carry out the recommended survey procedures (i.e. in cases where access to private lands is not granted) the precautionary approach should be taken and habitat should be assumed to continue into adjacent areas. The following surveys and methods are adapted from various provincially recognized protocols and/or current scientific information as prescribed by regulatory agencies (i.e. MNRF, CAs, MOE, MTO).

- Vegetation community assessment:
    - To be completed based on the protocol of the Ecological Land Classification System for Southern Ontario, first approximation (Lee *et al*. 1998).

- Assessment of existing crossing for fish and wildlife passage:
    - Assessment of structure permeability and use by fish and wildlife (e.g. existing dimensions and openness ratio, evidence of existing passage, limitations to terrestrial passage, presence and suitability of substrate within culvert, etc.).
    - To be completed for all existing crossings.
    - Map wetlands, watercourses, areas of groundwater upwelling *etc*..
    - Identification of substrate and water depth inside structure
    - Confirmation of bankfull channel under the crossing
    - Identification of barriers (e.g. perched culvert, woody debris *etc*.).
    - Assessment to be carried out in the spring during periods of high flow and in August under low flow conditions. High/ low flow data to be utilized to assess fish passage within the structure. See Appendix 2 for swimming speed of various species.

- Fish community:
    - Surveys to be completed if no existing or insufficient information on fish community is available
    - Electrofishing
        - Intermittent watercourses - April to June
        - Permanent watercourses - June to September
    - Spawning surveys – contact CVC for spawning protocol
        - Brook trout – October to November
        - Pike – March to April

- Amphibian call surveys:
    - To be completed where wetlands are within 200m of the road.
    - To be completed according to the protocol outlined in the Marsh Monitoring Program (Bird Studies Canada, 2009) with respect to timing and weather conditions.
    - CVC recommends extending the duration of each point count from the standard 3 minute length to 6 minutes to help ensure the data collected is representative

of the habitat conditions and function. CVC suggests the increased survey length recognizing that the existing protocol was designed for monitoring and not habitat function assessment.
    - If chorus frog (*Pseudacris triseriata*) is believed to be in the area and appropriate habitat conditions are present, day time surveys are required.

- <u>Vernal pool surveys:</u>
    - To be completed where vernal pools are present within 300m of the road.
    - Complete egg mass surveys and/or minnow trap surveys for the detection of woodland breeding amphibians.
    - Surveys are to be completed between March and May, depending on local weather and site conditions.
    - MNRF to be contacted for necessary permitting.

- <u>Turtle nesting surveys:</u>
    - To be completed where wetlands or open aquatic habitats are within 200m of the road.
    - Identify and map areas of sand and gravel substrates in open, sunny locations.
    - Nesting surveys are to be completed between late May and early July to observe actively nesting turtles.
    - Surveys to detect predated nests should be completed in June/July to increase chance of species identification based on egg size and count.

- <u>Turtle basking surveys</u>
    - To be completed where wetlands or open aquatic habitats are within 200m of the road.
    - Basking surveys to be completed in the morning/early afternoon between late April to July using binoculars on sunny days with temperatures between 50 °F (10 °C) and 80 °F (27 °C).
    - If basking traps are proposed, MNRF to be contacted for necessary permitting.

- <u>Wildlife movement corridors (potential and existing):</u>
    - To be identified and mapped, based on presence of valleyland features, critical habitat (e.g. overwintering, breeding, nesting etc.), and/or evidence of established crossings (e.g. defined paths, road mortality "hot spot" *etc*.).
    - Unconfined or confined valleylands should be considered as potential movement corridors in areas where there is an absence or scarcity of larger valley systems (e.g. in urban areas).

- <u>Significant wildlife habitat (potential and confirmed):</u>
    - To be identified and mapped, both onsite and on adjacent lands.
    - Refer to *MNRF Significant Wildlife Habitat Technical Guide* (2000), *MNRF Significant Wildlife Habitat Mitigation Support Tool* (2015), *MNRF Eco-Regional Criteria Schedule for 6E and 7E* (2015), and *Peel Caledon Significant Woodlands and Significant Wildlife Habitat Study* (North- South Environmental Inc., Dougan & Associates and Sorensen Gravely Lowes, 2009) for guidance on thresholds and habitat mapping.

- <u>Road mortality surveys:</u>
    - CVC recognizes that road mortality surveys are labour intensive and typically not required.
    - May be required when a road bisects a sensitive natural area, or when there is existing evidence of heavy road mortality.
    - Can be completed for the length of the study area, or in targeted areas depending on adjacent natural heritage features (scope to be determined during pre-consultation).
    - Surveys should be completed by walking or biking, as surveys by car can underestimate road mortalities for small bodied animals.
    - Multiple years of data should be collected to determine hot spot locations
    - Sample data sheet provided in Appendix 1.

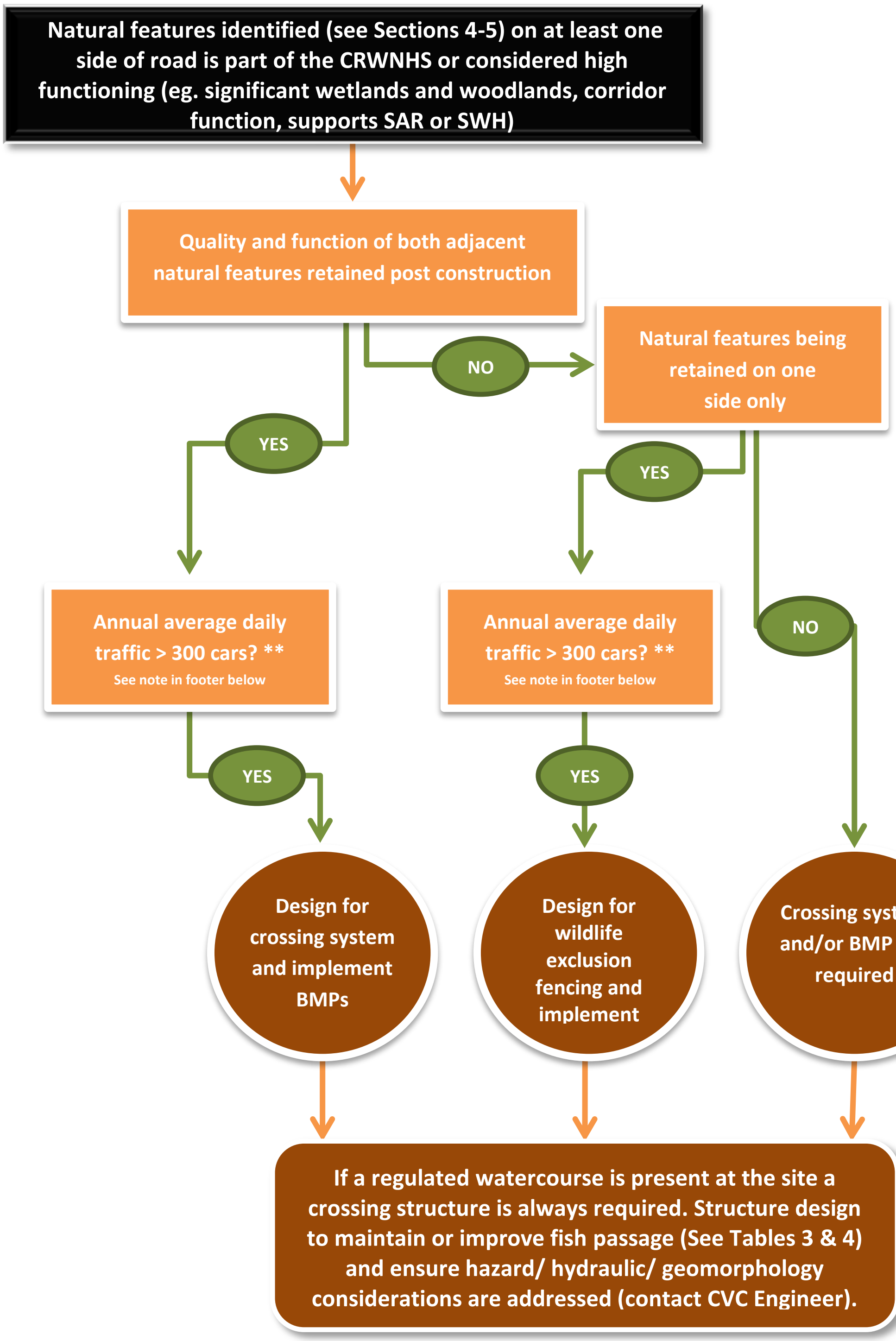
6 Analysis of Natural Heritage Features

Background and site level field assessment data should be analyzed and used to create a map that identifies where crossing systems are necessary to limit road impacts. Crossing systems must be considered when adjacent habitat on at least one side is part of the CRWNHS, a Municipal NHS or considered sensitive or significant (e.g. wetlands, watercourses, valleylands, woodlands, habitat that provides important corridor function, or supports significant wildlife habitat or habitat for species at risk). They must also be considered when there is evidence of existing road mortality or collision hot spots. Fish passage must be considered for all watercourse crossings. It is important to consider that thresholds for determining significance tend to be lower in urban areas compared to rural areas due to a more fragmented landscape, smaller size and lower quality of available habitat, lower species diversity as well as higher human populations and the corresponding number of vehicles.

7 Assessment of Need for Crossing Systems

Figure 2 can be used as an assessment tool to help determine when roads should be designed with wildlife crossing systems and when mitigation measures and/or aquatic passage should be considered. As defined previously, a crossing system refers to a crossing structure that is tied in with fencing. Best management practices refer to all other design or behaviour modification approaches to minimize impacts, including exclusion fencing without the use of crossing structures. Please note that a CVC Planning and Development Services review team, along with external agencies (i.e. MNRF) will assess each project individually. Using field data, experience and expertise, it will be determined when and where wildlife crossing systems and/or BMPs are necessary to limit potential impacts. This chart does not presuppose the degradation or removal of natural heritage features within a project site. Additional consultation and review is required in order to reach an agreement that is acceptable for the proponents, CVC, municipalities and all applicable agencies.

Figure 2: *Assessment tool to determine when roads should be designed with crossing systems, and when mitigation measures and/or fish passage should be considered*



*Crossing system design/ BMPs dependent on the target wildlife species/ group. Refer to Sections 7-9.
**** If annual average traffic volume is less than 300 cars a crossing system/ BMPs are typically not required. Considerations for fish passage is still required if a watercourse is present at the site.**
***Refer to Tables 3 & 4 for crossing system design considerations and BMPs by wildlife group.

If a fish or wildlife crossing structure and/or fencing is warranted based on the ecological assessments described in previous sections, the target fish or wildlife group(s) may be identified (see **Table 2** for the preferred habitat of different groups of wildlife common to the CVC watershed). The recommended design for crossing structures and fencing is dependent on the species or groups of species being targeted. Size, shape and material of the crossing can have an impact on crossing success for different species. Height, length, material and depth of fencing can affect a crossing system's success in funneling target species away from the road and through the crossing structure. There may be limited data available on certain wildlife in the watershed and wildlife surveys can be labour intensive and not always accurate in the depiction of species present Due to this, assumptions can be made on the likelihood of different groups of wildlife present based on habitat type as classified through preliminary ecological assessments.

Table 2 identifies preferred habitat movement corridors for different groups of wildlife. Habitat quality also affects species presence. While there are many ways for evaluating and ranking habitat type and quality within literature (i.e. Gunderson); professional experience, individual site evaluations and background data collection are most effective for determining the need for crossing systems.

Table 2: *Preferred habitat interactions of different groups of wildlife common to the CVC watershed.*

Preferred Habitat Movement Corridors	Wildlife Group
Valley > 3m deep	• Large mammals (e.g deer, coyote)
Forest to Forest	• Large mammals (e.g deer, coyote) • Small mammals (e.g. mouse, vole, squirrel) • Mid-sized mammals (e.g. fox, raccoon, skunk) • Amphibians and reptiles (e.g. frog, salamander, turtle, snake)
Forest to Meadow	• Large mammals (e.g deer, coyote) • Small mammals (e.g. mouse, vole, squirrel) • Mid-sized mammals (e.g. fox, raccoon, skunk) • Reptiles (e.g. snakes)
Forest to Wetland	• Amphibians and reptiles (e.g. frog, salamander, turtle, snake) • Small mammals (e.g. mouse, vole, squirrel) • Mid-sized mammals (e.g. fox, raccoon, skunk)
Wetland to Wetland	• Amphibians and reptiles (e.g. frog, salamander, turtle, snake)
Meadow to Meadow	• Small mammals (e.g. mouse, vole, squirrel) • Mid-sized mammals (e.g. fox, raccoon, skunk) • Reptiles (e.g. snakes)
All watercourses	• Fish and other aquatic species • Amphibians and reptiles (e.g. frog, salamander, turtle, snake) • Small mammals (e.g. mouse, vole, squirrel) • Mid-sized mammals (e.g. fox, raccoon, skunk)

***Note:** It is assumed that birds, bats, butterflies, odonates and other insects will travel between all habitats. Crossing systems are not designed specifically for these species, however, BMPs may be used to provide impact mitigation.

9 Fish and Wildlife Crossing and Fencing Design

A crossing system should be designed to allow for passage of all anticipated or target species identified by assessing the natural heritage features of an area. This could include the design of a multifaceted crossing system that accommodates passage for multiple species along the project span. For instance a road widening and culvert replacement project could incorporate components of large mammal passage (i.e. fencing) as well as amphibian and fish passage (i.e. bridge or BMP culvert installation). For further information on crossing system BMPs for various species please refer to Table 3.

New and the retrofitted crossing structures and fencing should integrate engineering and ecological requirements. This minimizes the risk of natural hazards, reduces road mortality and maintains or improves habitat connectivity. Ecological considerations for crossing structures and fencing are addressed in the proceeding sections. Design should be collaborative and should involve engineers and/or geomorphologists to ensure all engineering and natural hazard mitigation requirements are met (i.e. flooding, erosion, geomorphology). Refer to relevant CVC guidelines for other technical requirements.

9.1 New Crossing Structures

Crossing structures are presumed necessary for all watercourse crossings and for roads that bisect the CRWNHS, municipal NHS or habitat that is considered high functioning. This is true for new roads or for upgrades where culvert replacement is required. The significance of natural features is determined on an individual project basis in consultation with CVC and external regulatory agencies (i.e. municipalities, MNRF, NEC, etc.). Crossing structures can be dedicated terrestrial (i.e. dry) wildlife passages. They can also be required for hydraulics, geomorphology and fish passage, and have design elements to ensure dry passage for all or part of the year (e.g. over-sized banks, terrestrial shelves etc.). Crossing structures will ideally be designed to maximize species usage and maintain or improve connectivity at an ecosystem level. While some larger crossing structures (i.e. bridges, viaducts, culverts) may integrate human access, these structures should be designed to prevent human-wildlife impacts.

General recommendations for all wildlife crossing structures include ensuring that structure openness ratio (OR) and dimensions are adequate for the target species or habitat, and structure length is minimized to the extent possible. OR refers to the amount of light visible at the end of a structure and in road ecology is used as a measure of the permeability of the crossing structure to wildlife. It is calculated as the cross sectional area of the structure entrance divided by its length (all measurements in meters):

OR for:

Box Culvert = [Height X Width]/ Length

Corrugated Steel Pipe (CSP) = [πr^2]/Length
*where π= 3.14 and r= radius of the CSP opening

Studies have been completed on minimum recommended OR for different groups of wildlife. Achieving these sizes should be the target where possible. Minimizing culvert length, maximizing culvert height and width, and designing culverts with slotted openings on top to allow light to penetrate are design features that can increase OR. Hydraulics, geomorphology, cost, the footprint of the road and sensitivity of adjacent natural areas are factors that must also be considered in the sizing and design of the structure.

In addition to OR, it is important to consider placement of and spacing between structures, the shape of the structure, substrate and vegetation present, embeddedness, approaches and fencing. Clear line of sight from one end of the structure to the other is also important for some species. If crossing structures are designed to accommodate the target species with more restrictive passage preferences (e.g. largest openness ratio, tightest spacing etc.), the expectation is that they will often be suitable for other species whose preferences are not as limiting. In most cases design elements for different wildlife and habitat groups can be incorporated into a single design to increase likelihood of multi-species usage.

9.2 Retrofitting an Existing Structure

When there is a pre-existing road and it is not possible to replace an existing crossing structure, there are several mitigation measures that can be implemented to improve wildlife crossing. The extent of mitigation is determined through the same assessment process outlined in Figure 1. **The design engineer should be consulted prior to altering design features for any existing structure designed to pass flow.** Mitigation measures include but are not limited to the following:

- Removing barriers at structure entrances that could impede fish and wildlife passage (e.g. grates, fencing).
- Clearing debris/obstructions within the structure that impede passage.
- Improving the natural substrate or cover within the structure.
- Installing fencing to guide wildlife towards crossing structure entrances.
- For a structure with no dry passage for terrestrial species, installing ledges along the structure length on both sides, with ramps at structure entrances.
- Planting native vegetation around structure entrances to provide cover to wildlife, while maintaining clear line-of-sight through the culvert.
- Installing baffles in the structure to provide/enhance fish passage.
- If culvert is perched, applying mitigation measures to provide/enhance fish passage.

Additional measures that can be implemented while retrofitting an existing structure are identified in **Section 9: Best Management Practices**.

9.3 Fencing

Crossing structures alone may not effectively mitigate the impacts of roads. Conditions within structures can vary drastically from conditions on the surface of the road, which may deter wildlife from using them. Fencing enhances the effectiveness of crossing structures by funneling wildlife to these openings and creating a barrier to prevent them from crossing overland, reducing rates of road mortality. Alternatively, wildlife fencing may be used as a standalone management practice for scenarios in which the goal is to deter or exclude wildlife from crossing the road (i.e. a full crossing system with structures and fencing is not required). For instance, an area in which suitable habitat is only present on one side of the road.

Fencing, as interpreted in this document, is considered to be any type of barrier, including retaining walls and vertical trenching. A variety of different fencing material can be effective depending on the target species, including concrete, recycled plastic material, sheet piling, page wire fencing, and silt fencing. In addition, temporary and permanent one way movement and exclusion systems have been design specifically to keep wildlife off roads and funnel them to crossing structures (http://animexfencing.com/, http://www.aco.co.uk/index.php).

The target species should be a consideration when selecting fencing materials in order to reduce the risk of entanglement, and the opportunity for wildlife to climb the fence, pass underneath or through openings.

Fencing should be continuous on both sides of the road with no gap between the fence and the crossing structure entrance. The terminus of the fence should curve away from the road and be located beyond the target natural area, in a location where wildlife is less likely to cross the road. It is important that there be no vegetation or debris adjacent to the fence for wildlife to use as a ladder. Fencing should be located a sufficient distance from the road to minimize vehicular encroachment, and damage from snow removal and road maintenance.

Table 3 provides recommendations for the design of crossing structures and barrier fencing for different groups of wildlife and habitat types. The information in this table was compiled from several sources, including: Biolinx Environmental Research Ltd and E. Wind Consulting 2004, Cavallaro *et al*. 2005, Arizona Fish and Game Department 2006, Ecoplans Limited 2006, Beier *et al*. 2008, Ontario Ministry of Transportation 2008, Ontario Ministry of Natural Resources and Forestry 2016, Stantec Consulting 2010, Clevenger and Huijser 2011, Kintsch and Cramer 2011, OMNR 2013, Gunson *et al*. 2014, Eco-Kare International and the Town of Oakville 2015, Toronto and Region Conservation Authority 2015.

Table 3: *Wildlife crossing and fencing recommendations for species and habitats commonly found within the Credit River watershed*

WILDLIFE GROUP	OPENNESS RATIO (m)	CROSSING STRUCTURE DIMENSIONS	PLACEMENT / SPACING OF CROSSING STRUCTURES	SUBSTRATE WITHIN CROSSING STRUCTURE[1]	APPROACH TO CROSSING STRUCTURE	FENCING *where fencing is to be used as standalone/ exclusion strategy, eliminate ramps/ gates/ fence openings from design	OTHER CONSIDERATIONS
Large mammals ***e.g. deer, coyote***	• 0.6-1.0 for ungulates • 0.2 for other large mammals	• Recommend width and height both ≥3 m, but no less than 2 m tall • For ungulates, length should not be > 90 m without an open median	• Dependent on topography (i.e. valley over 3 m), habitat and target species • Ideally spaced every 1.5 km	• Natural, dry substrate that is vegetated where possible • Avoid use of rip-rap • If medium-large sized stone is required, fill interstitial spaces with material appropriate for wildlife footing	• Natural vegetative cover adjacent to entrances, while maintaining clear line-of-sight	• Galvanized steel chain-link fencing, retaining wall or similar, 2.8 m tall with posts every 4-5 m • Bottom of fence buried 20-40 cm underground to prevent animals from digging under • Angling fence away from road may prevent animals from climbing over • Fence should extend a min. 500 m on either side of crossing and incorporate earthen ramps or one-way gates every 0.5-1 km	• Minimal or no human use of structure • On highways, an open median can increase light levels and reduce tunnel effect, encouraging use of structure by deer
Mid-sized mammals ***e.g. fox, raccoon, skunk***	• Recommend ≥0.4, but no less than 0.1	• Width and height each ≥1 m	• Ideally spaced every 150-300 m • Multiple crossings are typically not required for this wildlife group. Incorporate dry passage for mid-sized mammals into crossing structures for other wildlife where possible.	• For dry culverts, install natural substrate with some cover (e.g. branches, debris) to provide refuge from predators • If medium-large sized stone is required, fill interstitial spaces with material appropriate for wildlife footing	• Natural cover (e.g. woody debris, flat rocks), and native vegetation near to entrances and leading to adjacent habitat	• Galvanized steel chain-link fence, retaining wall or similar, 1-2 m high • Bottom of fence buried 20-40 cm underground to prevent animals from digging under • Fence should extend a minimum 500 m on either side of the crossing and incorporate escape routes (earthen ramps or one-way gates) every 0.5-1 km	• Incorporate dry terrestrial passage zone at least 0.5-0.7 m in width (preferably 1 m) on either side of a watercourse • Incorporate elevated ledges in structures with no terrestrial passage zone • Cutback adjacent vegetation from fencing structures to prevent arboreal species from climbing over the fencing and into the ROW
Small mammals ***e.g. mouse, vole, squirrel***	• 0.05	• Width and height each 0.3-1.0 m	• Ideally spaced every 50m • Multiple crossings are typically not required for this wildlife group. Incorporate dry passage for small mammals into crossing structures for other wildlife where possible.	• Dry culverts - install natural substrate with some cover (e.g. branches, debris) to provide refuge from predators • Avoid rip-rap as this can impede animal movement • If medium-large sized stone is required, fill interstitial spaces with material appropriate for wildlife footing	• Natural cover and native vegetation near to entrances and leading to adjacent habitat	• Solid permanent material (e.g. concrete, aluminum), Animex, ACO or equivalent fencing, or hardware cloth with ¼ inch mesh or less • 1-1.8 m tall, depending on the jumping/climbing ability of the target species, and with a 15 cm wide lip along the top edge angled away from the road at 45° to prevent animals from climbing over • Bottom of fence buried 10-20 cm • Cloth fencing can be attached to the bottom of fencing for larger wildlife • Consider backfilling with natural soil and plant materials on side of fence adjacent to road. This may decrease impacts from snow collection, allow animals that become trapped in the ROW to climb over and decrease any visual/ aesthetic concerns	• Many species prefer dark lighting conditions • Incorporate dry terrestrial passage zone at least 0.5-0.7 m in width (preferably 1 m) on either side of a watercourse • Incorporate elevated ledges in structures with no terrestrial passage zone • Cutback adjacent vegetation from fencing structures to prevent arboreal species from climbing over the fencing and into the ROW • Incorporate cover structures within dry passage area of crossing (i.e. brush piles, roots, rock, grass)
Amphibians and Reptiles ***e.g. frog, salamander, turtle, snake***	• Turtles recommend ≥0.25, but no less than 0.1 • Amphibians and snakes recommend ≥0.1, but no less than 0.07	• Recommend width and height both ≥1 m, but no less than 0.5 m • Length ideally less than 25 m	• Ideally aligned with predictable movement paths (e.g. annual migration routes) • Structures should be no more than 50-100 m apart for amphibians (depending on migration radius of species) and 150-300 m apart for reptiles	• For dry culverts, install natural substrate with some cover (e.g. native soil, leaf litter, branches, debris, sod) to provide refuge from predators • Many species prefer/require moist substrate • Avoid large rocks and rip-rap • If medium-large sized stone is required, fill interstitial spaces with material appropriate for wildlife footing	• Natural cover but not obstructing entrance • Minimal/low growing vegetation to maintain clear path and line-of-sight	• Solid permanent material (e.g. concrete, aluminum), Animex, ACO or equivalent fencing, or hardware cloth with ¼ inch mesh or less • Height 0.4-1.2 m, depending on jumping/climbing ability of the target species. MNRF recommends a minimum height of 30 cm for salamanders, 60cm for turtles and 100 cm for snakes and anurans • Include a curved design or a 15 cm wide lip along the top edge angled away from the road at 45° to prevent animals from climbing over • Bottom of fence buried 10-20 cm • Fence should extend 100 m on each side of crossing structure • Cloth can be attached to the bottom of tall fencing	• Ambient light, temperature and moisture conditions maintained where possible; can be facilitated through the addition of slots/grates • Utilize cover structure (i.e. brush piles) at entry and exit of structure while ensuring clear line of site through the structure is maintained. • Steel is not a desirable material for structures due to its conductivity, which makes it cold during the spring migratory period • Polymer concrete maintains temperature and moisture conditions • Turtles prefer crossings with standing water or moderate flow

[1] Any engineered substrate of culverts/bridges must meet hydraulic/geomorphological requirements

						• Consider backfilling with natural soil and plant materials on side of fence adjacent to road. This may decrease impacts from snow collection, allow animals that become trapped in the ROW to climb over and decrease any visual/ aesthetic concerns	• Incorporate 0.5-1.0 m of terrestrial/ riparian passage zone on either side of a watercourse • Incorporate ledges in structures with no terrestrial passage
Fish	• N/A	• Preferred hierarchy of crossing structure: bridge> open box> closed box > CSP • Minimum bankfull span • Culvert not perched	• All watercourses	• Open bottom is required to maintain natural stream substrate and processes • Native substrate if closed bottom • Backfill with native substrate consistent with the existing upstream substrate size and texture • If stone is part of the design rounded or sub-angular is required.	• 10-20% embedded • Vegetation to provide stream shading • Pools U/S & D/S of culvert • Natural stream gradient should be maintained U/S, D/S and through the watercourse crossing. • Ensure low flow channel provided within structure. Minimum depth of water in low flow 15-20cm.	• N/A	• Match habitat conditions (e.g. stone sizing) inside the structure to natural conditions. If not possible, ensure conditions (e.g. water velocity and depth) allow passage. • Consider baffles as part of design for retrofits • Design for 0% slope in culvert where feasible • For slopes > 5% contact CVC planning ecology • Consider fish passage capabilities in relation to flows through the structure and swimming speeds of target fish species/ groups.. Refer to table in Appendix 2 for swimming speeds of various species/groups of fish.

10 Best Management Practices

In addition to installing fish and wildlife crossing systems, municipalities can incorporate BMPs into the design of a road, through the construction, operation and maintenance stages. BMPs can mitigate the impacts of roads on fish, wildlife and human safety, and can be applied to new and existing roads. **Table 4** identifies best management practices for the different target groups of wildlife species. These measures are most effective when implemented in conjunction with properly designed crossing structures and fencing. They can also be effective on their own when other opportunities are limited. Each of the measures in the proceeding table should be reviewed in conjunction with crossing and fencing design. Justification should be provided if implementation is not feasible.

Table 4: *Best management practices for road design and construction, operation and maintenance phases for target groups of wildlife*

Wildlife	Road Design	Construction, Operation and Maintenance
All fish and wildlife	• Minimize footprint of road and length of culvert where feasible. • Whenever possible, design new roads near edges of habitat (as opposed to directly through) to reduce fragmentation and potential need for crossings. • Install traffic calming measures (e.g. speed bumps, rumble strips, roundabouts), wildlife crossing signs, and/or animal-vehicle detection systems. • Install noise barriers (e.g. soil berms or solid walls) to minimize disturbance to adjacent natural areas. • Avoid or minimize artificial lighting adjacent to natural areas and wildlife corridors, unless required for human safety. If lighting is required, use downcast and directional options that avoid unnecessarily broadcasting light to the natural area. • Modify infrastructure (i.e. curbs, drainage grates, Jersey barriers) to facilitate wildlife movement.	• Reduce speed limits on roads with known high wildlife mortality or that bisect natural areas. • Implement seasonal road closures during times of wildlife migration. • Create public awareness and education campaigns. • Wildlife-habitat awareness signage may be placed in areas adjacent to SAR habitat. • Manage roadside vegetation to ensure that drivers and wildlife have a clear field of view. • In the event that a fish and/or wildlife rescue is needed, MNRF should be contacted to obtain a Wildlife Scientific Collector's permit. • Protect the existing habitat during the construction of the road and crossing structure through adequate erosion and sediment control and stormwater management; any measures implemented should be regularly monitored to ensure continued satisfactory performance. • Inspect fences periodically for damage that could affect the integrity of the fence or allow passage of wildlife. Inspections should occur following spring melt and heavy rain events; this is especially important when using temporary geotextile fencing. • Ongoing monitoring and maintenance of crossing structures and fencing post-construction, with adaptive management implemented as needed • Avoid use of salt for winter road maintenance near Natural Heritage System features, especially those adjacent to watercourse crossing structures (i.e. bridges, culverts) • Provide habitat creation/ offsetting at nearby location where impacts cannot be avoided
Reptiles and Amphibians	• During design, light sensitive areas (e.g. wetlands with breeding amphibians) should be mapped in order to inform the appropriate placement (or avoidance) of lighting fixtures. • Consider constructing habitat features for reptiles and amphibians beyond the footprint of the road, including turtle nesting habitat and snake hibernacula. Incorporating these habitat features may reduce the number of individuals attempting to cross the road if all critical habitat features of the species are located on one side of a road. Guidance on the creation of snake hibernacula and turtle nesting areas can be found on the Toronto Zoo website (http://www.torontozoo.com/AdoptAPond/resources.asp). • Incorporate sloped and roughened curbs along roadsides in areas with salamanders and turtles to prevent animals from being trapped in the ROW.	• Temporary fencing should be installed along road embankments/shoulders where work is proposed and around stockpiles of gravelly and sandy substrate to prevent turtles from nesting from late May to early July. • Avoid grading road shoulders during the following turtle nesting and incubation periods: ▪ Turtle nesting: late May to early July. ▪ Nest incubation: June to September. • Do not use fine wire or plastic mesh netting where snakes are present because they are easily entangled and killed in the material.
Mammals	• For bats, install taller streetlights (since bats forage on the insects that congregate near them). Diversionary methods (e.g. vegetation and berms adjacent to the road) can also be used to "lift" bats and encourage them to fly higher over a road. • Avoid constructing roads near or adjacent to known migration or hot spot routes. • Provide sloped and roughened curbs to allow small mammals (e.g.; moles) to get off the road surface.	• Avoid construction near sensitive habitat features and at sensitive times of year (i.e. during deer migration and overwintering yards) • Consider planting species that are less attractive to ungulates for food adjacent to ROW • Install roadside wildlife detection systems for larger mammals where installation of crossing system is limited by topography etc.
Birds	• Installation of diversionary methods (e.g. diversion poles, vegetation, berms, fencing) to encourage birds to fly higher over the road, out of the path of traffic. Diversion poles are used on crossing structures (usually bridges over water), whereas the other methods could be used on any roadway. • Reduced speed limits recommended for some types of birds (birds of prey, scavenger birds, geese, turkeys, grouse, ducks). • Install sound barriers (vegetated or constructed) to reduce potential disturbance in areas providing breeding bird habitat. • Studies indicate that terrestrial passage structures will be utilized by avifauna (specifically geese and ducks) if they are adequately sized (minimum 1.5m width and height, dry or wet passage). Signage and traffic calming measures may also be utilized in areas known for high	• Bridge maintenance activities should be timed to not interfere with bridge-nesting birds (e.g. cliff swallow), if present. • Please be aware of updates to and requirements of the Migratory Birds Convention Act which governs the protection and conservation of migratory birds within Canada. Any potentially destructive or disruptive activity such as vegetation clearing should be avoided between April and August. It is the proponent's responsibility to adhere to all pertinent laws, regulations and permit requirements including but not restricted to the Migratory Birds Convention Act and the Migratory Birds Regulations. Further information on the general nesting periods of migratory birds in Canada can be found at: http://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=4F39A78F-1.

	concentrations of geese and/or nesting sites.	
Fisheries	• Avoid building on meander bends, braided streams or other unstable areas • Fish passage is most easily maintained when the water crossing design maintains natural stream processes within or under the crossing. • Avoid use of gravel/unfixed material for road constructions near watercourses. Utilize hard surfaces (such as concrete or asphalt) when possible to limit disturbance impacts such as dust and excess sedimentation. • Use natural substrates in the crossing. • Avoid areas containing confirmed or potential breeding habitat. • Remove barriers and improve fish passage where barrier exists	• Construction should be completed in the dry, when there is no flow in the channel, or by use of a by-pass channel, dam and pump or other construction techniques.. • Work during low flow conditions and avoid work during large precipitation/runoff events • In-water works to be completed between ▪ July 1st and March 31st for warmwater communities; ▪ June 15th and September 15th for coldwater communities; and ▪ July 1st and September 15th for Redside Dace habitat. • Maintain fish passage during construction where feasible • Minimize the extent and duration of dewatering • Stabilize and re-vegetate any disturbed areas as soon as possible

11 Monitoring

Post-construction monitoring will be determined during the consultation process with CVC and other regulatory agencies through the planning process. Monitoring fish and wildlife crossing systems is not a typical requirement of linear infrastructure projects, however, it may be required under certain circumstances (e.g. in areas of high significance, as defined in the EIS TOR or EA process, or as a requirement of other regulatory agencies). Monitoring requirements typically relate to multiple aspects of a project (i.e. site stabilization, restoration success) however, incidental field observations may be used to determine a relative level of success for crossing system implementation. Monitoring guidelines are available by contacting CVC. For further information on appropriate strategies for monitoring wildlife crossing systems please refer to the *CVC Guidelines for Monitoring Fish and Wildlife Crossings*.

12 Glossary

Best Management Practices (BMP) - approaches based on current knowledge/ understanding that when utilized, seek to limit the potential negative impacts and achieve objectives. For instance, the use of wildlife crossing systems is a BMP of road ecology in limiting negative human-wildlife interactions on roadways.

Confined Valley Systems - means where the watercourse is located within a valley corridor, either with or without a floodplain, and is confined by valley walls. The watercourse may be located at the toe of the valley slope, in close proximity to the toe of the valley slope or removed from the toe of the valley slope. The watercourse can contain perennial, intermittent or ephemeral flows and may range in channel configuration, from seepage and natural springs to detectable channels.

Constraints Map - a map that documents and visually communicates all of the environmental concerns and restrictions that apply to an area, which can thereby be used to predict the best (if any) location at a site that is suitable for development.

Credit River Watershed Natural Heritage System (CRWNHS) - a system of natural heritage features, buffers on these features, and natural heritage areas in the Credit River watershed, intended to strategically protect and connect natural habitat, including both terrestrial and aquatic ecosystems. The natural heritage features of the system include valleylands, woodlands, wetlands, aquatic habitat, Lake Ontario shoreline, significant wildlife habitat and habitat of endangered and threatened species. For more information, please see the Credit River Watershed Natural Heritage System Final Technical Report (http://www.creditvalleyca.ca/wp-content/uploads/2015/12/CRWNHS-Phase-3-Natural-Heritage-System-methodology_2015-10-02-FINAL.pdf).

Crossing system - a fish and wildlife crossing structure coupled with fencing

Hydraulic assessment - Assessment of water flow, substrate and water depth inside structure

Hydrologic system - Wetlands, watercourses and areas of groundwater upwelling

Openness Ratio (OR) **-** cross sectional area of the structure entrance divided by its length (all measurements in meters)

Road Mortality Hot Spots - Areas exhibiting high rates of wildlife mortality due to vehicle collision

Sensitive and Significant Habitats - all watercourses and wetlands, significant woodlands, significant wildlife habitat (SWH), habitat for Species at Risk (SAR)], and known migration routes/wildlife movement corridors and linkage features.

Traffic Calming Measures - the utilization of physical design and other measures (such as behaviour modification) to improve safety for motorists, pedestrians and cyclists. It aims to encourage safer, more responsible driving and potentially reduce **traffic** flow.

Unconfined Valley Systems - means those systems where the watercourse is not located within a valley corridor with discernable slopes, but relatively flat to gently rolling plains and is not confined by valley walls. The watercourse can contain perennial, intermittent or ephemeral flows and may range in channel configuration, from seepage and natural springs to detectable channels.

13 References

CVC consulted the following references in the development of this document:

Animal Exclusion Solutions (Animex) - http://animexfencing.com/

Arizona Game and Fish Department, Habitat Branch. 2006. Guidelines for culvert construction to accommodate fish & wildlife movement and passage.

Beben, D. (2012). Crossings for animals–an effective method of wild fauna conservation. *Journal of environmental engineering and landscape management*, *20*(1), 86-96.

Beier, P., Majka, D., Newell, S., and Garding, E. 2008. Best management practices for wildlife corridors. Northern Arizona University.

Biolinx Environmental Research Ltd and E. Wind Consulting. 2004. Best management practices for amphibians and reptiles in urban and rural environments in British Columbia. Prepared for the BC Ministry of Water, Land and Air Protection, Nanaimo, BC.

Bird Studies Canada. 2009. Marsh Monitoring Program Participant's Handbook for Surveying Amphibians. Published by Bird Studies Canada in cooperation with Environment Canada and the U.S. Environmental Protection Agency.

Cavallaro, L, K. Sanden, J. Schellhase, and M. Tanaka. 2005. Designing Road Crossings for Safe Wildlife Passage: Ventura County Guidelines. MS Thesis, U.C. Santa Barbara.

Central Lake Ontario Conservation Authority. 2015. Wildlife Corridor Protection and Enhancement Plan. http://cloca.ca/resources/Natural%20Heritage/Wildlife_Corridor_Protection_Enhancement_Plan_2015.pdf

Charry, B. and J.Jones. "Traffic Volume as a Primary Road Characteristic Impacting Wildlife: A Tool for Land Use and Transportation Planning". In Proceedings of the 2009 International Conference on Ecology and Transportation, edited by Paul J. Wagner, Debra Nelson, and Eugene Murray. Raleigh, NC: Center for Transportation and the Environment, North Carolina State University, 2010.

Clevenger, A.P. and Huijser, M.P. 2011. Wildlife crossing structure handbook: Design and evaluation in North America. Prepared for the US Department of Transportation, Federal Highway Administration.

Clevenger, A.P. 2011. Best practice guideline: Planning considerations for wildlife passage in urban environments. Prepared for the Government of Alberta Transportation Department.

Clevenger AP, Waltho N (2005) Performance indices to identify attributes of highway crossing structures facilitating movement of large mammals. Biol Conserv 121:453–464

Collinson, W., Parker, D., Bernard, R., Reilly, B., & Davies-Moster, H. (2014). Wildlife road traffic accidents: a standardized protocol for counting flattened fauna. Ecology and Evolution, 4(15), 3060-3071.

Degregorio, B., Hancock, T., Kurz, D., & Yue, S. (2011). How quickly are road-killed snakes scavanged? Implications for underestimates of road mortality. Journal of the North Carolina Academy of Science, 127(2), 184-188

Dodd CK, Barichivich WJ, Smith LL (2004) Effectiveness of a barrier wall and culverts in reducing wildlife mortality on a heavily travelled highway in Florida. Biol Conserv 118:619–631
Rodriguez A, Crema G, Delibes M (1997) Factors affecting crossing of red foxes and wildcats through non-wildlife passages across a high-speed railway. Ecography 20:287–294

Eco-Kare International and the Town of Oakville. 2015. Road ecology strategy for the Town of Oakville (Draft).

Ecoplans Limited. 2006. Environmental guide for wildlife in the Oak Ridges Moraine. Prepared for the Ministry of Transportation Ontario.

Fisheries and Oceans Canada. 2015. Guidelines for the design of fish passage for culverts in Nova Scotia. Fisheries Protection Program, Maritimes Region, 95 pp.

Frantz, E. 2009. Judd Road Connector: Lessons learned in ecological mitigation – wildlife crossings, habitat preservation, wetlands and more. In Proceedings of the 2009 International Conference on Ecology and Transportation, edited by Paul J. Wagner, Debra Nelson, and Eugene Murray. Raleigh, NC: Center for Transportation and the Environment, North Carolina State University, 2010.

Glista DJ, De Vault TL, DeWoody JA (2009) A review of mitigation measures for reducing wildlife mortality on roadways. Landsc Urban Plan 91:1–7

Government of Ontario. 2016. Provincial Planning Act. https://www.ontario.ca/laws/statute/90p13

Government of Ontario. 2014. Provinicial Policy Statement. http://www.mah.gov.on.ca/Page215.aspx

Government of Ontario.2011. Conservation Authorities Act. https://www.ontario.ca/laws/statute/90c27

Grilo C, Bissonette JA, Santos-Reis M (2008) Response of carnivores to existing highway culverts and underpasses: implications for road planning and mitigation. Biodivers Conserv 17:1685–1699

Gunson, K.E., Ireland, D. and Schueler, F. 2012. A tool to prioritize high-risk road mortality locations for wetland-forest herpetofauna in southern Ontario, Canada. North-western journal of zoology 8: 409-413.

Gunson, K.E., Seburn, D. and Kintsch, J. 2014. MNRF guidelines for mitigation of road effects on amphibians and reptiles in Ontario (Draft). Prepared for the Ministry of Natural Resources and Forestry.

Huijser, M.P., A.V. Kociolek, T.D.H. Allen, P. McGowen, P.C. Cramer and M. Venner. 2015. Construction guidelines for wildlife fencing and associated escape and lateral access control measures. http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP25-25(84)_FR.pdf

Kintsch, J., and Cramer, P.C. 2011. Permeability of existing structures for terrestrial wildlife: A passage assessment system. Prepared for the Washington State Department of Transportation.

Lee, H.T., Bakowsky, W.D., Riley, J., Bowles, J., Puddister, M., Uhlig, P., and McMurray, S. 1998. Ecological Land Classification for Southern Ontario: First approximation and its application. Ontario Ministry of Natural Resources, Southcentral Science Section, Science Development and Transfer Branch, Field Guide FG-02.

Lehnert ME, Bissonette JA (1997) Effectiveness of highway crosswalk structures at reducing deer-vehicle collisions. Wildl Soc Bull 25:809–818

McDonald W, St-Clair CC (2004) Elements that promote highway crossing structure use by small mammals in Banff National Park. J Appl Ecol 41:82–93

Massachusetts Riverways Program. 2005. Massachusetts stream crossing handbook. Edited by Amy Singler and Brian Graber. Massachusetts Department of Fish and Game.

North- South Environmental Inc., Dougan & Associates and Sorensen Gravely Lowes.2009. *Peel Caledon Significant Woodlands and Significant Wildlife Habitat Study*.

Ontario Ministry of Natural Resources. 2013. Reptile and Amphibian Exclusion Fencing: Best Practices, Version 1.0. Species at Risk Branch Technical Note. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. 11 pp.

Ontario Ministry of Natural Resources. 2016 Best Management Practices for Mitigating the Effects of Roads on Amphibians and Reptile Species at Risk in Ontario. Queen's Printer for Ontario. 112 pp.

Ontario Ministry of Transportation. 2016. Best Management Practices for Species at Risk Protection During Maintenance Activities. DRAFT.

Ontario Ministry of Transportation. 2008. 407 East Environmental Assessment and Preliminary Design (Draft). Appendix D: Wildlife and Designated Natural Features.

Ontario Ministry of Transportation. 2009. Environmental Guide for Fish and Fish Habitat. http://www.raqsb.mto.gov.on.ca/techpubs/eps.nsf/0/513d053ea7596f88852572b300578ded/$FILE/MTO%20Fish%20Guide%20June%202009%20Final.pdf

Ontario Road Ecology Group. 2010. *A Guide to Road Ecology in Ontario.* Scarborough: Toronto Zoo. https://www.rom.on.ca/sites/default/files/imce/oreg_final.pdf

Rytwinski T, Soanes K, Jaeger JAG, Fahrig L, Findlay CS, Houlahan J, et al. (2016) How Effective Is Road Mitigation at Reducing Road-Kill? A Meta-Analysis. PLoS ONE 11(11): e0166941.doi:10.1371/journal.pone.0166941

Stantec Consulting Ltd. 2010. City of Edmonton wildlife passage engineering design guidelines. Prepared for the City of Edmonton, Office of Natural Areas.

Santos, S., Carvalho, F., & Mira, A. 2011. How long do the dead survive on the road? Carcass persistence probability and implications for road-kill monitoring surveys. PLoS ONE, 9.Toronto and Region Conservation. (2011). Heart Lake Road Volunteer Monitoring Project: Phase I.

Taylor, S.R., Stow, N., Hasler. C and Robinson, K. 2014. Lessons Learned: Terry Fox Drive Wildlife Guide System intended to reduce road kills and aid the conservation of Blanding's Turtle (*Emydoidea blandingii*). Proceedings, Transportation Association of Canada, September 2014.

Toronto and Region Conservation Authority. 2013. Heart Lake Volunteer Road Ecology Monitoring Project: Phase 1 – http://www.trca.on.ca/dotAsset/151730.pdf , Phase 2 - http://www.trca.on.ca/dotAsset/187823.pdf

Toronto and Region Conservation Authority. 2015. Crossing guidelines for valley and stream corridors.

Town of Oakville. 2015. Road Ecology Strategy Technical Report - Draft June 1 2015

van der Grift, E.A. and van der Ree, R. 2015. Guidelines for evaluating the use of wildlife crossing structures. In Handbook of Road Ecology, First Edition, edited by R. van der Ree, D.J. Smith and C. Grilo. John Wiley & Sons Ltd.

van der Grift, E.A., van der Ree, R., Fahrig, L., Findlay, S., Houlahan, J., Jarger, J., et al. 2013. Evaluating the effectiveness of road mitigation measures. *Biodiversity Conservation, 22*, 425-448.

van der Ree R, van der Grift EA, Gulle N, Holland K, Mata C, Suarez F (2007) Overcoming the barrier effect of roads: how effective are mitigation strategies? An international review of the use and effectiveness of underpasses and overpasses designed to increase the permeability of roads for wildlife. In: Irwin CL, Nelson D, McDermott KP (eds) 2007 Proceedings of the International Conference on Ecology and Transportation. Center for Transportation and the Environment, North Carolina State University, Raleigh, pp 423–431

van Vuurde MR, van der Grift EA (2005) The effects of landscape attributes on the use of small wildlife underpasses by weasel (*Mustela nivalis*) and stoat (*Mustela erminea*). Lutra 48(2):91–108

Appendix 1 - Road Mortality Surveys

Road mortality surveys can be labour intensive and may or may not be required by CVC depending on the scale of the project, the sensitivity of adjacent features, and whether or not appropriate design and mitigation is proposed. A sample data sheet has been provided below in the event that road mortality surveys are required.

Different groups of species exhibit patterns of road mortality that are often seasonal and coincide with the species' life history. When road mortality surveys are required they should be completed at different times of the year in order to fully assess the impacts of the road on wildlife populations. General patterns in Ontario include the following:

- Turtles exhibit high rates of mortality in late May to June, which coincides with breeding and nesting.
- Snakes exhibit bimodal peaks in road mortality in early spring and late autumn, coincident with emergence from and migration to hibernacula.
- Frogs and toads exhibit a bimodal peak in road mortality associated with adults moving to wetlands to breed in the spring, and juveniles moving from wetlands to upland habitats following metamorphosis in the summer. Surveys should be completed on warm rainy nights to yield the most accurate results.
- Generally mammals have not been shown to exhibit a seasonal pattern in road mortality, likely due to the fact that in Ontario many are active year round.

Hot spot locations can vary year-to-year. Multiple years of data should be collected prior to identifying hot spots.

CREDIT VALLEY CONSERVATION

Road Mortality Study Field Sheet

Observers:

Date: ________________________ **Air Temp:** _______°C
Start Time: ______________ **End Time:** ______________
Survey Method: Driving Biking Walking
Precipitation: None Light Heavy

Status
AOR – Alive On Road
ABR – Alive Beside Road
DOR – Dead On Road
DBR – Dead Beside Road

Survey Comments:

Wildlife Observations

#	Species	Status	Position & proximity on road	UTM		GPS Acc. (+/- m)	Comments (e.g. behaviour, size, etc.)
	EXAMPLE Snapping Turtle	AOR	Centre of northbound lane, facing W – 1m from edge of road	E	0597560	4	Turtle crossing from E to W side of rd – size of carapace 28cm from back of neck to tail – leeches on R rear leg
				N	4843928		
				E			
				N			
				E			
				N			
				E			
				N			
				E			
				N			
				E			
				N			
				E			
				N			

Continued From: Date:_______________ Observers: ___________________________________ Page ____ of ____

#	Species	Status	Position & proximity on road	UTM		GPS Acc. (+/- m)	Comments
				E			
				N			
				E			
				N			
				E			
				N			
				E			
				N			
				E			
				N			
				E			
				N			
				E			
				N			
				E			
				N			
				E			
				N			
				E			
				N			
				E			
				N			

Appendix 2 – Fish Swimming Speeds

Adapted from *MTO Environmental Guide for Fish and Fish Habitat* (2006). The following chart can be used in conjunction with flow data and fish collection records to determine if a structure is passible by the target species or species groups. If it is not passable, improvements and BMPs should be adopted to ensure passibility.

Species end Life Stage (size – mm)		Sustained* Speed (m/s)	Prolonged* Speed (m/s)	Burst * Speed (m/s)
Coho	Adults Juveniles (120mm) Juveniles (90mm) Juveniles (50mm)	0.0 – 2.7	2.7 – 3.2 0.4 – 0.6 0.3 – 0.5 0.2 – 0.4	3.2 – 6.6
Chinook	Adults	0.0 – 2.7	2.7 – 3.3	3.3 – 6.8
Rainbow Trout	Adults Juveniles (125mm) Juveniles (50mm)	0.0 – 0.9 0.0 - 0.38 0.0 – 0.15	0.9 – 1.8 0.38 – 0.75 0.15 – 0.3	1.8 – 4.3 0.75 – 1.13 0.3 – 0.45
Brown Trout	Adults Juveniles (>75mm)	0.0 – 0.7 0.0 – 0.6	0.7 – 1.9	1.9 – 3.9
Arctic Char	Adults		0.6 – 1.1	
Arctic Grayling	Adults	0 – 0.8	0.8 - 2.1	2.1 – 4.3
Whitefish	Adults	0 – 0.4	0.4 – 1.3	1.3 – 2.7
Walleye	Adults (230 – 410mm) Adults		0.0 – 1.1	
Carp	Adults	0 – 0.4	0.4 – 1.2	1.2 – 2.6
Suckers	Adults	0 – 0.4	0.4 – 1.5	1.6 – 3.1
Small forage fish	(50 – 65mm) **	0 – 0.22	0.22 – 0.29	0.29 – 0.40
Medium forage fish	(90 – 110mm) **	0 – 0.31	0.31 – 0.68	0.68 – 0.76
Large forage fish	(180 – 230mm) **	0 – 0.42	0.42 – 0.95	0.95 – 1.11
Game fish	(450 – 750mm) **	0 – 0.8	0.08 – 1.63	1.63 – 2.16

* Sustained speed can be maintained indefinitely.
Prolonged speed can be maintained for up to 200 minutes.
Burst speed can be maintained for up to 15 seconds.
(Chillbeck 1992)

** Calculations based on a generalized relationship between fish length and swimming speed for species using the same swimming form (Katopodis and Gervais 1991).

AMX60

Temporary & Permanent Wildlife Fencing

Specification & Installation Guides
SUMMER 2021

SUITABLE SPECIES
- SNAKES (Large)
- FROGS (Large)
- SMALL MAMMALS (Large)

Contents

Animex®

AMX 60
Basic Material Size & Features

NOTES:
This specification should be used to aid installation. Measurements are accurate but may need to be adjusted dependent on location, conditions and local authority recommendations.

The length of each **AMX 60** section will vary depening on the material choice.

AMX 60 dimensions based on Animex's optimal fencing materials.

SCORED PLASTIC - PERFORATED & NON-PERFORATED
Temporary Applications **(AMX-T)**
Thickness: 0.04in / 1mm
Length: 50ft / 15m
Weight: 50lbs / 23kg

Semi-Permanent Applications **(AMX-SP)**
Thickness: 0.08in / 2mm
Length: 20ft / 6m
Weight: 42lbs / 19kg

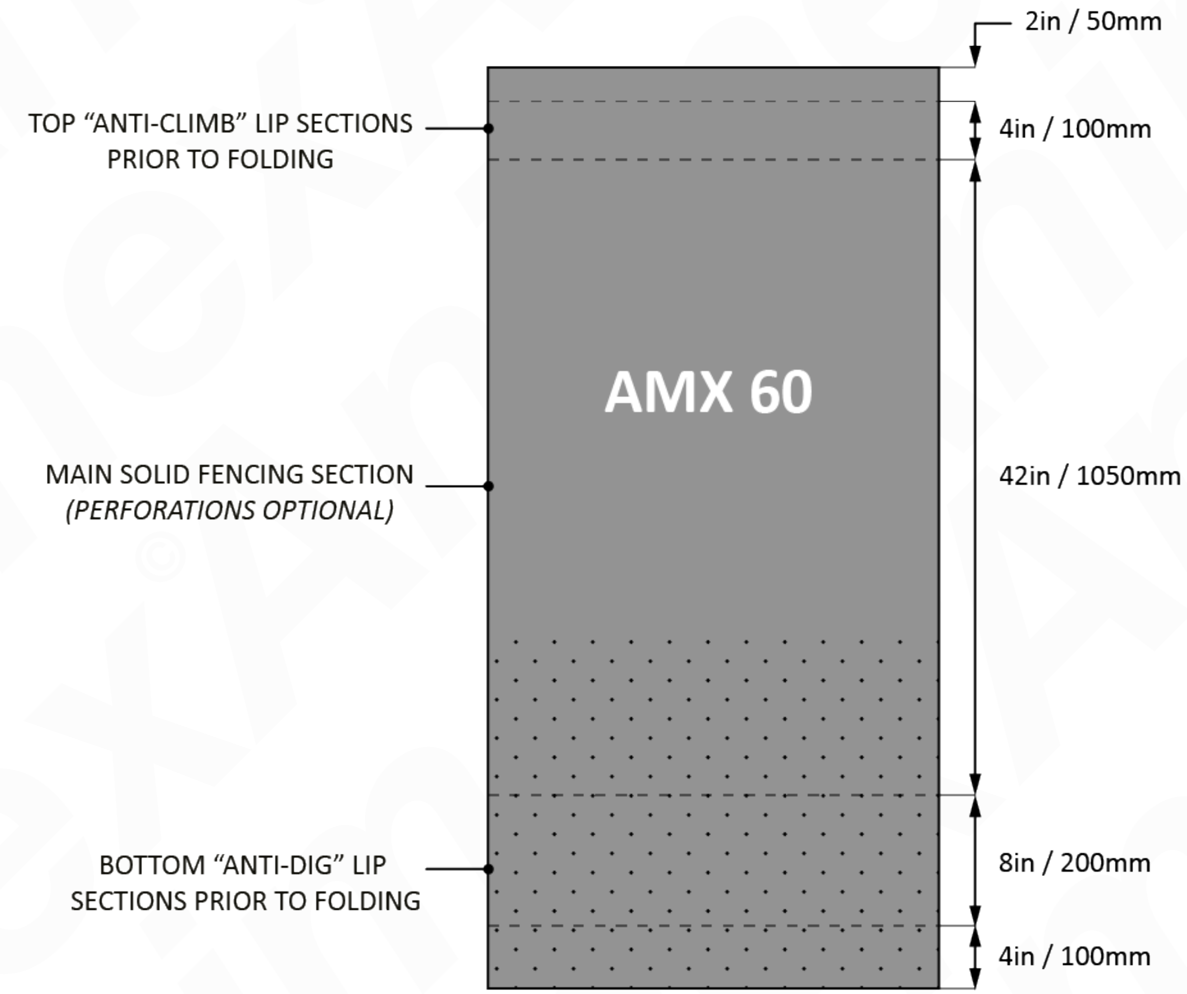
PREFORMED METAL- PERFORATED & NON-PERFORATED
Permanent Applications **(AMX-XP)**
Thickness: 0.08in / 2mm
Length: 8ft / 2.4m
Weight: 116lbs / 53kg

AMX 60 INSTALLED ABOVE GROUND HEIGHT: **42in / 1050mm**

Notes:
These dimensions are based on maximising the amount of material that can be shipped economically and manouvered on site in line with common heatlth and safety guidelines.

Material may be shipped in sheets or rolls depending on their length.

Customised options for alternative **AMX 60** barrier options are availible from Animex® Fencing suppliers upon request. Other traditional and exisiting fencing materials including posts and wire etc can be obtained from local contractors.



AMX 60
Step-by-Step Installation

1) Clear vegetation along the fence line and work area.

2) Mark out the Animex fence line.

3) Below Ground: Excavate trench. Ensure the trench is level and clear of large clumps or rocks.
Above Ground: Clear Ground. Ensure the ground is level and clear of large clumps or rocks.

4) Free-Standing: Lay out posts and roll out Animex barrier (Fold bottom lip if required).
Attached to exisiting fences: Roll out Animex barrier along fence (Fold bottom lip if required).

5) Install posts at the back of the trench using manual or machine powered post driver (Install horizontal wire if required and secure to end braces).

6) Place the Animex fence material into the trench with the lips facing towards the area that animals will encounter the fence.

7) Fasten the Animex to posts, straining wire or exisiting fence starting at the top and work down.

8) When attaching rolls overlap them following details on installation drawing Pg7. A minimum of 4 ties should be used on any joins in the fence

9) Back fill the trench. Ensure the backfill is compact to eliminate gaps for animals to crawl through. Do the same on the back side of the fence.

10) Fasten the top lips and install any additional features such as one-way funnels or pitfall traps (if required).

MATERIALS

Required
- Animex Fencing
- Animex Washers
- UV Resistant Zip-ties or Fencing Wire
- Fence Posts

Optional
- 12 Gauge Straining Wire
- Fence end braces & wire strainers
- Gripple Wire Joiners (or similar)
- Fence Post Saftey Caps

TOOLS & EQUIPMENT

Required
- Weed wacker / Whipper
- String Line & Marker Pain
- Box Cutter / Stanley Knife
- Trencher / Excavator
- Spade / Trench / Shovel
- Post Diver / Sledge Hammer
- Battery Powered Drill
- Spade Drill Bit 3/4 (20mm)
- Cutting Pliers

Optional
- Shear Attachement For Drill (Trim Fence)
- Battery Powered reciprocating Saw (Trim Posts)
- Drill Bit For Drainage Holes 1/8in (3mm)
- Gripple Tensioning Tool

Fixings & Fastening
Scorded Plastic HDPE

AMX-T & AMX-SP

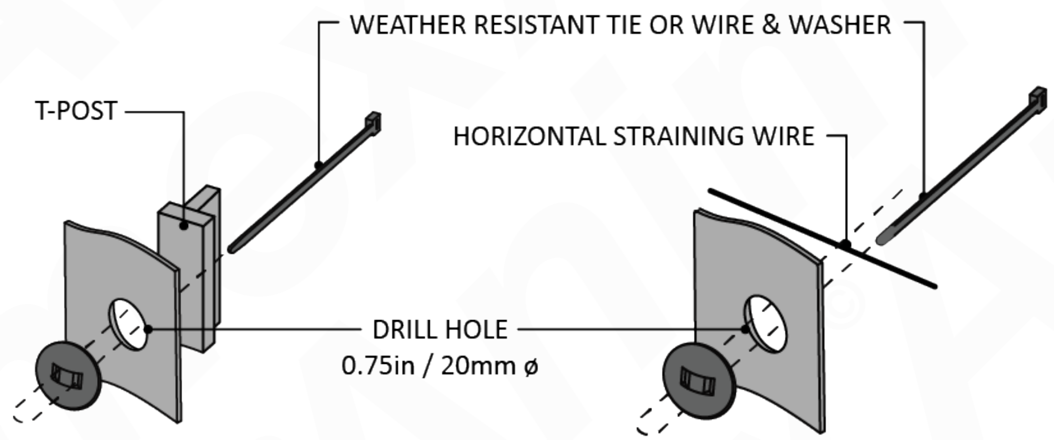
Pre-scored plastic (HDPE) sheets and rolls can expand in when installed inplaces where there are large flutucations in temperature. You should therfore avoid hard fixing this material as it can cause buckling and even open up gaps at overlapped or joining sections.

We have prepared some illustarions to demonstrate the best ways to connect and fasten HDPE rolls and sheets.

This technique helps to reduce the chances of gaps opening up at the joins and allows the fencing to expand and contract freely.

Ensuring the trench is backfilled correctly and the earth is compacted tightly against both sides of the fence is also essential to ensure there are no gaps at ground level where animals will be encountering the fence.

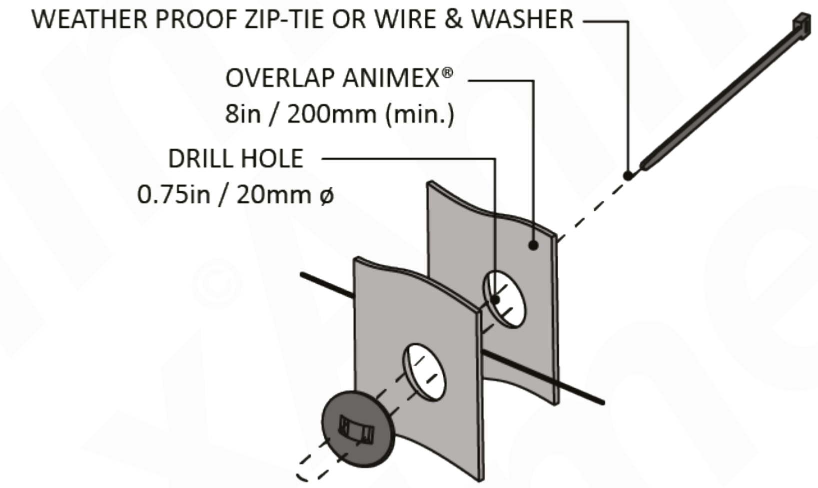
Joins should be made between posts and onto horizontal wire or horizontal parts of exitising fences where possible.



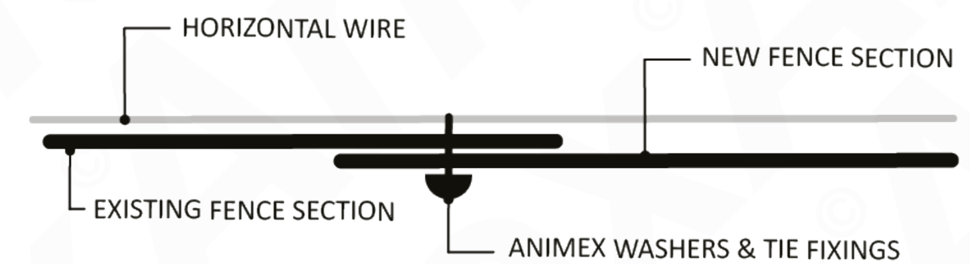
ATTACH TO POSTS
NOT TO SCALE

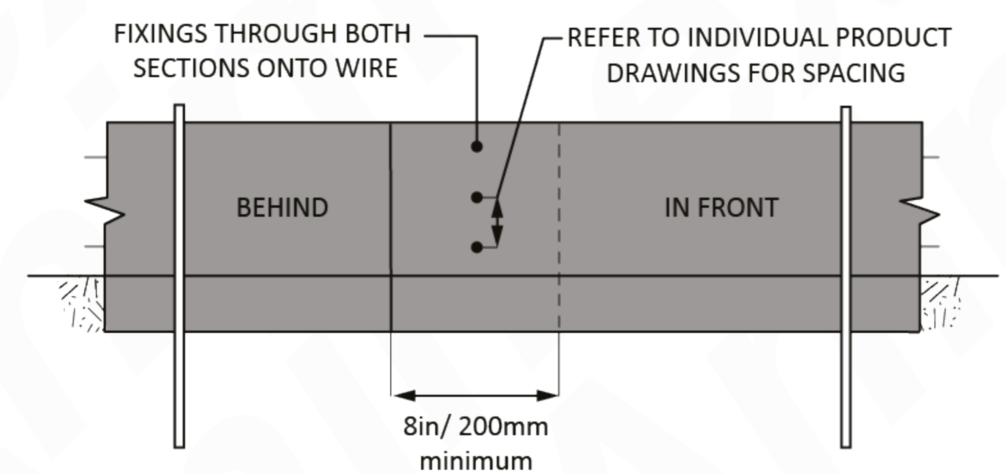
ATTACH TO WIRE
NOT TO SCALE

NOTES:
This specification should be used to aid installation. Measurements are accurate but may need to be adjusted dependent on location, conditions and local authority recommendations.



JOINING & OVERLAPPING SECTIONS
NOT TO SCALE





Fixings & Fastening
Preformed Metal

AMX-XP

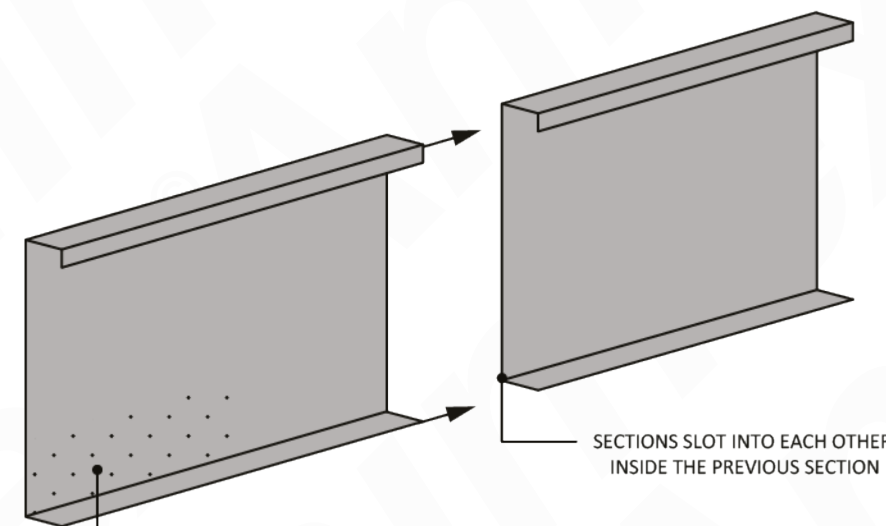
Preformed metal fencing is supplied in sections that are often custom made for your project.

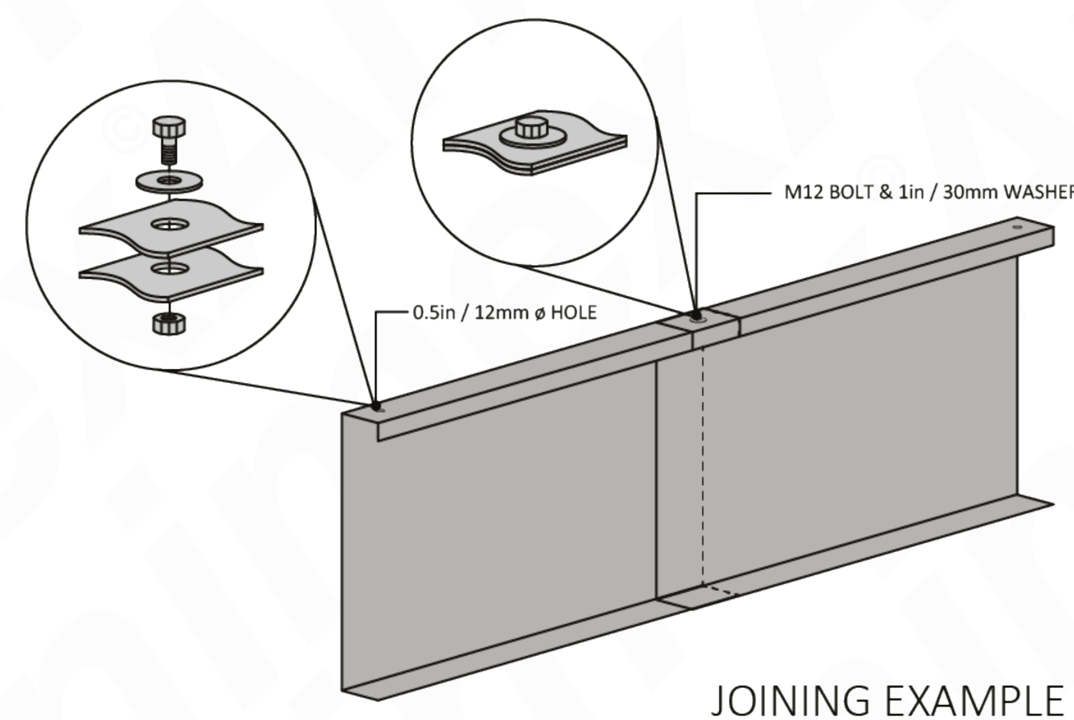
Each section slots inside the other and is then fastened by drilling holes through the overlapping sections and securing with bolt, nuts and washers.

End sections and turn arounds will also be custom made per project and fitted on site.

Panels can be supplied with a powercoating but this will increase costs and may need touch ups after installation.

NOTES:
This specification should be used to aid installation. Measurements are accurate but may need to be adjusted dependent on location, conditions and local authority recommendations.

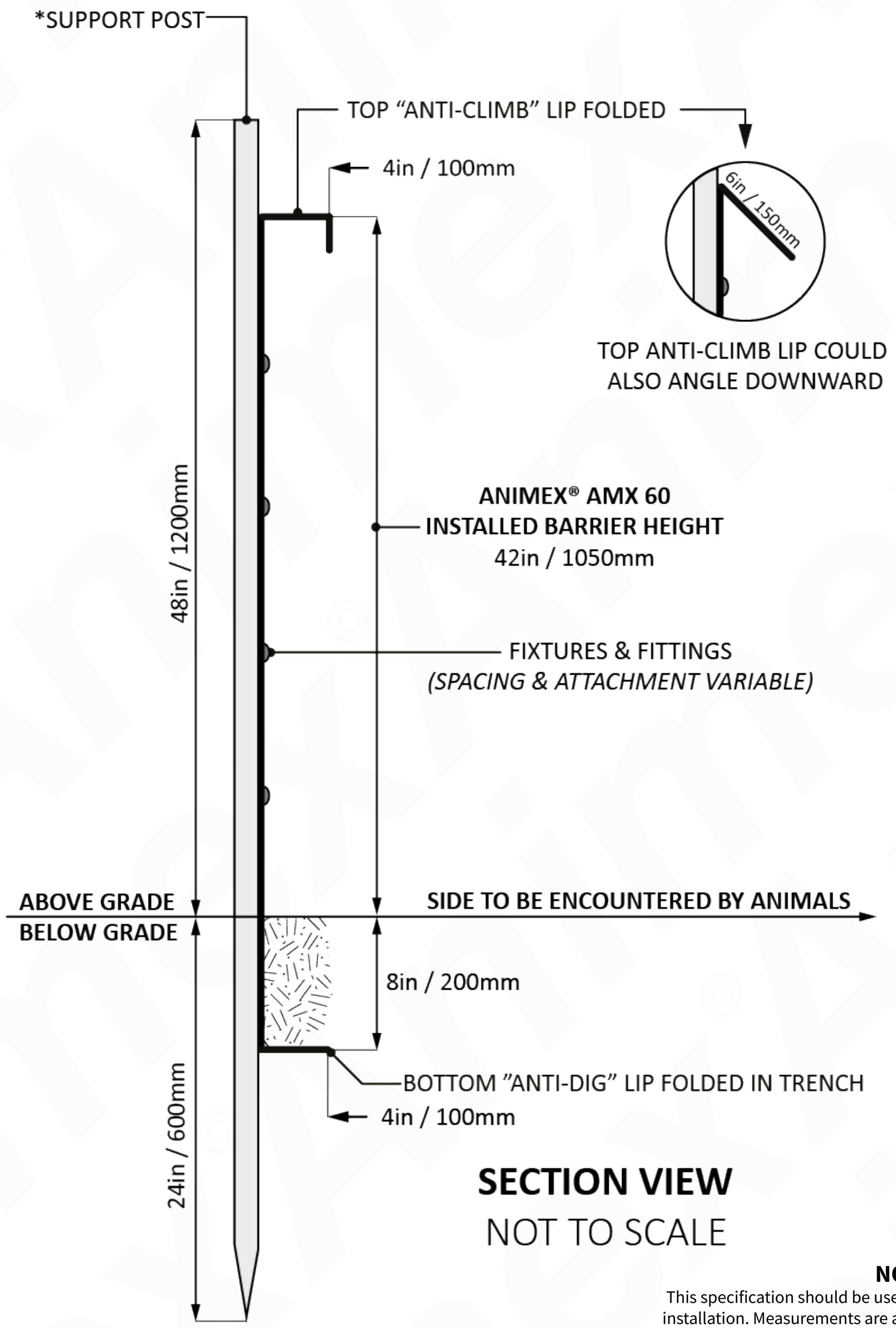




JOINING EXAMPLE
NOT TO SCALE

AMX 60

Free-standing Below Ground



SECTION VIEW

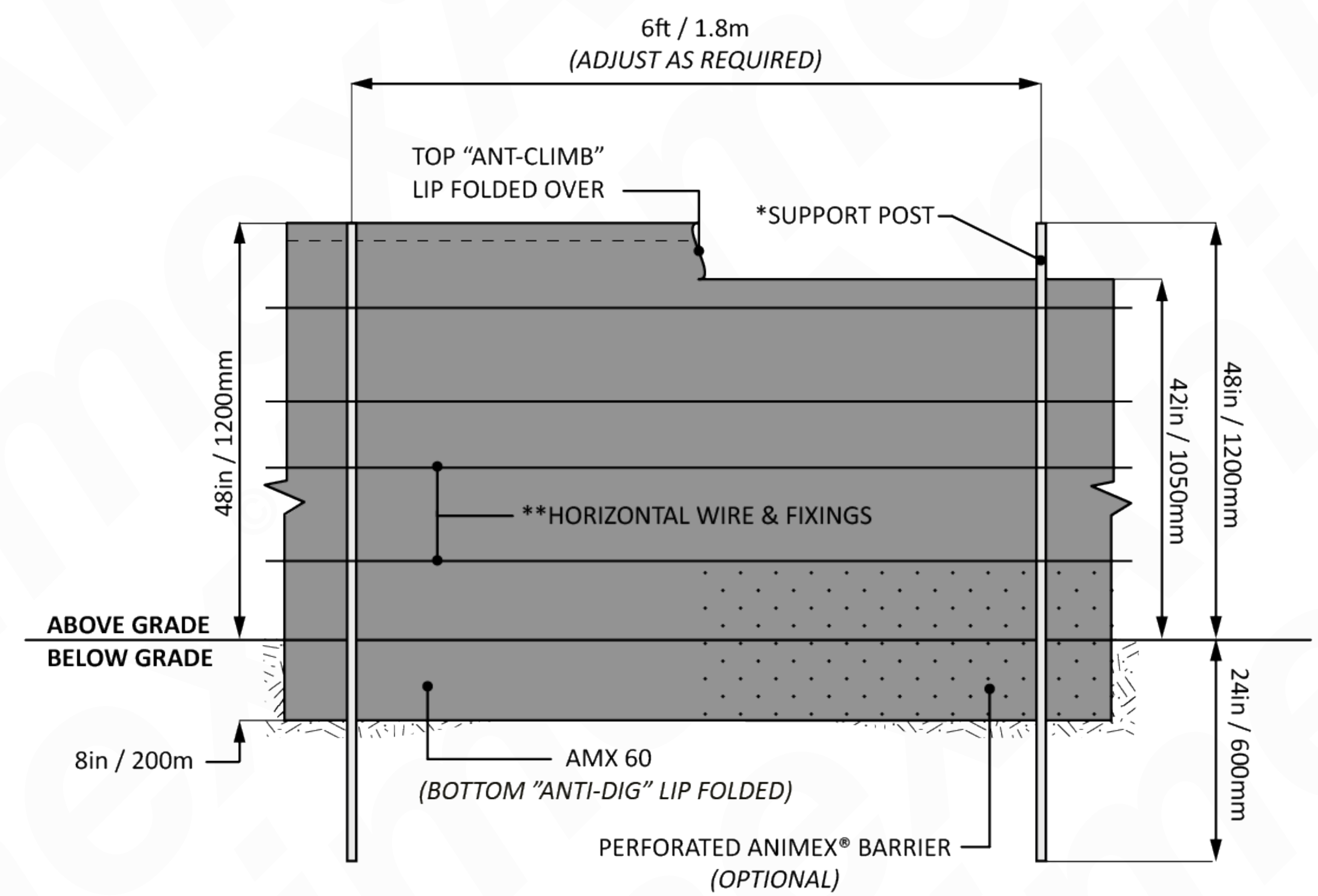
NOT TO SCALE

NOTES:
This specification should be used to aid installation. Measurements are accurate but may need to be adjusted dependent on location, conditions and local authority recommendations.

NOTES:
This specification should be used to aid installation. Measurements are accurate but may need to be adjusted dependent on location, conditions and local authority recommendations.

*SUPPORT POSTS & HORIZONTAL WIRE MAY NOT BE NEEDED FOR PREFORMED METAL (AMX-XP) FENCES

**HORIZONTAL WIRE MAY NOT BE NEEDED FOR TEMPORARY (AMX-T) FENCES

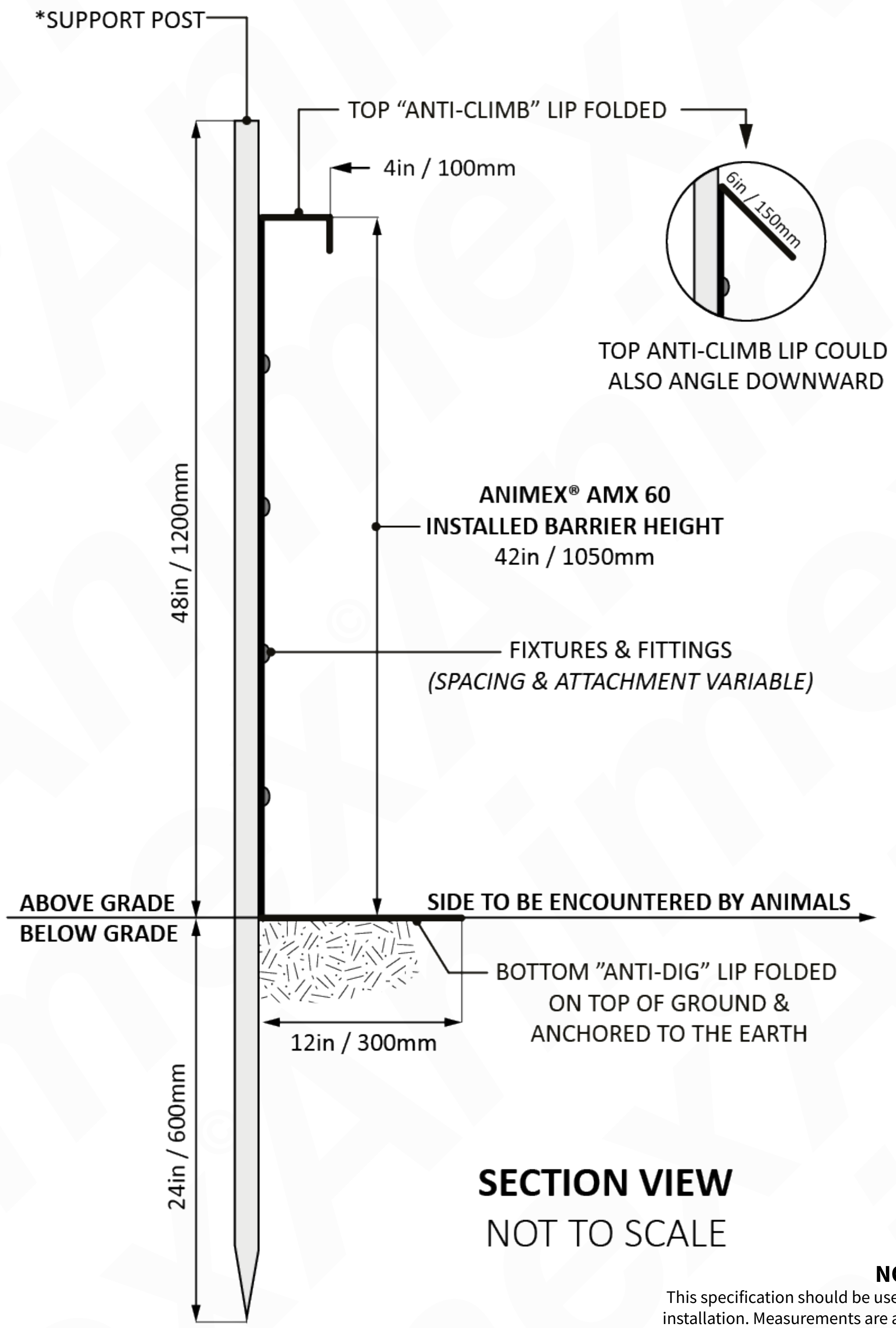


ELEVATION VIEW

NOT TO SCALE

AMX 60

Free-standing Above Ground



SECTION VIEW

NOT TO SCALE

NOTES:
This specification should be used to aid installation. Measurements are accurate but may need to be adjusted dependent on location, conditions and local authority recommendations.

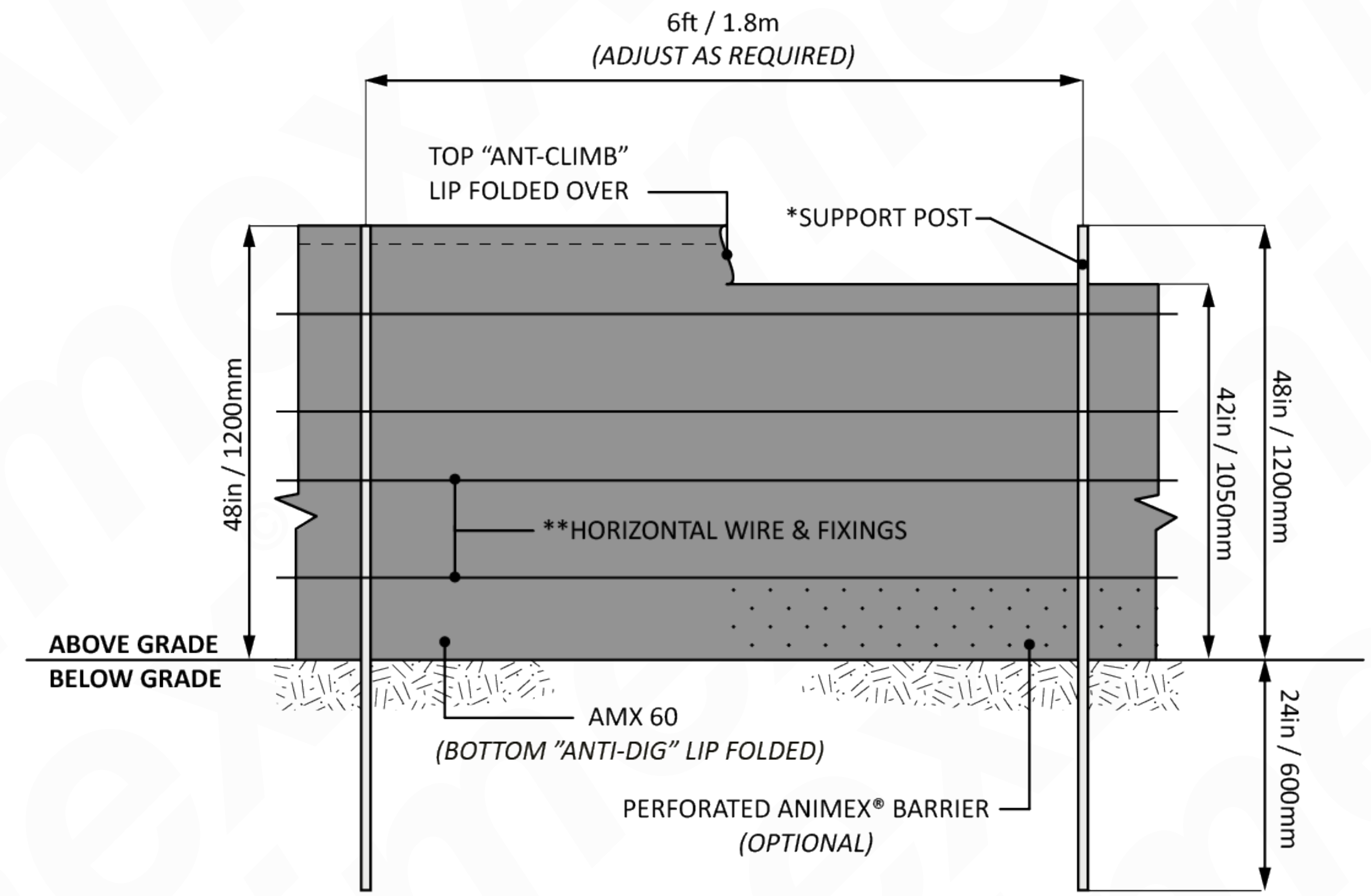
Animex®

NOTES:
This specification should be used to aid installation. Measurements are accurate but may need to be adjusted dependent on location, conditions and local authority recommendations.

APPLY THIS ABOVE GROUND METHOD WHEN ATTACHING TO EXISTING FENCE TYPES AS WELL

*SUPPORT POSTS & HORIZONTAL WIRE MAY NOT BE NEEDED FOR PREFORMED METAL (AMX-XP) FENCES

**HORIZONTAL WIRE MAY NOT BE NEEDED FOR TEMPORARY (AMX-T) FENCES



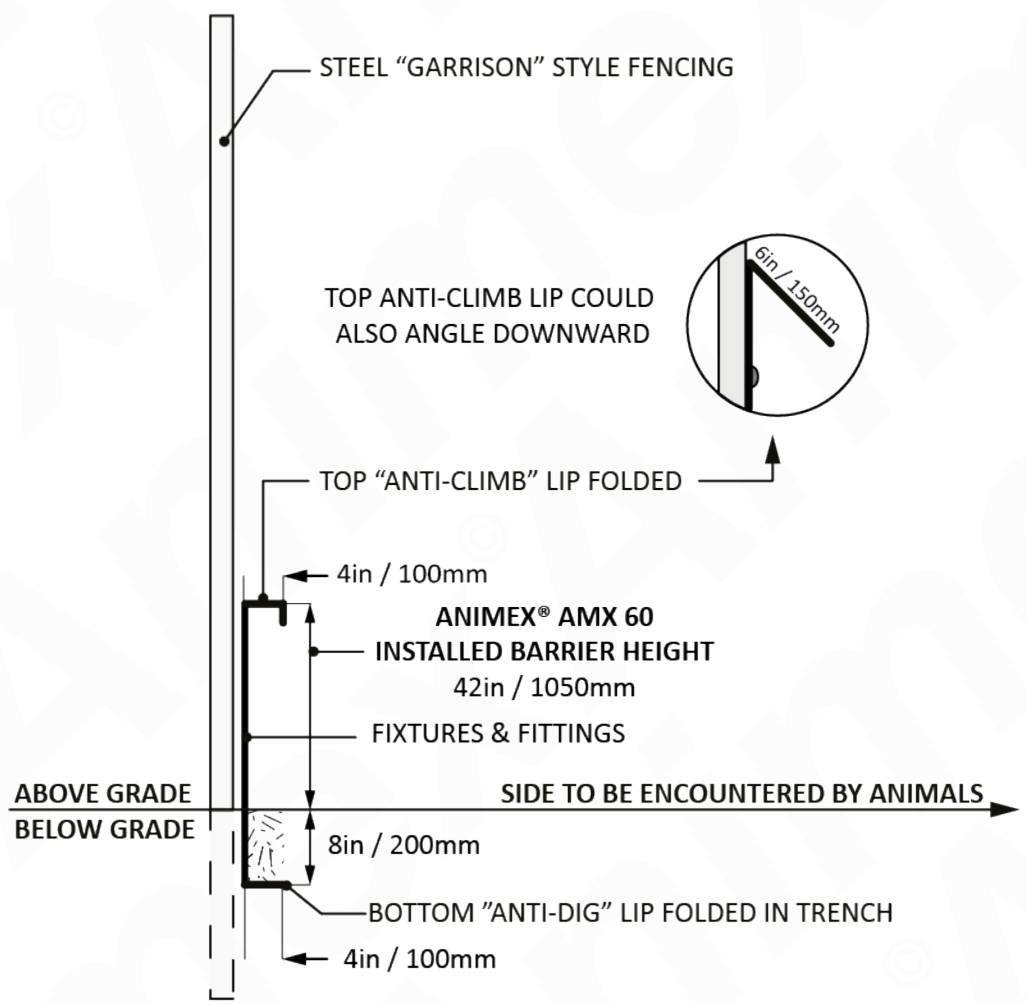
ELEVATION VIEW

NOT TO SCALE

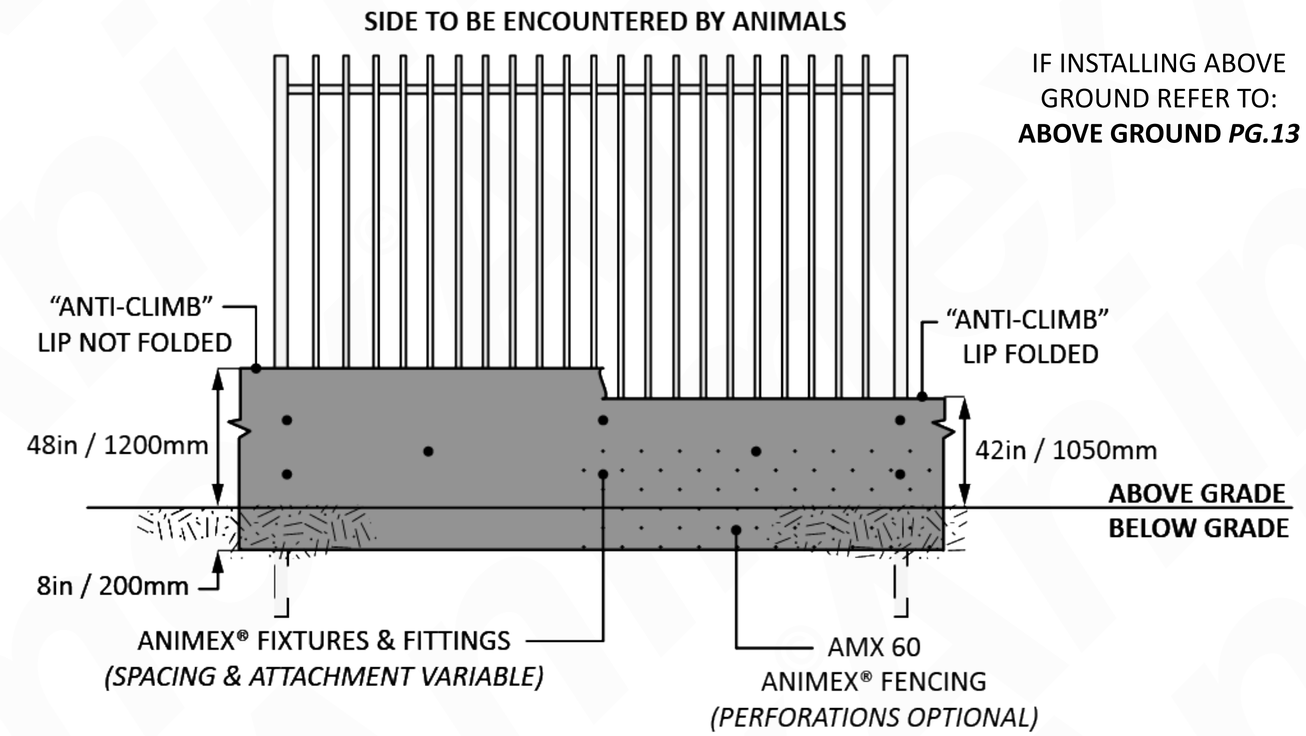
Animex®

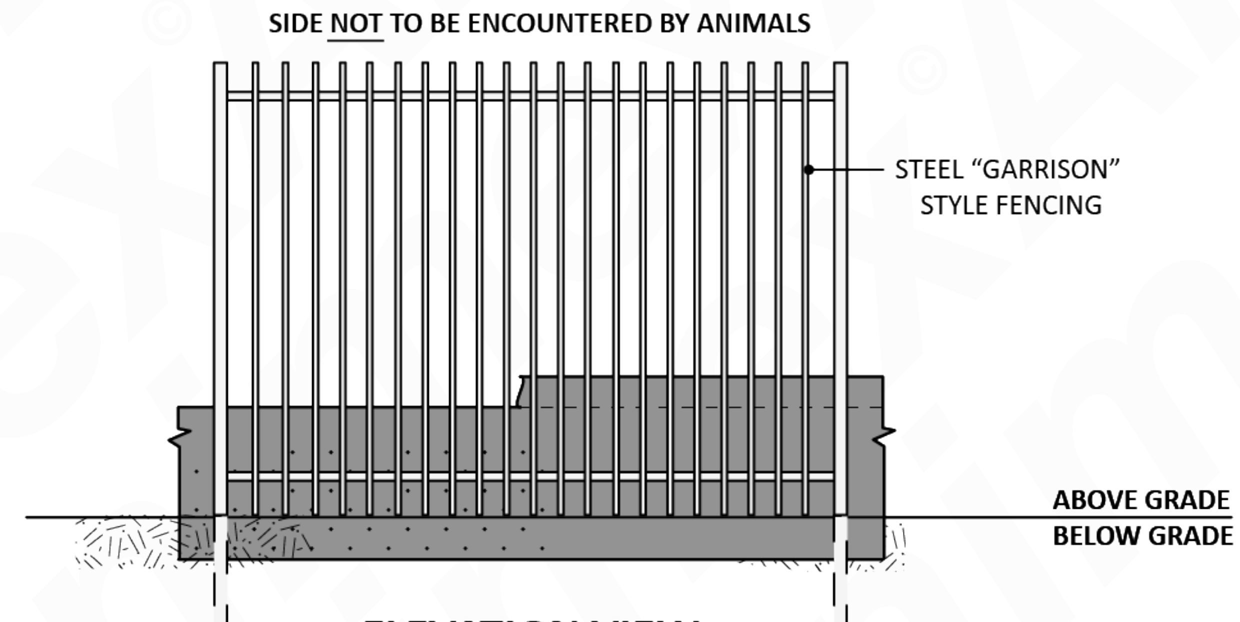
AMX 60
Attached Garrison

NOTES:
This specification should be used to aid installation. Measurements are accurate but may need to be adjusted dependent on location, conditions and local authority recommendations.



SECTION VIEW
NOT TO SCALE

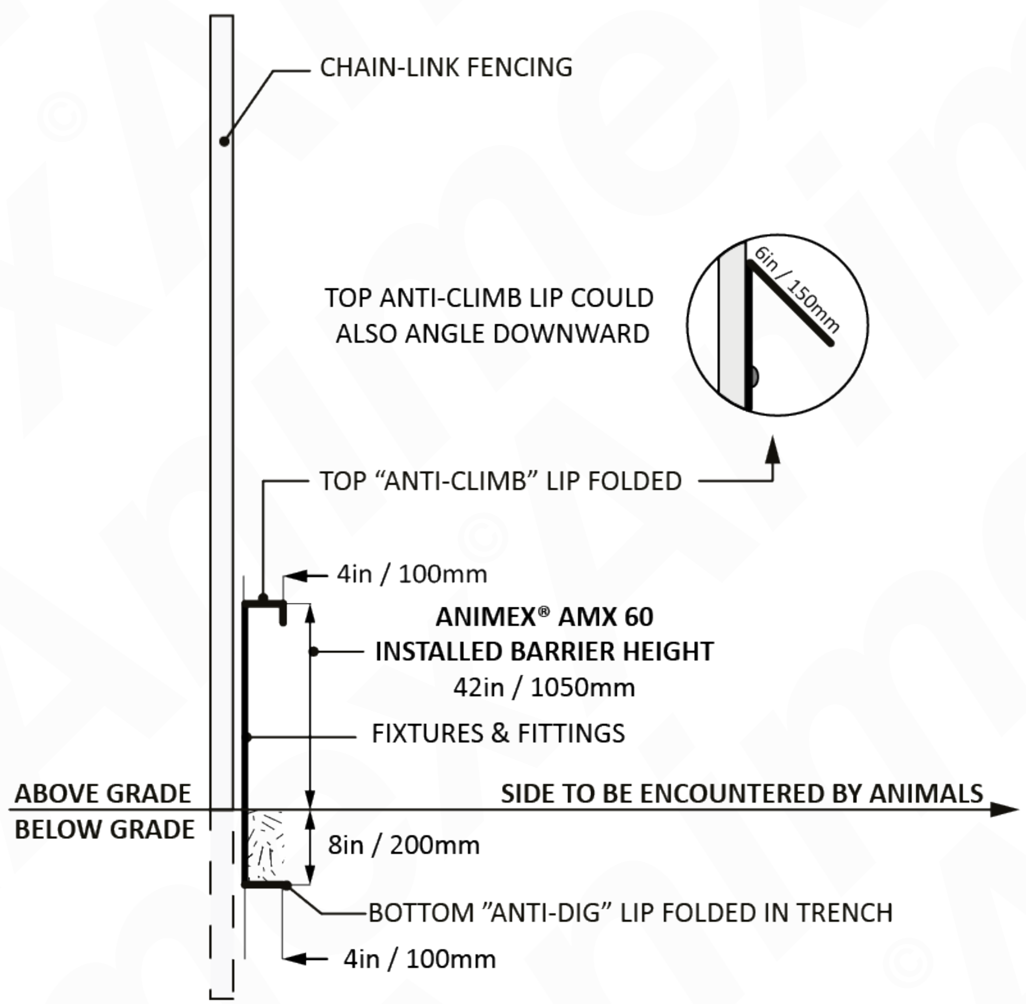




ELEVATION VIEW
NOT TO SCALE

NOTES:
This specification should be used to aid installation. Measurements are accurate but may need to be adjusted dependent on location, conditions and local authority recommendations.

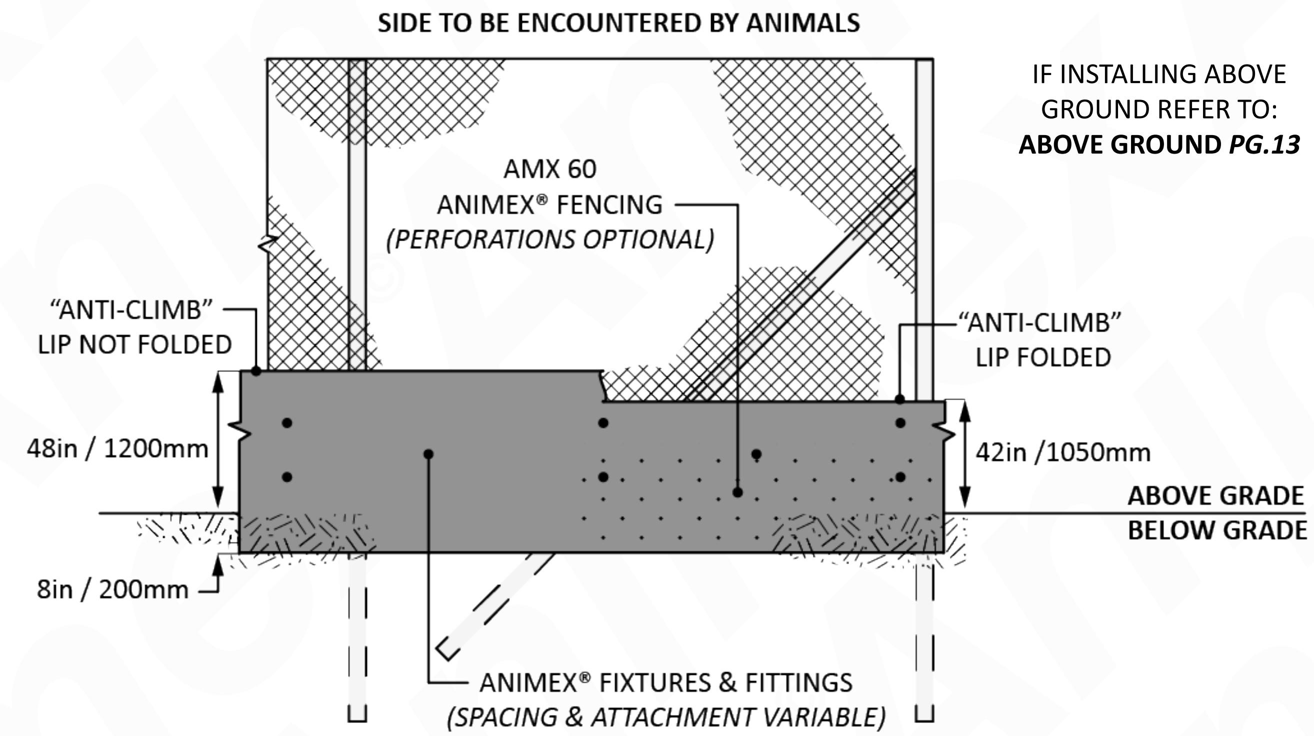
AMX 60
Attached Chainlink



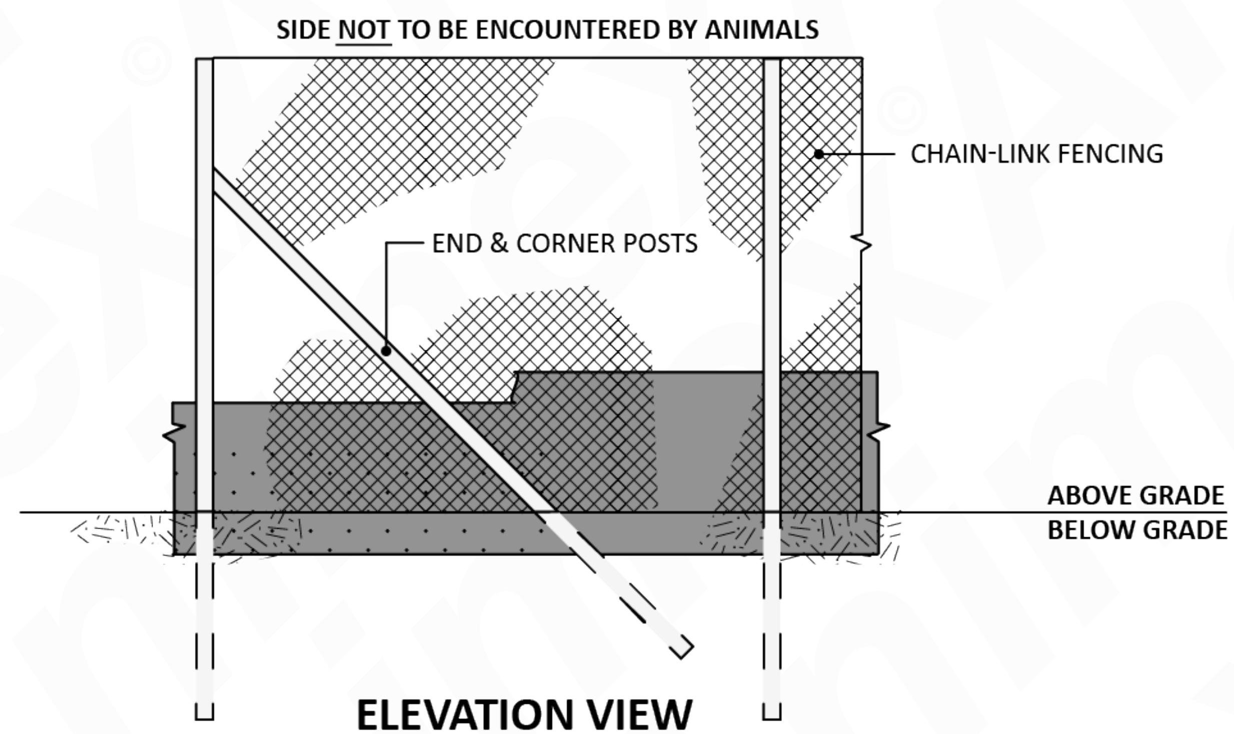
SECTION VIEW
NOT TO SCALE

NOTES:
This specification should be used to aid installation. Measurements are accurate but may need to be adjusted dependent on location, conditions and local authority recommendations.

NOTES:
This specification should be used to aid installation. Measurements are accurate but may need to be adjusted dependent on location, conditions and local authority recommendations.

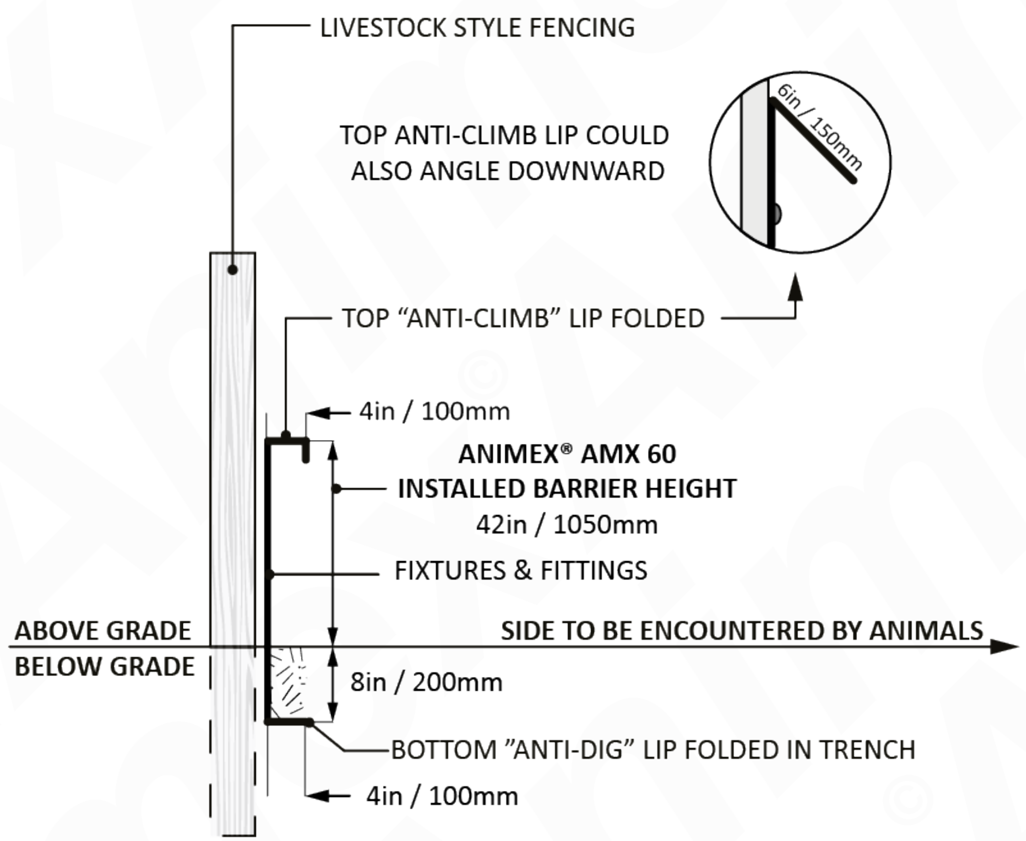


IF INSTALLING ABOVE GROUND REFER TO:
ABOVE GROUND *PG.13*



ELEVATION VIEW
NOT TO SCALE

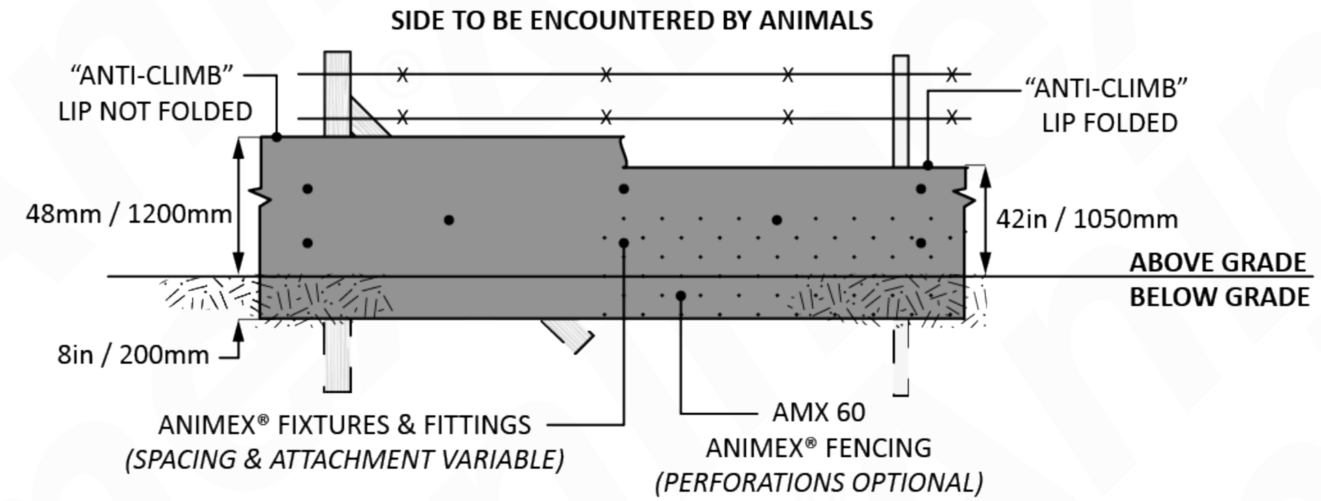
AMX 60
Attached Livestock

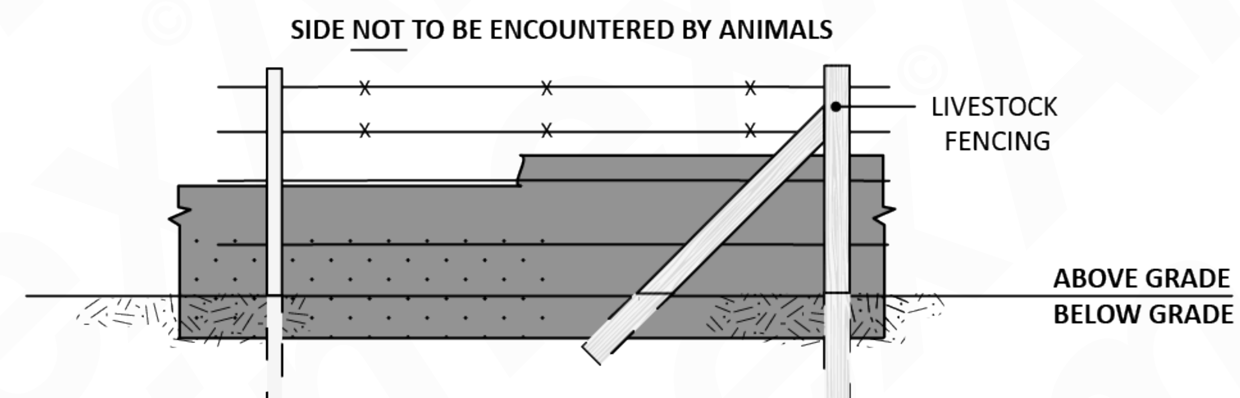


SECTION VIEW
NOT TO SCALE

NOTES:
This specification should be used to aid installation. Measurements are accurate but may need to be adjusted dependent on location, conditions and local authority recommendations.

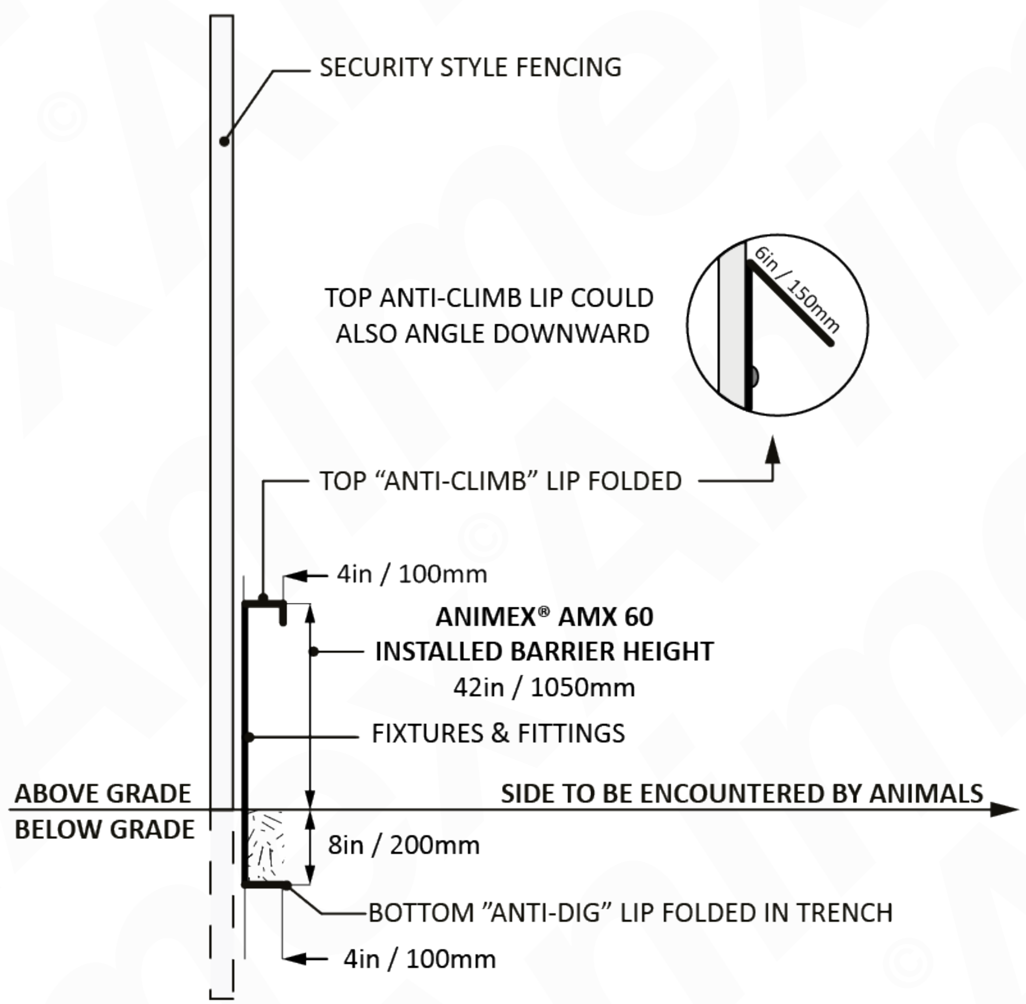
IF INSTALLING ABOVE GROUND REFER TO:
ABOVE GROUND *PG.13*





ELEVATION VIEW
NOT TO SCALE

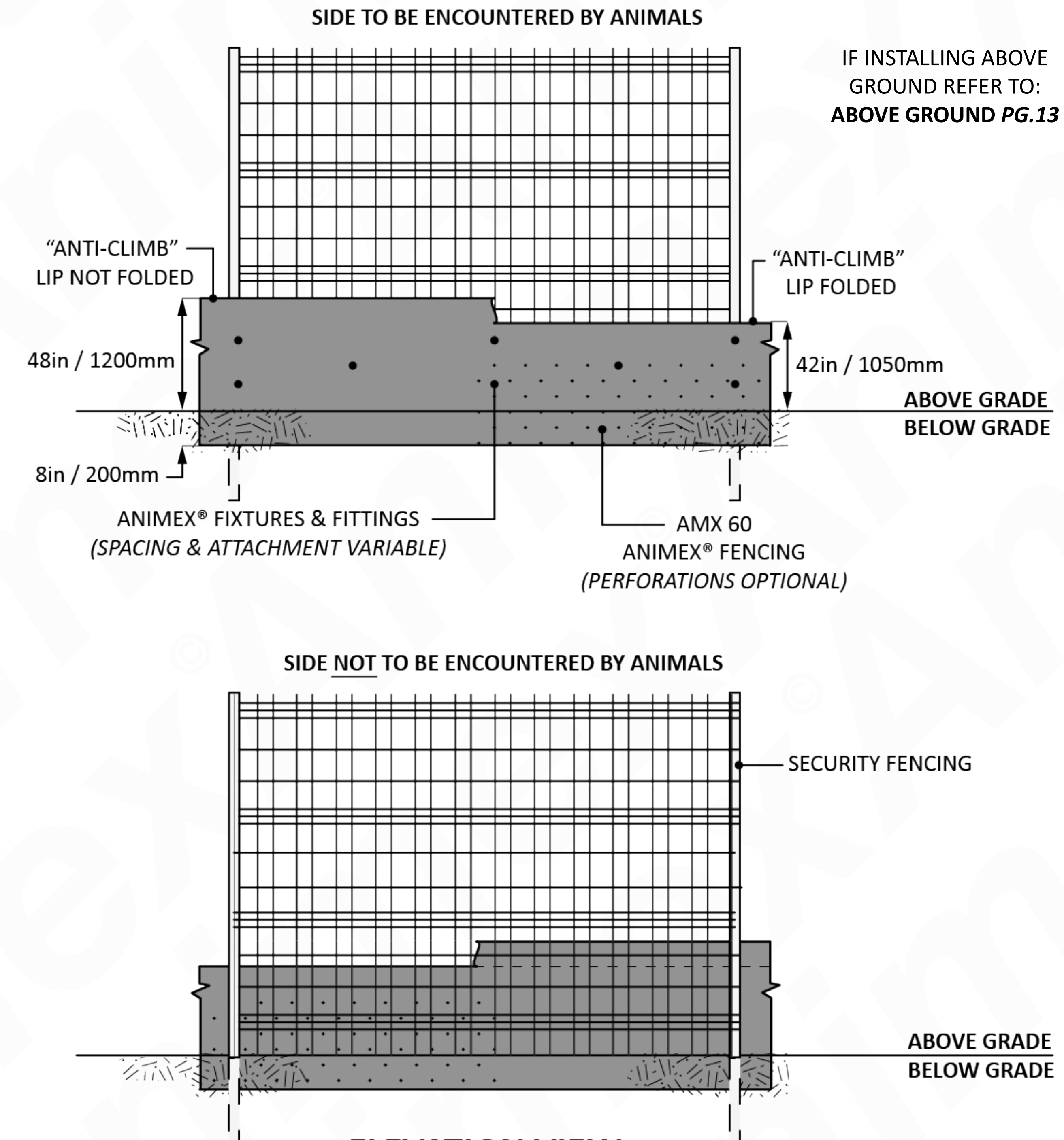
NOTES:
This specification should be used to aid installation. Measurements are accurate but may need to be adjusted dependent on location, conditions and local authority recommendations.



SECTION VIEW
NOT TO SCALE

NOTES:
This specification should be used to aid installation. Measurements are accurate but may need to be adjusted dependent on location, conditions and local authority recommendations.

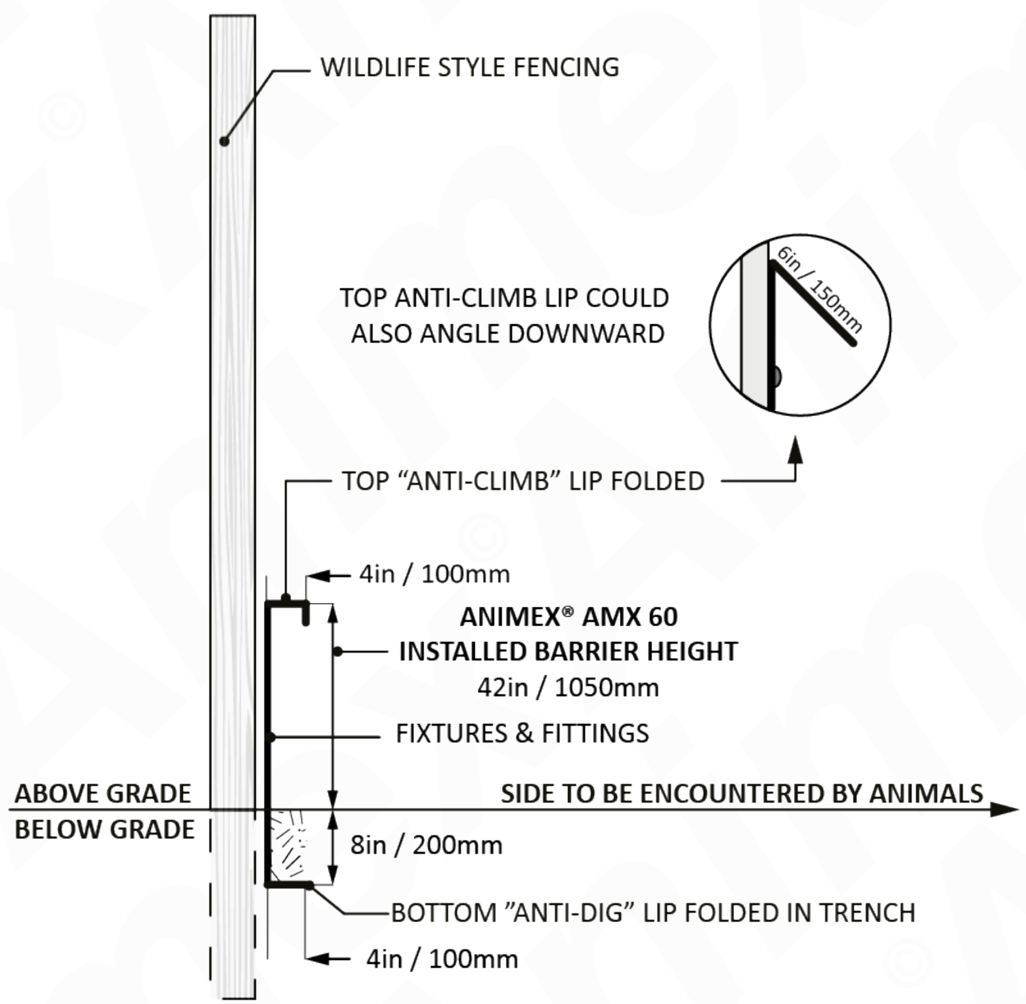
NOTES:
This specification should be used to aid installation. Measurements are accurate but may need to be adjusted dependent on location, conditions and local authority recommendations.



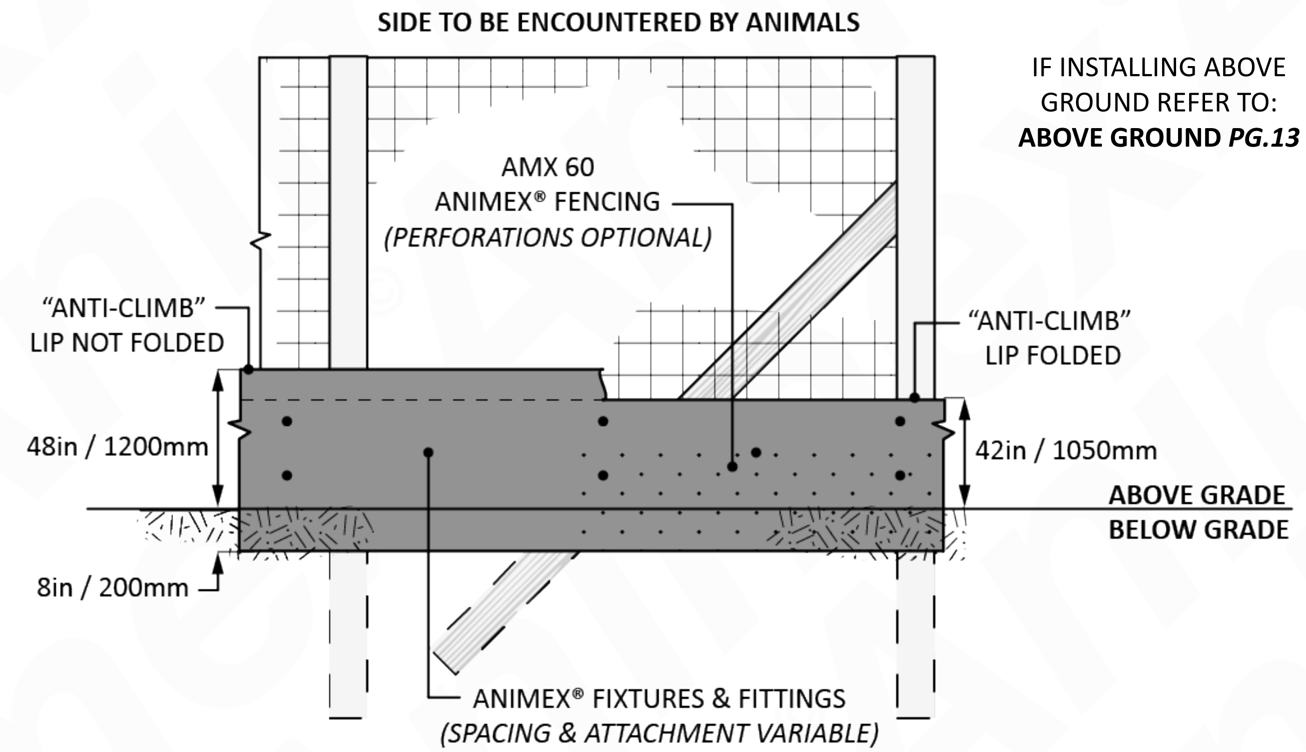
ELEVATION VIEW
NOT TO SCALE

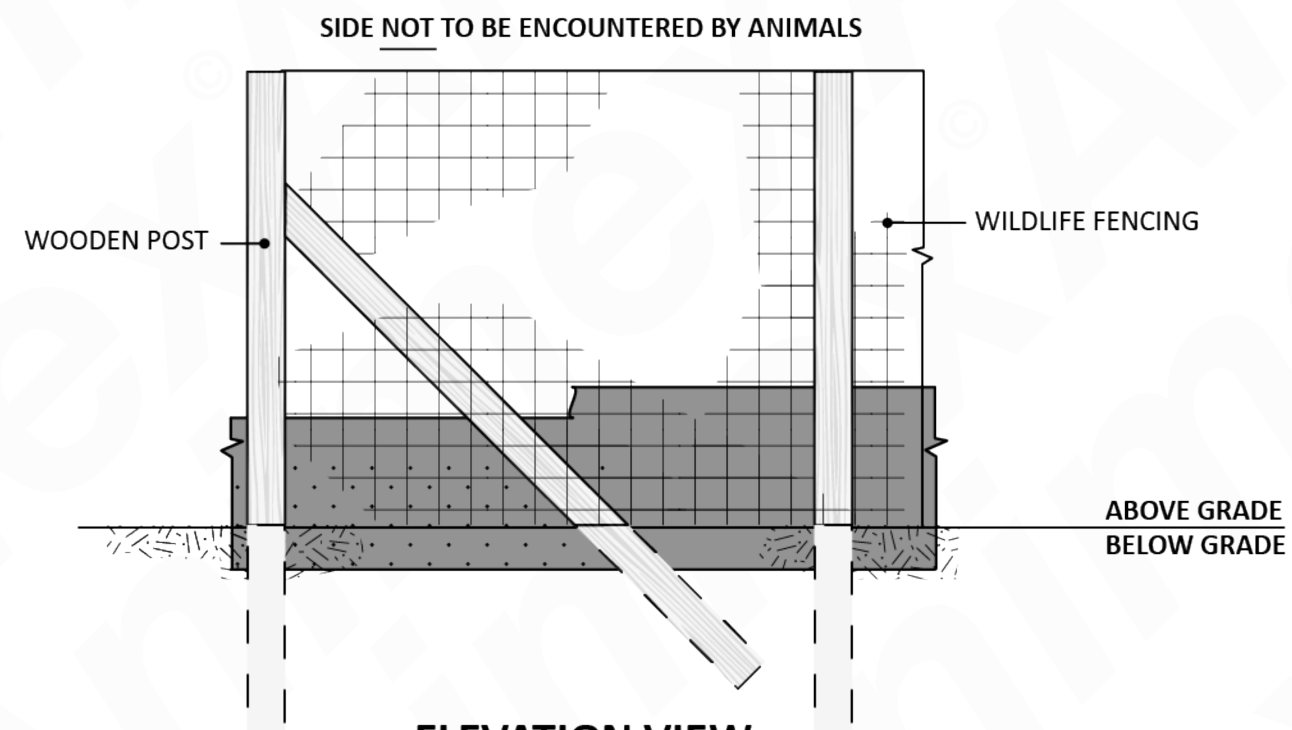
AMX 60
Attached Large Wildlife

NOTES:
This specification should be used to aid installation. Measurements are accurate but may need to be adjusted dependent on location, conditions and local authority recommendations.



SECTION VIEW
NOT TO SCALE

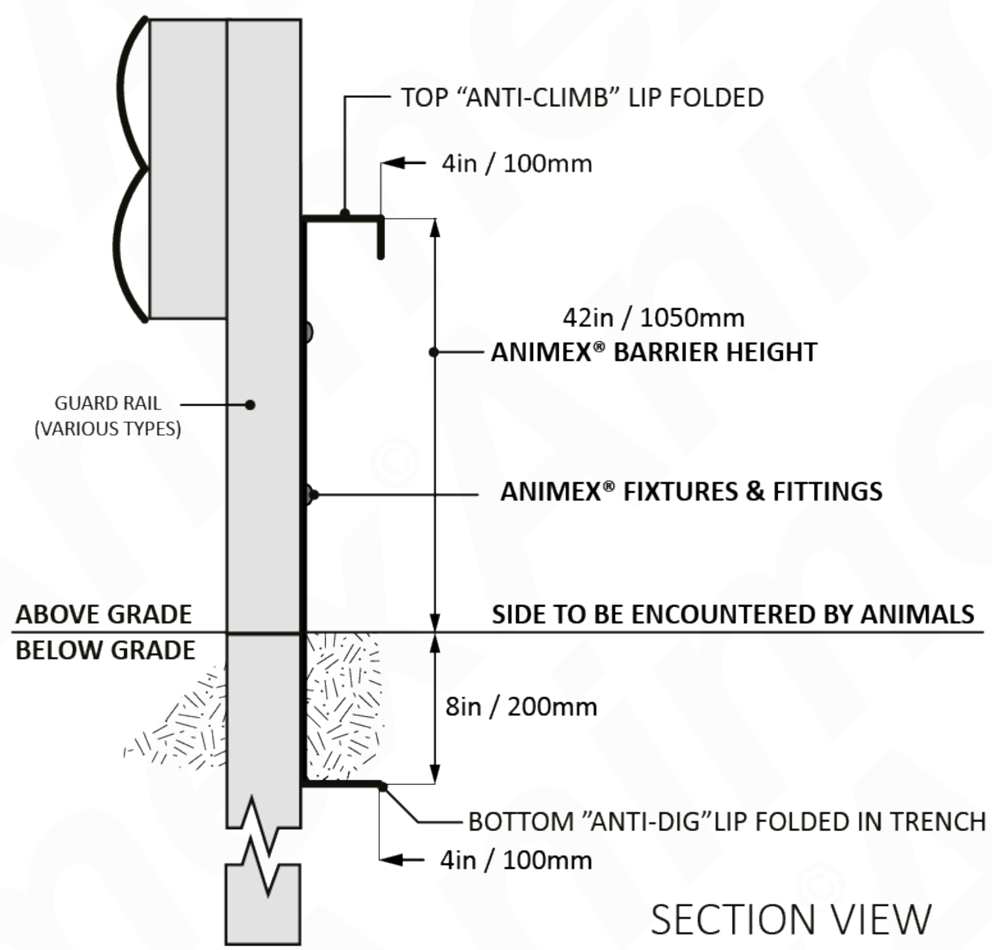




ELEVATION VIEW
NOT TO SCALE

NOTES:
This specification should be used to aid installation. Measurements are accurate but may need to be adjusted dependent on location, conditions and local authority recommendations.

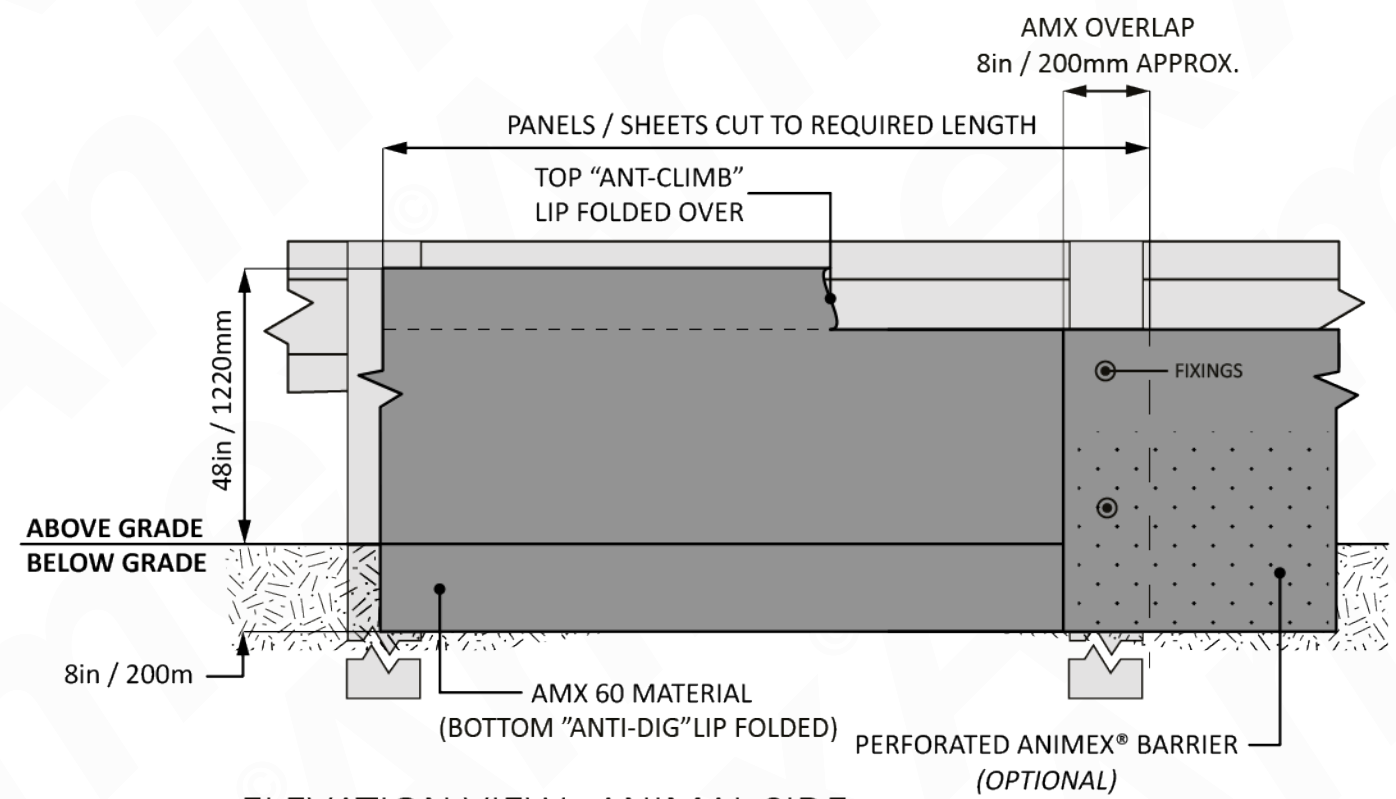
Specialised Fencing Specifications
Roadside Embankment



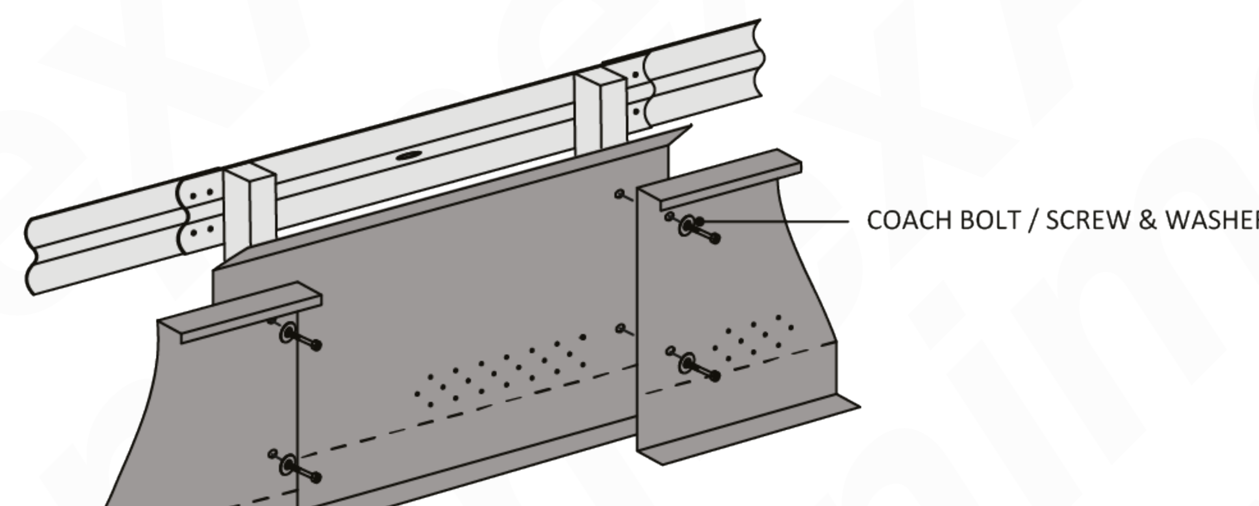
SECTION VIEW
NOT TO SCALE

NOTES:
This specification should be used to aid installation. Measurements are accurate but may need to be adjusted dependent on location, conditions and local authority recommendations.

ADJUSTMENTS CAN BE MADE TO FIT ALL ROADSIDE GUARD RAILS VARIATIONS



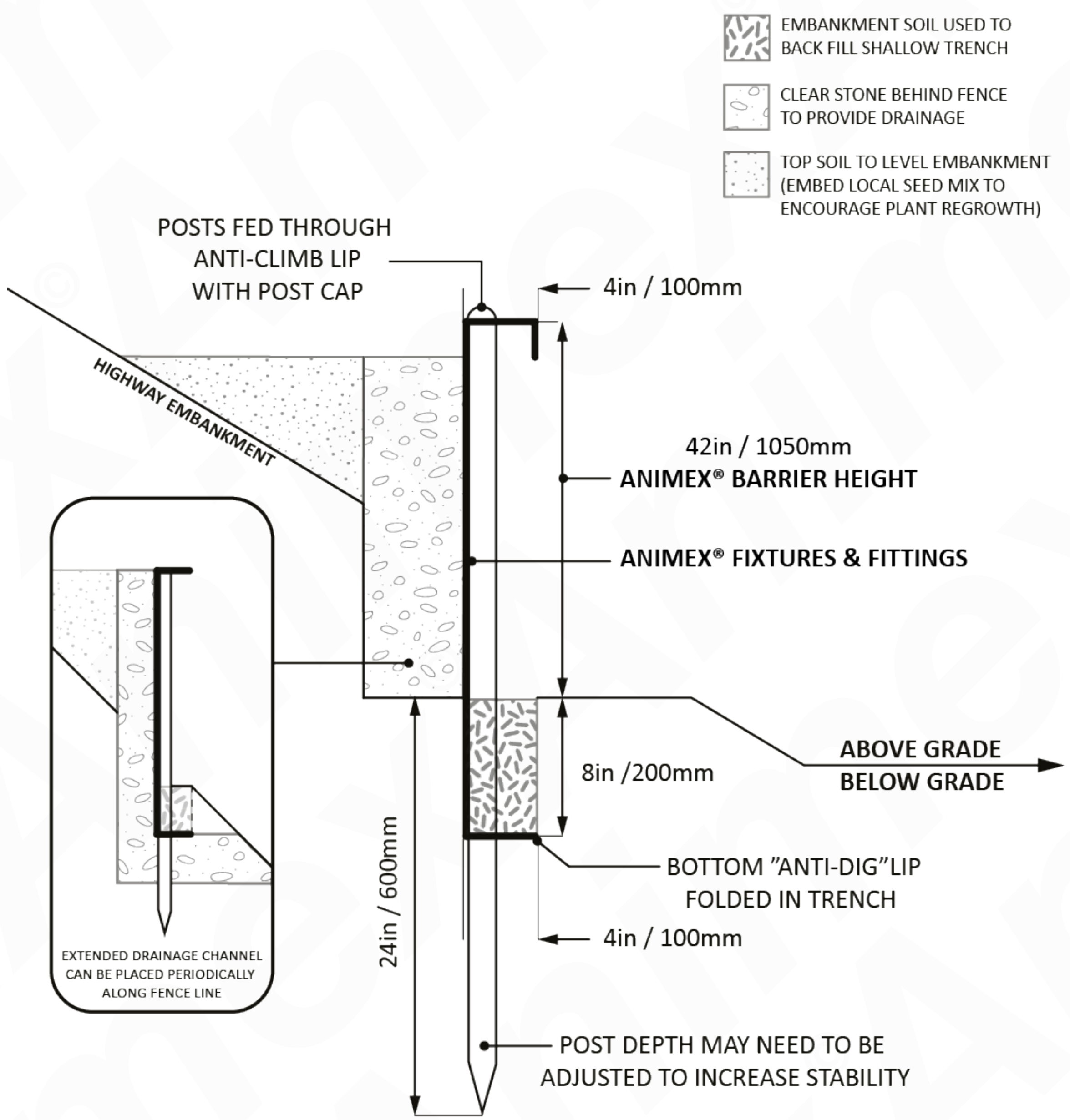
ELEVATION VIEW- ANIMAL SIDE
NOT TO SCALE



ATTACHMENT EXAMPLE
NOT TO SCALE

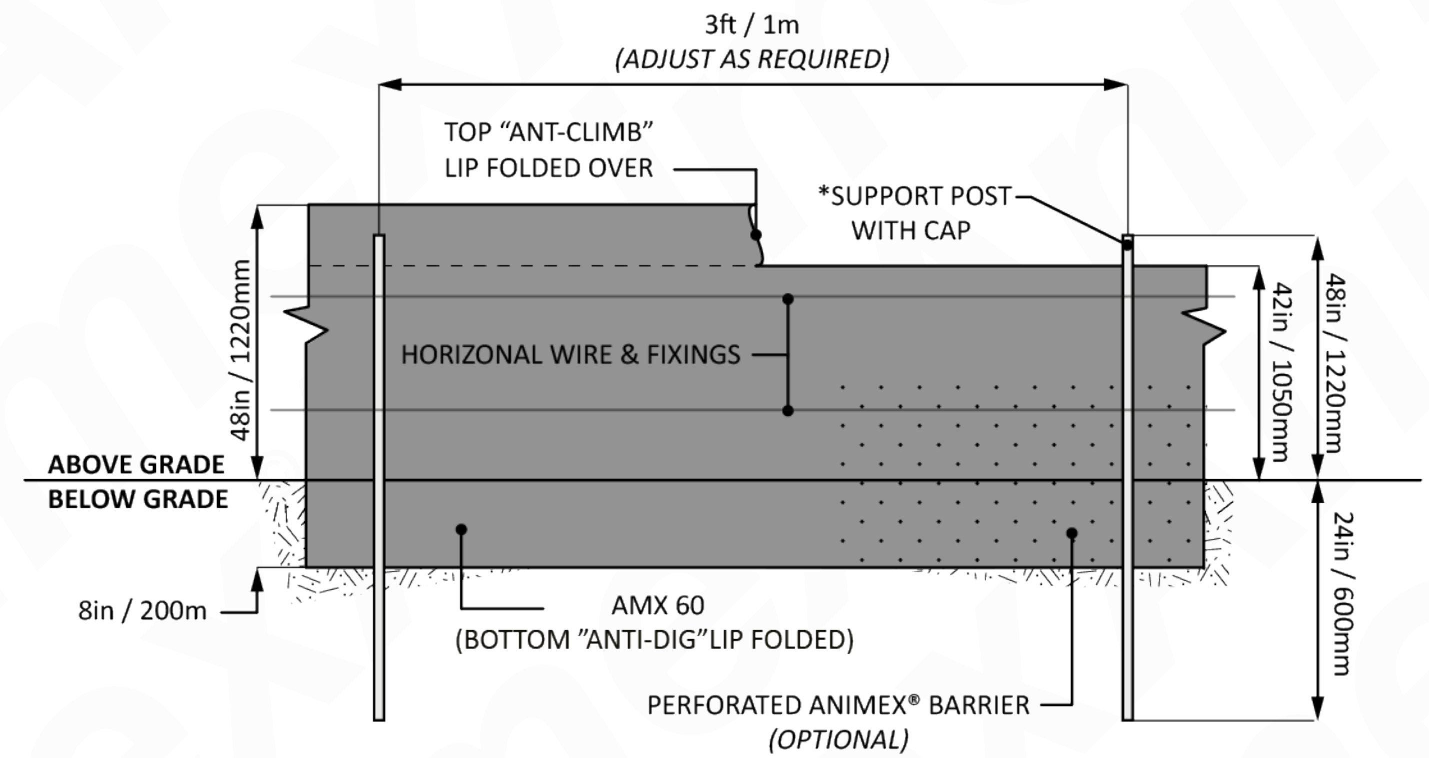
Specialised Fencing Specifications
Roadside Guardrail

NOTES:
This specification should be used to aid installation. Measurements are accurate but may need to be adjusted dependent on location, conditions and local authority recommendations.



SECTION VIEW
NOT TO SCALE

*SUPPORT POSTS MAY NOT BE NEEDED FOR PRE-FORMED METAL (AMX-XP) FENCES



ELEVATION VIEW
NOT TO SCALE

Tender Document Descriptions

AMX-T / AMX-SP

General Description:
Specifically designed solid Animex wildlife fencing barrier to protect, exclude or guide wildlife.

Common Applications:
Roads
Construction sites
Scientific research
Conservation zones
Species re-introduction

Material Height:
1015mm (40in)
1070mm (42in)
1220mm (48in)
1550mm (60in)
Custom options available

Material Thickness:
AMX-T (Temporary): 1mm
AMX-SP (Semi-Permanent): 2mm

Material Properties:
Solid barrier - no mesh, matrix or geo-textile material
Made from High Density Polyethylene (HDPE) in North America
Grooves or scoreline 100mm (4in) from the top and bottom edge to create fold-able lips
Glossy surface on one side
Perforations to allow water flow (if required)
Supplied in sheets or rolls
Maximum weight per item 25kg (55lbs)

Installation:
See relevant drawings and guides displayed in this document between pages 6 and 26

AMX-XP

General Description:
Specifically designed solid Animex wildlife fencing barrier to protect, exclude or guide wildlife.

Common Applications:
Roads
Construction sites
Scientific research
Conservation zones
Species re-introduction

Material Height:
1015mm (40in)
1070mm (42in)
1220mm (48in)
1550mm (60in)
Custom options available

Material Thickness:
AMX-XP - (Permanent): 2mm

Material Properties:
Solid metal barrier - no mesh, matrix or geo-textile material
Made from weather resistant metals
Pre-formed with top and bottom lips (as detailed in drawing pg9)
Perforations to allow water flow (if required)
Supplied in sheets
Maximum weight per item 40kg (88lbs)

Installation:
See relevant drawings and guides displayed in this document on pages 8 and 9

This document is continually updated based on new research and information.

To ensure you are referencing the most recent version please contact:
info@animexfecing.com

FOR MORE INFORMATION OF WILDLIFE FENCING PLEASE VISIT:

WWW.WILDLIFEFENCING.COM

Animex®
www.animexfencing.com

Appendix J

Council Resolution